Current State of the U.S. Ethanol Industry

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This report is dedicated to the memory of Lawrence J. Russo, Jr. in honor of his devoted service to the Office of the Biomass Program and in gratitude of his efforts to promote greater understanding of the U.S. biofuels industry.

Table of Contents

Tables

Figures

Chapter 1
Introduction and Objective

1.1 Introduction

The ethanol industry is one of the most significant success stories in American manufacturing over the past quarter-century. From a cottage industry that produced 175 million gallons in 1980, the American ethanol industry is poised to produce nearly 13 billion gallons in 2010. The structure of the ethanol industry has changed dramatically over the past 15 years. In 1991, 35 plants produced 865 million gallons of ethanol. Two-thirds of capacity was accounted for by wet mill plants that had an average capacity of 96 million gallons per year (MGY). The 20 operating dry mill plants had an average capacity of 16.5 MGY. Currently, the ethanol industry is comprised of more than 200 plants with an annual capacity of nearly 13.5 billion gallons. Dry mill plants account for more than 70 percent of capacity and virtually all new ethanol plants being built today are dry mills using grain as a feedstock or second-generation plants designed to produce ethanol from Advanced Biofuel Feedstocks or cellulose. Growth in U.S. ethanol production over the past twenty-five years is illustrated in Figure 1.

1.2 Objective

The objective of this study is to provide a comprehensive overview of the state of the U.S. ethanol industry and to outline the major forces that will affect the development of the industry over the next decade.

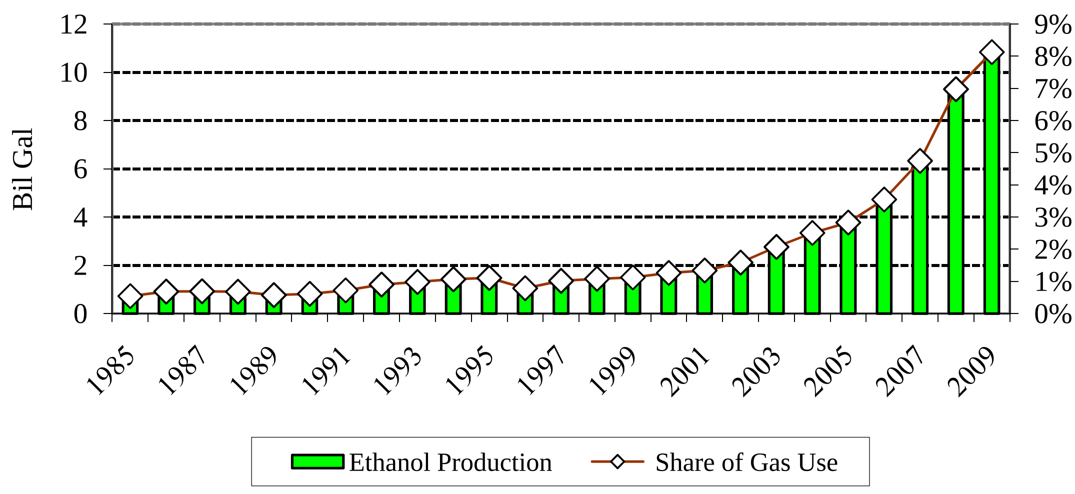

Figure 1 U.S. Ethanol Production and Share of Gasoline Use

Chapter 2

BACKGROUND ON ETHANOL

Ethanol is an alcohol produced by fermentation of sugars found in grains and other biomass. Ethanol can be produced from a diversity of feedstocks, including grains such as corn, wheat, barley and sorghum; and sucrose in the form of cane and beet sugar or molasses. Ethanol also can be produced by converting cellulose into its constituent sugars, which then are fermented and distilled into alcohol. Sources of cellulose include biomass such as crop waste (e.g. corn stover and cobs), energy grasses such as switchgrass, wood and wood waste, and other crop and vegetable waste.

Currently well over 90 percent of all ethanol produced in the U.S. uses corn as the primary feedstock. Sucrose from sugar cane is used as an ethanol feedstock in Brazil and Australia while sucrose from beets is used to produce ethanol in Europe. The technology for converting sucrose to ethanol is well established, but not widely used in the U.S.

2.1 Conventional Corn Starch Ethanol

Ethanol is made both by dry and wet milling of corn. Dry mill plants are designed to process corn into ethanol with Distiller's dried grains and carbon dioxide as the primary co-products. In dry milling, the entire kernel or corn or other starchy grain (wheat, barley, sorghum) is processed without separating out the various component parts of the grain such as the germ. Water is added to form a mash to which enzymes are added to convert the starch to dextrose, a simple sugar. The mash is cooked at high-temperatures to reduce bacteria levels then cooled and transferred to fermenters where yeast is added to convert the sugar to alcohol. This process produces a "beer" which is distilled to produce ethanol and carbon dioxide (CO_2) which can be recovered as a co-product. Typically conventional distillation produces 190 proof ethanol which is then dehydrated to approximately 200 proof (pure alcohol) through the use of a molecular sieve. This ethanol, termed anhydrous because of the absence of water, is then blended with about five percent of a denaturant such as unleaded gasoline so that it cannot be consumed as a beverage.[1] The denatured ethanol is then ready for shipment to distribution terminals for blending with gasoline or to retailers.

Cooking and fermentation converts the starch in the grain to sugar and alcohol. Left behind as "stillage" is the protein, nutrients, and fiber contained in the grain. This stillage is sent through a centrifuge that separates the solid matter and solubles which are concentrated to a syrup of about 30 percent solids by evaporation. The solid matter and the syrup are combined and dried together to produce a co-product called Distillers dried grains with solubles (DDGS). DDGS is a high quality, medium protein, nutritious feed ingredient widely used in beef and dairy cattle, swine and poultry feed. Dry mill ethanol plants also can separate corn oil out by centrifuge at the front end of the process (at grinding).

1 Anhydrous ethanol can be directly blended with gasoline since it contains virtually no water which would separate out of the gasoline blend. By contrast Brazil also produces hydrous ethanol which can be used in automobile engines specifically designed to burn "neat", or 100 percent, ethanol.

Wet mill plants refine corn into high fructose corn syrup or ethanol and produce a wide range of other products ranging from corn oil to starches. The principal co-products of corn wet milling are corn gluten feed and corn gluten meal. In wet milling, the grain is soaked or "steeped" in water and dilute sulfurous acid to facilitate the separation of the grain into its many component parts.

After steeping, the corn slurry is processed through a series of grinders to separate the corn germ. The corn oil from the germ is either extracted on-site or sold to crushers who extract the corn oil. The remaining fiber, gluten and starch components are further segregated using centrifugal, screen and hydroclonic separators.

The steeping liquor is concentrated in an evaporator. This concentrated product, called heavy steep water, is co-dried with the fiber component and is then sold as corn gluten feed to the livestock industry. Heavy steep water is also sold by itself as a feed ingredient and is used as a component in consumer products such as Ice Ban, an environmentally friendly alternative to salt for removing ice from roads.

The gluten component (protein) is filtered and dried to produce a high-value corn gluten meal co-product which is widely used in poultry feed. The starch and any remaining water from the mash can then be fermented into ethanol, dried and sold as dried or modified corn starch, or processed into corn syrup.

Since dry mill ethanol plants are dedicated single-purpose facilities they are less expensive to build than multi-product wet mill plants which are typically larger. Also, dry mill plants have a higher ethanol yield than do wet mill plants.

2.2 Co-products of Ethanol Production

The principal co-products of dry mill ethanol production are Distiller’s dried grains and carbon dioxide (CO2). Distiller’s dried grains (DDGS) are byproducts of the grain milling and distilling industry.[2] Animal feeders use distillers dried grains as a protein supplement for dairy cattle and in beef cattle, swine, and sheep rations because it is an economical source of protein compared to soybean meal.

DDGS produced from corn typically has a protein content of 25 to 27 percent. DDGS competes with a wide range of other high protein feeds including other cereal protein feeds, oilseed meals, and animal protein feeds. Cereal grains typically provide 30 to 70 percent of dietary protein for swine and poultry. Incorporating grain byproducts into feed rations can provide additional protein. Most of these medium-protein feeds are byproducts of the corn milling processes used to produce high fructose corn sweeteners, starch, and ethanol, and include corn gluten feed and meal, distiller's dried grains, and brewers dried grains.

[2] Alcohol production from grain involves the fermentative conversion of starch to alcohol. The fermented mash is then distilled to remove the alcohol. The remaining slurry contains 5 to 10 percent dry matter and is called whole or spent stillage. Whole stillage is processed by various techniques to remove the large volume of water associated with the residual dry matter. The first step involves screening and pressing, or centrifuging to remove the coarser grain particles, which are then dried. The resulting product is DDGS. The liquid remaining after screening or centrifuging contains fine grain particles and yeast cells and is called thin stillage. Thin stillage is generally evaporated to produce a syrup which may be added back to distiller’s grains and then the mixture is dried to form dried distillers grains with solubles (DDGS).

