

Producing Biofuels in Kansas

Building a renewable fuel facility requires careful planning and compliance with a number of local, state and federal statutes and rules and regulations. The following state agencies may have resources and information of interest to you:

The **Kansas Department of Commerce's** agriculture marketing division can help fund feasibility studies, business plans and equity drives. They also may be able to help with funding through the agriculture value-added loan program or economic development loans through the community development block grant program. Contact Corey Mohn at (785) 296-3737 or cmohn@kansascommerce.com.

The **Kansas Department of Agriculture's** division of water resources can answer your questions about water law and help you meet your water needs for renewable fuel production. Contact Ken Kopp at (785) 296-3717 or kkopp@kda.state.ks.us.

The **Kansas Department of Health and Environment's** bureau of water can help you with water quality and wastewater permit requirements. Contact Don Carlson at (785) 296-5547 or dcarlson@kdhe.state.ks.us. The department's bureau of air and radiation can help you with permits related to air quality and emissions. Contact John Ramsey at (785) 296-1992 or jramsey@kdhe.state.ks.us.

The **Kansas Securities Commissioner's** office can help you with registrations and filings needed for equity drives. Contact Steve Wassom at (785) 296-3307 or steve.wassom@ksc.ks.gov.

The **Kansas Department of Revenue** can help you with licensing, bonding, motor fuels taxes and tax credits. Contact Edie Martin at (785) 296-5327 or edie_martin@kdor.state.ks.us.

Other practical considerations include financing, site selection, access to transportation, communication with investors, access to feedstock supply, communicating to gain public support, access to markets for co-products and the fuel produced, and information about state and local production incentives.

How are ethanol and biodiesel fuel produced?

Most ethanol in the U.S. is made from corn, but it also can be produced from other feedstocks such as grain sorghum, wheat, barley, or potatoes. Brazil, the world's largest ethanol producer, makes renewable fuel from sugarcane.

More than half the ethanol produced in Kansas is made from grain sorghum. Most Kansas facilities use corn and sorghum interchangeably.

Ethanol can be made by a dry mill process or a wet mill process. Most ethanol in the U.S. is made using the dry mill method. In the dry mill process, the starch portion of the corn is fermented into sugar then distilled into alcohol.

What are the primary steps in the dry mill process?

Milling. The feedstock passes through a hammer mill, where it is ground into a fine powder called meal.

Liquefaction. The meal is mixed with water and alpha-amylase and passed through cookers where the starch is liquefied. Heat is applied at this stage to enable liquefaction. Cookers with a high temperature stage (120-150 degrees Celsius) and a lower temperature holding period (95 degrees Celsius) are used. High temperatures reduce bacteria levels in the mash.

Saccharification. The mash from the cookers is cooled and the secondary enzyme (gluco-amylase) is added to convert the liquefied starch to fermentable sugars (dextrose).

Fermentation. Yeast is added to the mash to ferment the sugars to ethanol and carbon dioxide. Using a continuous process, the fermenting mash is allowed to flow through several fermenters until it is fully fermented and leaves the final tank. In a batch process, the mash stays in one fermenter for about 48 hours before the distillation process is started.

Distillation. The fermented mash, now called beer, contains about 10 percent alcohol plus all the non-fermentable solids from the corn and yeast cells. The mash is pumped to the continuous flow, multcolumn distillation system where the

alcohol is removed from the solids and the water. The alcohol leaves the top of the final column at about 96 percent strength, and the residue mash, called stillage, is transferred from the base of the column to the co-product processing area.

Dehydration. The alcohol from the top of the column passes through a dehydration system where the remaining water will be removed. Most ethanol plants use a molecular sieve to capture the last bit of water in the ethanol. The alcohol product at this stage is called anhydrous ethanol (pure, without water) and is approximately 200 proof.

Denaturing. Ethanol that will be used for fuel must be denatured, or made unfit for human consumption, with a small amount of gasoline (2 percent to 5 percent). This is done at the ethanol plant.

Co-Products. There are two main co-products created in ethanol production: distillers grain and carbon dioxide. Distillers grain, used wet or dry, is a highly nutritious livestock feed. Carbon dioxide is given off in great quantities during fermentation and many ethanol plants collect, compress and sell it for use in other industries.

Ethanol From Cellulose

Even with the growth of biofuel production from grain, there will not be an adequate supply of starch-based ethanol to meet demand. Ethanol from cellulosic sources can provide additional fuel and contribute to our energy independence.

