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Bioenergy from Agriculture

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Bioenergy

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Bioenergy industry

According to the U.S. Department of Energy, oil prices are expected to rise through 2035 to $3.71 per gallon while ethanol and E85 (85% ethanol, 15% petroleum) are predicted to reach only $2.07 and $2.93, respectively (Fig. 1).

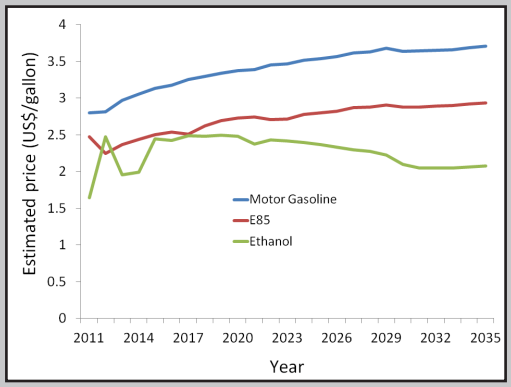

Fig. 1. Estimated changes in gasoline and ethanol prices (U.S. Energy Information Administration).

The Renewable Fuels Standard, established by the U.S. government in 2005, mandates that increasing proportions of U.S. transportation fuels come from biofuel sources (Fig. 2).

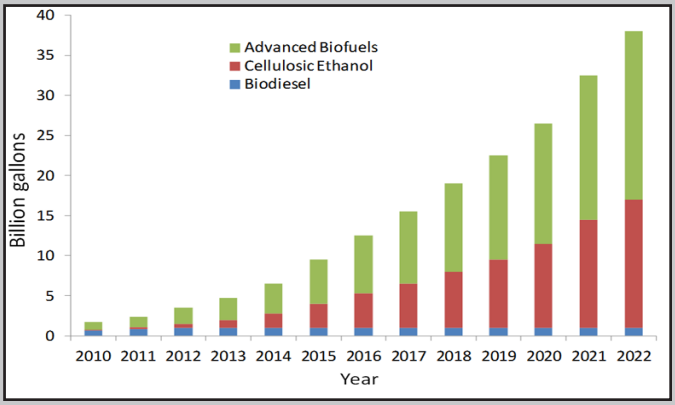

Fig. 2. Federal mandates for biofuels usage in transportation fuels according to the Renewable Fuels Standard 2.

This is expected to save around $41.5 billion dollars in oil imports and require the annual production of 36 billion gallons of biofuels by 2022.

Currently, there are two basic types of biofuels; ethanol and biodiesel. Ethanol has traditionally been produced from corn (corn ethanol) but it can also be produced from other plant material like grasses (cellulosic ethanol) (Fig. 3).

Fig. 3. Switchgrass is an example of the types of grasses that can be used to produce cellulosic ethanol.

The process to create corn ethanol involves removing and fermenting the sugars present in corn. The process to produce cellulosic ethanol involves an extra step, however. The sugars in other plant materials are not as readily available as in corn so it must be made available through the addition of enzymes or dilute acids. Once this step is completed, the process is essentially the same as for corn ethanol production.

Biodiesel can be produced from oil seed crops like canola. The seeds are pressed to remove the oil which is then heated and processed using methanol and sodium hydroxide to produce biodiesel.

Agricultural products can also be used to produce electricity. Plant material may be burned along with or instead of coal or natural gas in power plants to generate power.

Bioenergy Feedstocks

The table below includes some of the more common agricultural feedstocks for biofuels.

Ethanol	Biodiesel
Corn	Canola
Sugar cane	Sunflower
Switchgrass	Soybean
Sorghum	Mustard
Miscanthus	Peanut

Advantages

1) **Greenhouse gas reduction** The production and combustion of corn ethanol and soy biodiesel on land already under production reduce net greenhouse gas emissions by 12% and 41%, respectively, as compared to fossil fuels.

2) **Create jobs** It is estimated that a biorefinery producing 100 million gallon per year will create about 1600 jobs in Tennessee. Biorefineries will have to be located in rural areas where bioenergy crops are grown to reduce transportation costs. This will, therefore, directly impact these rural economies.

3) **Reduce U.S. dependence on foreign oil** The majority of petroleum available (domestic production and imports) to the U.S. is used for transportation. The U.S. imports about 46% of its petroleum from other countries. About 40% of these imports come from OPEC nations. This leads to volatile prices and less control over our own energy needs.

Disadvantages

1) **Availability** Currently, biofuel like cellulosic ethanol is not available as the conversion technology is still in the beginning stages of development. Biodiesel is more available than cellulosic ethanol but limited to specific areas of the nation and metropolitan locations. To view these locations go to: http://www.afdc.energy.gov/locator/stations/

2) **Lower gas mileage** Ethanol and biodiesel generally provide lower gas mileage than gasoline and diesel. The National Renewable Energy Laboratory found that at E10 (10% ethanol) fuel economy decreased by about 3.5% as compared to pure gasoline. The E85 vehicles can have 23-30% lower gas mileage than pure gasoline.

Before engaging in any new venture, it is always important that the current state of government policies, the bioenergy feedstock market, and processing facilities are assessed to ensure that the most effective risk management strategies are considered.

Additional Resources

de Koff, J.P., and D.D. Tyler. 2011. Improving switchgrass yields for bioenergy production. Tennessee State University Cooperative Extension Service, ANR-B1; University of Tennessee Cooperative Extension Service, W271. http://www.tnstate.edu/agriculture/documents/W271.pdf

Farm Energy Extension. http://www.extension.org/ag+energy

Garland, C.D. 2008. Growing and harvesting switchgrass for ethanol production in Tennessee. University of Tennessee Cooperative Extension Service, SP701-A. https://utextension.tennessee.edu/publications/Documents/SP701-A.pdf

Jackson, S. 2008. Biodiesel: a primer. University of Tennessee Cooperative Extension Service, SP700-C. https://utextension.tennessee.edu/publications/Documents/SP700-C.pdf

Jackson, S. 2008. Ethanol: a primer. University of Tennessee Cooperative Extension Service, SP700-B. https://utextension.tennessee.edu/publications/Documents/SP700-B.pdf

Wilcox, M., D. Lambert, and K. Tiller. 2008. Biofuels '101'. University of Tennessee Cooperative Extension Service, SP700-A. https://utextension.tennessee.edu/publications/Documents/SP700-A.pdf

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