DDGS is particularly valued because of its bypass protein. Bypass protein is that protein which escapes digestion in the rumen. This protein is subsequently digested in the small intestine, absorbed as amino acids, and used for reproductive functions including milk production. Other valued characteristics of the product include color, smell, palatability and texture. Up to 40 percent of a dairy cow feed ration may consist of DDGS. Dairy cows consume more feed and the feed passes through the digestive tract more quickly than in beef cattle. Dairy cows require more bypass protein than beef cattle and also more digestible fiber to maintain milk fat levels. The combination of bypass protein, digestible fiber, and fat in DDGS makes it a highly desirable feed for dairy cows.[3]

DDGS is sold on a spot market and contract basis. Corn processing is the primary source of DDGS and the product competes with other high protein feeds and feed ingredients of which soybean meal is the market leader. As a result, food and industrial use of corn and the price of soybean meal will be major determinants of the supply and price of DDGS. Every bushel of corn processed in an ethanol dry mill produces 17.5 pounds of DDGS. Typically DDGS is dried and sold in meal or pelletized form. However, when cattle feedlots or dairy operations are located in relative close proximity to an ethanol plant (50 miles is a general guideline) distiller's grains can be fed "wet", or in slurry that typically has 65 percent moisture content. This product is known as WDG. When this is possible, the ethanol producer can reduce energy costs associated with drying DDGS and virtually eliminate one of the most significant problems with DDGS – scorching. WDG has advantages and disadvantages compared to dried distiller's grains. Aside from price, one of the principal benefits of WDG is that it acts as a palatability enhancer in diets where dry feeds predominate. On the other hand, storage losses for WDG can be higher.[4]

2.3 Cellulose Ethanol

Ethanol also can be produced by converting cellulose in biomass into its constituent sugars, which then are fermented and distilled into alcohol. Examples of cellulosic materials include wood and other fibrous plant material such as crop residues, energy grasses, waste materials such as paper and cardboard and Municipal Solid Waste (MSW). Cellulosic resources are widespread and abundant. For example, forests comprise about 80 percent of the world's biomass. Cellulosic materials are a relatively inexpensive feedstock for ethanol production since they are abundant and outside the human food chain. [5]

The limiting factors for cellulosic ethanol production principally involve technology and economics. Accessing the glucose in cellulose under existing technology has high capital and operating costs. Cellulosic materials are comprised of lignin, hemicellulose, and cellulose. One of the primary functions of lignin is to provide structural support for the plant. Thus, in general, trees have higher lignin contents then grasses. Unfortunately, lignin which contains no sugars encloses the cellulose and hemicellulose molecules, making them difficult to reach.

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[3] Glen Aines, Terry Klopfenstein, and Rick Stock. *Distillers Grains*. Institute of Agriculture and Natural Resources. University of Nebraska-Lincoln. 1986.

[4] Schroeder, J.W. "Distiller's Grains as a Protein and Energy Supplement for Dairy Cattle." AS-1241. North Dakota State University. February 2003.

[5] An excellent overview of cellulose conversion technology is presented in the EPA Proposed Rule for the 2011 Renewable Fuel Standard. *Federal Register*. Vol 75, No. 138. Tuesday, July 30, 2010.

Cellulose molecules consist of long chains of glucose molecules as do starch molecules, but have a different structural configuration. These structural characteristics plus the encapsulation by lignin makes cellulosic materials more difficult to hydrolyze than starchy materials.

Hemicellulose is also made up of long chains of sugar molecules; but also contains a different sugar structure known as pentose, or a 5-carbon sugar. These make up a high percentage of the available sugars in hemicellulose. Several firms have developed genetically engineered microorganisms that can ferment 5-carbon sugars into ethanol with relatively high efficiency. The complicating factor is that the exact sugar composition of hemicellulose can vary depending on the type of plant, thereby requiring specialized enzymes or microorganisms for each type of plant. [6]

There are three basic processes for cellulosic ethanol production: acid hydrolysis, enzymatic hydrolysis, and thermo chemical. In acid hydrolysis an acid solution is combined with high temperature and pressure to recover the sugar in the cellulosic material which are then fermented and distilled into alcohol. Sulfuric acid is most commonly used since it is usually the least expensive.

Another basic method of cellulosic ethanol production is enzymatic hydrolysis. Enzymes are naturally occurring proteins that cause certain chemical reactions to occur. However, for enzymes to work, they have to be able to access the cellulose molecules. This requires a pretreatment process to break the crystalline structure of the lignocellulose and remove the lignin to expose the cellulose and hemicellulose molecules. Depending on the biomass material, either physical or chemical pretreatment methods may be used. Physical methods employ high temperature and pressure, milling, radiation, or freezing—all of which require expensive high-energy consumption.

In the thermochemical process the biomass materials is gasified under heat and pressure and the synthesis gas is bubbled through specially designed fermenters. A microorganism capable of converting the synthesis gas is introduced into the fermenters under specific process conditions to cause fermentation to ethanol. An alternative approach doesn't use microorganisms. The biomass materials are gasified and the synthesis gas passed through a reactor containing catalysts, which cause the gas to be converted into ethanol.

As reported in a recent review of the current status of the technology, thermochemical conversion of biomass has certain advantages over biochemical conversion technologies such as fermentation. (Kumar et al. 2009). The main advantages of the process are the wide range of potential feedstocks that can be used. These include virtually any type of biomass including agricultural residues, forestry residues, non-fermentable byproducts from biorefineries, byproducts of food industry, byproducts of any bioprocessing facility and even organic municipal wastes. Other advantages are that the gasses produced via thermochemical conversion can be converted to a variety of fuels and chemicals that can be substitutes for petrochemical based products. Finally, the products of thermochemical conversion are very compatible with existing petroleum refining operations.

The major disadvantages of thermochemical conversion are the high costs of removing contaminants like tar and alkali compounds from the product gasses; process inefficiency due to the high temperatures required for conversion; and the lack of experience with the use of thermochemical conversion products (e.g. syngas and bio-oil) as transportation fuels.

6 Badger, P.C. 2002. Ethanol from cellulose: A general review. p. 17–21. In: J. Janick and A. Whipkey (eds.), Trends in new crops and new uses. ASHS Press, Alexandria, VA.

There is little published data regarding actual commercial scale capital and operating costs for technologies other than conventional biochemical processes. However, the production of ethanol from biomass feedstocks using acid hydrolysis or thermochemical conversion is considered to be considerably more expensive tha fermentation. A 2006 survey of biomass processing indicated that the capital costs for producing ethanol under a thermochemical gasification process approach $2.40 per gallon while the acid hydrolysis process has a capital cost of $4.70 per gallon. Operating costs for acid hydrolysis were estimated at $1.80 per gallon (compared to $1.15 for corn dry milling). (Gallagher 2006). A more recent analysis of ethanol production systems in Minnesota suggested that the capital costs associated with feedstock and handling for conventional fermention plants are two to three times less expensive than for cellulose plants. (Smith and Suh, 2008). This capital cost is a primary factor underlying the estimated 50 cents per gallon production cost difference between ethanol producted by thermochemical conversion and conventional corn starch conversion reported by Smith and Suh.

The ultimate profitability of cellulosic ethanol depends in large part on improvements in technology. A major emphasis of research is devoted to reducing the high cost of pretreatment enzymes and fermentation bacteria. Enzyme costs are about $.50 per gallon and significant work is underway to reduce these to about $.10 per gallon. Additionally, access to licenses for enzymes and genetically engineered bacteria need considerable work as well.

A number of technical advances will need to occur before biomass-fermentation adoption becomes economical. The first of these is yield improvements that provide a biomass yield that approaches the 98 gallons per ton level of corn. Second, enzyme costs for biomass-ethanol must fall to the low levels of the corn-ethanol industry.

Chapter 3
SIZE AND STRUCTURE OF THE U.S. ETHANOL INDUSTRY

According to the Renewable Fuels Association as of September 1, 2010 the U.S. ethanol industry was made up of 200 nameplate refineries with a total capacity of 13.544 million gallons per year (MGY).[7] Of these, 192 refineries were operational with an annual capacity of 12.9 MGY. An additional 12 plants were under construction or undergoing expansion. The location of these ethanol plants is illustrated in Figure 2.

As can be seen in Figure 2 ethanol production is concentrated in the Midwest corn-belt states. The top ten ethanol producing states also are the nation's leading corn producers. This is further illustrated in Table 1 which compares operating ethanol capacity and corn production.

Figure 2 Location of U.S. Ethanol Plants: September 1, 2010
(Green flags designate an operational plant; red flags are plants under construction)

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[7] http://www.ethanolrfa.org/bio-refinery-locations/

Table 1 Ethanol and Corn Production by State

	Online Capacity (9/1/2010) (MGY)	Share (%)	Corn Production 2009 (Mil bu)	Share (%)
IA	3,183.0	24.6%	2,438.8	18.5%
IL	1,350.0	10.4%	2,065.0	15.7%
NE	1,454.0	11.2%	1,575.3	12.0%
MN	1,112.6	8.6%	1,251.3	9.5%
SD	1,016.0	7.9%	933.7	7.1%
IN	706.0	5.5%	719.1	5.5%
WI	498.0	3.9%	598.3	4.5%
KS	436.5	3.4%	546.4	4.2%
OH	314.0	2.4%	448.3	3.4%
TX	250.0	1.9%	254.8	1.9%
All Others	2,614.0	20.2%	2,320.2	17.6%
Total	12,934.1	100.0%	13,151.1	100.0%

As ethanol production shifts to new feedstocks necessary to meet RFS targets (non-corn starch Advanced Biofuel feedstocks and cellulose), the geographic distribution of ethanol production is expected to expand with the Southeast, Mid-Atlantic, and Northwestern states experiencing the most significant growth as more wood and wood waste feedstocks are used to produce bioenergy..

The U.S. ethanol industry is relatively un-concentrated. Based on capacity data published by RFA, the largest 10 ethanol producers currently account for less than 50 percent of total industry output while the largest three firms account for about 32 percent of total production. This is illustrated in Table 2.

Table 2 Ethanol Industry Concentration: September 2010 Production of the Ten Largest Ethanol Firms

	Operating Production Capacity (MGY)	Share	Aggregate Share
POET	1,537.0	11.9%	11.9%
Archer Daniels Midland	1,450.0	11.2%	23.1%
Valero Renewable Fuels	1,130.0	8.7%	31.8%
Green Plains Renewable Energy	500.0	3.9%	35.7%
Big River Resources, LLC	310.0	2.4%	38.1%
The Andersons	275.0	2.1%	40.2%
White Energy	258.0	2.0%	42.2%
Aventine Renewable Energy, LLC	244.0	1.9%	44.1%
BioFuel Energy	230.0	1.8%	45.9%
Flint Hills Resources LP	220.0	1.7%	47.6%

Source: RFA

It is interesting to note that the third largest ethanol producer is a gasoline refiner and marketer – Valero -- while Flint Hills Resources, the tenth largest producer, is a subsidiary of Koch Industries, Inc., one of the largest private companies in the world. Refiners have expressed increasing interest in direct investments in biofuel production and several, most notably Valero, took advantage of the financial difficulties experienced by the ethanol industry in 2008 and 2009 to make acquisitions. Valero was the first refiner to enter the ethanol industry when it purchased seven VeraSun plants through a bankruptcy auction in 2008. Since then Valero has acquired three additional ethanol plants. Other refiners/marketers that have entered the ethanol industry include Murphy Oil who acquired a former VeraSun plant in Hankinson, ND and Sunoco Inc. who acquired the former Northeast Biofuels plant in Fulton, NY. Both of these acquisitions were made in 2009. (Bevill, 2010).

