Final
Environmental Impact Statement

for the

Proposed Abengoa Biorefinery Project near Hugoton, Stevens County, Kansas

Summary

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

DOE/EIS-0407

August 2010

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DOE National Renewable Energy Laboratory
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CONVERSION FACTORS

Metric to English			English to Metric		
Multiply	by	To get	Multiply	by	To get
Area					
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Concentration					
Kilograms/sq. meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/sq. meter
Milligrams/liter	1[a]	Parts/million	Parts/million	1[a]	Milligrams/liter
Micrograms/liter	1[a]	Parts/billion	Parts/billion	1[a]	Micrograms/liter
Micrograms/cu. meter	1[a]	Parts/trillion	Parts/trillion	1[a]	Micrograms/cu. meter
Density					
Grams/cu. centimeter	62.428	Pounds/cu. ft.	Pounds/cu. ft.	0.016018	Grams/cu. centimeter
Grams/cu. meter	0.0000624	Pounds/cu. ft.	Pounds/cu. ft.	16,025.6	Grams/cu. meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Micrometers	0.00003937	Inches	Inches	25,400	Micrometers
Millimeters	0.03937	Inches	Inches	25.40	Millimeters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F – 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cu. meters/second	2,118.9	Cu. feet/minute	Cu. feet/minute	0.00047195	Cu. meters/second
Meters/second	2.237	Miles/hours	Miles/hour	0.44704	Meters/second
Volume					
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1,233.49	Cubic meters
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
English to English					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion factor is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor		
exa-	E	1,000,000,000,000,000,000	=	10^{18}
peta-	P	1,000,000,000,000,000	=	10^{15}
tera-	T	1,000,000,000,000	=	10^{12}
giga-	G	1,000,000,000	=	10^{9}
mega-	M	1,000,000	=	10^{6}
kilo-	K	1,000	=	10^{3}
deca-	D	10	=	10^{1}
deci-	D	0.1	=	10^{-1}
centi-	C	0.01	=	10^{-2}
milli-	M	0.0 001	=	10^{-3}
micro-	μ	0.000 001	=	10^{-6}
nano-	N	0.000 000 001	=	10^{-9}
pico-	P	0.000 000 000 001	=	10^{-12}

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COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

COOPERATING AGENCY: The U.S. Department of Agriculture-Rural Development is a cooperating agency in the preparation of the Abengoa Biorefinery Project EIS.

TITLE: *Final Environmental Impact Statement for the Abengoa Biorefinery Project near Hugoton, Stevens County, Kansas* (DOE/EIS-0407) (Abengoa Biorefinery Project EIS).

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The Final EIS and information about the document are available on the Internet at the Abengoa Biorefinery Project Web site at http://www.biorefineryprojecteis-abengoa.com and on the DOE NEPA Web site at http://www.nepa.energy.gov.

ABSTRACT: DOE's Proposed Action is to provide federal funding to Abengoa Bioenergy Biomass of Kansas, LLC (Abengoa Bioenergy) to support the design, construction, and startup of a commercial-scale integrated biorefinery to be located near the city of Hugoton, Stevens County, Kansas. If DOE decides to provide federal funding, it would negotiate an agreement with Abengoa Bioenergy to provide up to $71 million, subject to annual appropriations, of the total anticipated cost of approximately $685 million (2009 dollars). The biorefinery would use lignocellulosic biomass (corn stover, wheat straw) as feedstock to produce ethanol and biopower (electricity) sufficient to meet the needs of the biorefinery and produce excess electricity for sale to the regional power grid. DOE also evaluates an Action Alternative, under which the biorefinery would not produce excess electricity for sale to the regional grid, and a No-Action Alternative, under which the biorefinery would not be constructed. The Final Abengoa Biorefinery Project EIS evaluates the potential direct, indirect, and cumulative environmental impacts from the construction, operation, and decommissioning of the biorefinery. DOE encourages public participation in the NEPA process. In preparing this Final EIS, DOE considered comments on the Draft EIS received by letter, and oral and written comments given at a public hearing in Hugoton, Kansas, and revised the EIS as appropriate.

ACRONYMS AND ABBREVIATIONS

To ensure a more reader-friendly document, the U.S. Department of Energy (DOE or Department) limited the use of acronyms and abbreviations in this Abengoa Biorefinery Project EIS. In addition, acronyms and abbreviations are defined the first time they are used in each chapter. The acronyms and abbreviations used in the text of this document are listed below. Acronyms and abbreviations used in tables and figures are listed in footnotes to the tables and figures.

ABBK	Abengoa Bioenergy Biomass of Kansas (also called Abengoa Bioenergy)
AERMOD	American Meteorological Society/EPA Regulatory Model
°C	degrees Celsius
CFR	Code of Federal Regulations
CRP	Conservation Reserve Program
dBA	A-weighted decibels
DOE	U.S. Department of Energy (also called the Department)
EIS	environmental impact statement
EPAct 2005	*Energy Policy Act of 2005*
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FR	*Federal Register*
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation
K.A.R.	Kansas Administrative Regulation
NRCS	Natural Resources Conservation Service
NEPA	*National Environmental Policy Act*, as amended
PM_{10}	particulate matter with an aerodynamic diameter of 10 micrometers or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 micrometers or less
USDA	United States Department of Agriculture
USGS	United States Geological Survey
U.S.C.	United States Code

TERMS AND DEFINITIONS

In this Abengoa Biorefinery Project EIS, DOE has italicized terms that appear in the Glossary (Chapter 11) the first time they appear in a chapter.

UNDERSTANDING SCIENTIFIC NOTATION

DOE has used scientific notation in this Abengoa Biorefinery Project EIS to express numbers that are so large or so small that they can be difficult to read or write. Scientific notation is based on the use of positive and negative powers of 10. The number written in scientific notation is expressed as the product of a number between 1 and 10 and a positive or negative power of 10. Examples include the following:

Positive Powers of 10	Negative Powers of 10
$10^1 = 10 \times 1 = 10$	$10^{-1} = 1/10 = 0.1$
$10^2 = 10 \times 10 = 100$	$10^{-2} = 1/100 = 0.01$
and so on, therefore,	and so on, therefore,
10^6 = 1,000,000 (or 1 million)	10^{-6} = 0.000001 (or 1 in 1 million)

Probability is expressed as a number between 0 and 1 (0 to 100 percent likelihood of the occurrence of an event). The notation 3×10^{-6} can be read 0.000003, which means that there are 3 chances in 1 million that the associated result (for example, a fatal cancer) will occur in the period covered by the analysis.

Summary

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S.1 Introduction

The U.S. Department of Energy (DOE or the Department) is proposing to provide federal funding to Abengoa Bioenergy Biomass of Kansas, LLC (Abengoa Bioenergy) to support the final design, construction, and startup of a biomass-to-ethanol and biomass-to-energy production facility (hereafter referred to as the Abengoa Biorefinery Project). The integrated biorefinery would use a combination of biomass feedstocks, such as corn stover and wheat straw, to produce ethanol and to generate sufficient electricity to power the facility and supply excess electricity to the regional power grid.

BIOREFINERY

Biorefineries are similar to petroleum refineries in concept; however, biorefineries use biological matter (biomass) as feedstock (raw materials), instead of petroleum feedstock, to produce transportation fuels (for example ethanol), industrial chemicals, and heat and power. Such transportation fuels, chemicals, and heat/power are referred to as biofuels, bioproducts, and biopower, respectively.

An integrated biorefinery uses combinations of biomass feedstocks (for example, wood waste, and corn and corn stover, wheat straw, and other nonfood crop residues) and conversion technologies to produce a variety of products, but typically biofuels.

In this EIS, the term "biorefinery" refers to the physical structures, including associated infrastructure, of the biomass-to-ethanol and -energy production facility.

The Biorefinery Project site would be located adjacent to and west of the city of Hugoton, in Stevens County, southwestern Kansas (Figure S-1). The Project site comprises approximately 810 acres of row-cropped agricultural land. The biorefinery facilities would be developed on 385 acres of the Project site, and the remaining 425 acres would remain agricultural and act as a buffer between the biorefinery and the city of Hugoton (Figure S-2).

In accordance with the implementing regulations of the *National Environmental Policy Act*, DOE has prepared this *Final Environmental Impact Statement for the Proposed Abengoa Biorefinery Project near Hugoton, Stevens County, Kansas* (DOE/EIS-0407) (Abengoa Biorefinery Project EIS) to evaluate the potential environmental impacts of its proposal to use federal funds to support the Abengoa Biorefinery Project.

S.1.1 PURPOSE AND NEED

The *Energy Policy Act of 2005* (EPAct 2005), Section 932 directs the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for bioenergy, including integrated biorefineries that can produce biopower, biofuels, and bioproducts. In carrying out a program to demonstrate the commercial application of integrated biorefineries, EPAct 2005 authorizes the Secretary to provide funds to biorefinery demonstration projects to encourage (1) the demonstration of a wide variety of lignocellulosic feedstocks; (2) the commercial application of biomass technologies for a variety of uses,

BIOENERGY TERMS

Biopower:
The use of biomass feedstock to produce electric power.

Biofuels:
Fuels made from biomass resources, or their processing and conversion derivatives.

Bioproducts:
Any products—fuels, chemicals, raw materials—made from renewable biomass resources.

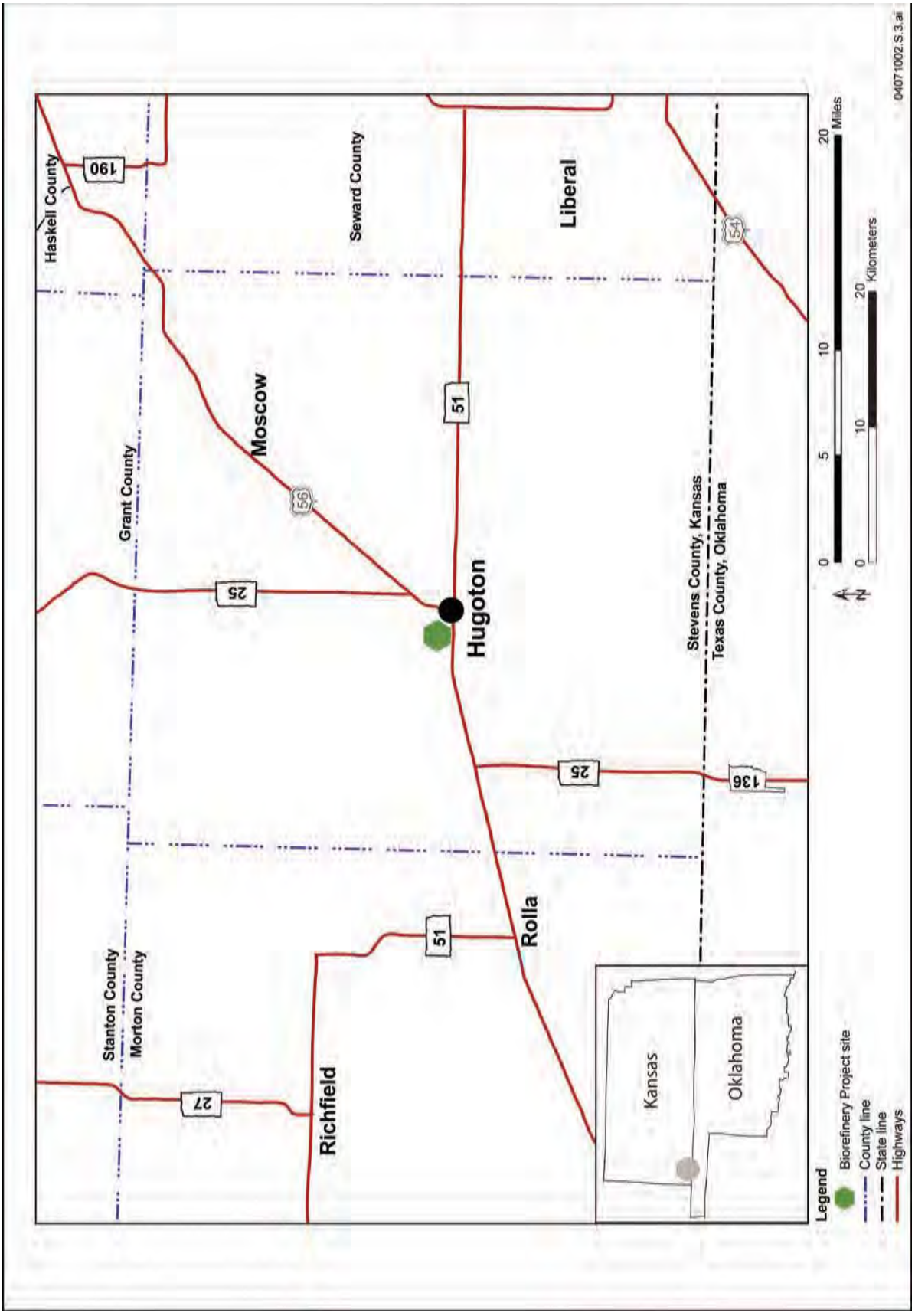

Figure S-1. Biorefinery Project site.

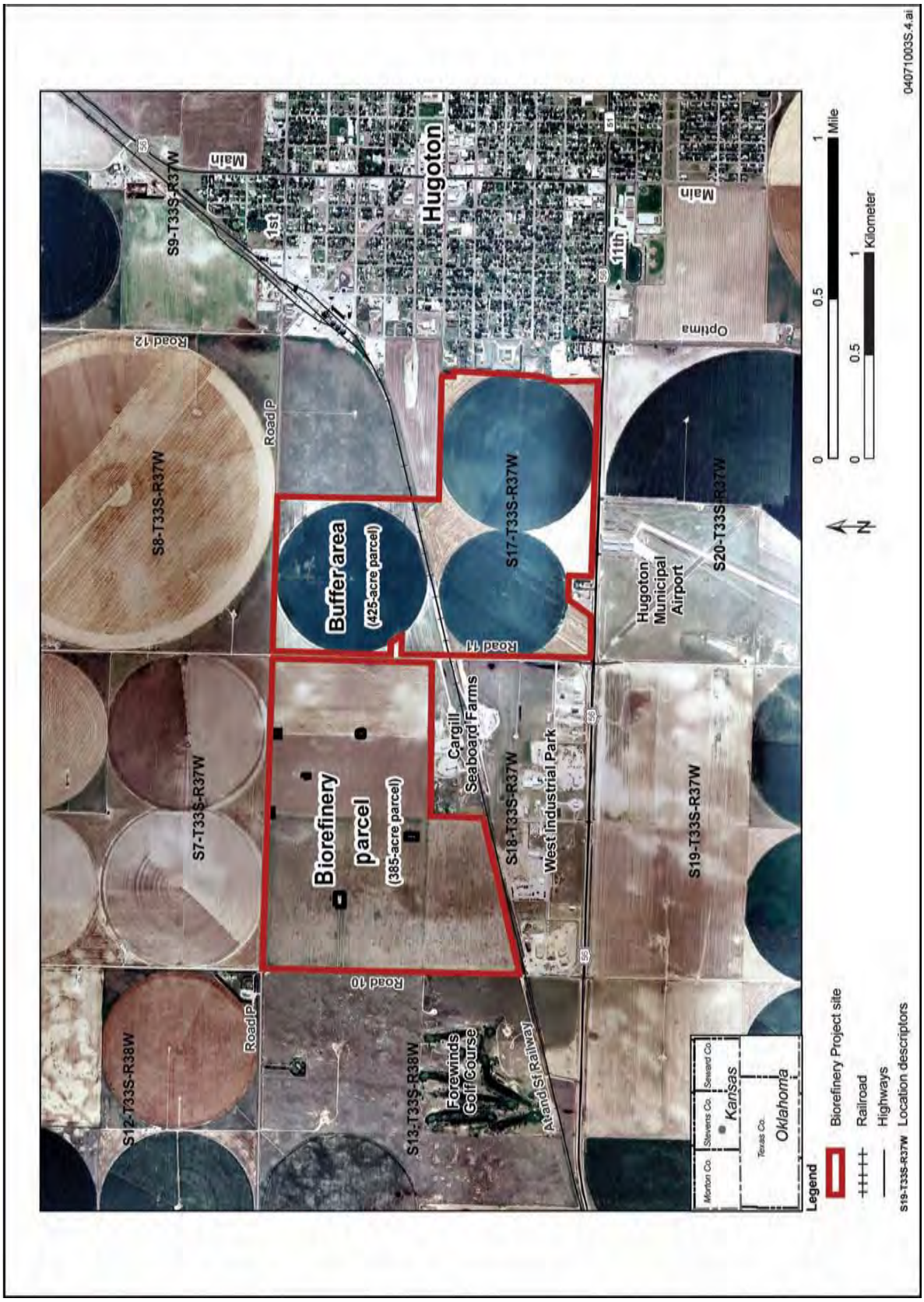

Figure S-2. Biorefinery Project site and vicinity.

including liquid transportation fuels, high-value bio-based chemicals, substitutes for petroleum-based feedstocks and products, and energy in the form of electricity or useful heat; and (3) the demonstration of the collection and treatment of a variety of biomass feedstocks.