Research on ethanol from cellulosic sources, such as switchgrass, wood chips, corn stover or other plant sources, is ongoing. Experts believe the technology to make widespread production of cellulosic-based fuels is approaching, but there are no commercial-

scale cellulosic ethanol plants currently operating in the U.S.

In February 2007, the United States Department of Energy issued \$385 million in grants to help fund startup costs for six cellulosic ethanol facilities. One grant was issued to Abengoa Bioenergy to develop a facility in Kansas. The plant will use corn stover, wheat straw, milo stubble, switchgrass and other feedstocks to produce ethanol.

Significant challenges to commercial-scale cellulosic ethanol production include harvesting, transportation and storage technology.

Biodiesel

It is simpler to produce biodiesel than to produce ethanol. Biodiesel is made through a chemical process called transesterification, where glycerin is separated from fat or vegetable oil. The process leaves behind two products – methyl esters (the chemical name for biodiesel) and glycerin (a valuable byproduct usually sold to be used in soaps and other products). Since most U.S. biodiesel is made from soybeans or canola, soybean meal remains after the oil is removed. Although there are plants under construction and in the permitting process, there are no biodiesel plants currently operating in Kansas.

With what local, state and federal regulations must plants comply before they can operate?

Local. Developments must comply with local zoning. Interested developers should contact the local planning and zoning board early in the process to ensure that the project complies with all local regulations. Getting the project authorized by the local planning

commission is essential to getting the process off the ground.

State. Renewable fuel production plants must comply with regulations established by various state agencies, including the Kansas Department of Health and Environment's bureau of air and radiation and bureau of water, and the Kansas Department of Agriculture's division of water resources.

The states also requires:

- construction permit – air quality
- air operating permit
- wastewater treatment permit
- pollution control permit (if the facility proposes to treat and dispose of its wastewater)
- stormwater runoff permit (for construction that disturbs one acre or more of land)
- above- and below-ground storage tank permit (if applicable)
- livestock waste permit (if applicable)

Plants also must have permits to appropriate water in the amount necessary to produce biofuels. Water rights are governed by the Kansas Department of Agriculture's division of water resources. If the plant will be built in an area closed to new water appropriation, existing water rights must be purchased and a change of use approved.

Federal. Federal regulations relating to ethanol and biodiesel plants are enforced by the Environmental Protection Agency.

Specific regulations that may apply include:

- National Pollutant Discharge Elimination System. This is a wastewater treatment program, and the Kansas Department of Health and Environment issues NPDES permits on behalf of the Environmental

Protection Agency. Separate permits will be needed for construction and industrial operation.

- Federal Underground Injection Control, if the facility disposes wastewater by directing it to a disposal/injection well.
- Spill Prevention, Control, and Countermeasure program.
- Clean Air Act (covered by Kansas Department of Health and Environment permitting).
- Maximum Achievable Control Technology program (based on excessive hazardous air pollutant emissions) likely would not apply to ethanol plants with production capacities of less than 100 million gallons a year.
- Alcohol production is governed by the Department of the Treasury's Alcohol and Tobacco Tax and Trade Bureau.

What other energy sources or resources are consumed when the renewable fuel is produced?

Energy Balance. Ethanol production is energy efficient. It yields almost 25 percent more energy than is used to grow the corn, harvest it and distill it into ethanol. The return on this production is estimated at about 1.6 units of fuel energy output for each unit of energy input.

No fuel is produced without consuming other energy. Biodiesel has one of the best energy balances; electricity, the worst.

Energy Use in Production Process. Energy needs for ethanol production have decreased in the last decade because of new technology and improvements in plant operations and design. The energy use is almost 50 percent less than it was 15 years ago, and it is expected to continue to improve.

The price of natural gas is critical to most ethanol production. It is used to dry the co-product, distillers grains. Many Kansas plants save energy costs because they are located in areas where the distillers grains can be sold wet for cattle feeding.

Ethanol yield per bushel has nearly doubled in the last 30 years. At the same time, the energy used per gallon has decreased by more than 50 percent.

Ethanol Yield From Corn. According to the National Corn Growers Association, every 56-pound bushel of corn used in the dry grind ethanol process yields 18 pounds of distillers grains, a source of energy and protein for livestock and poultry. Similarly, a bushel of corn in the wet mill ethanol process creates 13.5 pounds of corn gluten feed and 2.6 pounds of high-protein corn gluten meal, as well as corn oil used in food processing. The ethanol process removes only starch—not protein—from the feed and food market. The starch portion of the kernel is converted to ethanol, while the protein, fat and other nutrients are passed through to the feed co-products, or human food ingredients. Protein, which is left intact by the ethanol process, is a highly valued product in world food and feed markets.