Local farmer ownership has been a hallmark of the U.S. ethanol industry but ownership of ethanol production also has changed. In 1991 the majority of ethanol plants and production were corporate owned and operated. Farmer-owned cooperatives accounted for a small share of ownership and production. As recently as five years ago nearly half of all ethanol plants were owned and operated by farmer cooperatives or limited liability companies (LLC). These plants account for 38 percent of total ethanol production. However, during the last several years there has been a substantial influx of non-farmer venture capital into the ethanol market and the share of farmer ownership has declined. In large part this decline can be traced to the outright acquisition or majority ownership stake of farmer-owned cooperative ethanol plants by POET. Table 3 illustrates the change in ownership of ethanol plants and capacity between 2005 and 2009.

Table 3 Number, Production Capacity, and Average Size of Farmer- and Non-Farmer Owned Ethanol Plants

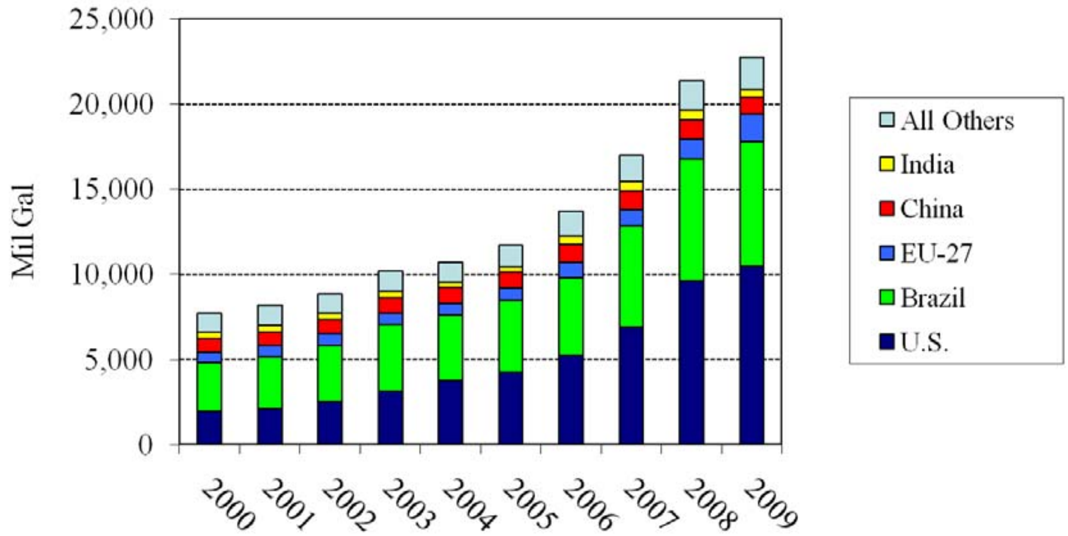
	2005	2006	2007	2008	2009
Farmer-Owned Plants	40	46	48	40	38
Non-Farmer-Owned Plants	41	49	63	102	151
Farmer-Owned Capacity (MGY)	1,388.6	1,678.1	1,823.6	1,615.6	2,028.1
Ave Farmer-Owned Capacity (MGY)	34.7	36.5	38.0	40.4	53.4
Non-Farmer-Owned Capacity (MGY)	2,255.1	2,658.3	3,669.8	6,272.8	9,799.3
Ave Non-Farmer-Owned Capacity (MGY)	55.0	54.3	58.3	61.5	73.7

Source: RFA

Chapter 4

U.S. ETHANOL IN A GLOBAL CONTEXT

The U.S. is the world's largest producer and consumer of ethanol, followed by Brazil. Figure 3 illustrates the distribution of global ethanol output by major producing country between 2000 and 2009. Taken together the U.S. and Brazil account for nearly 80 percent of total world ethanol production. Over the last decade world ethanol production nearly tripled reaching 22.7 billion gallons in 2009 with the most significant growth posted in the U.S.



Source: F.O. Licht

Figure 3 World Ethanol Production: 2000-2009

As indicated earlier most U.S. ethanol is produced from corn while Brazil uses sugarcane as the predominate feedstock. Generally speaking production costs for Brazilian ethanol are lower than for dry mill ethanol produced from corn in the U.S. There are a number of reasons for this difference but the most significant is that Brazilian producers avoid the cost of natural gas by burning sugar cane bagasse, the solid residue remaining after the sugar juice is extracted. Energy is the second largest production cost after feedstock for first generation ethanol producers. As more biomass feedstocks are used for ethanol production, the sizeable cost of enzymes will become a significant component of operating costs.

Chapter 5

ETHANOL INDUSTRY ECONOMICS

Dry mill ethanol production is a relatively simple process that involves milling grain, cooking and fermenting, and distillation. Wet mill ethanol production is more involved and costly because it requires more equipment to handle multiple products. Cellulose ethanol production is even more costly because it requires a pre-processing stage to break down the cell walls to release sucrose embedded in the cellulose.

As indicated earlier about 70 percent of current ethanol is produced by dry mills and most plants under construction are dry mills. Capital costs for a new dry mill ethanol plant will vary depending on the designer and builder and “extras” included such as CO_2 capture, corn oil recovery or advanced water handling. Industry sources indicate that typical capital costs for a new dry mill ethanol plant are in the $2.00 to $2.25 per gallon of nameplate capacity. Capital costs for a commercial scale cellulose ethanol plant will be difficult to estimate until several plants have been built and are operating. Industry sources suggest that the capital costs for a cellulose ethanol plant using a biochemical enzyme conversion process could be twice than of an equivalent dry mill ethanol plant.

Operating costs for a dry mill ethanol plant also will vary from producer to producer. However feedstock and energy costs (primarily natural gas) account for the largest share of variable costs. The Ag Marketing Resource Center at Iowa State University publishes an estimate of operating costs and returns for a typical 100 MGY dry mill ethanol plant located in Northern Iowa. The ISU cost model has been in operation since 2005 and is updated and published monthly.[8] The results of this model appear to be generally consistent with other generic models of ethanol costs and returns and provide a consistent overview of ethanol profitability in the Nation’s leading producing state.

The basic assumptions for the ISU model include a 100 MGY nameplate capacity facility operating at 110 percent of capacity built in 2007. The plant produces 2.8 gallons of ethanol and 16.5 pounds of DDG per bushel of corn. CO_2 is not captured. ISU bases their costs on a facility construction cost of $1.97 per gallon of nameplate capacity.

The key parameters of the ISU model and annualized returns are presented in Table 4 and summarized graphically in Figures 4 and 5.

[8] Prof Don Hofstrand, “Ag Decision Maker, D1-10 Ethanol Profitability. Agricultural Marketing Resource Center, Iowa State University.

Table 4 Costs and Net Returns for an Iowa Dry Mill Ethanol Plant

Year	Prices				Revenue		
	Ethanol ($/Gal)	DDGS ($/ton)	Corn $/bu)	Nat Gas ($/mcf)	Ethanol ($/Gal)	DDGS ($/Gal)	Total ($/Gal)
2005	$1.58	$74.06	$1.75	$9.22	$1.58	$0.22	$1.81
2006	$2.30	$88.49	$2.23	$8.36	$2.30	$0.27	$2.57
2007	$1.94	$115.04	$3.47	$8.20	$1.94	$0.35	$2.29
2008	$2.18	$156.11	$4.94	$9.46	$2.18	$0.47	$2.65
2009	$1.63	$111.76	$3.56	$5.62	$1.63	$0.34	$1.97
Jan-Oct 2010	$1.68	$109.00	$3.69	$6.05	$1.68	$0.33	$2.01

Year	Cost per Gallon						Returns Over	
	Corn	Natural Gas	Other Var.	Total Var.	Fixed	Total All Costs	Variable Costs	All Costs
2005	$0.62	$0.28	$0.21	$1.11	$0.21	$1.32	$0.70	$0.48
2006	$0.80	$0.25	$0.21	$1.26	$0.21	$1.47	$1.31	$1.10
2007	$1.24	$0.25	$0.21	$1.69	$0.21	$1.91	$0.60	$0.38
2008	$1.76	$0.28	$0.21	$2.26	$0.21	$2.47	$0.39	$0.18
2009	$1.27	$0.17	$0.21	$1.65	$0.21	$1.86	$0.32	$0.11
Jan-Oct 2010	$1.32	$0.18	$0.21	$1.71	$0.21	$1.92	$0.30	$0.09

Other variable costs include enzymes, yeast, chemicals, water, electricity, repairs and maintenance, and transportation. Fixed costs include depreciation, interest, labor and management and taxes.