GREENHOUSE GAS

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic (resulting from or produced by human beings), which absorb and emit thermal infrared radiation (heat) emitted by the earth's surface, the atmosphere itself and by clouds. Water vapor, carbon dioxide, nitrous oxide, methane and ozone are the primary greenhouse gases in the earth's atmosphere. Greenhouse gases trap heat between the earth's surface and the lower part of the atmosphere (troposphere)—the greenhouse effect.

Accordingly, DOE needs to implement Section 932 of EPAct 2005 and support biofuel production pursuant to the Renewable Fuel Standard established by the *Energy Independence and Security Act of 2007*. Thus, DOE's purpose is to demonstrate that commercial-scale integrated biorefineries that use a wide variety of lignocellulosic (second-generation) feedstocks to produce biofuels, bio-based chemicals, and biopower can operate without direct federal subsidy after construction costs are paid, and that these biorefineries can be easily replicated.

LIGNOCELLULOSIC FEEDSTOCK

Any portion of a plant or a byproduct used in the conversion of organic materials to energy, including crops, trees, forest wastes, and agricultural wastes not specifically grown for food. These would include, for example, barley grain, grapeseed, rice bran and hulls, soybean matter, corn stover, and organic materials that have been segregated from municipal solid waste.

Lignocellulosic (cellulosic) feedstocks would not include, for example, plant-based oils intended for human consumption, such as soy, canola, sunflower, and peanut oils, or foods intended for human and animal consumption, such as corn.

S.1.2 BACKGROUND

Under EPAct 2005, Congress directed the Department to carry out a program to demonstrate the commercial application of integrated biorefineries for the production of biofuels, in particular ethanol, from lignocellulosic feedstocks. Federal funding for cellulosic ethanol production facilities is intended to further the government's goal of rendering ethanol cost-competitive with gasoline by 2012, and along with increased automobile fuel efficiency, reducing gasoline consumption in the United States by 20 percent within 10 years.

To implement its responsibilities under EPAct 2005, DOE issued a funding opportunity announcement in February 2006 for the design, construction, and startup of commercial-scale integrated biorefineries. In February 2007, the Department selected Abengoa Bioenergy and five other applicants for negotiation of award. Abengoa proposed an innovative approach to biorefinery operations that would involve production of biofuel and energy in the form of steam that could be used to meet energy needs and displace fossil fuels, such as coal and natural gas. The proposal also included an integrated grain-to-ethanol facility.

In January 2009, Abengoa Bioenergy modified its proposal by omitting the integrated grain-to-ethanol facility and including a steam-driven turbine that would generate sufficient electricity to power the

production facility and supply excess electricity to the regional power grid. In addition, Abengoa applied for loan guarantees from the Department's Loan Guarantee Program pursuant to Title XVII of EPAct 2005, and from the U.S. Department of Agriculture Rural Development Biorefinery Assistance Program pursuant to Section 9003 of the *Food, Conservation, and Energy Act of 2008*. The Department of Agriculture Rural Development is a cooperating agency in the preparation of this EIS.

U.S. DEPARTMENT OF AGRICULTURE RURAL DEVELOPMENT

The Department of Agriculture Rural Development is an agency within the U.S. Department of Agriculture. The role of Rural Development is to increase economic opportunities for rural residents and improve their quality of life by forging partnerships with rural communities; funding projects that bring housing, community facilities, utilities, and other services; and by providing technical assistance and financial backing for rural businesses and cooperatives to create jobs in rural areas. Rural Development maintains general responsibility for renewable energy and energy-efficient improvements programs, one of which is the Biorefinery Assistance Program.

The Department considered Abengoa Bioenergy's proposed project changes and concluded that the project remained eligible for federal funding under Section 932 of EPAct 2005. On August 28, 2009, the Department determined, however, that it would not proceed with Abengoa's request for a loan guarantee.

On December 22, 2009, after publication of the Draft Abengoa Biorefinery Project EIS on September 23, 2009, Abengoa Bioenergy filed a revised loan guarantee application, and in March 2010, the Department determined that the proposed biorefinery was eligible for consideration under Title XVII, Section 1703 of EPAct 2005, and requested that Abengoa submit the Part II portion of its loan guarantee application. Abengoa submitted the Part II application on May 14, 2010.

At this time, the Department is not proposing to issue a loan guarantee for the construction and startup of the biorefinery. DOE is reviewing the Part II submission and, pending the results of the Part II review, will decide whether to initiate the due diligence, underwriting, and negotiation phase of the loan guarantee process[1]. If DOE initiates that process with Abengoa, DOE's proposed action (that is, to issue a loan guarantee) would be subject to NEPA review. If DOE decides to proceed to consider the loan guarantee, DOE would use this Final Biorefinery EIS to comply with NEPA review requirements for the loan guarantee. If DOE determines that the Final Biorefinery EIS sufficiently addresses all activities covered by the loan guarantee, DOE could either issue a Record of Decision deciding to issue a loan guarantee, or amend any Record of Decision issued by the Department to provide federal funding to Abengoa Bioenergy under Section 932 of EPAct 2005.

The U.S. Department of Agriculture Rural Development also considered Abengoa's application for a loan guarantee and did not approve it for funding in Fiscal Year 2009. Should Abengoa submit an application for a loan guarantee in the future, Rural Development will use this EIS as part of its evaluation of project eligibility and sufficiency.

1. The project due diligence, underwriting and negotiation phase of the loan guarantee process involves DOE's detailed examination of the project, including reviews of the applicant's technical information, business and financial plans, and proposed organizational structure and staffing.

Accordingly, the Department of Energy is now proposing to negotiate a second agreement to provide federal funding to support the final design, construction, and startup of the Abengoa Biorefinery Project. If DOE decides to provide federal funding, it may do so under the provisions of the *American Recovery and Reinvestment Act of 2009*.

Based in part on the analyses in this Abengoa Biorefinery Project EIS, DOE will decide (1) whether to provide funding to support the final design, construction, and startup of the Biorefinery Project as proposed by Abengoa Bioenergy (the Proposed Action); (2) whether to provide funding to support the final design, construction, and startup of the Biorefinery Project for all elements of the facility as proposed by Abengoa, at a reduced ethanol production level using syngas and without the portion dedicated to generating electricity for commercial sale (the Action Alternative); or (3) whether to provide funding for either the Proposed Action or Action Alternative, contingent on the implementation of environmental mitigation measures, which would be determined based on the environmental impact analysis in this EIS.

S.1.3 NATIONAL ENVIRONMENTAL POLICY ACT PROCESS

This Abengoa Biorefinery Project EIS is intended to comply with the *National Environmental Policy Act* (NEPA), the Council on Environmental Quality regulations (40 CFR Parts 1500 to 1508), and DOE's implementing procedures (10 CFR Part 1021) and provide DOE and other state and federal agency decisionmakers with information needed to make informed decisions in connection with the construction and startup of the proposed project.

In August 2008, DOE published in the *Federal Register* its "Notice of Intent to Prepare an Environmental Impact Statement and Notice of Wetlands Involvement for the Abengoa Biorefinery Project near Hugoton, KS" (73 FR 50001), opened a 45-day public scoping period, and held a public scoping meeting in Hugoton, Kansas. In April 2009, DOE re-opened public scoping and published in the *Federal Register* its "Amended Notice of Intent to Modify the Scope of the Environmental Impact Statement for the Abengoa Biorefinery Project near Hugoton, KS" (74 FR 19543). The amended notice informed the public about changes in the project relevant to the scope of the ongoing EIS. The Department opened a 30-day public scoping period and held a second public scoping meeting in Hugoton, Kansas. During these scoping periods, the Department received oral and written comments of the following three types: support for the project, statements of no negative environmental impacts, and requests for additional information from federal and state agencies and members of the public.

In response to the scoping comments, the Department conducted surveys of portions of the Biorefinery Project site and assessed biomass removal to estimate potential environmental impacts. The Department also evaluated socioeconomic, air quality, soil, and traffic and transportation impacts, as well as other impacts, in this Abengoa Biorefinery Project EIS.

On September 23, 2009, DOE published in the *Federal Register* its Notice of Availability for the *Draft Environmental Impact Statement for the Abengoa Biorefinery Project Near Hugoton, Stevens County, KS* (DOE/EIS-0407D) (74 FR 48525). DOE's Notice of Availability invited the public to comment on the Draft EIS during a 45-day public comment period that ended on November 9, 2009, and described how the public could submit oral and written comments on the Draft EIS. DOE's Notice also announced that a public hearing would be held in Hugoton, Kansas on October 21, 2009, at the Stevens County

Courthouse. On September 25, 2009, the U.S. Environmental Protection Agency listed the Draft Abengoa Biorefinery Project EIS in its weekly notice of availability (74 FR 48951).

In advance of the public hearing, DOE placed a notice in the *High Plains Daily Leader*, in Liberal, Kansas, announcing the upcoming public hearing. The notice also was placed with the *Hugoton Hermes*, in Hugoton, Kansas, the morning of the public hearing.

DOE made the Draft Abengoa Biorefinery Project EIS available on the Internet on two websites and provided the Draft EIS to four reading rooms in Hugoton, Kansas, Golden and Grand Junction, Colorado, and Washington, D.C. The Department sent electronic and bound copies of the Draft EIS to members of Congress, federal agencies, state and local governments, American Indian tribes and organizations, and other organizations and individuals, and made the Draft EIS available at the October public hearing in Hugoton. In total, the Department distributed approximately 110 bound copies each of the summary and the Draft EIS.

DOE provided public hearing attendees the opportunity to submit written comments or make statements to the court reporter. Approximately 20 people attended the public hearing. A couple of attendees expressed support for the project (for example, for job creation in the community).

The Department received approximately 40 comments from six commenters during the public comment period. DOE prepared a comment-response chapter for this Final Abengoa Biorefinery Project EIS (Chapter 10), which provides responses to these public comments. Chapter 10 contains each comment and DOE's response. The Final EIS reflects changes resulting from public comments, and, accordingly, the responses in the comment-response chapter identify sections of the Final EIS to which changes have been made.

This Final Abengoa Biorefinery Project EIS also reflects changes based on new and updated information. Substantive changes in this Final EIS are indicated by vertical change bars shown in the margins. Examples of these changes include:

- Updated information related to the design and operation of the biorefinery including the addition of wood waste (wood chips) as part of the biomass feedstock mix used to produce electricity under the Proposed Action, which further assures meeting the agreement to provide power;

- Updated information and revised analyses of potential impacts from the disposal of solid waste during construction and operation of the biorefinery and from cumulative impacts;

- Revised air quality modeling to reflect new information and changes in biorefinery design; and

- Additional information regarding the impacts of biomass harvest on soil sustainability.

Additional information about the public scoping process, as well as the Abengoa Biorefinery Project EIS in general, is available on the Internet at http://www.biorefineryprojecteis-abengoa.com/.

S.2 Proposed Action and Alternatives

The biomass-to-ethanol and -energy facility proposed by Abengoa Bioenergy would use lignocellulosic biomass (biomass) as feedstock to produce biofuels. In more traditional grain-to-ethanol facilities, biofuel producers ferment the simple sugars contained in grains such as corn and milo (grain sorghum) to produce ethanol. For the proposed biorefinery, biomass, including corn stover, wheat straw, milo stubble, mixed warm season grasses (such as switchgrass), and other available materials, would be harvested as feedstock and fermented to produce ethanol. Initially, the feedstock would be corn stover.

The biorefinery would also produce biopower, or bioenergy, in the form of electricity. The bioenergy generation facilities co-located at the site would use direct-firing (that is, using the biomass as a solid fuel in a boiler) and gasification (Action Alternative only) to produce steam. Gasification of biomass occurs when biomass is heated in a low-oxygen environment, producing a biofuel known as syngas. The syngas would be used as boiler fuel, which would lower the demand for natural gas at the biorefinery. Steam produced in the biomass boilers would be used for facility processes and to produce electricity.

S.2.1 PROPOSED ACTION

PREFERRED ALTERNATIVE

The Proposed Action presented in this Abengoa Biorefinery Project EIS is the Department's preferred alternative. To meet the mandates of EPAct 2005 and other governing policies, it is in the best interest of DOE to select and fund the most technologically and economically viable alternative. The Proposed Action represents this alternative.

DOE's Proposed Action is to provide federal funding of up to $71 million (2009 dollars), subject to annual appropriations, to Abengoa Bioenergy to support the design, construction, and startup of the biorefinery, whose total anticipated cost is approximately $685 million (2009 dollars). The Proposed Action is the Department's preferred alternative in this Abengoa Biorefinery Project EIS.

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. Figure S-3 presents a simplified diagram of the process Abengoa Bioenergy would use to convert biomass feedstock to biofuel and biopower under the Proposed Action.

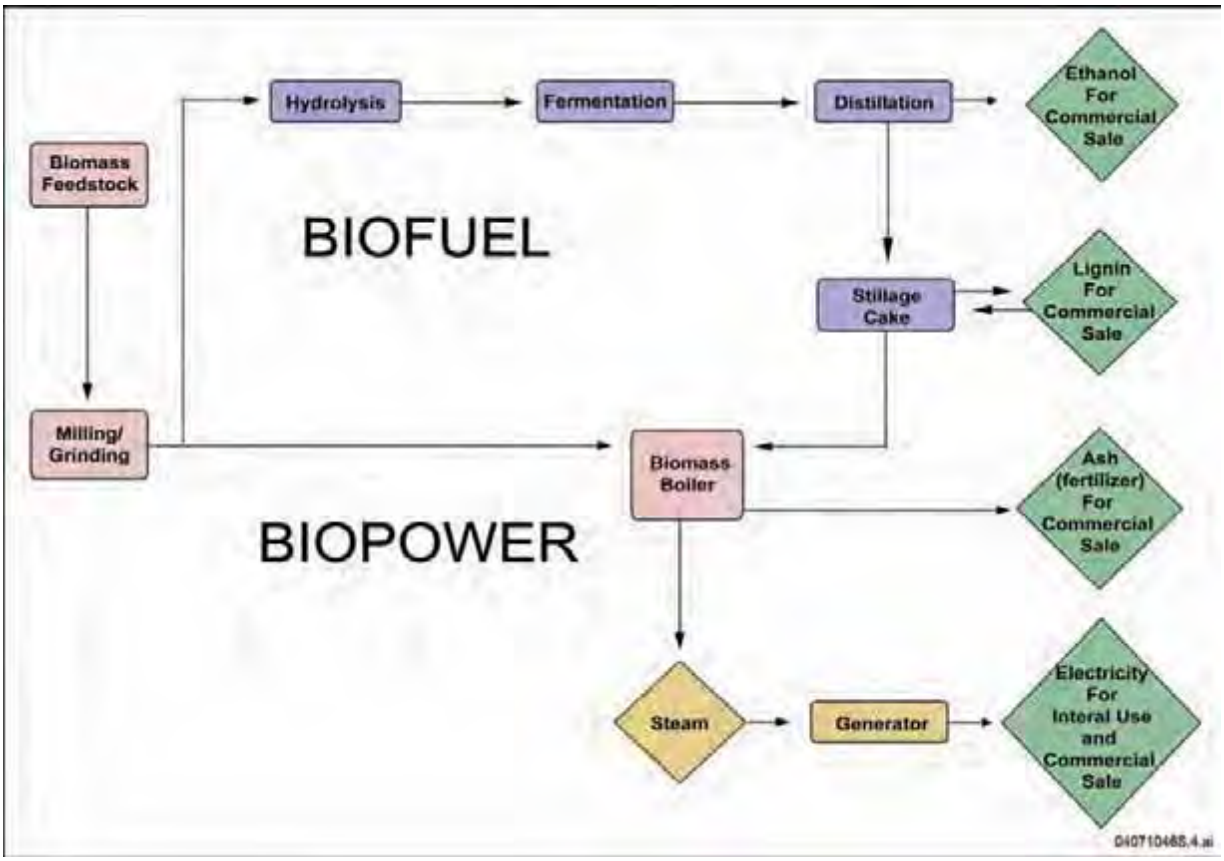

Figure S-3. Simplified diagram showing conversion of feedstocks to biofuel and biopower under the Proposed Action.

