# Chapter 5: Biomass—Biofuels

For additional data related to energy efficiency and conservation, please refer to the *Kansas Energy Chart Book*, Chapter 5 (http://kec.kansas.gov/chart_book/).

## Topic / Issue Description

Biomass can be defined as living or recently dead (non-fossil) organic matter of any kind. Biofuels are combustible solids, liquids, or gases derived from a biomass feedstock.

Ethanol and biodiesel are the two most commonly produced biofuels, and their production in the U.S. is on the rise. From 2004 to 2006, annual ethanol production increased from 3.4 billion gallons to about 4.9 billion gallons, and annual biodiesel production rose from 28 million gallons to roughly 287 million gallons, which, taken together, accounted for about 3 percent of gasoline and diesel motor fuel used.[1]

Most U.S. ethanol is made from corn, but it can also be produced from other feedstocks such as grain sorghum, wheat, barley, or potatoes. In Kansas, over half of the ethanol produced comes from grain sorghum, with most facilities using corn and sorghum interchangeably. Ethanol can be produced using a dry mill or a wet mill process. In the dry mill process most commonly used in the U.S., the starch in the feedstock is fermented into sugar and then distilled into alcohol. Two additional co-products are distillers grain, a highly nutritious livestock feed, and carbon dioxide, which can be collected and compressed for sale to other industries.

Cellulosic ethanol uses lignocellulose, the structural material comprising most of the mass in any plant, as a feedstock. Research on cellulosic feedstocks, such as switchgrass, wood chips, corn stover, is ongoing. Cellulosic feedstocks require an extra step to break down the lignocellulose into fermentable starch, increasing production costs. Other costs are associated with harvesting, transporting, and storing the bulkier cellulosic feedstock. The U.S. Department of Energy (DOE) has set 2012 as a target to achieve technological advances to make cellulosic ethanol cost competitive with corn ethanol.[2]

Biodiesel is produced using oils extracted from crops such as soybeans or peanuts, animal fat, or waste vegetable oil. Most U.S. biodiesl is made from soybeans or canola. Biodiesel is produced through a chemical process called transesterification, where glycerin is separated from fat or vegetable oil, leaving behind two products—methyl esters (the chemical name for biodiesel) and glycerin (which can be used in soaps and other products).



[1] U.S. Government Accountability Office (GAO), 2007, Biofuels: DOE Lacks a Strategic Approach to Coordinate Increasing Production with Infrastructure Development and Vehicle Needs (GAO-07-713), p. 5.
[2] U.S. GAO, 2007.

As an agricultural state, Kansas has great potential for biofuel production, and the state has seen rapid growth in the ethanol industry. As of September 2007, Kansas had ten grain-ethanol plants in operation, representing 360 million gallon/year (MGY) in capacity (with six more under construction); one cellulosic ethanol in the permitting phase; and one 72-MGY biodiesel plant under construction.

There is no doubt that the growth in the ethanol industry has provided economic benefits to the state, both in terms of the jobs associated with each of the state's nine ethanol facilities (with the newest plants providing approximately 35 jobs) and the additional market for the state's corn producers. Given the substantial federal and state incentives in place to support biofuels (see list of existing policies and programs below), it is likely that demand for corn and other food crops for fuel feedstocks will remain high and continue to impact prices.

The impact of higher corn prices on food has been widely discussed in recent months. According to U.S. Department of Agriculture estimates, 2007 prices for chicken, milk, and eggs (foods strongly affected by the price of corn) will be 10 percent,14 percent, and 21 percent higher, respectively, than in 2006,[3] though other inputs such as fuel costs are also driving the higher food prices.[4]

Ethanol production, like many industrial and agricultural practices, involves a consumptive use of water. A 50-MGY ethanol plant uses about 200 MGY of water (or about 550,000 gallons per day), primarily from evaporation during cooling and wastewater discharge. Although plant technology is improving to conserve and make better use of water (plants today use about 50 percent less water 10 to 15 years ago[5]), it currently takes roughly three to four gallons of water to produce one gallon of ethanol. Under the State's established system for appropriating water resources, all ethanol plants must purchase water from a rural water district or municipality or acquire a water right. In parts of the state closed to new water appropriations, any new venture must purchase existing water rights, and any new use of that appropriation must be approved by the Chief Engineer to ensure that the net consumptive impact does not increase. However, because growing corn requires a significant amount of water, increased corn production statewide may cause additional declines over time, as a result of diminished recharge (less irrigation water replenishing aquifers).