Source: Iowa State University. Ag Decision Maker, D1-10 Ethanol Profitability

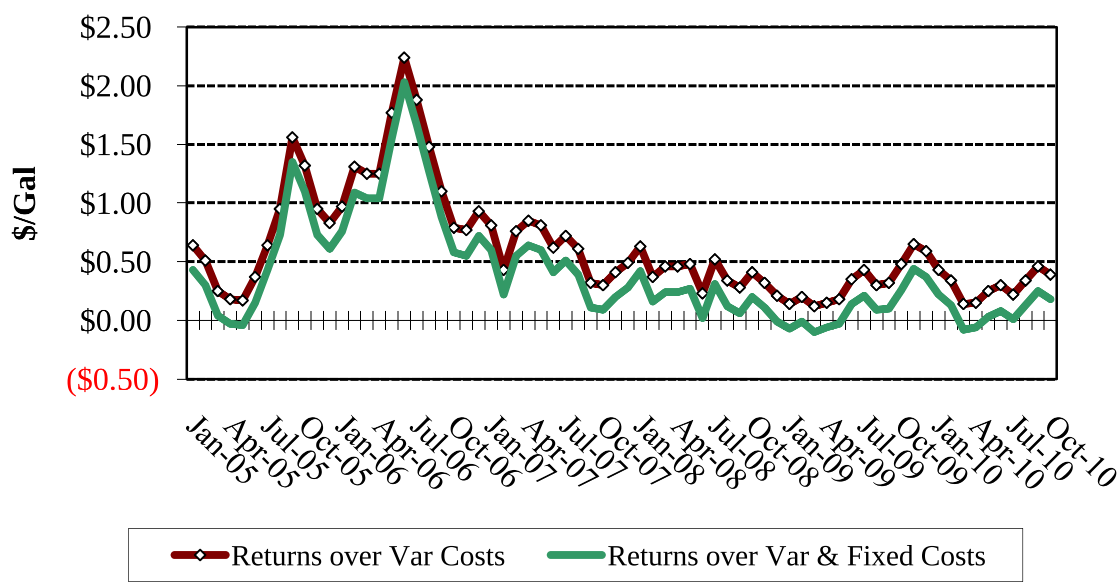


Figure 4 Net Returns for Iowa Dry Mill Ethanol Producers

As can be seen in Table 4 and Figure 4 ethanol profitability peaked at about $2.25 per gallon in mid-2006 but has been relatively flat over the past three years. Stubbornly high corn prices have constrained profitability and year-to-date 2010 returns over variable costs are estimated at $0.30 per gallon, the lowest average in more than five years.

The sensitivity of ethanol profitability to corn prices is reflected in the fact that for an Iowa dry mill plant feedstock (corn) accounts for about 70 percent of variable costs while natural gas accounts for another 16 percent. The relationship between net returns and corn prices is further illustrated in Figure 5.

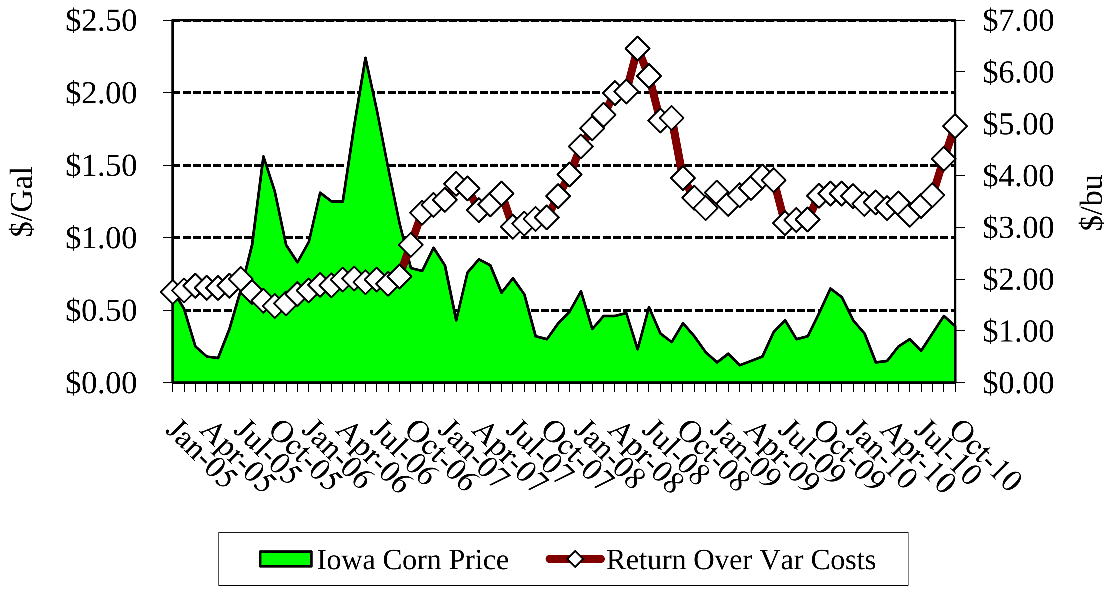


Figure 5 Ethanol Net Returns and Corn Prices

Chapter 6

HOW ETHANOL IS USED

Typically ethanol is blended with gasoline to produce an oxygenated motor fuel. Ethanol is used to improve octane in conventional gasoline, to add oxygen to meet Clean Air Act requirements, and as an extender for gasoline. While ethanol adds octane to gasoline it has a lower energy content. According to the Oak Ridge National Laboratories ethanol provides on average 75,700 Btu's per gallon compared to 115,000 for motor gasoline.[9] As a result, it takes 1.52 gallons of ethanol to provide the same energy as a gallon of gasoline.

Since the majority of ethanol is sold as E10, a blend of 90 percent gasoline and 10 percent ethanol. The impact of the energy loss to most drivers is negligible. The use of E85, a blend of 85 percent ethanol and 15 percent gasoline, also is increasing and will continue to grow as the number of flexible fuel vehicles and refueling stations expands. Since E85 is used in engines specifically designed to use higher blends of ethanol, the loss of energy is minimized.

Ethanol adds octane to gasoline and improves engine performance. Since an E-10 blend adds 2.5 points of octane, a consumer who uses E-10 benefits from a better quality gasoline. This characteristic also works to the advantage of gasoline refiners who can refine a sub-octane base to which ethanol is blended to provide an 87 octane regular gasoline.

The demand for ethanol is determined by economics, price, and government policy. In addition to octane, ethanol displaces more expensive petroleum. Ethanol is a substitute for hydrocarbons, and when crude oil prices increase, more ethanol is used to meet demand for gasoline.

Since ethanol is blended with gasoline, ethanol use closely follows gasoline use. Consequently, the largest ethanol markets are on the West and East coasts.

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[9] Energy contents are expressed here as Low Heating Value (HHV). The reported High Heating Values (HHV) for ethanol and gasoline are 84,000 and 125,000 Btus, respectively. Source: http://bioenergy.ornl.gov/papers/misc/energy_conv.html

Chapter 7

ENVIRONMENTAL ISSUES CONFRONTING ETHANOL

7.1 Net Energy Balance

Ethanol requires an amount of energy in itself to be created. That is, it takes energy to grow, collect, transport, dry and convert feedstocks in order to produce ethanol. The fossil "energy balance" of ethanol has been the subject of debate. Some studies have suggested that corn-based ethanol has a negative energy balance—it takes more energy to produce ethanol than is generated. However, a preponderance of recent studies using updated data about corn production methods demonstrates a positive energy balance for corn ethanol (AFDC 2010). In addition cellulosic ethanol uses less fossil fuel and more energy-efficient feedstocks, such as fast-growing trees, corn stover, grain straw, switchgrass, forest product residues, and municipal waste.

A June 2010 USDA report on the energy balance of the corn-ethanol industry[10] indicated that ethanol has made the transition from an energy sink (i.e., more energy used than energy produced), to a moderate net energy gain in the 1990s, to a substantial net energy gain in the present. And there are still prospects for improvement. Ethanol yields have increased by about 10 percent in the last 20 years, so proportionately less corn is required. In addition to refinements in ethanol technology, corn yields have increased by 39 percent over the last 20 years, requiring less land to produce ethanol. The report measured all conventional fossil fuel energy which amounted to 53,785 BTU used in the production of one gallon of corn ethanol. For every BTU of energy required to make ethanol, 2.3 BTUs of energy are produced. The ratio is somewhat higher for some firms that are partially substituting biomass energy in processing energy (e.g. thermal and electrical energy). Since the last study in 2004, the net energy balance of corn ethanol has increased from 1.76 BTUs to 2.3 BTUs of required energy.

7.2 Greenhouse Gasses

Carbon dioxide (CO_2) is the primary greenhouse gas implicated in global warming (others include methane and nitrous oxide). CO_2 is produced when carbon that had been stored on or within the Earth is released into the atmosphere—such as when fossil fuels are burned. CO_2 can also be removed from the atmosphere, primarily by the action of plants, which consume it during photosynthesis. In order to understand the GHG contribution of ethanol experts rely on lifecycle analysis. Lifecycle GHG emissions are the aggregate quantity of GHGs related to the full fuel cycle, including all stages of fuel and feedstock production and distribution, from feedstock generation and extraction through distribution and delivery and use of the finished fuel. Life-cycle analyses are used to calculate CO_2 emissions and uptake at each step of the ethanol and gasoline production and use processes (USDA 2010). For ethanol, these steps include growing of the feedstock crops,

[10] "2008 Energy Balance for the Corn-Ethanol Industry" AER Number 846. June 2010. USDA Office of the Chief Economist, Office of Energy Policy and New Uses.

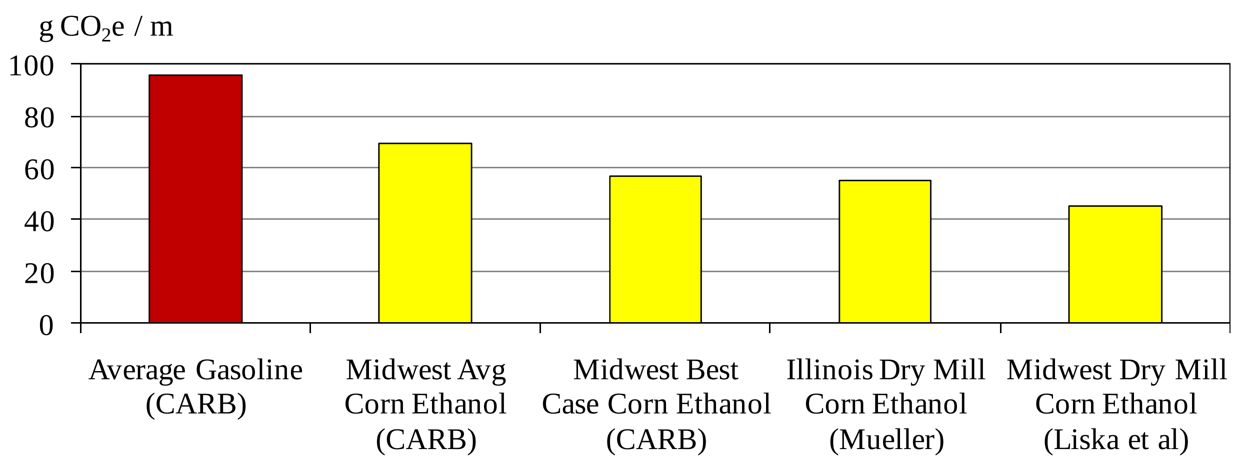
transporting the feedstock to the production plant, producing the ethanol, distributing it, and burning it in vehicles. For gasoline, crude oil must be extracted from the ground, transported to an oil refinery, refined, distributed, and burned in vehicles (AFDC 2010).