S.2.1.1 Construction

The biorefinery would be constructed on a 385-acre parcel near Hugoton, Kansas (Figure S-2). Abengoa Bioenergy 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 optioned parcel would continue to be used as agricultural land, and might be used to test production of biomass feedstocks.

Construction of the biorefinery would take approximately 18 months and would require infrastructure improvements, such as construction of site roads that would tie to Rural Road P, a 1.5-mile-long electrical transmission line, and an approximately 0.5-mile railroad spur on the Biorefinery Project site that would tie into the Cimarron Valley Railroad. Temporary connections to utilities would include electricity, cable, telephone, and a nonpotable water line. Temporary potable water and sanitary facilities would be provided onsite until construction of permanent, onsite facilities.

S.2.1.2 Operations

Biomass for use as feedstock would be procured within 50 miles of the biorefinery. The primary feedstock would be corn stover; secondary feedstocks would include milo stubble, wheat straw, and mixed warm season grasses (such as switchgrass). Over time, mixed warm season grasses could replace corn stover as the primary feedstock. Corn stover, milo stubble, and mixed warm season grasses harvesting would begin mid-October and wheat straw harvesting would begin mid-June.

Harvested bales of biomass would be transported to a 10-acre onsite storage yard or to one of seven offsite storage sites to be located within 30 miles of the Biorefinery Project site. At each location, bales would be stacked to accommodate offloading of arriving trucks during the biomass harvesting season and loading of trucks for shipment to the biorefinery. Each offsite storage location would be about 160 acres and would have no permanent structures. These sites would store enough biomass to support biorefinery operations for up to 1 year.

Bales of corn stover and other biomass ready to be processed at the biorefinery would be transported to a bale barn and sent by conveyor for grinding and cleaning. The ground feedstock would then enter the production process or be stored temporarily in silos onsite. Approximately 2,500 dry short tons of biomass per day would be processed for feedstock.

In addition, wood waste would be used as boiler fuel to generate electricity. Up to 1,000 tons per day would be brought from various sources by rail and truck to the biorefinery.

FERMENTATION

Ethanol fermentation is the biological process of bacteria and yeast breaking down simple sugars for their cellular energy and producing ethanol and carbon dioxide as products.

The ethanol production process would involve the following steps: (1) enzymatic hydrolysis and fermentation, (2) distillation and dehydration, and (3) ethanol denaturant and storage (Figure S-3). During hydrolysis and fermentation, the feedstock would be treated with enzymes and genetically modified organisms (enzymatic hydrolysis) to simultaneously break down the cellulose and ferment the recovered 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 45,200-gallon-capacity shift tanks to hold the anhydrous ethanol produced during each 8-hour shift. Ethanol product not meeting required quality control specifications (for example, ethanol containing water) would be transferred back to the distillation, dehydration, and evaporation facility for reprocessing. Each tank in the storage area would be built onsite and would have an internal floating roof design. The storage tanks would be enclosed in a bermed area to contain spills.

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.

Solids would be recovered from the distillation process. Approximately 120,000 dry short tons of solids, referred to as lignin-rich stillage cake, would be produced per year. The stillage cake would be transferred by conveyor to an onsite third-party lignin producer. After extracting the lignin, the lignin producer would return the lignin-poor stillage cake to the biorefinery and Abengoa Bioenergy would use it as fuel for the solid biomass boilers. Until a lignin extraction facility was built, Abengoa would burn the lignin-rich stillage cake as solid fuel in the biomass boilers. As an option, Abengoa could use lignin-rich stillage cake as fuel for the solid biomass boiler during the life of the biorefinery.

The biomass receiving, grinding, and storage operations would be an enclosed system with a high-velocity, positive pressure collection system to transfer airborne particles to a dirt loadout tank. The loadout tank, grinding activities, and associated transfer points would have fabric filter dust collectors (baghouses). Volatile organic matter released during processing would be captured in a vent scrubber.

Electricity would be produced via the high-pressure, steam-condensing turbine generator. The gross power produced at the biorefinery would be 125 megawatts. Biomass boilers would be used to produce steam. Steam would be used for ethanol production processes and electricity production.

Approximately 1,900 dry short tons per day of biomass feedstock would be supplied to the boilers. The biomass boilers would also burn much of the waste resulting from ethanol production, including fines collected during milling, stillage cake, and syrup from the distillation process. These processes would produce approximately 127,000 tons of ash annually. This ash would contain potassium and phosphorous and would be marketed to the contracted feedstock producers as a soil amendment. If there is no market for the ash, it would be sent to landfills.

The biorefinery would also include the following support facilities and infrastructure:

- An emergency firewater tank and pump and diesel fuel storage tank;
- A chemical storage pad with a 90,000-gallon tank for ammonia, 15,000-gallon tank for sodium hydroxide, 45,000-gallon tank for sulfuric acid, 45,000-gallon tank for ammonia associated with the boilers, two 22,500-gallon tanks for the hydrolytic enzyme cocktail, 90,000-gallon tank for corn syrup, two 2,000-cubic-foot silos for lime storage, and two 2,000-cubic-foot silos for storage of limestone;
- A wastewater treatment facility that would treat all domestic and process wastewater. Treated process wastewater would be recycled in the ethanol production process. Wastewater treatment facility sludge would be used in the boiler fly ash pelletization process or burned in the solid biomass boilers;
- Two non-contact cooling towers. Wastewater from the cooling towers would be used to irrigate fields in the buffer zone;
- Paved in-facility haul roads;
- A railroad spur connecting the biorefinery to the Cimarron Valley Railroad;
- A new 115-kilovolt transmission line that would be about 1.5 miles long; and
- A system to deliver water from up to eight existing wells for which Abengoa Bioenergy has optioned irrigation water rights.

S.2.2 ACTION ALTERNATIVE

For the Action Alternative, DOE would provide federal funding to support the design, construction and startup of a biorefinery that would use a two-stage process to pretreat and hydrolyze and ferment sugars for bioethanol production and that would produce syngas using a gasification system. A syngas boiler as well as the biomass boilers would produce steam. Steam would be used for ethanol production processes and electricity production. Under the Action Alternative, the biomass boilers and the turbines would be used to generate electricity solely to operate the plant and would be smaller than those for the Proposed

Action. Figure S-4 presents a simplified diagram of the process Abengoa Bioenergy would use to convert biomass feedstock to biofuel and biopower under the Action Alternative.

Under the Action Alternative, the biorefinery would produce approximately 12 million gallons per year of denatured ethanol, 19,000 short tons per year of lignin-rich stillage cake, and 20 megawatts of electricity for use at the facility.

The milling process for the Proposed Action and Action Alternative is the same. Once milled, the feedstock would be pretreated with dilute acid to remove hemicellulose and pectin (the Proposed Action does not include pretreatment). The hemicellulose and pectin would be recovered as simple sugars and separated from the water-insoluble, cellulose-rich, lignin-rich fiber. The fiber would be treated with enzymes and genetically modified organisms (enzymatic hydrolysis) to simultaneously break down the tougher cellulose and ferment the recovered sugars.

The simple sugars recovered after pretreatment would be transferred to the fermentation tanks and mixed with genetically modified organisms to ferment. At the conclusion of the fermentation process, the beer would be conveyed to the distiller for purification. The beers from enzymatic hydrolysis and the fermentation process would be combined, distilled, and dehydrated.

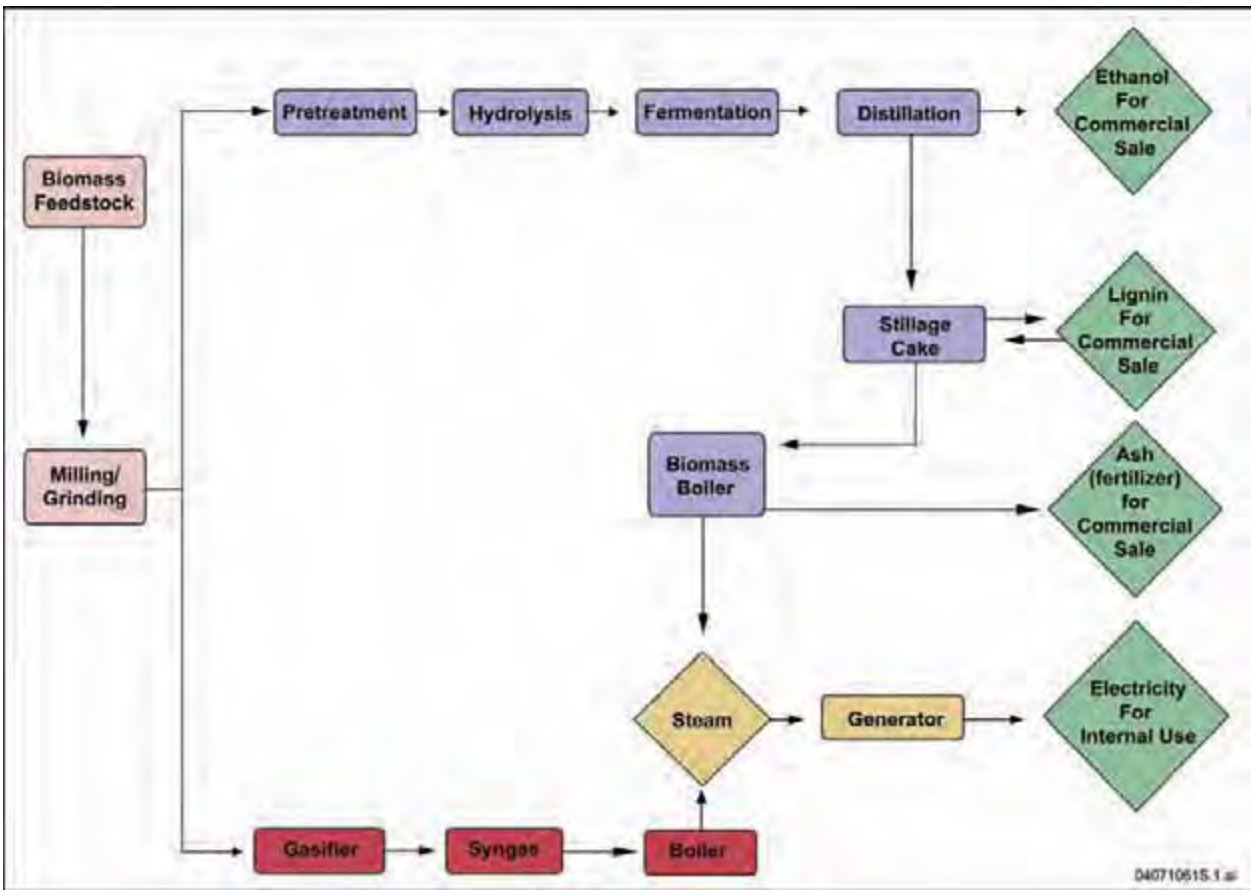

Figure S-4. Simplified diagram showing conversion of feedstocks to biofuel and biopower under the Action Alternative.

Approximately 71,000 dry short tons per year of soluble and insoluble solids would be recovered from the bottom of the distillation column. The soluble solids would be concentrated to a thin stillage syrup in an evaporator and would be combusted in the biomass boilers. About 130 dry short tons per day of insoluble, lignin-rich stillage cake would be transferred to an onsite processing facility for extraction of lignin. After the lignin was extracted, the lignin producer would return the lignin-poor stillage cake to the biorefinery, and Abengoa Bioenergy would use it as fuel for the solid biomass boiler. Until a lignin extraction facility is built, Abengoa would burn the lignin-rich stillage cake as solid fuel in the biomass boiler. If recovery of lignin is not economically feasible, the lignin-rich stillage cake would be used as fuel in the biomass boiler.

Denaturing the produced ethanol and loadout for the Proposed Action and Action Alternative are the same.

Syngas produced in the gasification plant under the Action Alternative would be used to operate a fire-tube boiler to produce steam. A small biomass solids boiler would also produce steam to power the biorefinery process operations only. Steam would be used to operate a small turbine that would produce 20 megawatts of power.

S.2.3 DECOMMISIONING AND DESTRUCTION OF THE BIOREFINERY

For the purposes of the analysis in this EIS, the projected life of the biorefinery is 30 years; however, Abengoa Bioenergy has not projected a life for the facility. The bioenergy industry is so new that no bioenergy facilities have been decommissioned. While there are no data on which to base the impacts associated with decommissioning and destruction of the biorefinery, DOE does not anticipate impacts to be greater than the impacts associated with construction.

S.2.4 COMPARISON OF DESIGN FEATURES

Table S-1 provides a comparative overview of the biorefinery design features and products under the Proposed Action and Action Alternative.

S.2.5 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not provide federal funding to Abengoa Bioenergy to support the design, construction, and startup of a biorefinery. Abengoa would not build a biorefinery and the biorefinery parcel would remain agricultural land. The Department recognizes, however, that Abengoa could pursue alternative sources of capital for development of the biorefinery.

Table S-1. Comparison of the design features and products of the biorefinery under the Proposed Action and Action Alternative.

Design features/products	Proposed Action	Action Alternative
Biomass feedstock	Approximately 2,500 dry short tons per day	800 dry short tons per day
Fermentation facility	One step feedstock hydrolysis/fermentation process	Feedstock pretreatment to remove simple sugar molecules followed by hydrolysis/fermentation process on the remaining cellulose
Gasifier	No	Yes, syngas production
Steam production	Four biomass boilers (500 million Btu/hr each)	Two syngas boilers (132 million Btu/hr each) and one biomass boiler (190 million Btu/hr)
Denatured Ethanol production	19 million gallons per year	12 million gallons per year
Lignin-rich stillage cake (not including distiller's syrup)	120,000 dry short tons per year	45,000 dry short tons per year
Lignin production	45,000 dry short tons per year	19,000 dry short tons per year
Electricity production	125 megawatts (75 megawatts sold to the grid)	20 megawatts (none sold to the grid)
Electricity purchase	None	10 megawatts (15 megawatts during peak demand)
Boiler ash	127,000 tons per year	11,000 tons per year
Gasifier ash	0	9,000 tons per year

S.3 Environmental Impacts of the Proposed Action and Action Alternative

The following sections summarize the potential environmental impacts of the Proposed Action and Action Alternative for 13 resource and subject areas the Department considered in this Abengoa Biorefinery Project EIS. Section S.4 summarizes impacts of the No-Action Alternative and Section S.5 summarizes cumulative impacts.

S.3.1 LAND USE

Because production of crops and livestock forage is the primary use of land in the region surrounding the Biorefinery Project site, and because procurement of feedstock could alter agricultural practices in the region, the analysis of land use impacts focused on the potential changes that construction and operation of the biorefinery could have on agricultural land uses and land management practices.

Proposed Action. Operation of the biorefinery would require approximately 0.88 million dry short tons of lignocellulosic feedstock per year. 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. Approximately 20 percent of the total feedstock demand would consist of corn stover for cellulosic ethanol production, with the remaining 80 percent consisting of any combination of feedstocks for bioenergy production.