Corn yields are increasing rapidly. New technology and genetic modification promise to continue to increase production of grains and cellulose sources for producing renewable fuels.

It is good to recall that ethanol made from corn comes from the starch in the corn kernel. Starch for human food is not in short supply. Most of the corn grown in this country is used for animal feed, not humans. Most of our corn exports also are used to feed livestock, not people. Separating the starch

for ethanol production allows us to produce fuel and feed.

Water Usage

In Kansas, we encourage sensible growth in the renewable fuels industry, both for the future of the industry itself and for the contributions it makes to our rural areas. One area where this is most evident is in water consumption.

Water is required for nearly every human venture, whether raising children, crops or livestock, or producing food, fuel and fiber. To ensure that our state's water resources are adequately managed to meet the needs of our communities, of industry, of farmers and ranchers, and for recreation, Kansas long ago established an effective system for appropriating the state's groundwater and surface water for beneficial use.

Some areas of Kansas have a more limited water supply than others, and some are closed to new water appropriation. If a new venture is planned in an area closed to new water appropriation, that entity must purchase existing water rights from another entity. If the new use will be different than the use for which the water was originally appropriated, the new use must be approved by the chief engineer of the Kansas Department of Agriculture's division of water resources. The approval process involves a review of how the type of use will change and applying a formula to ensure that the net consumptive impact on the water source does not increase.

Consumptive water use is defined as any use of water that reduces the supply from which it is withdrawn. When changing a water right from irrigation to an industrial use, the appropriated amount could be reduced by as

much as 40 percent to ensure that net consumptive use does not increase.

Consumptive water use by ethanol plants comes primarily from evaporation during cooling and wastewater discharge. Ethanol plant technology is improving to conserve and make better use of water. At the same time, state government will maintain strong oversight over where renewable fuel plants locate, taking into account important factors like water supply and availability.

To put water use by ethanol production into perspective:

- One dairy cow uses about 35 gallons of water a day.
- One feedlot animal uses about 15 gallons of water a day.
- One human uses 150 gallons of water a day.
- A 50 million gallon ethanol plant uses about 200 million gallons of water a year, or about 550,000 gallons per day; that's enough to irrigate about 400 acres of corn in western Kansas.
- One gallon of ethanol is produced using three to four gallons of water.

Questions Potential Developers Should Answer

- What is the capacity of the proposed plant? Have you located, or contracted for, a suitable amount of input commodity to reach this capacity (i.e. corn, soybeans, etc.)?
- Is the transportation infrastructure in place to support the shipment of goods both to and from the plant? Has an analysis been performed regarding existing highway and rail infrastructure? What additional traffic is expected?
- What is your track record as a developer? Do you have a portfolio of other projects

completed? Do the principals of your company have experience completing projects and retiring debt?

- Is there a credible consultant involved in your project who understands all the necessary inputs in the process and can effectively plan for the development?
- Has appropriate contact been made with all government officials with a stake in the project? (i.e. MUNICIPAL – mayor, planning and zoning, engineer; STATE – Department of Health and Environment, Department of Revenue, Securities Commission, Department of Agriculture, etc.)
- Do you have a solid business plan? Do you understand the market for the product and does your plan take advantage of that market? Do you have contingencies for downturns or price fluctuations?
- Do you have suitable equity or access to equity?

State Renewable Energy Incentives

Ethyl Alcohol Production Incentive

- \$0.075 for each gallon sold by the producer.
- Producers who commenced production on or after July 1, 2001, and who sold at least 5 million gallons qualify for the incentive for a maximum of 15 million gallons sold per year.
- \$875,000 per quarter is added to the fund for distribution. If production exceeds the fund balance, a pro-ratio of the distribution is performed.
- Program sunsets July 1, 2011.
- Reference: Kansas Statutes 79-34,163

Biodiesel Fuel Producer Incentive

- \$0.30 for each gallon sold by the producer.
- Kansas qualified biodiesel fuel producers may file for the incentive beginning July 1, 2007.

- \$875,000 per quarter is added to the fund for distribution. If production exceeds the fund balance, a pro-ratio of the distribution is performed.
- Program sunsets July 1, 2016.
- Reference: Senate Bill 388, 2006.