In 2009 the EPA issued a report of the Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels. The EPA results suggest that biofuel-induced land use change can produce significant near-term GHG emissions; however, displacements of petroleum over subsequent years can "payback" earlier land conversion impacts. The results of EPAs analysis are summarized in Table 5.

Table 5 EPA Lifecycle Analysis Results

Fuel Pathway	100 years, 2% Discount Rate	30 year, 0% Discount Rate
Corn Ethanol (Natural Gas Dry Mill)	-16%	+5%
Corn Ethanol (Best Case Natural Gas Dry Mill)	-39%	-18%
Corn Ethanol (Biomass Dry Mill)	-39%	-18%
Corn Ethanol (Biomass Dry Mill with CHP)	-47%	-26%
Sugarcane Ethanol	-44%	-26%
Switchgrass Ethanol	-128%	-124%
Corn Stover Ethanol	-115%	-116%

The results indicated a substantial offset in GHG produced by ethanol plants on the fuel pathway. Continued technological advancement will held to ensure further reductions. Results of a recent analysis of greenhouse gas emissions conducted by the California Air Resources Board and recently published LCAs is shown in Figure 6. These results showcase the 30 percent to 50 percent reduction in GHGs provided by corn ethanol.



Sources:

CA Air Resources Board, ISOR, Vol. 1, Mar 2009

Mueller et. al "The Global Warming and Land Use Impact of Corn Ethanol at the Illinois River Energy Center" Oct 2008. Lliska et al "Improvements in Life Cycle Energy efficiency and Greenhouse Gas Emissions of Corn Ethanol" Journal of Industrial Ecology, Jan 2009

Figure 6 Corn Ethanol GHGs vs. Average Gasoline

7.3 Water Use

The use of all natural resources, including water, in ethanol production is a major environmental issue. Energy and water demands of ethanol processes are closely integrated. The amount of water required to produce ethanol depends heavily on the feedstock such as corn and local and regional precipitation and irrigation characteristics. According to a 2009 analysis published by the U.S. Department of Energy's Argonne National Laboratory , it currently takes three gallons of water on average to produce one gallon of ethanol. The analysis also reported that ethanol producers have become more efficient regarding water use with water consumption declining 26.6% between 2001 and 2006. (Wu et al. 2009)

Water is an important resource. It is a consideration and part of the permitting process when ethanol plants are built. A typical ethanol plant capable of producing 40 million gallons of ethanol per year could use up to 330,000 gallons of water per day or 120 million gallons of water per year (RFA 2010). This is equivalent to the amount of water used by a town of 5,000 people or a standard-sized golf course. The average home uses 107,000 gallons of water per year. An average person uses 50 gallons of water each day (RFA 2010). As ethanol technology progresses, environmental consideration concerning water use in ethanol production will decrease.

Chapter 8
LOGISTICS OF ETHANOL

8.1 Geography of Ethanol Demand and Use

U.S. total consumption of ethanol has increased significantly over the last decade. This large demand increase can be explained in part by recent federal and state polices which mandate a proportion of renewable fuel such as ethanol to be blended into the nation's motor fuel supply. Some states have expanded this federal fuel standard by incorporating it into their own fuel blend mandates. Currently, 14 renewable fuel standards or mandates exist--requiring terminal suppliers, importers, blenders, or wholesalers to sell or offer a blend of ethanol. These mandates often increase demand for ethanol in the regions of the U.S. in which transportation fuel demand is large such as highly populated areas thereby shaping the geography of demand for ethanol to areas outside of states where ethanol production is high.[11]

An estimated 10.7 billion gallons of ethanol were consumed in the U.S.in 2009. Uusing EIA motor gasoline consumption statistics this means that ethanol accounted for nearly eight percent of the nation's motor fuel supply in 2009. Since ethanol is blended with gasoline, ethanol use closely follows gasoline use. Figure 7 compares ethanol and gasoline use expressed as a share of total U.S. use for the 20 largest consuming states.

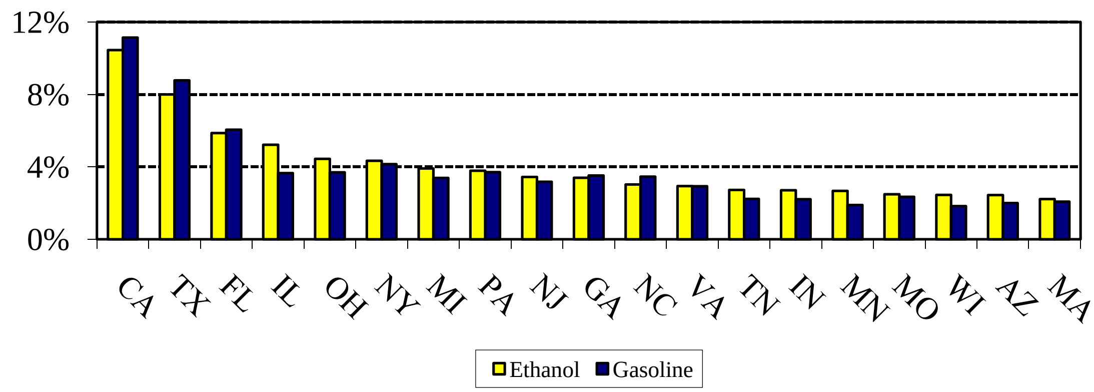


Figure 7 Ethanol and Gasoline Use, Pct of U.S.

11 The following states currently require ethanol blends be sold or offered for use in motor vehicles: Florida, Hawaii, Iowa, Louisiana, Massachusetts, Minnesota, Missouri, Montana, New Mexico, Oregon, Pennsylvania, and Washington

U.S. automakers also have taken advantage of corporate average fuel economy (CAFE) standard incentives to increase the production and sale of flex-fuel vehicles (FFV's) that are capable of using E85 (USDA 2007). The Alternative Motor Fuels Act (AMFA) of 1988 vehicle manufactures to increase their calculated CAFE by producing FFVs (USDA 2007). The act, extended by the Automotive Fuel Economy Manufacturing Incentives for Alternative Fueled Vehicles Rule of 2004, encourages the production of motor vehicles capable of operating on alternative fuels. It gives a credit of up to 1.2 mpg toward an automobile manufacturer's CAFE, which helps it avoid penalties of the CAFE standards.

Automakers have pledged to increase that number and make FFV's 50 percent of their production line by 2015 (DOE 2009). As the number of FFVs increases, the retail availability of E85 gas stations and fuel is expected to increase. Thus, the relationships between ethanol blending increases, flex-fuel vehicles, and refueling stations highlight the geography of demand and growing transportation infrastructure and distribution of ethanol.

8.2 Ethanol Blending

The distribution of ethanol primarily consists of movements from ethanol plants to bulk terminals via transport truck, rail car, or barge. Once stored in a terminal, ethanol is blended with gasoline. In some market areas, sub-octane or premium octane gasoline is blended with ethanol to achieve higher octane level products (Reynolds 2000). When ethanol is used as the oxygenate in reformulated gasoline, it is blended with a gasoline specifically designed for the addition of ethanol known as Reformulated Blendstock for Oxygenate Blending (RBOB). These base fuels are designed such than when ethanol is blended into them the finished gasoline ethanol blend meets federal or state quality requirements.

Ethanol blending typically occurs at the rack level where the two products are combined in the proper proportion and transferred on to the loading rack for delivery into the transport truck.

There are some variations to this process as described by Reynolds 2000:

- Sequential Blending: This process is also computerized but instead of going through a blending unit the products are injected into the truck in the proper proportion, in sequence. This process depends on the agitation of the loading, transport, and dropping of the blended product to achieve a homogenous blend.
- Top-off Blending: In this scenario, ethanol and gasoline are injected separately into the transport truck with the agitation from loading, transport, and unloading accomplishing the blending process. Volumes are controlled by preset meters activated by loading cards. This could be done within a single terminal (i.e. one loading rack) or by loading the ethanol at one terminal and the gasoline at another terminal (both terminals in the same proximity). This method was successfully used throughout the Midwest for a number of years and is still utilized at some terminals.
- Tank Blending: Ethanol and gasoline could be blended in one or more terminal tanks. A few terminals in the Midwest, especially those with recirculation capability (in tank devices to re-circulate/stir the product) have distributed ethanol blends in this manner. However this method is the least preferred due to the potential for the blend to encounter excessive moisture which could result in the ethanol phase separating from the blend. Additionally terminal tankage is not routinely equipped with recirculation/ mixing devices.

Once the blending process is accomplished by one of the above methods, the gasoline ethanol blend is then handled and delivered to retail and commercial facilities.

8.3 How Ethanol is Shipped from Plant to End User

Ethanol can easily be contaminated by water, and ethanol dissolves entrained residues in the pipelines. As a result, railroad cars and tanker trucks made from biofuel-compatible materials are needed to transport large volumes of Ethanol to market (USDA 2007).

Distribution of ethanol starts at the ethanol production facility where it is shipped from by one of three modes; transport truck, rail car, or river barge. From the plant, the ethanol is transported to one of two primary destinations, either a bulk terminal or a redistribution bulk terminal where it is stored until it is blended with gasoline.

For purposes of comparison, a large petroleum 2-barge unit tow hauls 2.52 million gallons (although ethanol is usually shipped in smaller, 630,000-gallon tanker barges), which is equivalent to about 80 railcars or 300 tanker trailers (Table 6*)*.