DOE conservatively estimates that the total annual demand for crop residue by the biorefinery would equal about 60 percent of the targeted crop residues that could be sustainably removed from the 50-mile region surrounding the Biorefinery Project site. The demand for corn residue for ethanol production would be about 20 percent of the amount that could be sustainably removed from irrigated corn acreage. Thus, production of targeted crop residues exceed biorefinery demand and Abengoa would have 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, it anticipated that mixed warm season grasses (such as switchgrass) would replace corn residue as the primary feedstock for producing ethanol. Land use changes associated with increased mixed warm season grasses production 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. The opportunity cost associated with increased mixed warm season grasses production would likely only impact the segment of livestock producers in the region that rely on land not under their control for their livestock forage needs. DOE does not consider the indirect opportunity cost to those non-landowners an adverse impact. 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. Thus, biomass removal for the Proposed Action would not result in adverse levels of soil 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.

Biomass would be harvested using typical harvesting methods and equipment, would be independent of grain harvesting, and thus would not significantly impact cropping practices in the region. DOE anticipates that harvesting mixed warm season grasses would have a negligible impact on soil conditions. Any associated opportunity costs would be negligible.

Seven 160-acre offsite biomass storage sites would be developed on land near major roads. Abengoa Bioenergy would select and develop these sites in a manner that would minimize impacts to productive agricultural land. DOE does not anticipate adverse impacts to conservation programs, prime farmland, highly erodible soil, or public lands.

Development of the biorefinery would result in the irreversible conversion of 385 acres from agricultural to industrial use. The Proposed Action is consistent with existing land use and zoning at the 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.

Action Alternative. Under the Action Alternative, the biorefinery would require about 0.27 million dry short tons of feedstock per year. Because the demand for crop residue would be substantially less than the amount available in the region, there would be no incentive to alter land uses to meet the demand for biomass feedstock. In addition, DOE does not anticipate any changes in the amount of land in the Conservation Reserve Program.

DOE concludes the Action Alternative would not impact cropping practices in the region or cause substantial opportunity costs associated with harvesting crop residue. The offsite biomass storage sites would be selected and developed in a manner that would minimize impacts to productive agricultural land. Further, DOE does not anticipate adverse impacts to conservation programs, prime farmland, highly erodible soil, or public lands.

The Action Alternative is consistent with existing land use and zoning. Conversion of the Biorefinery Project site to industrial use and the reduction in irrigated farmland associated with water rights would have negligible impacts on regional land use.

S.3.2 AIR QUALITY

Due to the rural nature of the region surrounding the Biorefinery Project site, levels of air pollution are relatively low, and the area is in attainment with National Ambient Air Quality Standards.

Proposed Action. Construction of the biorefinery 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 18-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 would be well below the National Ambient Air Quality Standards. The estimated concentrations from the biorefinery, combined with ambient background concentrations of pollutants in the region, are about 67 percent of the National Ambient Air Quality Standard for 24-hour PM_{10}, 12 percent for nitrogen dioxide, and less than 10 percent of the standard for other pollutants. DOE therefore concludes that impacts to air quality would be less than levels deemed to be protective of human health and the environment and would not degrade the existing air quality.

The biorefinery also would be a source of greenhouse gases, with carbon dioxide the most abundant. The boilers would be the main source of 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) would be 3.61 million tons per year. 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 would be 0.046 percent of the total U.S. carbon dioxide equivalent value.

Greenhouse gases emitted by the Abengoa biorefinery would mix and be stable in the atmosphere and would not result in direct impacts to the Hugoton area. The emissions would pose no direct hazard to

human health, such as from toxicity or asphyxiation, and any incremental climate change impacts attributable to the relatively small quantities of greenhouse gases the biorefinery would emit would be too small to observe, either globally or in the Hugoton area. However, the greenhouse gases the biorefinery would emit would add to past and future emissions from all other sources of U.S. and global greenhouse gas emissions, contributing to cumulative impacts on climate change, such as those described below.

While the scientific understanding of climate change is evolving, the Intergovernmental Panel on Climate Change Fourth Assessment Report *Climate Change 2007* states that warming of the earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric greenhouse gas concentrations caused by human activities. The Fourth Assessment Report indicates that changes in many physical and biological systems, such as increases in global temperatures, more frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts, are linked to changes in the climate system and that some changes may be irreversible. At present, there is no methodology that would allow DOE to correlate greenhouse gas emissions from the Proposed Action to any specific climate change impact.

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. 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 not only by producing a fuel that displaces gasoline, but also by producing power that displaces electricity from other electricity generating sources. 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. The metric used to express lifecycle effects on greenhouse gas emissions is the relative percent reduction calculated by comparing (a) the quantity of greenhouse gas emissions (grams of carbon dioxide equivalent per mile) under a range of scenarios with (b) a baseline in which the biorefinery is not built and passenger vehicles use 100 percent conventional or reformulated gasoline. In using the GREET Model to make these comparisons, DOE accounted for energy consumed by and exported by the biorefinery; biomass-generated electricity exported to the grid was applied to the total energy balance of the biorefinery as an "energy credit" (approximately -42 kilowatt hours per gallon of ethanol). DOE assumed that the exported energy would replace electricity that would have been produced by the average U.S. mix, approximately 70 percent or more of which is from fossil energy sources. Results of calculations, presented below, with percentage reductions that exceed 100 percent reflect the relatively large "negative" contribution of the energy credit.

The GREET Model was used to compare greenhouse gas emissions from three scenarios with the baseline scenario: (1) vehicles fueled only by ethanol, (2) vehicles fueled by 85-percent ethanol and 15-percent gasoline (E85), and (3) vehicles fueled by 10-percent ethanol and 90-percent gasoline (E10). Based on the GREET Model, the Proposed Action under the first scenario would result in a 340-percent reduction in greenhouse gas emissions compared with the gasoline-only baseline. The reductions in greenhouse gas emissions are due largely to the emissions "credit" for the electricity being exported to the grid. The exported biopower would replace electricity that would have been produced largely through coal, nuclear,

and natural gas. Thus, the greenhouse gas emission credit is essentially equal to the difference between the greenhouse gases from producing biomass-based electricity and greenhouse gases from producing coal, natural gas, and nuclear-based electricity. Because the majority of the electricity the biorefinery would produce would be exported rather than used for biorefinery operations, the greenhouse gases displaced by the biorefinery would be larger than the greenhouse gases emitted by biorefinery operations, thus causing a decrease in greenhouse gas that exceeds 100-percent. As a comparison, if only enough electricity was produced to run the biorefinery (none would be sold to the grid), the percent reduction under the Proposed Action would be 69-percent as compared with the gasoline-only baseline. In the second scenario (E85), DOE estimates a 329-percent reduction in greenhouse gas emissions, once again, primarily due to the emissions credit. As a comparison, without the export of electricity to the grid, the percent reduction in greenhouse gas under the second scenario would be 62-percent. In the third scenario (E10), DOE estimates that a 29-percent reduction in greenhouse gas emissions could be achieved relative to the gasoline-only baseline.

Action Alternative. Construction impacts would be the same as those for the Proposed Action. Under the Action Alternative, the estimated concentrations of air pollutants from the biorefinery along with ambient background concentrations of pollutants in the region are about 53 percent of the National Ambient Air Quality Standard for 24-hour PM_{10}, 13 percent for nitrogen dioxide, and less than 10 percent of the standard for other pollutants. DOE therefore concludes that impacts to air quality in the Hugoton area would be less than levels deemed to be protective of human health and the environment and would not degrade the existing air quality.

DOE also used the GREET Model to compare the same three ethanol-related scenarios with a gasoline-only baseline scenario, as described above under the Proposed Action. Based on the GREET Model, the use of biomass-produced ethanol and electricity under the first scenario would result in a 39-percent reduction in greenhouse gas emissions compared with the gasoline-only baseline. In the second scenario (E85), DOE estimates a 33-percent reduction in greenhouse gas emissions, and in the third scenario (E10), a 3-percent reduction in greenhouse gas emissions could be achieved relative to the gasoline-only baseline.

S.3.3 HYDROLOGY

There are no perennial streams within the region evaluated for surface waters. Throughout most of Stevens County, including the Project site, surface water drains internally to depressions, or playas, that are common throughout the region. Water for construction and operation of the biorefinery would be pumped from the High Plains Aquifer. Groundwater levels throughout much of that aquifer have been in decline for decades because of the high rate of withdrawals, primarily for irrigation.

S.3.3.1 Surface Water

Proposed Action. Wastewater, petroleum products, and hazardous chemicals could be released from the biorefinery. Planned releases of wastewater would be limited to the non-contact wastewater that would be conveyed to two 11.5-acre ponds and then used for irrigation of the buffer area. Petroleum products and hazardous chemicals used during construction and operations 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 distribution of where infiltration would occur.

Alterations to surface water drainage would be limited to minor changes within the 385-acre parcel and possibly within the buffer area. Natural low areas where runoff accumulates would not be altered. No wetlands would be filled and no floodplains would be affected.

The Department concludes the potential for adverse impacts to surface waters from the Proposed Action is negligible.

Action Alternative. The amount and location of land disturbed under the Action Alternative, volume of non-contact wastewater applied, types and quantities of petroleum products and hazardous chemicals, hazardous materials management strategies and containment structures, and the storm water runoff control strategy would be the same or similar to those for the Proposed Action. DOE, therefore, concludes the potential for adverse impacts to surface waters from the Action Alternative is negligible.

S.3.3.2 Groundwater

Proposed Action. Construction of the biorefinery would require approximately 220 acre-feet of water, and operations would require about 2,900 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 to approximately 2,950 acre-feet per year.

Abengoa Bioenergy has optioned existing irrigation water rights from eight wells to meet the water demand for construction and operation of the biorefinery under the Proposed Action. The maximum permitted withdrawal associated with those water rights is about 7,240 acre-feet per year, and the total volume discharged from those wells in 2008 was about 4,380 acre-feet. Thus, use of those water rights for operation of the biorefinery would result in a reduction of more than 4,290 acre-feet compared with the permitted annual volume, and a reduction of more than 1,430 acre-feet compared with withdrawals during 2008. DOE concludes that operation of the biorefinery would result in a beneficial decrease in groundwater withdrawals from the High Plains aquifer.

As Section S.3.1 discusses, changes in cropping practices as a result of 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 countermeasure plan, which would minimize or eliminate potential impacts to the groundwater quality from construction and operation of the biorefinery.

Action Alternative. Under the Action Alternative, operation of the biorefinery would require a net annual demand of 700 acre-feet of water per year, including the domestic needs of workers. Under the Action Alternative, the maximum permitted withdrawal associated with the irrigation water rights

Abengoa has optioned for three wells is about 2,200 acre-feet per year, and the total volume discharged from those wells in 2008 was about 1,380 acre-feet. Thus, use of those water rights for operation of the biorefinery would result in a reduction of more than 1,500 acre-feet compared with the permitted annual volume, and a reduction of more than 680 acre-feet compared with withdrawals during 2008. As with the Proposed Action, DOE concludes that operation of the biorefinery under the Action Alternative would result in a beneficial decrease in groundwater withdrawals from the High Plains aquifer.

Cropping patterns and associated use of groundwater under the Action Alternative would be similar to those for the Proposed Action, and 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.

S.3.4 BIOLOGICAL RESOURCES

Proposed Action. 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, but these 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 Proposed Action indicated that conversion of Conservation Reserve Program lands to tilled cropland from the Proposed Action is not expected, and other changes in land use would be minimal. Thus, DOE does not expect the Proposed Action to impact biological resources within the region surrounding the Project site.

Action Alternative. DOE concludes that construction and operation of the biorefinery under the Action Alternative would have no impacts on threatened or endangered species or their designated critical habitat. Impacts from construction and operation of the biorefinery on biological resources would be minor and would only affect common species within 1 mile of the Biorefinery Project site. DOE does not expect the Action Alternative to impact biological resources within the region surrounding the Project site.

S.3.5 UTILITIES, ENERGY, AND MATERIALS

Proposed Action. The domestic water needs of biorefinery workers and their families would be provided by the City of Hugoton water system. Those workers and their families would also rely on the City of Hugoton sewage system and the Stevens County landfill. The Hugoton water system would supply potable water for the biorefinery facilities. Process water, sewage, and solid waste would be managed independently at the biorefinery, and the potential impacts of those processes are analyzed elsewhere in this EIS.

For purposes of analysis, DOE conservatively assumed that all construction workers and their families would live in Hugoton, which would increase demand on the City of Hugoton water system by approximately 50 gallons per minute during biorefinery construction. During operations, water consumption from that system would increase by about 30 gallons per minute to support workers and

their families and to supply potable water to the Biorefinery Project site. These demands are well below the 190-gallon-per-minute excess capacity of the City water system.

The City of Hugoton sewage treatment lagoons were designed to accommodate 4,000 people and are currently used by approximately 3,400 people. During the 3-month peak of construction, up to about 480 additional people could be living temporarily in Hugoton, which would approach the capacity of the sewage lagoons. The addition of up to 140 people during operations would not stress the capacity of the lagoons. The sewage collection system in Hugoton has sufficient capacity to accommodate use of the system by construction and operations workers and their families.

The Stevens County landfill has a permit limit of 20 tons of solid waste per day, and currently receives about 13 tons per day. DOE estimates the amount of solid waste received at the landfill would increase to approximately 15 and 14 tons per day during construction and operations, respectively, due to the influx of workers and their families living in Hugoton.

The biorefinery would require no electric power from the regional grid during operations. Rather, the biorefinery would supply 75 megawatts of electricity to the grid during normal operations, which equals 5.8 percent of the production capacity in the western-central region of Kansas, but only about 0.2 percent of current summer demand in the Southwest Power Pool. 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.

The Proposed Action 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.

Action Alternative. The increase in water consumption by the workforce and their families from the City of Hugoton water system would be 45 and 50 gallons per minute during construction and operations, respectively, which is well below the 190-gallon-per-minute excess capacity of that system. The Hugoton sewage system and Stevens County landfill have sufficient capacity to accommodate workers and their families.

Under the Action Alternative, the biorefinery would require electric power from the regional grid. The amount required would be a small portion (less than 1 percent) of the combined production capacity of Sunflower Electric Power Corporation and the Mid-Kansas Electric Company, the two electricity suppliers in the region, and a smaller portion (about 0.024 percent) of the average electricity demand within the Southwest Power Pool. The additional electric needs would not be an adverse increase in demand on the regional distribution system.

The amount of construction materials required for the Action Alternative would be similar to or less than those evaluated for the Proposed Action. With the possible exception of stainless steel, there would be no availability issues, and the needs would not stress the regional market for these materials.

S.3.6 WASTES, BYPRODUCTS, AND HAZARDOUS MATERIALS

The wastes and byproducts the biorefinery would produce include construction wastes, wastewater, solid biomass boiler 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 ash and lignin are byproducts that could be sold to consumers within the 50-mile region of influence. Abengoa Bioenergy would burn stillage cake, dirt and fines from biomass processing, and genetically modified organisms in the solid biomass boilers as part of the 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. Wastewater treatment facility sludge would be used in the boiler fly ash pelletization process or burned in the solid biomass boilers. Abengoa would apply non-contact wastewater on the buffer area and would treat, recycle, and/or dispose of boiler bottom ash, municipal solid waste, hazardous waste, and construction debris at permitted facilities within the region of influence.

Proposed Action. Up to 80 tons per day of solid waste would be generated during the 18-month construction period. The Stevens County landfill would not have adequate capacity to receive the construction wastes generated and maintain its small arid landfill exempt status (limited to 20 tons per day), and 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 affecting their capacity, but permission for disposal would be required from those facilities (for example, Grant County construction and demolition landfill). To mitigate impacts to disposal facilities within the region of influence, Abengoa's construction specifications should direct contractors where to recycle and/or dispose of construction-generated wastes.