Regarding the impacts of biofuels on air quality, research has shown various impacts depending on how the fuels are blended and where they are used. Most ethanol used through 2005 was in blends under 10 percent to meet minimum oxygenate requirements for reformulated gasoline to reduce vehicle emissions in targeted

[3] Lester Brown, 2007, Biofuels blunder (briefing before U.S. Senate Committee on Environment and Public Works, June 13, 2007 (http://www.earth-policy.org/Transcripts/SenateEPWo7.htm).
[4] Renewable Fuels Association, 2007, Energy prices, not corn, chief reason for rising food prices, study finds, June 14, 2007: http://www.exploration-processing.com/content/view/374/31/ (accessed September 5, 2007).
[5] Greg Krissek, ICM, personal communication, September 2007.

metropolitan areas with high ground-level ozone readings.[6] With respect to carbon dioxide, because the amount of carbon sequestered by replanting the biofuel feedstock is roughly equivalent to the amount emitted by combusting the biofuel, biofuels are often considered carbon neutral. However, inputs such as fertilizer and the energy used to produce the ethanol involve substantial carbon emissions, especially if the energy comes from the combustion of coal. On average, current ethanol production and consumption results in 19% reduction in carbon emissions compared to gasoline; this reduction is expected to be 21% by 2010.[7] A similar study found that biodiesel achieves a net carbon emission reduction of 78% compared to petrodiesel.[8]

Because of its chemical characteristics (e.g., it is water soluble and a corrosive solvent), ethanol can't share the existing gasoline pipeline distribution system; gasoline pipelines would have to be switched over to transporting ethanol exclusively, which is unlikely to happen. Nationwide, 75% of the ethanol produced is shipped by rail, then offloaded and further transported via truck, pipeline, or barge to the point of sale. In Kansas, as in most of the Midwest, where ethanol plants are numerous, most ethanol for use in state is shipped short distances to the terminal via rail and then further distributed by tanker trucks.[9] The majority of ethanol produced in Kansas is shipped out of state for use in western and southwestern U.S.

Blending of ethanol and gasoline (e.g., E10, which contains 10% ethanol by volume) usually occurs at or near local fueling terminals. After being blended at the terminal, the resulting ethanol-gasoline mixture is transported to fueling stations via tanker trucks. Of the 18 terminals (totaling 50 loading bays) operating in Kansas as of September 1, 2007, 11 have E10 available (at a total of 27 bays). Only three terminals in eastern Kansas had E85 available, and only the McPherson terminal had biodiesel. Due to this somewhat limited availability of blended product, many marketers, especially in western Kansas, have to send a tanker truck to both a gasoline fueling terminal and an ethanol plant and splash-blend the product in the tanker.[10]

Because of ethanol's solubility and solvency, marketers have to pay special attention to pumping and storage equipment. Although E10 can be combusted in nearly any gasoline engine, higher blends such as E85 are officially approved only for flex-fuel vehicles. According to DOE data, 6.6% of all light duty vehicles sold in 2007 were

[6] Although oxygenates reduce emissions of carbon monoxide, in some instances they can lead to higher emissions of nitrogen oxides and volatile organic compounds, which can in some areas lead to increased ground-level ozone formation due to atmospheric conditions (GAO, 2007).

[7] M. Wang, M. Wu, and H. Huo, 2007, *Life-cycle Energy and Greenhouse Gas Emission Impacts of Different Corn Ethanol Plant Types*, DOE Office of Energy Efficiency and Renewable Energy, p. v (http://www.iop.org/EJ/article/1748-9326/2/2/024001/erl7_2_024001.html#erl245942s5.6).

[8] J. Sheehan, V. Camobreco, J. Duffield, M. Graboski, and H. Shapouri, 1998, *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus*, National Renewable Energy Laboratory, p. v (www. nrel.gov/docs/legosti/fy98/24089.pdf).