Table 6 Comparison of Transportation Mode Capacities

Cargo Capacity Comparison

Capacity (units)	Railcar	Barge	Truck
Ethanol (gallons)	29,400	630,000	8,000

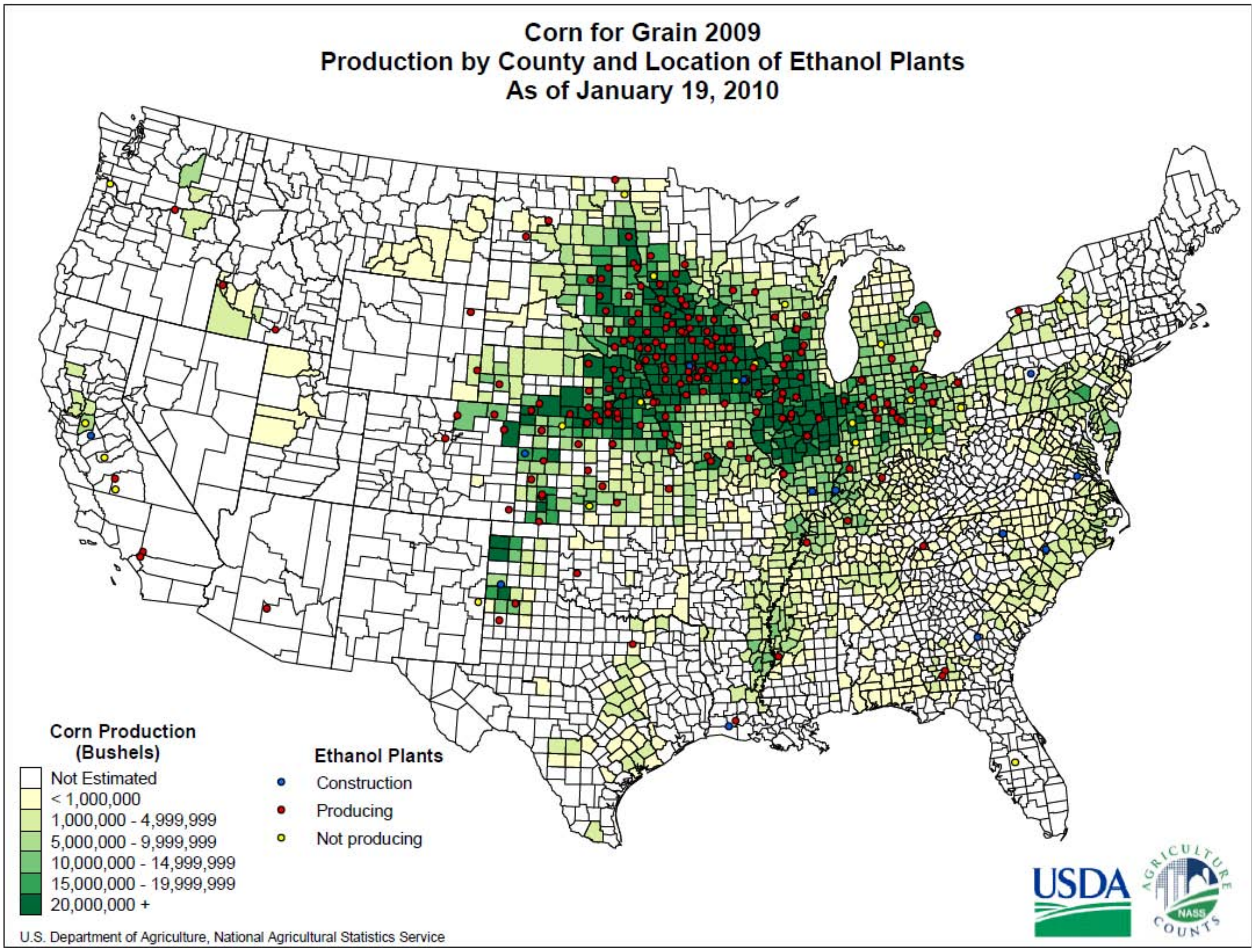
Source: USDA Agricultural Marketing Service, Ethanol Transportation Backgrounder (2007)

Once at the redistribution terminal, the ethanol is broken down into smaller quantities, usually truck loads, and delivered to other terminals in the area (Reynolds 2000). Some of the ethanol may also be blended into gasoline and distributed as a blend directly from the redistribution terminal.

As reported by USDA in its study of rural transportation issues, most ethanol is shipped via rail (66 percent); followed by trucks (29 percent), and water (barges 5 percent). (USDA/USDOT 2010)

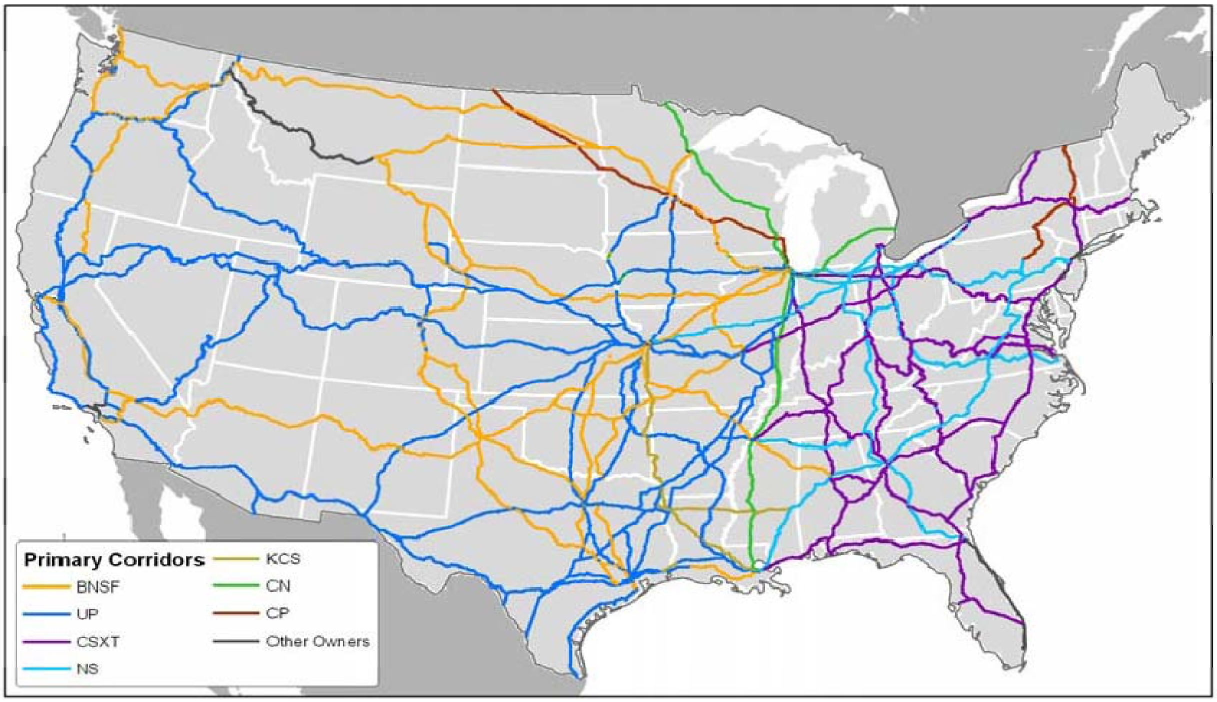
8.4 Location of Major Markets and Terminals

Currently, nearly all U.S. ethanol production facilities are located close to the production of corn in the Midwest. This minimizes the transportation costs for bulky, unrefined feedstocks. Figure 8 overlays the location of ethanol plants on corn production by county. As can be readily seen, most of these facilities are far from the major ethanol consumption centers on the East and West Coasts. Therefore, transportation of ethanol to these major markets is mostly by railcar to bulk terminals. Figure 9 shows the primary railcar freight corridors in the U.S. From the bulk terminal, ethanol is blended and shipped to end user via transport truck—generally no more than 100 miles from the terminal (USDA 2007).



Source: USDA Nation Agricultural Statistics Service 2010

Figure 8 Ethanol Plants and Corn Production



Source: Cambridge Systematics, Inc. 2007

Figure 9 Primary Rail Freight Corridors

8.5 Status of Dedicated Ethanol Pipeline

At the present time relatively little ethanol is transported via pipeline. Because of the propensity of ethanol to absorb water, ethanol shipments must be thoroughly segregated from other products in a pipeline. This represents a significant increase in costs and limitation of flexibility for the pipeline operator. Consequently, long-distance significant pipeline shipments of ethanol are contingent on construction of a dedicated ethanol pipeline.

Magellan Midstream Partners L.P. and POET Ethanol Products are partnering to construct and operate a new pipeline dedicated to the shipment of ethanol from South Dakota to New York harbor, a distance of more than 1,800 miles. Magellan Midstream Partners' primary business is the transportation, storage, and distribution of refined petroleum products. Magellan currently operates a 9,500 mile refined petroleum products pipeline system including 51 terminals; seven marine terminals; 27 inland terminals and a 1,100 mile ammonia pipeline system. POET is the nation's largest ethanol marketer with a network of 35 plants in eight states producing more than 1.8 billion gallons of ethanol annually. POET LLC also provides design, engineering, construction, and management services for the ethanol industry.