Less than 1 ton per day of municipal solid waste would be generated during the expected 30-year operating life of the biomass-to-ethanol and -electricity facility. This solid waste stream 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 onsite wastewater treatment facility would treat all process wastewater generated at the Biorefinery Project site and would not discharge any to the Hugoton wastewater system. Wastewater treated onsite would be reused in the ethanol production process. Wastewater that would not be recycled and reused in the production process or treated onsite (non-contact wastewater) would be produced at a rate of 370 gallons per minute and would be used to irrigate biomass crops on the buffer area. This water would be conveyed to two 11.5-acre storage ponds prior to application to the buffer area. Wastewater treatment facility sludge would be used in the boiler fly ash pelletization process or burned in the solid biomass boilers.. Based on an agronomy study, the chemical composition of the wastewater and the anticipated stipulations of a required discharge permit, 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. Based on the availability of chemical supplies within the region of influence, DOE concludes that 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.

The biomass-to-ethanol and -electricity facility would generate 2,000 pounds per year of hazardous waste (for example, gasoline, spent solvents, waste ethanol, and caustics). Those 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 if Abengoa Bioenergy's proposed hazardous waste management practices are 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.

The solid biomass boilers would generate up to 16 tons of bottom ash per day. The bottom ash would be sent to 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 2.2 years. In addition, the solid biomass boilers would generate up to 350 tons of fly ash per day. Abengoa Bioenergy plans to sell the fly ash as a nutrient replacement co-product to biomass producers in the region. If the ash could not be sold or otherwise used in a beneficial manner, it would require disposal at permitted solid waste disposal facilities. Stevens County landfill would not have adequate capacity to receive this amount of ash without a permit modification. This waste stream could be split among permitted landfills and transfer stations within 35 miles of the biorefinery; permission would be needed from those facilities to receive the waste. 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. Abengoa should develop and implement a contingency plan for alternative beneficial uses of the fly ash, in the event a significant percentage of the material was not used by biomass producers as soil amendment. This mitigation strategy is identified in Chapter 6, Section 6.2 of this EIS. 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.

Action Alternative. The facility considered under the Action Alternative would produce up to 70 tons of construction waste per day, which is more than the current capacity of the Stevens County landfill. Non-recycled construction waste could be split among other permitted landfills within the region. Under the Action Alternative, about 25 tons of solid waste (primarily dirt and fines) as well as from 50 to 70 tons of ash would be generated daily. As with the Proposed Action, if the ash could not be sold as a nutrient replacement, it would have to be disposed of in a landfill. There is not adequate capacity at the Stevens County landfill to receive this amount of solid waste and ash without modification of its small arid landfill exempt status. With permission, the waste and ash could be split among the other landfills and transfer stations in the region.

Up to 115 gallons per minute of non-contact wastewater would be discharged and used for irrigation under the Action Alternative. This wastewater would be stored in a 15 million-gallon storage pond during winter. Treatment of wastewater, disposal of sludge and hazardous materials, and processing of genetically modified organisms would be treated in the same manner as that for the Proposed Action.

S.3.7 TRANSPORTATION

Proposed Action. There would be approximately 32,000 truck shipments of materials during construction, and about 80,000 to 116,000 truck and 1,300 to 6,600 rail shipments per year during the 30-year operating period of the biorefinery. DOE estimates there would be 35 to 41 traffic fatalities due to these shipments and the commuting of workers, the majority (32 to 38) of which would be due to shipments of biomass, chemicals, denatured ethanol product, and waste. For perspective, over the 30-year operations period, there would be an estimated 13,400 traffic fatalities in Kansas and 820 traffic fatalities in the nine counties surrounding the Project site.

DOE estimates that 1,075 rail carloads of denatured ethanol and waste and 211 to 5,554 rail carloads of biomass and chemicals would be shipped to and from the biorefinery per year of operation, which is equivalent to about 49 to 241 additional trains per year. This would result in an increase in the approximately 600 trains per year that travel on the Cimarron Valley Railroad, but is 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 to range from $580,000 to $840,000.

Action Alternative. Under the Action Alternative, there would be approximately 28,600 truck shipments of materials during construction, and about 30,500 truck and 730 rail shipments per year during operations. DOE estimates there would be 13 traffic fatalities due to those shipments and the commuting of workers. As with the Proposed Action, the majority of these fatalities (11) would be due to shipments of biomass, chemicals, denatured ethanol product, and waste.

No roadway improvements were identified as necessary to help truck and employee traffic access the biorefinery. As with the Proposed Action, the additional rail traffic from the Project site would not adversely affect the operations of the Cimarron Valley Railroad.

DOE estimated the annual cost of pavement damage associated with truck shipments of biomass, chemicals, and wastes under the Action Alternative to be $220,000.

S.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.

S.3.8.1 Visual Resources

Proposed Action. The tallest structure at the biorefinery considered under the Proposed Action would be approximately 115 feet, but many of the other structures would be 40 feet tall or less. 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. Thus, implementation of the Proposed Action would result in additional but similar structures that 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. Additional night lighting at the biorefinery may be noticeable to viewers in the city of Hugoton, but would be similar to night lighting at the nearby Hugoton Municipal Airport.

The Proposed Action would require a new 1.5-mile-long transmission line. This transmission line would be visible from Road P and Road 11 near the Biorefinery Project site, but would result in minimal visual impacts to viewers from a distance.

Action Alternative. Under the Action Alternative, two groups of tall structures, comprising the biomass boiler operations and the turbine facilities, would not be constructed or would be smaller than those constructed for the Proposed Action. Thus, under the Action Alternative, fewer tall structures would be visible from surrounding vantage points; however, some additional structures that are similar to existing facilities in the area would be visible from surrounding vantage points.

The Action Alternative would be a source of night lighting, which might be noticeable to viewers in Hugoton. Finally, under the Action Alternative, the 1.5-mile-long transmission line would not be required.

S.3.8.2 Noise

Proposed Action. 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, permissible noise exposure levels are not expected to be exceeded.

The nearest residence to the Biorefinery Project site, approximately 0.6 mile away, may experience some annoyance from construction noise, but the impact would be small because at that distance, the noise would not be very loud (approximately 56 decibels) and would be temporary. At 0.6 mile, noise from operation of the wood hog during operations could be distinguishable from other background sources of noise. 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 70 truck shipments to the biorefinery site per day, or about one truck arriving every 12 minutes (assuming all traffic occurs from 7:00 a.m. to 9:00 p.m.). During operations, 202 trucks per day are expected (one truck every 4 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 8 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 21 minutes during operations. Noise from these passing trucks would frequently interfere with outdoor conversations and cause annoyance indoors. Rail traffic would increase by about 255 trains per year. Most of the rail shipments would carry wood waste and are expected to occur on weekdays during normal working daylight hours.

Action Alternative. Under the Action Alternative, noise from biorefinery construction would be the same as that described for the Proposed Action. However, noise from operations would be less without

the wood hog. DOE does not anticipate impacts to members of the public from construction or operation of biorefinery. The number of shipments by truck per day during operations would be approximately one-quarter of those for the Proposed Action. Along the most frequently traveled routes in and around Hugoton, trucks would pass residential areas about once every 30 minutes. Rail traffic for the Action Alternative would be less than the rail traffic for the Proposed Action.

S.3.8.3 Odor

Odors emitted from the biorefinery generally would be volatile organic compounds, including ethanol, hazardous air pollutants, nitrogen dioxide, and sulfur dioxide. Engineered controls implemented to minimize these emissions would reduce odors from the biorefinery.

Proposed Action. 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.

Action Alternative. Air dispersion modeling indicates that one odorous compound (nitrogen dioxide) might be detectable at the biorefinery parcel fence line, but no odorous compounds would be detected at offsite locations where the public would commonly be located. Therefore, DOE anticipates no impacts to the public from the release of odorous compounds under the Action Alternative.

S.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.

Proposed Action. The Proposed Action would require 256 workers at the peak of construction. About 190 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. That small increase in population would have little impact on the availability or cost of housing. Construction of the biorefinery also would have little impact on public services, as there would be less than 1 percent increase in the ratio of law enforcement officers-to-residents, firefighters-to-residents, and residents-to-staffed hospital beds. 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 $17-million infusion of earnings, which equals about 1 percent of the 2006 per capita income in the region.

The anticipated life of the biorefinery is 30 years, during which it would employ 43 people. This would result in a regional increase in the local population of less than 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 $4.4 million infusion in earnings.

Action Alternative. Under the Action Alternative, about 230 workers would be employed during the peak of construction, and about 170 of those positions would be filled by workers who migrate into the region. Thirty-four workers would be employed during operations. Construction of the biorefinery

would result in a temporary increase in the population of the four-county region of less than 1 percent, and operations would result in an increase of less than 0.1 percent. Thus, impacts on socioeconomic variables would be very small. During construction and operations, the region would experience an annual infusion in earnings of $16 million and $3.5 million, respectively.

S.3.10 CULTURAL RESOURCES

Proposed Action. No properties listed on the National Historic Register are within or on properties adjoining the Biorefinery Project site. Based on DOE review of published information, coordination with the State Historic Preservation Office, and the results of a Phase I/II investigation of a 160-acre portion (areas investigated were coordinated with the State Historic Preservation Office) 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 would be evaluated for cultural resources in coordination with the Kansas State Historical Preservation Office.

Action Alternative. Construction and operation of the biorefinery under the Action Alternative 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.

S.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.

Proposed Action. The potential for adverse impacts to health and safety from the 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. During operations, the total annual industrial health and safety impacts to workers from all operations at the biorefinery (such as, ethyl alcohol manufacturing, milling and grinding operations, and electric power generation) are estimated to be 2.7 total recordable cases, 0.94 day away from work, and 0.0014 fatality. Based on these results, DOE concludes that a fatality would be unlikely.

Action Alternative. During construction, the industrial health and safety impacts to workers are estimated to be 12 total recordable cases, 6.3 days away from work, and 0.023 fatality under the Action Alternative. During operations, the total annual industrial health and safety impacts to workers from all operations at the biorefinery (such as, ethyl alcohol manufacturing and milling/grinding operations) are estimated to be 2.3 total recordable cases, 0.68 day away from work, and 0.0011 fatality. As with the Proposed Action, DOE concludes that a fatality would be unlikely under the Action Alternative.

S.3.12 FACILITY ACCIDENTS AND SABOTAGE

To evaluate impacts from accidents, DOE examined the hazardous materials associated with facility operations, evaluated external (for example, aircraft hazards and range fires) and internal events (such as

a tank failure) to determine the frequency that selected hazardous materials could be released, and analyzed the consequences of such events, including blast effects and releases of toxic chemicals. DOE also considered intentional destructive acts associated with operation of the biorefinery.

Proposed Action. Based on the operational history of existing ethanol plants, DOE concludes that the hazards of ethanol production to members of the public are 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 ethanol or gasoline storage tank, workers could be injured or killed depending on the location of the worker at the time of the event.

DOE considered the most 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.

Action Alternative. The Action Alternative includes a change in the amount of biomass used and elimination of the co-generation capability, but the same types of chemical would be stored at the biorefinery as under the Proposed Action. Thus, impacts would be as described above for the Proposed Action.

S.3.13 ENVIRONMENTAL JUSTICE

Proposed Action. No impacts to communities with high percentages of minority and low-income populations were identified that would experience impacts exceeding 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 Proposed Action.

Action Alternative. Impacts to populations in the region surrounding the Biorefinery Project site under the Action Alternative would be similar to those for the Proposed Action. Thus, the conclusions described for the Proposed Action also apply to the Action Alternative.

S.4 No-Action Alternative

Under the No-Action Alternative, none of the adverse impacts identified above for the two action alternatives (for example, emissions of air pollutants, use of land for disposal of solid wastes, increase in truck traffic, and associated increase in accidents and noise) or beneficial impacts (for example, increased employment, decrease in groundwater use, and increase in the electrical production capacity for the region) would occur. Nor would any of the cumulative impacts identified below occur. Further, the benefits that would be gained from the development, demonstration, and commercial operation of an integrated biorefinery that uses lignocellulosic feedstocks would not be realized. In addition, no benefits would be realized from the development of a renewable energy system that would reduce air pollutants and sequester emissions of greenhouse gases. For example, the reductions in greenhouse gas emissions estimated to occur if the Proposed Action were implemented would not be realized with the continued use of gasoline instead of biofuel and no generation of biopower.

S.5 Cumulative Impacts

DOE evaluated public-and private-sector past, present, and reasonably foreseeable activities that could, when combined with the Proposed Action or Action Alternative, result in cumulative impacts. DOE considered reasonably foreseeable future actions that could have effects that coincide in time and space with the effects of the Abengoa Biorefinery Project and associated transportation activities. The Department identified those actions within and near a 50-mile radius of the Project site based on interviews with representatives of government and private organizations; reviews of resource, policy, land use, and other plans; and review of published media accounts.

CUMULATIVE IMPACTS

A cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal or person undertakes such other actions" (Council on Environmental Quality Regulations, 40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively potentially significant actions that occur over time.

S.5.1 REASONABLY FORESEEABLE FUTURE ACTIONS

The following actions were considered by the Department in the analysis of cumulative impacts. The first action, a grain-to-ethanol facility that could be constructed by Abengoa Bioenergy at the same location as the proposed biomass-to-ethanol facility, is described in some detail. This is done because many of the impacts of that facility would occur in the same locations, and some could be additive to that of the Proposed Action or Action Alternative. Brief descriptions of other reasonably foreseeable future actions follow.

Grain-to-Ethanol Facility. Abengoa Bioenergy has developed plans and designs to add a grain-to-ethanol facility to the proposed biomass-to-ethanol facility. As described in Section S.1.2, Abengoa has, at this time, eliminated from consideration the construction and operation of the grain-to-ethanol facility. However, the grain-to-ethanol facility could be developed in the future.

The grain-to-ethanol facility would be located on the same 385-acre parcel as the biorefinery. It would be constructed after, and would operate independently of the biomass-to-ethanol facility, although certain then-existing systems would be used. The grain-to-ethanol facility would produce approximately 100 million gallons of denatured ethanol based on a 350-day annual operating schedule. It would utilize approximately 31 million bushels of grain (corn, sorghum, and wheat) purchased from area farmers and from producers in the Midwest. Solids from the process would be converted to animal feed, which would result in the production of up to 782,000 tons per year of wet distiller's grains with solubles. The facility would have the capability to dry up to 50 percent of the wet distiller's grains, producing a maximum of 152,000 tons per year of dried distiller's grains with solubles.

Grain would be received from trucks or rail cars and conveyed to storage silos and the grain milling operation, where it would be cleaned and ground. The ground grain, or meal, would be mixed with hot water to form a slurry. Baghouses and other technologies would be employed during this process to capture resuspended particles and other emissions. The slurry would be heated to liquefy and break down starches to sugars, and then sent to fermenter process vessels. Saccharifying enzymes, nutrients, and industrial antibiotics would be added to feed and control the fermentation process, and caustic or anhydrous ammonia, thin stillage recycle, or sulfuric acid would be added as required to control pH.

Gases generated during fermentation would pass through wet scrubbers, which collect ethanol vapors and provide emission control for volatile organic compounds and hazardous air pollutants. Carbon dioxide would be captured and pumped via pipeline to an offsite party for use in enhancing the amount of crude oil recovered from existing oil fields.

Fermented mash, called beer, would be transferred to the distillation column in which ethanol would be separated from the residual grain solids and water. The separated grain solids, known as stillage, would be further processed into wet or dry distiller's grain with solubles for use as cattle feed, and the water would be recycled. Ethanol vapor from distillation would be drawn and superheated using steam, which would be generated in natural gas-fired boilers. The superheated ethanol vapor would flow through molecular sieve units in a process known as dehydration to increase the ethanol to 98 percent by weight. Vent emissions would be equipped with vent condensers to control emissions, and volatile organic compounds and hazardous air pollutants produced when the distiller's grain is dried will be burned off.

Dried distillers grains with solubles would be stored indoors until shipped offsite by truck or rail to cattle feedlots. Wet distiller's grains with solubles would be stored outdoors on a concrete pad until shipped by truck to local feedlots, or transferred to the drying process.