[9] Construction of long distance pipelines to transport ethanol has been discussed as an economical distribution method parallel to that used for gasoline, but the solubility and solvent properties of ethanol make a pipeline technically challenging.

[10] Curt Wright, personal communication, September 2007.

E85 capable flex-fuel vehicles, up from 3.4% in 2004.[11] In Kansas, as of August 2007, there were 23 stations selling E85.[12]

**Existing Policies and Programs**

1. The Volumetric Ethanol Excise Tax Credit (VEETC), established under the 2004 American Jobs Creation Act, provides an excise tax exemption of $0.51 per gallon of ethanol blended into gasoline by petroleum blenders. The credit is currently set to expire in 2010. The 2004 Act also provides a $1.00 per gallon excise tax credit for agri-biodiesel producers and blenders, a $0.50 cents per gallon excise tax credit for biodiesel producers and blenders using agricultural products and animal fats, and a $1.00 per gallon excise tax for "renewable diesel" producers and blenders. The biodiesel tax credits will expire at the end of 2008.

2. The Renewable Fuel Standard (RFS), part of the 2005 Energy Policy Act, mandates that 4.0 billion gallons of renewable fuel be blended in 2006, increasing incrementally to 7.5 billion gallons in 2012.

3. The 2005 Energy Policy Act extended and slightly modified the existing federal production tax credit; ethanol and biodiesel producers with capacity below 60 MGY receive $0.10 per gallon for the first 15 million gallons produced.

4. The 2006 Tax Relief and Healthcare Act imposes a 2.5% *ad valorem* tariff and a most-favored-nation duty of $0.54 per gallon of ethanol imported to the U.S. from most countries, with some exceptions such as the Caribbean Basin Initiative nations.

5. The Kansas Ethyl Alcohol Production Incentive (K.S.A. 79-34,163) provides producers with $0.075 per gallon of ethanol sold and $0.30 per gallon of biodiesel sold. Ethanol producers must produce at least 5 million gallons per year to qualify and are limited to a maximum of 15 million gallons per year (or $1.125 million per year). Funding for the ethanol incentive is $875,000 per quarter starting June 30, 2008; funding for the biodiesel incentive is also $875,000 per quarter starting June 30, 2008, with a one-time payment of $400,000 added to the fund for distribution through June 30, 2008.

6. Kansas H.B. 2038 provides 10 year property tax exemptions, accelerated depreciation over 10 years (55% the first year and 5% thereafter, and Kansas Development Finance Authority (KDFA) financing for biomass to energy projects.

[11] Table of Light Duty Vehicle Sales by Technology Type, DOE; http://www.eia.doe.gov/oiaf/aeo/supplement/pdf/suptab_39.pdf

[12] A regularly updated listing of current E85 stations with addresses is maintained at: http://www.ksgrains.com/ethanol/e85.html

7. The Kansas Alternative-Fuel Fueling Station Tax Credit provides tax credits to distributors of renewable fuels. Alternative-fuel fueling stations in service between January 1, 1996, and January 1, 2005, qualify for 50% of total expenditures up to $200,000; stations built between January 1, 2005, and January 1, 2009, receive 40% of expenditures up to $160,000; and stations built after January 1, 2009, receive 40% of expenditures up to $100,000.

8. K.S.A 79-34,141 reduces the ethanol fuel tax from $0.24 per gallon to $0.17 per gallon, starting January 1, 2007. Beginning in 2020, the tax will be reduced to $0.11 per gallon.

9. The Kansas Dealers Incentive Fund provides incentives to retail dealers who sell and dispense renewable fuels or biodiesel at the pump. This fund will begin receiving quarterly payments of $400,000 on January 1, 2009, giving dealers $0.065 per gallon for ethanol sales and $0.03 per gallon for biodiesel.

10. The Storage and Blending Equipment Tax Credit provides an income tax credit for equipment used to store and blend biofuels as well as petroleum-based fuels. The income tax credit of 10 percent is provided for the first $10 million of the taxpayer's qualified investment, with a 5 percent credit applied to the amount of investment that exceeds $10 million. The program applies to tax years beginning January 1, 2007, and running through December 31, 2011.