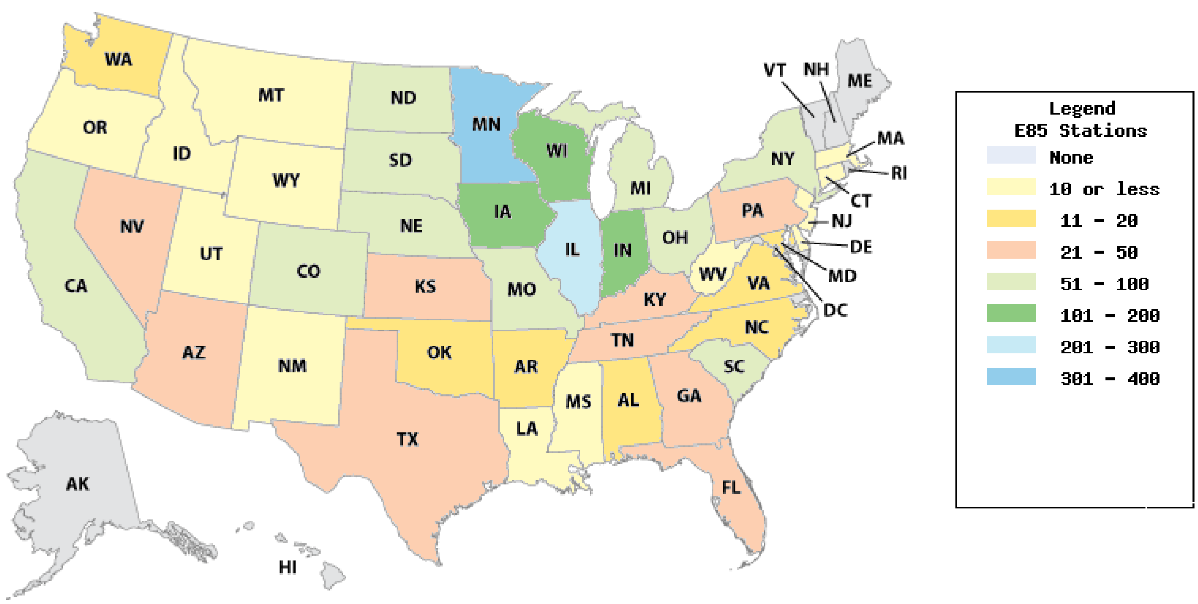
This pipeline will facilitate the shipment of ethanol produced in the Midwest to the major markets in the Northeast and will be the first long-distance pipeline dedicated to ethanol in the United States. When complete and operational, this pipeline will have the capacity to ship 240,000 barrels of ethanol a day. This amounts to more than 3.6 billion gallons of ethanol or about one-fourth of the ethanol required to be used in the U.S. by RFS.

A feasibility study conducted by the Department of Energy concluded that a dedicated ethanol would enhance the fuels delivery infrastructure, reduce congestion of rail, truck, and barge transportation, and would reduce greenhouse gas emissions when compared to current delivery methods. Moreover the DOE study determined that a dedicated ethanol pipeline can become a competitive option if there is adequate demand for the ethanol , estimated at about 4.1 billion gallons per year. (DOE 2010)

The cost to develop and construct this pipeline is estimated at more than $4 billion. Magellan is working to obtain a federal loan guarantee to help reduce the risk associated with this project. As of this writing the loan guarantee has not yet been approved and the project is on hold.

8.6 E-85 Pumps and Infrastructure

Since U.S. automakers have taken advantage of to increase the production and sale of flex-fuel vehicles (FFVs) that are capable of using E85, the retail availability of E85 gas stations and fuel has increasingly become available. As of July, 2009, more than 1,950 U.S. fueling stations offered E85 (AFDC 2010). Figure 10 shows the number of E85 stations by state.



Source: AFDC 2010

Figure 10 Number of E85 Stations by State: July 2009

It is estimated that currently there are more than 7 million FFVs in operation (ADFC 2010). These vehicles can be fueled by gasoline, E85, or any combination of the two. Manufacturers first started making FFVs in the late 1990s; however, by 2004, there were only eight different flex-fuel vehicle models on the market (DOE 2009). In 2008, however, there were 28 different flex-fuel vehicle models available, most of them from GM, Chrysler, and Ford. Although Nissan and Mercedes-Benz are the only foreign manufacturers to produce FFVs in 2008, Toyota and Mitsubishi will also produce flex-fuel pickup trucks in 2009 (DOE 2009).

Chapter 9

OVERVIEW OF FEDERAL AND STATE POLICIES THAT SUPPORT ETHANOL

9.1 Federal Policies

To a large extent, increased use of ethanol in conventional gasoline has been the result of government policies and economics. Federal environmental and energy policy and incentives provided at the Federal and State levels play an important role in determining ethanol demand. The most significant Federal incentives for ethanol are the Renewable Fuels Standard (“RFS”), the Volumetric Ethanol Excise Tax Credit (“VEETC”), the Small Ethanol Producer Tax Credit, and the tariff on imported ethanol.

The federal ethanol program has been developed and expanded by Congress with three central objectives in mind: energy security, environmental quality, and domestic economic development. The program combines a blending mandate with federal tax incentives designed to encourage the nation’s use and production of ethanol and other biofuels. By expanding the domestic use and production of biofuels, the U.S. will reduce harmful emissions and become less dependent on foreign oil, while at the same time expand the economy and create American jobs from the development of new, low-carbon energy sources. Through the U.S. ethanol program, Congress continues to recognize that:

- Ethanol and other renewable fuels improve our energy security by expanding the supply of domestically produced energy that displaces the need for imports of crude oil and refined products.
- Ethanol is a major component of environmental regulations designed to improve and maintain air quality.
- The domestic ethanol and renewable fuels industry provides a steadily growing market for domestically produced agricultural products and is a major engine for economic growth in largely rural communities where the production facilities are located and operate. The ethanol industry provides direct jobs and supports the creation of other new jobs in all areas of the economy that benefit from construction and operation of the ethanol industry. In addition to jobs, the industry generates additional income for households and families in local communities and additional tax revenue for government at all levels.

The major components of the federal ethanol program include:

9.1.1 Renewable Fuel Standard

EPACT 2005 created a Renewable Fuel Standard (RFS) which required that 7.5 billion gallons of renewable fuels be blended with gasoline by 2012. The RFS was expanded under the Energy Independence and Security Act of 2007 (“EISA”) to require that 36 billion gallons of renewable fuels be used in the nation’s motor fuel supply by 2022. EISA caps the use of conventional ethanol produced from corn starch at 15 billion gallons in 2015 and requires the remaining 21 billion gallons to be produced from advanced biofuels including at least 16 billion gallons from cellulosic feedstocks. By way of comparison, an estimated 10.6 billion gallons of ethanol were produced and used in 2009, up from 9.2 billion in 2008. The RFS requirement is illustrated in Figure 11.

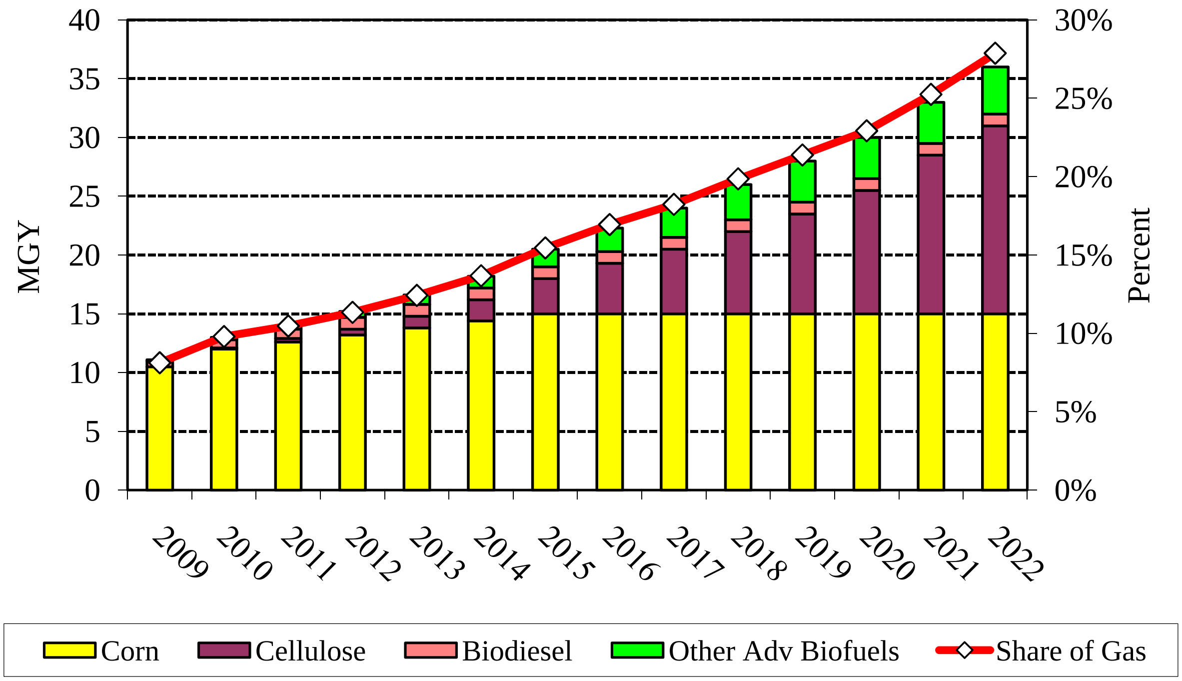


Figure 11 RFS Renewable Fuel Mandate

9.1.2 Federal Tax Incentives

The first federal tax incentive for ethanol was the partial exemption for ethanol from federal excise taxes on motor fuel enacted as part of the Energy Tax Act of 1978. The partial exemption was set at 4 cents per gallon for motor fuels that contained at least 10 percent ethanol (or 40 cents per gallon for every gallon of ethanol). The tax exemption was increased to 60 cents per gallon in 1984. The Omnibus Budget Reconciliation Act of 1990 reduced the rate of exemption to 54 cents per gallon. This level was maintained until it was reduced by the 1998 Transportation Equity Act for the 21st Century. This legislation reduced the exemption to 53 cents per gallon for 2001 and 2002, 52 cents per gallon for 2003 and 2004, and 51 cents per gallon through September 20, 2007. The American Jobs Creation Act of 2004 changed the partial excise tax exemption to an excise tax credit (the Volumetric Ethanol Excise Tax Credit, or VEETC) and extended it through December 31, 2010. The 2008 Farm Bill reduced the VEETC from 51 cents to 45 cents per gallon.

In addition to the VEETC, current law provides for a Small Ethanol Producer Tax Credit (SEPTC). Producers with capacity of no more than 60 million gallons can claim a credit against the producer's income tax liability of 10 cents per gallon of ethanol on the first 15 million gallons of ethanol produced in a tax year. This incentive also expires December 31, 2010. (Reference 26 U.S. Code 40).