Cellulosic Alcohol Tax Credit

- An income tax credit, beginning with the 2006 tax year, for expenditures in new construction or expansion of the capacity in an existing plant.
- The credit is 10 percent of the taxpayer's qualified investment on the first \$250 million invested, and 5 percent of the taxpayer's qualified investment that exceeds \$250 million.
- If the amount of credit exceeds the taxpayer's tax liability in any one taxable year, the remaining portion can be carried forward until the credit is used, and not to exceed the 14th taxable year after the first annual installment is allowed.
- Reference: Senate Bill 303, 2006.

High Performance Incentive Program

- The High Performance Incentive Program provides an investment tax credit to companies that pay above-average wages and have a strong commitment to skills development for their workers.
- Employer must invest 2 percent of payroll in training or participate in one of the Kansas Department of Commerce's workforce training programs.
- A capital investment tax credit equal to 10 percent of eligible investment that exceeds \$50,000.
- A project description must be submitted prior to any commitment of investment.
- Credits can be carried forward 10 years.
- A company can elect to take the High Performance Investment Credits or the

Enterprise Zone Investment Tax Credits, but not both.

Agriculture Value-Added Loan

- Loans for feasibility studies, business plans or equity drives are typically funded at the 50 percent level.
- Loans for feasibility studies are forgivable if the project does not move forward. Equity drive loans are typically paid back within 120 days of successful conclusion of the equity drive.
- Other loans are interest free for two years and 1 percent over prime for the balance of the loan.

Community Development Block Grant – Economic Development Loans

- The maximum amount of funding is \$35,000 per created job up to a ceiling of \$750,000.
- At least 51 percent of the jobs must meet HUD’s low-and-moderate income test for the county in which the project is located.
- The local unit of government must apply for infrastructure funding on behalf of a private for-profit biofuel entity. Funds may be used for water, sewer, road or a rail spur.
- This program requires that half the funds be paid back over a 10-year period at a 2 percent rate. This payment stream is accomplished through a special assessment placed on the property.

Enterprise Zone Incentives

- Investment tax credit of \$1,000 for each qualified business facility investment starting at \$51,000 or more.
- Job tax credit of \$1,500-\$2,500, with a minimum of two jobs created.
- Exemption from state and local sales tax on all tangible personal property or

services purchased for the construction, enlarging, or remodeling of a business. The sale and installation of machinery and equipment purchased for the installation at the business is also exempt from sales tax.

- Credits can be carried forward until used.

Workforce Training Funds

- The Kansas Industrial Training program is designed to help new and expanding companies offset the cost of training workers for new jobs.
- Training funds can be used to reimburse negotiated costs for pre-employment, on-the-job and/or classroom training.
- The average reimbursement level for Kansas Industrial Training is \$300 to \$500 per position.

Other

In 2005, legislation was enacted to remove the mandatory labeling requirement for E10 ethanol. This resulted in a 700 percent-plus increase in Kansas E10 sales. In 2006, legislation was successful to reduce the tax on E85 ethanol by 7 cents per gallon at the pump to reflect the BTU content of E85. The law took effect in December 2006.

How many ethanol plants do we have now, and how much fuel are we producing?

Nationwide, there are 127 operational ethanol plants producing 6.384 billion gallons per year. There are 81 under construction or undergoing expansion, for an additional 5.965 billion gallons per year. This will result in a total capacity of 12.349 billion gallons per year (numbers are current as of July 2007, courtesy of the American Coalition for Ethanol).

Kansas currently has nine ethanol plants operating and another six are under

construction. As of July 2007, we were at a production capacity of 240 million gallons from nine working plants. Other plants are in the planning stages, and we expect some 585 million gallons of potential new production to take us to production of some 800 million gallons by the end of the next year.

**Consumers Information:
Ethanol and Your Vehicle**

The two common ethanol fuel formulations are E10 and E85. E10 pumps are not required to be labeled here in Kansas, but voluntary product marketing is allowed. E85 must be labeled as such.

All modern American vehicles are warranted to use E10, a clean burning and high-performance fuel. E85, however, should only be used in vehicles that are

designed for it. These flex fuel vehicles have the equipment to determine how much ethanol is in the fuel system and make necessary adjustments for vehicle performance and emission control.

If you are unsure if you have a flex fuel vehicle, check the fuel tank door for a sticker saying the car can use E85. There may be some loss of mileage performance with some vehicles, but blending ethanol can reduce the cost of gasoline.

The number of E85 fueling stations in Kansas continues to grow. Ethanol production, flex fuel vehicle availability and E85 fueling stations are all necessary to help curb our reliance on imported oil. A current list of E85 stations can be found at www.e85refueling.com.

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