11. The Biomass-to-Energy Plant Tax Credit (K.S.A. 79-32) establishes an income tax credit for new construction or expansion of a biomass-to-energy facility. Investors get a 10% tax credit for the first $250 million invested and a 5% tax credit for any investment exceeding $250 million. The tax credit is applied over 10 years in equal annual installments.

12. A new Kansas law (K.S.A. 79-32,201) establishes an income tax credit covering up to 40% of the incremental or conversion cost of an alternative fuel vehicle (AFV). Owners of E85 flex fuel vehicles must show that they have used at least 500 gallons of E85 in their vehicle to qualify.

13. The 2006 Tax Relief and Healthcare Act allows a 50% tax deduction of the adjusted basis of a new enzymatic cellulosic ethanol plant in its first year of operation.

14. Among Kansas laws targeting biofuels and the state vehicles, K.S.A. 75-3744a requires that a 2% or higher blend of biodiesel or a 10% or higher blend of ethanol be purchased for use in state vehicles, provided the cost is not more than $0.10 per gallon more than gasoline. In addition, SB 262 requires the purchase of E85 vehicles when making new purchases or leases.

15. The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) provides biorefinery grants to address specific technological improvements in the refining process.

16. The 2000 Federal Biomass Research and Development Act establishes grants for research, development, and demonstration of feedstock production, cellulosic ethanol, and product diversification. The grants are administered by the Biomass Research and Development Initiative (BRDI), which is coordinated jointly by USDA and DOE.

17. The DOE offers a number of biofuels loan guarantee and incentive programs authorized by the 2005 Energy Policy Act. Several loan guarantee programs support the production of ethanol from cellulose, municipal waste, or sugar cane. One program authorizes the DOE to provide loan guarantees to projects that reduce air pollution and greenhouse gas emissions, including biofuels projects.

18. The U.S. Department of Agriculture (USDA) Bioenergy Program, established by a 1999 Executive Order, reimburses ethanol and biodiesel producers for commodity purchases necessary for expanding production.

# Policy and Program Recommendations Requiring Administrative Action

**1. Encourage State agencies currently administering biofuel incentives to coordinate an internal program review of existing biofuel incentives and report to Legislative Committees on both the effectiveness and potential problems, inefficiencies.**

Since 2001, the Kansas Legislature has passed various incentives to promote the state's production and use of biofuels. As each tax credit, incentive, or other policy became law, State agencies—specifically, the Kansas Corporation Commission (KCC), the Kansas Department of Commerce (Commerce), and the Kansas Department of Revenue (Revenue)—were tasked with establishing rules and regulations and then implementing these various programs. Because most of these incentive programs were enacted in the past two years, information is lacking to determine whether they are achieving their intended purposes.

As a first step in better understanding how well these incentives are achieving their intended purposes, the KCC, Commerce, and Revenue should conduct reviews of those incentive and credit programs they administer.[13] The findings over the course of the review period would be compiled by Commerce and reported to the Kansas Legislature, along with any program design problems or inefficiencies as seen on the administrative level.

Reports will be made to the appropriate legislative committees at the beginning of each Legislative session. There will be no fiscal note associated with this recommendation; the only cost to implementation will be the labor hours associated with composing and reporting notes on the programs.

The resulting dialogue between the Legislature and agencies will provide essential information of the effectiveness of these incentives and allow for needed improvements or eliminations.



[13] Among the programs to be reviewed are: the Coal Gasification Power Plant Tax Credit (KCC), Biomass-to-Energy Plant Tax Credit (Commerce), Coal or Coke Gasification Nitrogen Fertilizer Plant Tax Credit (Commerce), Renewable Electric Cogeneration Facility Tax Credit (Commerce), Storage and Blending Equipment Tax Credit (Commerce), Ethyl Alcohol Production Incentive (Revenue), Biodiesel Fuel Producer Incentive (Revenue), Alternative-Fuel Fueling Station Tax Credit (Revenue), Kansas Retail Dealers Incentive Fund (Revenue), Waste Heat Utilization System Tax Credit and Deduction (Revenue).