Prior to shipping fuel-grade ethanol, it would be denatured with gasoline. Product loading would consist of submerged loading of natural gasoline (denaturant) and denatured ethanol to and from tanker trucks and tanker rail cars. The emissions from the tanker truck and rail car loadout would be collected by a vapor recovery system and routed to a carbon adsorption hydrocarbon vapor recovery system.

Nexsun Ethanol and Biodiesel Facility. Nexsun Ethanol LLC plans to develop, in two phases, an integrated biorefinery in Ulysses, Grant County, Kansas. The first phase of the project would be a 44-million-gallon per year ethanol production facility that also would produce about 455,000 tons per year of wet distiller's grains and associated "syrup" that would be sold for animal feed. The second phase of the project would be a 3-million-gallon per year biodiesel plant at an adjacent location. Biodiesel would be produced from commercially available tallow and yellow grease (grease from restaurants and other similar sources).

Tallgrass Transmission, LLC Project. New 765 kilovolt transmission lines are planned in western Oklahoma to facilitate development and transmission of wind-generated electricity. One segment of the transmission lines would terminate in the vicinity of Guymon, Oklahoma , which is within the 50-mile region of influence for this Abengoa Biorefinery Project EIS.

Transportation Infrastructure Improvements. The Departments of Transportation for the states of Kansas, Texas, and Colorado maintain plans for improvements to the transportation system infrastructure in the region. These projects involve a range of actions including improvements to grade and drainage, road widening over relatively short distances, removal and replacement of damaged road surfaces (resurfacing), improvements to railroad crossings, and development of a rest area.

U.S. Department of Agriculture Biomass Crop Assistance Program. This program was created by The *Food, Conservation, and Energy Act of 2008* (2008 Farm Bill) to support the establishment and production of crops for conversion to bioenergy and to assist with the collection, harvest, storage, and transport of eligible material for use in a biomass conversion facility. In general, agricultural producers in project areas will receive a payment of up to 75 percent of establishment costs. Further, the Department

of Agriculture will match dollar-for-dollar what the biomass collector is paid by the biomass user facility for the collection, harvest, storage, and transport to the biomass conversion facility, up to $45 per dry ton. At this time, there is insufficient information available for DOE to assess potential cumulative impacts from the implementation of the Biomass Crop Assistance Program. Even so, the Department has identified the program as a reasonably foreseeable future action because of the potential for cumulative impacts to occur during the lifetime of the biorefinery under either the Proposed Action or Action Alternative, and because information regarding the program rules may become available in the relatively near future.

S.5.2 CUMULATIVE IMPACTS

This section summarizes the potential incremental impacts of the reasonably foreseeable future actions relative to the Proposed Action and the Action Alternative. Impacts to biological resources, cultural resources, and environmental justice are not discussed, as the impacts to those resources and subject areas under the Proposed Action and Action Alternative would be negligible, and impacts from the addition of the reasonably foreseeable future actions would not change.

S.5.2.1 Land Use

Grain-to-Ethanol Facility. Construction of the grain-to-ethanol facility would expand the footprint of the Biorefinery Project site relative to the Proposed Action and Action Alternative. The buffer area would continue to be used for irrigated crop production. Use of those sites would be consistent with planned zoning. Operation of the grain-to-ethanol facility would not result in cumulative land use impacts to the Project site and would result in a small change in land use in the buffer area because there would be an increase in the amount of non-contact wastewater disposed of on the buffer site through the existing irrigation system. Infrastructure-related impacts, such as improvements to roads or installation of utility supply lines, would be confined generally to existing transportation and utility corridors. The associated minor impacts are related to short-term loss of use during construction.

To meet the increased need for water to operate the facility, some irrigated cropland near the Biorefinery Project site would be converted to dryland farming, in addition to that converted for the Proposed Action or Action Alternative. Because the amount and type of converted cropland would be small relative to the amount within the region, the cumulative impact would be minor.

About 2 to 3 percent of the corn produced in the region would be consumed annually by the grain-to-ethanol facility, and DOE does not expect demand of such a low portion of production to result in noticeable land use changes. Current production of grain sorghum in the region would meet a large portion, but not all, of the anticipated demand for that grain by the grain-to-ethanol facility. The amount of grain sorghum produced in the region probably would increase to meet that demand. That increase in production likely would come from a shift in grain sorghum production at the expense of other crops currently grown on cropland and not result in conversion of less-intensive lands. Grain sorghum requires less fertilizer and water than corn so a long-term shift in increased production has the potential to have a net beneficial impact.

The grain-to-ethanol facility would not change biomass demand for the biorefinery, so impacts resulting from that demand would be unchanged relative to the Proposed Action and Action Alternative. The grain-to-ethanol facility would not have a noticeable cumulative impact on soil conditions, and the

cumulative impact to conservation programs would be negligible because biomass demand is not anticipated to result in land use conversion.

Other Future Actions. Incremental impacts from construction of the other reasonably foreseeable future actions on land use are expected to be small. Infrastructure construction related impacts would be confined generally to existing transportation and utility corridors. The Tallgrass Transmission, LLC project would likely be constructed across agricultural land, but the amount of land taken out of production is expected to be limited to construction of the towers that support the transmission lines and substations. Since approximately 97 percent of the land within the region of influence is in farms, construction of the transmission project would have a negligible impact on land use. Land use between the towers and beneath the transmission lines would largely remain unaffected. Construction of the Nexsun Ethanol and Biodiesel Facility would be expected to impact land use similarly to construction of Abengoa Biorefinery Project, which would be small. Therefore, DOE anticipates the incremental impact of construction of these projects would be small.

Operation of the Nexsun facility, in addition to the grain-to-ethanol facility at the Abengoa Biorefinery Project site, would result in an incremental increase in the demand for grain in the region. The increased demand for corn is not anticipated to have a noticeable impact on land use because the amount of corn produced in the region greatly exceeds the cumulative incremental demand. However, the demand for grain sorghum would exceed production of that grain in the region. DOE anticipated that some of the grain sorghum for that facility may be shipped in from outside the region. Any increase in grain sorghum product in the region would likely come from increased production on existing cropland.

S.5.2.2 Air Quality

Grain-to-Ethanol Facility. DOE anticipates that the cumulative impacts to the air quality resulting from emissions during construction of the grain-to-ethanol facility would be only slightly greater than the impacts that would occur solely due to the operations of the Proposed Action or Action Alternative.

The grain-to-ethanol facility would involve additional processes that would result in air emissions, including grain handling and milling, grain fermentation and distillation, production of distiller's grains with solubles, increased volume of stored denatured ethanol, additional traffic, and additional boilers for steam production. In addition, the grain-to-ethanol facility would increase the production of denatured ethanol (from 19 million gallons per year to 119 million gallons per year), which would result in a corresponding increase in air emissions from the storage tanks and denatured ethanol loadout. These additional processes would result in an increase to ambient air concentrations for most of the pollutants relative to those of the biorefinery considered under the Proposed Action and Action Alternative. However, predicted cumulative concentrations, plus existing background concentrations, remain less than the National Ambient Air Quality Standards (for example, predicted concentrations for the grain-to-ethanol facility and Proposed Action for 24-hour PM_{10} are about 73 percent, nitrogen dioxide 13 percent, and other pollutants less than 10 percent of National Ambient Air Quality Standards). Consequently, the cumulative concentrations would not degrade the ambient air quality to levels that pose a risk to the public.

Adding the grain-to-ethanol facility to the biorefinery (Proposed Action) would increase the overall benefit to the greenhouse gas lifecycle compared with the gasoline-only scenario. The grain-to-ethanol facility would utilize some of the electricity produced by the Proposed Action; therefore, the percent

reduction in greenhouse gas from the Proposed Action would decrease because less electricity would be exported to the grid. The percent reduction in greenhouse gas from the Proposed Action in this scenario would be 297-percent under the first scenario as compared to the gasoline only baseline case rather than 340-percent. The total greenhouse gas reduction from the Proposed Action with grain-to-ethanol facility under the first scenario as compared to the gasoline-only baseline case would be 357-percent.

The emissions from the Action Alternative would be less than the emissions from the Proposed Action because under the Action Alternative, the biorefinery would not produce excess power. Although a source of greenhouse gas emissions, the addition of the grain-to-ethanol facility with carbon dioxide capture to the biorefinery under the Action Alternative would remain beneficial to the overall greenhouse gas lifecycle, in that it would result in an increased reduction in greenhouse gas compared with the baseline gasoline scenario.

Other Future Actions. Because of the distance between the Nexsun Ethanol and Biodiesel Facility, the Tallgrass Transmission, LLC project, and the biorefinery proposed by Abengoa Bioenergy, emissions from these future actions would not cause cumulative impacts to air quality.

S.5.2.3 Hydrology

S.5.2.3.1 *Surface Water*

Grain-to-Ethanol Facility. Activities associated with the grain-to-ethanol facility that would affect surface water would be very similar to those described for the Proposed Action and Action Alternative. Any incremental impacts would be minor because there are limited surface water features in the immediate area of the proposed biomass-to-ethanol facility. The increase in potential for accidental releases of hazardous materials would be minor, and possible impacts would be no different than those for the Proposed Action or Action Alternative.

During combined operations of the biomass and grain-to-ethanol facilities, the only planned release would be non-contact wastewater. The amount of non-contact wastewater generated would increase from a nominal rate of 370 gallons per minute under the Proposed Action to a rate of 530 gallons per minute with the addition of the grain-to-ethanol facility. Under the Action Alternative, the amount of water released would increase from 115 to 275 gallons per minute. The holding ponds constructed for collection of non-contact wastewater would be expanded for the increased production rate.

The volumes and types of hazardous materials that would be present at the site would generally increase with incorporation of the grain-to-ethanol facility. However, measures developed for the Proposed Action and Action Alternative to contain hazardous material and control drainage from material transfer areas would be expanded as necessary to accommodate the increased inventory.

The size of the area disturbed during construction would increase by about 5 acres, and the built-up area at the Biorefinery Project site that would have little or no infiltration and heavy runoff would double for the grain-to-ethanol facility, relative to both the Proposed Action and Action Alternative. However, any increase in runoff would be controlled within the site or within adjacent parcels. Even with the grain-to-ethanol facility, there would be no effects on surface water drainage or on runoff and infiltration rates on the land areas outside of the Project site.

Other Future Actions. Neither the Nexsun Ethanol LLC facility nor the Tallgrass Transmission, LLC project actions would involve surface water impacts that could be cumulative with those of the biomass and grain-to-ethanol facilities.

S.5.2.3.2 *Groundwater*

Grain-to-Ethanol Facility. Construction of the grain-to-ethanol facility would require about 60 acre-feet of water during a 30-week period. The increased demand would be cumulative to the demand of the operating biorefinery.

The total water demand for operation of the biorefinery (Proposed Action) with the addition of the grain-to-ethanol facility would be about 4,350 acre-feet per year, which is 1,400 acre-feet per year more than that required for the Proposed Action. Abengoa Bioenergy has optioned 7,240 acre-feet per year of existing irrigation water rights from eight wells to meet the water demand of the biorefinery plus grain-to-ethanol facility. The total volume withdrawn from those wells in 2008 was 4,380 acre-feet. Thus, use of those water rights for operation of the biorefinery and grain-to-ethanol facility would result in a reduction of about 2,890 acre-feet compared with the permitted annual volume, and a reduction of 30 acre-feet compared with withdrawals during 2008. A similar reduction would occur under the Action Alternative. DOE therefore concludes that there would be no adverse cumulative effects from the addition of the grain-to-ethanol facility.

DOE also evaluated the potential for impacts to groundwater resources attributable to changes in land use within the region to meet the demand for grain for the grain-to-ethanol facility. DOE concluded that the potential exists for changes in cropping patterns and associated changes in water use for irrigation (see Section S.7.2.1); however, these changes would be limited and would not create adverse cumulative effects on groundwater resources.

Other Future Actions. Water required for the construction and operations of the Nexsun Ethanol LLC facility could be obtained from the same aquifer used to supply the biorefinery. Groundwater withdrawals near Ulysses, Kansas, for that facility would be subject to Kansas water appropriation regulations and would not be expected to impact groundwater availability in and around Hugoton. Changes in land use and increases in irrigation to meet the demand for grains are not expected to be substantial, and water appropriation regulation would tend to limit increased irrigation and, thus, incremental effects on groundwater resources.

The Tallgrass Transmission, LLC project is a considerable distance from the Biorefinery Project site, and there would be little or no cumulative effects on the availability of groundwater near the Project site.

S.5.2.4 Utilities, Energy, and Materials

Grain-to-Ethanol Facility. The grain-to-ethanol facility would require a peak workforce of 148 persons during construction and 74 persons during operations. This would be an addition to the 110 (Action Alternative) to 140 (Proposed Action) people working at the operational biorefinery.

During biorefinery operations, including the grain-to-ethanol facility, the total demand for potable water from the City of Hugoton water system would be about 80 gallons per minute (for the Proposed Action or Action Alternative). Demand would be less during construction of the facility. These additional water

demands are within the 190-gallon-per-minute excess capacity of the water system, and there would be no adverse cumulative impact to that system.

The City of Hugoton sewage treatment lagoons are designed to support 4,000 people and currently are used by about 3,400 people. A total of up to 426 workers and family members would be living in Hugoton during construction of the grain-to-ethanol facility and biorefinery operations, and up to 381 people would be living there after completion of the grain-to-ethanol facility. Thus, there would be no adverse cumulative impact to the sewage treatment system.

DOE estimates that the total amount of solid waste received by the Stevens County landfill from all biorefinery construction and operations workers and their families (grain-to-ethanol facility and Proposed Action or Action Alternative), plus all other residents and businesses using the landfill, would be about 14 tons per day. This is below the permit limit of 20 tons per day and would not result in an adverse cumulative impact to operation of the landfill.

Operation of the grain-to-ethanol facility would involve an average electrical demand of about 10 megawatts. Thus, the amount of electricity provided to the regional grid by the biorefinery under the Proposed Action would decrease to an average of 65 megawatts during normal operations. This decrease represents 0.8 percent of the production capacity in the western-central region of Kansas and 0.02 percent of the current summer demand within the Southwest Power Pool. Under the Action Alternative, the electricity demand for the biorefinery would increase from 10 to 20 megawatts under normal conditions with the addition of the grain-to-ethanol facility. Twenty megawatts is 0.05 percent of the summer load within the Southwest Power Pool, and this increase in demand would have minimal effect on the regional capacity.

The small amounts of natural gas, other fossil fuels, and petroleum products required for construction of the grain-to-ethanol facility, along with operation of the biorefinery (Proposed Action or Action Alternative) would not cumulatively impact the availability of those products in the region.

Construction of the grain-to-ethanol facility would require a notable increase in the total quantities of materials required for the project. Stainless steel is the only materials for which there would be a relatively high risk of unavailability in the market, but the need for those materials would be minor percentage (about 0.006 percent) of the U.S. production capacity.

Other Future Actions. The cumulative amount of electricity, natural gas, other fossil fuels, and petroleum products required by the biorefinery under the Proposed Action or Action Alternative and the other future actions considered would be a small portion of the quantities available within the region, and this demand is not expected to adversely impact the availability of these products.

The only construction material required by the biorefinery and the other future actions that may not be easily available is stainless steel. The cumulative demand for steel for the biorefinery and the Nexsun Ethanol LLC facility (the only future action requiring a substantial amount of stainless steel) would be about 23,000 tons, a small portion of 107 million tons of steel produced annually in the United States.

S.5.2.5 Wastes and Hazardous Materials

Grain-to-Ethanol Facility. Up to 100 tons per day of waste would be generated during construction of the grain-to-ethanol facility. There is insufficient capacity at the Stevens County landfill to handle that waste in addition to the waste generated during operation of the biomass-to-ethanol and -electricity facility. The construction waste could be split among other permitted landfills and transfer stations in the region, where there is adequate disposal capacity to receive that waste. Thus, there would be no adverse cumulative impacts from the disposal of construction waste from the grain-to-ethanol facility and operation of the biomass-to-ethanol facility.

Consumption of wet and dry distiller's grain, byproducts of the grain-to-ethanol facility, that would be sold as livestock feed would require approximately 350,000 head of cattle. Market research indicates that there is sufficient capacity in the region of influence for consumption of those products. If much of the distiller's grain must be shipped farther away, the facility would have the capacity to dry up to 50 percent of the product (dry distiller's grain has a longer storage life and can be shipped longer distances). Alternatively, a portion of the distiller's grain could be used as a substitute for biomass feedstock to the solid biomass boilers.

Management and treatment strategies for wastes and byproducts produced by operation of the grain-to-ethanol facility would be the same as those for the biomass-to-ethanol facility, as discussed in Section S.5.6. Operation of the grain-to-ethanol facility would generate additional municipal solid waste and construction debris (57 tons per year), non-contact wastewater (156 gallons per minute), wastewater treatment plant sludge (2.5 to 5 gallons per minute), and hazardous waste (0.5 ton per year). DOE concludes that the Stevens County landfill would have adequate capacity to dispose of municipal solid waste generated from operation of the grain-to-ethanol facility and the facilities considered under the Proposed Action and Action Alternative. The other operation phase waste streams could be divided among the other landfills and transfer stations within the region, with permission from the operators of those facilities. Because there is adequate capacity within the region to receive those wastes, DOE concludes there would be no adverse cumulative impacts to landfills from the addition of the grain-to-ethanol facility. The additional wastewater generated by the grain-to-ethanol facility would require a larger winter storage pond, but based on the quantity of wastewater to be applied, DOE does not anticipate adverse cumulative impacts from this land application.

Chemicals needed for operation of the grain-to-ethanol facility, and the facilities considered under the Proposed Action or Action Alternative, would need to be imported from suppliers outside the 50-mile region of influence. DOE concludes that the chemical needs of the grain-to-ethanol facility would have no adverse cumulative impacts on chemical users or suppliers within the region of influence because the annual demands for the chemicals would be insignificant percentages of annual U.S. production quantities.

Other Future Actions. Potentially significant waste streams or use of hazardous materials would not be anticipated for the Tallgrass Transmission project. Most of the wastes and hazardous materials impacts anticipated due to other future actions would be associated with the construction and operation of the Nexsun Ethanol LLC proposed ethanol/biodiesel production facility. It is anticipated that the Nexsun facility will generate approximately one-half the construction and operation wastes estimated for the Abengoa Bioenergy grain-to-ethanol facility (as it would generate about one-half the ethanol as the Abengoa facility).

The Nexsun Ethanol LLC facility construction wastes likely would be disposed of at the Grant County construction and demolition landfill. The construction wastes from the Proposed Action, Action Alternative, and grain-to-ethanol facility would be disposed of at the Grant County construction and demolition landfill, Seward County landfill, and Finney County landfill. These landfills have adequate capacity to receive the construction wastes; therefore, the cumulative adverse impact of Proposed Action, Action Alternative, grain-to-ethanol facility, and other future actions is considered negligible.

Similar to the Abengoa Bioenergy grain-to-ethanol facility, the Nexsun Ethanol LLC facility would produce wet distiller's grain with solubles. There would be adequate capacity of cattle feedlots in the region of influence to consume that additional livestock feed.

DOE does not anticipate adverse impacts from the handling and disposal of the additional hazardous waste generated during operation of the Nexsun Ethanol LLC facility, and the demand for chemicals for that facility would have no adverse cumulative impacts. Municipal sewage and process wastewater generated by the Nexsun facility would be disposed of in different facilities or on different lands than those Abengoa Bioenergy would use, and would have no cumulative impacts relative to the Proposed Action, Action Alternative, or grain-to-ethanol facility.

S.5.2.6 Transportation

Grain-to-Ethanol Facility. Construction and operation of the grain-to-ethanol facility would substantially increase the number of truck and rail shipments to and from the biorefinery as well as the associated number of fatalities. Based on a traffic impact analysis, no roadway improvements were identified as necessary to reduce congestion at intersections or improve access if the grain-to-ethanol facility were constructed.

Operation of the biorefinery and grain-to-ethanol facility would add about 170 additional trains per year carrying denatured ethanol and waste, and 120 additional trains per year carrying chemicals and grain, or a total of 290 additional trains per year. The existing rail traffic on the Cimarron Valley Railroad is about 600 trains per year and the capacity of single-track rail lines is generally 40 to 60 trains per day; thus, this additional rail traffic would not adversely affect operations of the Cimarron Valley Railroad.

Construction of the Proposed Action and grain-to-ethanol facility would require an estimated total of about 50,000 shipments of materials. Operation of those facilities would require approximately 260,000 shipments of materials per year, an incremental increase of about 140,000 to 170,000 shipments per year over that of the Proposed Action. DOE estimates that, during construction and the 30-year operational life of the biorefinery, there would be about 120 traffic fatalities due to truck and rail shipments, an increase of 80 to 86 fatalities over the Proposed Action. The majority of the fatalities (116) would be from shipments of biomass, chemicals, denatured ethanol product, and waste.

Construction of the Action Alternative and grain-to-ethanol facility would require an estimated total of 46,000 shipments of materials. Operation of those facilities would require 170,000 shipments of materials per year. DOE estimates that, during the 30-year operational life of the biorefinery, there would be about 99 traffic fatalities due to truck and rail shipment, an increase of 86 fatalities over the Action Alternative. The majority of the fatalities (95) would be from shipments of biomass, chemicals, denatured ethanol product, and waste.

The increased traffic associated with the grain-to-ethanol facility would result in increased pavement deterioration. DOE estimates the annual cost of pavement damage caused by additional shipments of biomass, chemicals, and wastes would be $950,000 (Proposed Action) and $330,000 (Action Alternative).

Other Future Actions. Over the expected 30-year operations phase of the biorefinery, there would be an estimated 13,400 traffic fatalities in Kansas and 820 traffic fatalities in the nine counties surrounding the Biorefinery Project site. The Nexsun Ethanol LLC facility and Tallgrass Transmission, LLC project could result in increased traffic fatalities in those counties and elsewhere in Kansas. Traffic fatalities for these projects have not been estimated. However, based on the descriptions of these projects, it is anticipated that additional traffic fatalities from these projects would be minimal.

S.5.2.7 Aesthetics

S.5.2.7.1 *Visual*

Grain-to-Ethanol Facility. The grain-to-ethanol facility would require additional structures at the Biorefinery Project site. Some of these structures, such as the grain storage silos, would be about 100 feet tall, but would be visually similar to silos and other tall structures south of the Project site. Thus, construction of the grain-to-ethanol facility would result in additional, similar structures visible from surrounding vantage points.

Other Future Actions. DOE does not anticipate cumulative impacts to visual resources from the other future actions.

S.5.2.7.2 *Noise*

Grain-to-Ethanol Facility. By complying with occupational health and safety requirements and employing best management practices, no cumulative noise impacts to biomass facility workers or workers from constructing the grain-to-ethanol facility would be expected.

At the nearest residence to the biorefinery, noise from construction of the grain-to-ethanol facility, along with noise from ongoing operations of the biomass-to-ethanol and -energy facilities, would attenuate close to about 55 decibels, the level recommended by the U.S. Environmental Protection Agency for avoidance of annoyance. Noise from operations of all of these facilities concurrently would attenuate to about 46 decibels at the nearest residence. Because the noise level at this residence could increase above background level, annoyance from cumulative noise impacts could occur.

Truck traffic to the biorefinery would be higher if the grain-to-ethanol facility were to be constructed. During construction of that facility, an additional 11 trucks per day would use the truck bypass and pass by two residences along Road Q just west of US-56. There would be a total of about 122 truck passes per day there, or one truck every 7 minutes, during construction of the grain-to-ethanol facility and operation under the Proposed Action, and a total of about 38 truck passes per day (one truck every 22 minutes) during construction of the grain-to-ethanol facility and operation under the Action Alternative.

During operations, there would be an increase of 264 trucks per day over the Proposed Action and Action Alternative. Assuming 50 percent of all trucks travel to the biomass-to-ethanol facility from the northeast used the truck bypass, two residences along Road Q would experience 233 truck passes per day, or one truck every 3 to 4 minutes under the Proposed Action. Under the Action Alternative, there would be 159

trucks passing per day, or about one truck every 5 to 6 minutes. Noise from these trucks would be sufficient to interfere with outdoor conversations and cause annoyance indoors at some residences and facilities. The cumulative amount of truck traffic for the grain-to-ethanol facility and Proposed Action or Action Alternative could be frequent enough to cause almost continuous annoyance at some locations.

Operation of the grain-to-ethanol facility and biorefinery would require the handling of about 7,650 railcars per year. The grain-to-ethanol facility would require about 293 trains per year, compared with 255 trains per year for the Proposed Action and 28 trains per year for the Action Alternative. A rail spur would be built on the western portion of the biomass-to-ethanol facility site that would come within approximately 500 feet of the residence at the northwest Project site boundary. Movement of trains on the rail spur would increase noise levels in the area and may cause annoyance at the nearby residence.

In summary, the cumulative noise produced by passing trucks and trains would be of sufficient frequency and magnitude so as to interfere with outdoor conversation and likely would be an annoyance indoors to the nearest resident, as well as to other receptors (for example, residences, places of worship, and schools) along the transportation routes.

Other Future Actions. The Nexsun Ethanol LLC facility and Tallgrass Transmission, LLC project are not close enough to cause noise impacts to the same receptors as those for the Proposed Action or Action Alternative. Therefore, DOE concludes that no cumulative noise impacts would occur.

S.5.2.7.3 *Odor*

Grain-to-Ethanol Facility. The addition of the grain-to-ethanol facility would increase the amount of some odorous compounds released by the biorefinery and introduce additional sources of odors such as grain fermentation and distillation, drying of wet distiller's grain with solubles, and storage and loadout of distiller's grain with solubles. Air dispersion modeling indicates that no odorous compounds (acetaldehyde and nitrogen dioxide) might be detectable at the biorefinery fence line, or at offsite locations where the public would commonly be located. Therefore, DOE anticipates no cumulative impacts from the release of odorous compounds from the grain-to-ethanol facility.

Other Future Actions. The Nexsun Ethanol LLC facility and Tallgrass Transmission, LLC project are distant from the Bioenergy Project site and would not result in cumulative impacts from odorous emissions.

S.5.2.8 Socioeconomics

Grain-to-Ethanol Facility. Construction of the grain-to-ethanol facility would require a maximum of about 150 workers for 3 months and fewer workers for the balance of the construction phase. About 73 additional workers would be employed at the biorefinery to operate the grain-to-ethanol facility. Under the Proposed Action and Action Alternative, this would result in an increase of less than 1 percent of the population in Stevens County and the adjacent three counties, and less than a 1-percent change in other socioeconomic variables or conditions in the region. Thus, cumulative socioeconomic impacts from the grain-to-ethanol facility would be very small.

Other Future Actions. The Nexsun Ethanol LLC facility and Tallgrass Transmission, LLC project are far enough away from the Biorefinery Project site that there would be no cumulative socioeconomic impacts.

S.5.2.9 Health and Safety

Grain-to-Ethanol Facility. DOE estimates that 150 construction workers at the grain-to-ethanol facility would experience about 8 additional total recordable cases, about 4.1 additional days away from work, and about 0.015 additional fatality. About 5 additional total recordable cases, about 1.4 additional days away from work, and about 0.0017 additional fatality would occur during operations of the grain-to-ethanol facility. These statistics are in addition to the approximately 3 total recordable cases, 1 day away from work, and 0.001 fatality estimated to occur annually during operation of the biorefinery (Proposed Action and Action Alternative).

Other Future Actions. Construction and operations of additional future actions would create the potential for injuries or fatalities to workers involved in those actions. However, the details of such projects are not yet sufficiently developed for the number of workers, and likewise for the health and safety impacts to be estimated.

S.5.2.10 Accidents

One additional toxic chemical, phosphoric acid, would be stored and used at the Abengoa Biorefinery Project site if the grain-to-ethanol facility were to be constructed and operated. That chemical is not combustible; has a moderate toxicity; and a harmful contamination of the air would not, or would only very slowly, be reached. Therefore, DOE concludes that failure of the phosphoric acid storage tank and subsequent release of phosphoric acid vapors would not result in any lasting health effects to workers or members of the public. DOE also concludes that any changes in the size and number of the ethanol storage tanks, or other chemical storage tanks, required for the grain-to-ethanol facility would not result in a meaningful increase in accident impacts to either workers or the public when compared to the Proposed Action or Action Alternative.

S.6 Mitigation

The Department identified two categories of measures to mitigate adverse environmental impacts from the construction and operation of the biorefinery: best management practices and mitigation measures. DOE would consider these measures in developing a Record of Decision about whether to provide federal funds for the design, construction, and startup of the biorefinery.

MITIGATION MEASURES

Mitigation measures are defined by the Council on Environmental Quality regulations (40 CFR 1508.20) as:

a) Avoiding the impact altogether by not taking a certain action or parts of an action

b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation

c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment

d) Reducing or eliminating the impact over time by reservation and maintenance operations during the life of the action

e) Compensating for the impact by replacing or providing substitute resources or environments.

For the purposes of this EIS, best management practices are defined as the practices, techniques and methods, and processes and activities commonly accepted and used throughout the construction and ethanol- and energy-production industries to facilitate compliance with applicable requirements, and that provide an effective and practicable means of avoiding or reducing the potential environmental impacts of the Proposed Action and Action Alternative. Best management practices are integral to the design, construction, and operation of the biorefinery, and thus are incorporated into the description of the Proposed Action and Action Alternative. In general, best management practices include actions taken in compliance with other government agency regulations, stipulations, or guidance; coordination with other agencies and interested parties; implementation of Departmental policies and orders; implementation of industry practices and policies; and monitoring of relevant ongoing or future activities.

DOE regards mitigation measures as activities or actions that would be above and beyond (in addition to) best management practices and, therefore, does not include them in the Proposed Action and Action Alternative, but rather addresses them separately. Table S-2 lists the mitigation measures being considered for the Proposed Action and Action Alternative.

Table S-2. Mitigation measures under consideration.

Air quality
• Use well-maintained construction equipment having appropriate emissions controls.
Biological resources
• Design transmission line to minimize the risk to raptors and other migratory birds from electrocution.
Visual resources
• Maintain the current visual status of the buffer area over time by only utilizing the land in the buffer area for agricultural activities.
• Reduce the impacts from night lighting at the biorefinery by using downward-facing or directional lighting and the minimum amount of lighting needed for safe operation.
Odor
• Control odorous emissions through the use of an odor control plan, which would identify sources of odorous emissions, controls used on those sources, operation and maintenance plans with schedules for routine maintenance of the control equipment, and a response plan if any of the control equipment fails to meet specifications. The operation and maintenance plans and schedules would be evaluated and updated over time to ensure improvements are recognized and incorporated as appropriate.
Socioeconomics
• Initiate timely communication with local and regional organizations to disseminate information relative to the construction schedule and expected worker influx to assist in planning for increased demand on community services.
Wastes and hazardous materials
• Implement the waste management plan developed for the construction and operation of the biorefinery. Construction specifications should direct contractors where to recycle/dispose of construction-generated wastes.
• Develop and implement a contingency plan for alternative beneficial uses of the solid biomass boiler fly ash in the event a significant percentage of the material is not used by biomass producers as soil amendment.
Transportation
• Stagger workforce schedules to minimize traffic delays and congestion on nearby roadways.
• Develop safety-based criteria to be used, in part, to select carriers (truck). Criteria should include elements of the Federal Motor Carrier Safety Administration regulations (see next bullet), as well as provisions for drivers to be paid hourly and receive bonuses for accident-free driving, mandatory safety training, and avoidance of teen-age drivers and drivers having less than 5-years experience.
• Require carriers and drivers to meet the Federal Motor Carrier Safety Administration regulations that establish: commercial driver license standards, requirements, and penalties; general qualifications for drivers and rules for driving a commercial motor vehicle: hours of service limits for drivers; safety fitness standards; motor carrier safety regulations; minimum levels of financial responsibility for motor carriers; requirements to test drivers for controlled substance and alcohol use; and driver training requirements.
• Require safety training protocols/programs for selected carriers.
• Ensure the onsite rail system is sufficient to handle unit trains without blocking railroad crossings near the Biorefinery Project site for long periods of time.
• Maximize the use of rail for shipments to and from the Project site.

S.7 Conclusions

S.7.1 MAJOR CONCLUSIONS OF THE EIS

In this Abengoa Biorefinery Project EIS, the Department assessed the potential environmental impacts of the construction and operation of a commercial-scale integrated biorefinery to be located in southwestern Kansas. Under the Proposed Action, the biorefinery would use lignocellulosic biomass to produce up to 19 million gallons of denatured ethanol per year. It would also produce sufficient electricity to meet the electrical needs of the facility and to sell excess electricity to the regional power grid. DOE also evaluated the impacts of the Action Alternative under which the biorefinery would produce 12 million gallons of denatured ethanol per year, but would produce only sufficient electricity to power the biorefinery.

S.7.1.1 Summary of Beneficial Impacts

Construction and operation of the integrated biorefinery would result in some beneficial changes to the environment. The following are the most important beneficial impacts DOE identified.

Economic Stimulus. The biorefinery would employ up to 230 to 260 workers (Action Alternative and Proposed Action, respectively) during the peak of construction, and would employ from 34 to 43 workers during the expected 30 years of operations. This would result in an annual infusion of earnings into the regional economy of about $16 to $16.6 million dollars per year during construction and $3.5 to $4.4 million dollars per year during operations.

Reduction in Greenhouse Gas Emissions. The overall regional greenhouse gas emissions would be reduced through the production of biopower and biofuel; and emissions from burning of residual crop material, a common practice in the region, would be reduced. DOE estimates the Proposed Action would result in an approximately 340-percent reduction in greenhouse gas emissions compared with the continued use of gasoline instead of biofuel and no generation of biopower. The Action Alternative would result in an approximately 39-percent reduction in greenhouse gas emissions compared with the continued use of gasoline.

Use of Groundwater. Under the Proposed Action, up to 2,950 acre-feet of groundwater would be pumped per year from eight wells near the Biorefinery Project site. This is about 4,290 acre-feet less than the currently permitted annual volume for those wells. Under the Action Alternative, up to 850 acre-feet would be pumped per year from three wells, which is 1,500 acre-feet less than the currently permitted annual volume. Thus, operation of the biorefinery would result in a decrease in groundwater use at the Project site.

S.7.1.2 Summary of Adverse Impacts

In general, adverse impacts of constructing and operating the biorefinery would be small. For example, DOE does not anticipate that there would be substantial changes in land use practices in the region surrounding the Biorefinery Project site (such as conversion of marginal cropland or lands in the Conserve Reserve Program) to meet the biomass demand of the biorefinery. Many of the adverse impacts that could occur, especially those resulting from construction, would be temporary and local. The following are the major adverse impacts, including cumulative impacts, of the Proposed Action and Action Alternative.

Traffic Fatalities. Under the Proposed Action, there would be approximately 32,000 truck shipments of materials during construction, and about 80,000 to 116,000 truck and 1,300 to 6,600 rail shipments per year during the 30-year operating period of the biorefinery. DOE estimates there would be 35 to 41 traffic fatalities due to these shipments and the commuting of workers. Under the Action Alternative, there would be approximately 28,600 truck shipments of materials during construction, and about 30,500 truck and 730 rail shipments per year during operations, and an estimated 13 traffic fatalities due to these shipments and the commuting of workers. For perspective, over the operations phase, there would be an estimated 13,400 traffic fatalities in Kansas and 820 traffic fatalities in the nine counties surrounding the Biorefinery Project site.

Construction and operation of a grain-to-ethanol facility at the Biorefinery Project site at a point in the future would substantially increase the cumulative number of truck and rail shipments to and from the biorefinery, and the associated number of fatalities. Approximately 260,000 truck and rail shipments per year would be required for construction and operation of the Proposed Action and grain-to-ethanol facility, and about 170,000 shipments per year for the Action Alternative and grain-to-ethanol facility. DOE estimates that 120 and 99 (Proposed Action and Action Alternative, respectively) fatalities would occur as a result of the cumulative truck and rail shipments to and from the biorefinery and grain-to-ethanol facility.

Traffic Noise. Truck shipments to the biorefinery would result in an increase in noise at some locations in and around the city of Hugoton. For the Proposed Action, about 202 truck shipments per day would pass through and around Hugoton to support the biorefinery operations. Along the most frequently traveled routes to the biorefinery, trucks would pass a few residences about once every 8 minutes. Trucks would travel a route that passes the Stevens County Hospital, several schools, residences, and places of worship along US-56/K-51 about once every 21 minutes. The noise from each passing truck would be sufficient to interfere with nearby outdoor conversations and cause annoyance indoors at some residences and facilities. Fewer shipments of biomass would be required to support the Action Alternative (50 per day), but trucks would still pass residential areas about once every 30 minutes.

If Abengoa Bioenergy were to construct the grain-to-ethanol facility at some time in the future, the cumulative impacts of truck traffic and associated noise would be substantially greater. Up to 466 truck shipments per day would be needed to support the Proposed Action and the grain-to-ethanol facility. Trucks would pass two residences along Road Q west of US-56 and the residence at the northwest property boundary about once every 3 to 4 minutes and would pass the hospital and other facilities about once every 9 minutes. For the Action Alternative and grain-to-ethanol facility, there would be up to 320 truck shipments per day, and they would pass nearby residences every 5 to 6 minutes. The cumulative amount of truck traffic for the grain-to-ethanol facility and the Proposed Action or Action Alternative would cause almost continuous annoyance at some locations in and near Hugoton.

Landfill Capacity. Up to 78 tons per day of solid waste would be generated during the 18-month construction phase. In addition, if ash from the solid biomass boilers (up to 350 tons per day under the Proposed Action) was not sold as a soil nutrient replacement, it could require disposal at permitted solid waste disposal facilities. The Stevens County landfill would not have adequate capacity to receive the construction wastes or ash generated and maintain its existing permit (limited to 20 tons per day), and revising that permit would be expensive. These waste streams could be split among permitted landfills and transfer stations within 35 miles of the Biorefinery Project site, but permission for disposal would be required from those facilities. However, impacts on existing permitted solid waste disposal facilities

could be problematic if a significant amount of the boiler fly ash was not marketable as a soil amendment byproduct. Abengoa should develop and implement a contingency plan for alternative beneficial uses of the fly ash in the event a significant percentage of the material is not used by biomass producers as soil amendment. This mitigation strategy is identified in Chapter 6, Section 6.2 of this EIS.

S.7.1.3 Differences Among the Proposed Action, Action Alternative, and No-Action Alternative

Table S-3 summarizes the potential impacts of the Proposed Action, Action Alternative, and No-Action Alternative. In general, there are differences between the two action alternatives. Because fewer shipments of biomass and other materials would be required for the Action Alternative, DOE anticipates there would be fewer traffic fatalities and less noise impacts to local residents. Under the Proposed Action, about 10 percent more workers would be employed at the biorefinery, and thus more earnings would be spent in the local economy.

S.7.1.4 Areas of Controversy

No information was obtained during the development of this EIS that would suggest the Proposed Action or Action Alternative is controversial. Impacts of constructing and operating the biorefinery generally would be small..

S.7.1.5 Issues to be Resolved

The U.S. Department of Energy must decide whether to provide, subject to annual appropriations, up to $71 million (of the $685 million total anticipated cost) to support the design, construction, and startup of the biorefinery under Section 932 of EPAct 2005. If funds are to be provided, the Department must also decide whether those funds would be used for the Proposed Action, which includes the generation of electricity for sale to the regional grid, or the Action Alternative, which includes generation of sufficient electricity only to support the needs of the biorefinery.

Table S-3. Comparison of potential impacts under the Proposed Action, Action Alternative, and No-Action Alternative.

Resource area	Proposed Action	Action Alternative	No-Action Alternative
Land use			
	Conversion of 385 acres to non-agricultural production.	Same as Proposed Action.	Land use for the 385 acres would remain agricultural.
	No change to land use or agricultural practices to meet demand for biomass feedstock.		
	No changes to land in Conservation Reserve Program, prime farmland, highly erodible land, or public lands.		
	No change in soil erosion.		
	Minor adverse impact on soil organic content in some fields. No regional impact on agricultural production.		
	Biorefinery consistent with local zoning and land use.		
Air quality			
	Short-term and intermittent emissions during construction.	Same as Proposed Action.	There would be no construction.
	Concentration from operations, along with background concentrations, are about 67% of the National Ambient Air Quality Standards for 24-hour PM_{10}, 12% for nitrogen dioxide, and less than 10% of the standards for other pollutants.	Concentration from operations, along with background concentrations, are about 53% of the National Ambient Air Quality Standard for 24-hour PM_{10}, 13% for nitrogen dioxide, and less than 10% of standards for other pollutants.	There would be no changes in air emissions from current background levels.
	Estimated reduction in greenhouse gas emissions of 340% by replacing gasoline fuel in vehicles with biomass-derived ethanol.	Estimated reduction in greenhouse gas emissions of 39% by replacing gasoline fuel in vehicles with biomass-derived ethanol.	There would be no reduction in greenhouse gas emissions.
Surface water			
	Minor changes to drainage patterns on the Biorefinery Project site.	Same as Proposed Action.	There would be no changes in drainage patterns on the Biorefinery Project site.
	Runoff and planned releases of wastewater limited to the Project site.		
	No surface waters would be affected by accidental spills.		
	No floodplains or wetlands would be affected.		

Table S-3. Comparison of potential impacts under the Proposed Action, Action Alternative, and No-Action Alternative (continued).

Resource area	Proposed Action	Action Alternative	No-Action Alternative
Groundwater			
	Water Requirements: • Construction phase – 220 acre feet • Operations phase – 2,950 acre-feet annually Net operations water demand is 4,290 acre-feet per year less than permitted for eight supply wells, thus there would be a beneficial decrease in water withdrawals from the High Plains aquifer.	Water Requirements: • Construction phase – 210 acre feet • Operations phase – 700 acre-feet annually Net operations water demand is 1,500 acre-feet per year less than permitted for three supply wells, thus there would be a beneficial decrease in water withdrawals from the High Plains aquifer.	Water withdrawal from the affected wells would continue to be used for crop irrigation. There would be no net reduction in water withdrawal from the High Plains aquifer (i.e., 4,290 acre-feet from the Proposed Action or 1,500 acre-feet from the Action Alternative).
Biological resources			
	Minor short-term and long-term impacts to common species from construction and operations within 0.5 mile of the biorefinery. No threatened or endangered species would be impacted by the construction and operation of the biorefinery.	Same as Proposed Action.	No impacts to biological resources.
Utilities, energy, and materials			
	Maximum domestic and potable water demand about 25% of unused capacity of Hugoton water system.	Same as Proposed Action.	There would be no impact on the Hugoton water system.
	Design capacity of Hugoton sewage lagoons approached during construction, but not exceeded.		There would be no increase in the sewage load (beyond current loads) to the Hugoton sewage lagoons.
	Energy: Needs of biorefinery generated onsite, and 75 megawatts of electricity supplied to regional grid (equal to 5.8% of production capacity in western-central Kansas).	Requires electrical power from regional grid, equal to less than 1% of production in local region.	No additional electrical power would be needed and no electricity would be supplied to the regional grid.
	Construction materials: With possible exception of stainless steel, no availability issues, and needs would not stress regional market for materials.	Same as Proposed Action.	No additional demand (beyond current levels) for construction materials.

Table S-3. Comparison of potential impacts under the Proposed Action, Action Alternative, and No-Action Alternative (continued).

Resource area	Proposed Action	Action Alternative	No-Action Alternative
Waste, byproducts, and hazardous materials			
	Except for operation phase municipal solid wastes, the Stevens County landfill would not have adequate capacity to receive construction or other operations wastes generated and maintain its small arid landfill exempt status. This waste could be split among other landfills and a transfer station in the region.	Same as Proposed Action.	There would be no wastes, byproducts or hazardous materials generated.
	Ash not used as a soil amendment would be disposed of among the landfills and transfer stations in the region.		
	No adverse impacts from land application of non-contact wastewater.		
	No adverse impacts if proposed hazardous waste management practices are implemented.		
Transportation			
	35 to 41 estimated traffic fatalities from shipments and commuting workers.	13 estimated traffic fatalities from shipments and commuting workers.	There would be no shipments or commuting workers and thus no associated traffic fatalities.
	$580,000 to $840,000 annual cost of pavement damage from biomass, chemical, and waste shipments.	$220,000 annual cost of pavement damage from biomass, chemical, and waste shipments.	There would be no shipments or commuting workers and thus no associated pavement damage.
	No adverse impacts to operation of local railroad.	No adverse impacts to operation of local railroad.	
	No roadway improvements required to reduce congestion or improve access to site.	No roadway improvements required to reduce congestion or improve access to site.	
Visual resources			
	Several structures, including a 115-foot-tall structure, visible from surrounding vantage points.	Fewer tall structures than Proposed Action, thus less visible from surrounding vantage points.	No structures would be built on the Biorefinery Project site and visual resources would be unchanged.
	Source of night lighting.	Source of night lighting.	No source of night lighting.
	A 1.5-mile-long transmission line visible from Road P and Road 11.	No new transmission line.	No new transmission line.

Table S-3. Comparison of potential impacts under the Proposed Action, Action Alternative, and No-Action Alternative (continued).

Resource area	Proposed Action	Action Alternative	No-Action Alternative
Noise			
	Noise exposure to workers would be minimized through implementation of a hearing conservation program.	Same as Proposed Action.	There would be no change in noise from background levels.
	Construction and operations noises would be near background levels at the nearest residences.		
	Nearby residences and a hospital, churches, and other facilities in Hugoton would experience noise from passing trucks about every 8 to 21 minutes, which would interfere with conversations outdoors and cause annoyance indoors.	Trucks would pass residences and facilities in Hugoton every 30 minutes or less, which would interfere with conversations outdoors and cause annoyance indoors.	There would be no trucks passing and thus no interference with conversations outdoors and annoyance indoors.
Odor			
	Odors would not be detectable offsite.	Same as Proposed Action.	There would be no odors.
Socioeconomics			
	Up to 256 workers employed during construction and 43 during operations.	Up to 230 workers employed during construction and 34 during operations.	There would be no increase in employment above current levels.
	1% increase in the population of the region during construction, and 0.1% increase during operations.	0.9% increase in the population of the region during construction, and 0.1% increase during operations.	
	Little impact to public services.	Little impact to public services.	There would be no impact on public services.
	$17 million annual infusion of earnings during construction and $4.4 million annually during operations.	$16 million annual infusion of earnings during construction and $3.4 million annually during operations.	There would be no annual infusion of earnings.
Cultural resources			
	No adverse impacts.	Same as Proposed Action.	Same as Proposed Action.
Health and safety			
	Public not affected by industrial hazards.	Same as Proposed Action.	There would be no hazards to the public.
	Construction workers: 13.5 total recordable cases, 7 days away from work cases, and 0.026 fatality estimated.	Construction workers: 12.1 total recordable cases, 6.3 days away from work cases, and 0.023 fatality estimated.	
	Operations workers: 2.7 total recordable cases, 0.94 day away from work, and 0.0014 fatality estimated.	Operations workers: 2.3 total recordable cases, 0.68 day away from work, and 0.0011 fatality estimated.	

Table S-3. Comparison of potential impacts under the Proposed Action, Action Alternative, and No-Action Alternative (continued).

Resource area	Proposed Action	Action Alternative	No-Action Alternative
Accidents			
	Accidents during operation of the biorefinery would be unlikely to impact the general public.	Same as Proposed Action.	There would be no potential for accidents and thus no hazards to the general public.
Environmental justice			
	No impacts to communities with high percentages of minority and low-income populations. 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.	Same as Proposed Action.	There would be no environmental justice impacts.