Finally, in an effort to facilitate and encourage the growth of second generation biofuels that expand the basket of available feedstocks for biofuel production, such as perennial grasses, crop residues, forestry products, and waste, Congress also established the Cellulosic Biofuel Producer Tax Credit

(CBPTC). The CBPTC, which was created under the 2008 Farm Bill, provides producers of ethanol from cellulosic feedstocks with an income tax credit of up to $1.01 for each gallon of cellulosic ethanol it produces. This credit includes, and must be reduced by, the amount of the VEETC and the SEPTC. The CBPTC expires December 31, 2012.

9.1.3 Tariff on Imported Ethanol

In connection with VEETC, a 2.5 percent ad valorem tax and a tariff of 54 cents per gallon is imposed on imports of ethanol from all countries except Caribbean Basin Initiative (CBI) countries. The tariff was originally established by Congress to offset the expected tax benefits received by foreign ethanol producers under VEETC. Because the VEETC is claimed by the purchaser of ethanol and does not distinguish between imported or domestically produced ethanol, without the tariff American tax dollars would go to support foreign ethanol producers in such countries as Brazil that already provide ample support for their industry.

Under the CBI program, CBI countries may export ethanol to the U.S. duty free provided that the ethanol is produced from a local feedstock or value is added via processing. The CBI exemption is limited to 7 percent of U.S. consumption. Prior to 2006, U.S. imports of ethanol from all countries were generally less than 200 million gallons (USITC). Ethanol imports from all countries totaled 578 million gallons in 2008 (6.1 percent of consumption) as record high oil prices and high domestic ethanol prices made imports attractive even with the tariff. As a consequence of the current lower ethanol prices, imports have fallen and are on track to total about 300 million gallons in 2009.

9.1.4 Environmental Standards

The Clean Air Act Amendments of 1990 (“CAA90”) mandated increased oxygen content for gasoline to meet ozone and carbon monoxide (CO) standards. In order to meet these requirements, gasoline refiners and blenders had to add an oxygenate to motor gasoline to allow it to burn cleaner and to reduce ozone forming compounds and CO emissions. CAA90 required metropolitan areas not in compliance with CO and ozone standards to use gasoline containing an oxygenate. The CAA90 created a wintertime oxygenate (“oxy-fuel”) program and a Reformulated Gasoline Program (RFG) that, at its peak, covered more than 35 percent of all the motor gasoline used in the United States. EPACT 2005 removed the requirement to add an oxygenate to RFG but did not change the requirement to meet and maintain the ozone and CO emission standards of the CAA90.

The two predominate oxygenates used to meet both oxy-fuel and RFG requirements were MTBE (methyl tertiary butyl ether) and ethanol. MTBE is an ether made from methanol produced from natural gas and was the most widely used oxygenate until it was voluntarily removed from the nation’s motor fuel supply by the major gasoline marketers in 2006 due to environmental and financial liability concerns. This provided a significant boost to ethanol demand.

9.2 State Policies

States currently employ numerous tax exemption, producer incentives, and mandates for ethanol. By design, these policies are used to promote job creation or emissions reduction through production investments and incentives and increases in consumer demand for ethanol. Often these police work in unison in order to achieve individual state objectives. For example, a mandate may require a certain percentage of ethanol be incorporated into the existing fuel infrastructure to reduce emissions. An accompanying tax exemption acts to promote production and use of ethanol which reduces the use of petroleum-based fuels which improves air quality and helps achieve climate initiatives.

9.2.1 State Tax Exemptions

Currently, state tax exemptions encompass eight states: Illinois, Massachusetts, Michigan Nebraska, Oklahoma, Oregon, Washington, and Wisconsin. These exemptions, depending on design, are developed either to reduce costs incurred by consumers', thereby stimulating demand for ethanol, or to promote an increase in ethanol infrastructure through tax reductions such as property tax. Tax exemptions often lower the cost of purchasing ethanol providing price indication to substitute away from other fuel types or more expense blends. Furthermore, exemptions may be design to eliminate property tax on land used in ethanol production thereby lowering costs and thus ethanol market prices. Reductions in capital costs may also provide incentive to enter the market or to expand production. Provided below is a summary of tax exemptions by state:

9.2.1.1 Illinois Ethanol Tax Exemption

Sales and use taxes do not apply to ethanol-blended fuels containing between 70 percent and 90 percent ethanol sold between July 1, 2003, and December 31, 2013. These taxes apply to 100 percent of the proceeds from sales made thereafter. (Reference 35 Illinois Compiled Statutes 120/2-10, 105/3-10, and 105/3-44)

9.2.1.2 Massachusetts Cellulosic Biofuel Tax Exemption

For taxable years beginning January 1, 2009, and ending December 31, 2017, fuel consisting of cellulosic biofuel or a blend of gasoline and cellulosic biofuel is eligible for an exemption of the $0.21 per gallon fuel tax, in proportion to the percentage of the fuel content consisting of cellulosic biofuel. For these purposes, eligible cellulosic biofuel includes fuel derived from cellulose, hemicellulose, or lignin derived from renewable biomass that yields at least a 60% reduction in lifecycle greenhouse gas emissions (GHG) relative to the average lifecycle GHG emissions for petroleum-based fuel sold in 2005. (Reference Massachusetts General Laws Chapter 64A, Section 1 and 1A and Massachusetts Department of Revenue TIR 09-4)

9.2.1.3 Michigan Alternative Fuel Development Property Tax Exemption

A tax exemption may apply to industrial property which is used for, among other purposes, high-technology activities or the creation or synthesis of biodiesel fuel. High-technology activities include those related to advanced vehicle technologies such as electric, hybrid, or alternative fuel vehicles and their components. In order to qualify for the tax exemptions, an industrial facility must obtain an exemption certificate for the property from the State Tax Commission. (Reference Michigan Compiled Laws 207.552 and 207.803)

9.2.1.4 Nebraska: Ethanol and Biodiesel Tax Exemption

Motor fuels sold to an ethanol or biodiesel production facility and motor fuels manufactured at an ethanol or biodiesel facility are exempt from certain motor fuel tax laws enforced by the Motor Fuels Division of the Nebraska Department of Revenue. (Reference Nebraska Statutes 66-489 and 66-496)

9.2.1.5 Oklahoma Biofuels Tax Exemption

An individual that produces biofuels or biodiesel from feedstock grown on property and used in a vehicle owned by the same individual are exempt from the state motor fuel excise tax. (Reference Oklahoma Statutes 68-500.4 and 68-500.10)

9.2.1.6 Oregon Biofuels Production Property Tax Exemption

Property used to produce biofuels may be eligible for a property tax exemption, provided that it is located in a designated Renewable Energy Development Zone. The Oregon Economic and Community Development Department must receive and approve an application from a qualified rural area to designate the area as a Rural Renewable Energy Development Zone. (Reference Oregon Revised Statutes 285C.350 and 285C.353)

9.2.1.7 Washington Biofuels Distribution and Biofuels Production Tax Exemption

Fuel delivery vehicles, machinery, equipment, and related services that are used for the retail sale or distribution of biodiesel blends or E85 motor fuel are exempt from state retail fuel sales and use taxes until July 1, 2015. (Reference Revised Code of Washington 82.08.955 and 82.12.955)

Qualifying buildings, equipment, and land used in the manufacturing of alcohol fuel, biodiesel, or biodiesel feedstocks are exempt from state and local property and leasehold excise taxes for a period of six years from the date the facility or addition to the existing facility becomes operational. (Reference Revised Code of Washington 82.29A.135 and 84.36.635)

9.2.1.8 Wisconsin Alternative Fuel Tax Exemption

No county, city, village, town, or other political subdivision is allowed to levy or collect any excise, license, privilege, or occupational tax on motor vehicle fuel or alternative fuels, or on the purchase, sale, handling, or consumption of motor vehicle fuel or alternative fuels. (Reference Wisconsin Statutes 78.82)

9.2.2 State Producer Incentives

In addition to consumer tax exemptions, states employ a wide range of producer tax incentives. A central aspect of producer incentives is to reduce operating and capital expenditures thereby facilitating investment and growth in the ethanol industry. Since incentives provide a tax credit per gallon of ethanol produced, the reduction in operating expense often leads to a reduction in taxable income. Other incentives included tax credits on capital expenditures associated with ethanol investment. Currently, 23 states provide producers with incentives associated with ethanol. A list and summary of incentives corresponding with each state is provided below:

9.2.2.1 Alabama Biofuel Production Facility Tax Credit

Companies that invest in the development of a biofuel production facility may be eligible for a tax credit against the state income tax or financial institution excise tax liability generated by the project each year for up to 20 years in the amount equal to 5 percent of the capital costs of the project. For the purposes of the credit, biofuel is defined as a motor vehicle fuel that is produced from grain, starch, oilseeds, vegetable, algae, animal, or fish materials including fats, greases and oils, sugarcane, sugar beets, sugar components, tobacco, potatoes, and lignocellulosic or other biomass. In order to be eligible for the tax credit, the capital costs of the production facility must be at least

$2,000,000 if the facility is not located in a favored geographic area, and $500,000 if the facility is located in a favored geographic area. A favored geographic area is defined as an area or county that is designated as an enterprise zone or is considered to be less developed by the Alabama Department of Industrial Relations. (Reference House Bill 568, 2009)

9.2.2.2 Hawaii Ethanol Production Incentive

An income tax credit is available for qualifying ethanol production facilities equal to 30% of nameplate capacity between 500,000 and 15 million gallons per year. The facility must produce at least 75 percent of its nameplate capacity to be eligible to receive the tax credit each year, and the tax credit may be taken for up to eight years. The credit is only available to the first 40 million gallons of ethanol produced per year. Qualifying ethanol production facilities must be in operation prior to January 1, 2017. (Reference Hawaii Revised Statutes 235-110.3)

9.2.2.3 Indiana Ethanol Production Tax Credit

An ethanol producer located in Indiana is entitled to a credit of $0.125 per gallon of ethanol produced, including cellulosic ethanol. The Indiana Economic Development Corporation must review and approve applications for this credit. The amount of credits granted to a single taxpayer may not exceed the following amounts for all taxable years:

Tax Credit	Annual Production
$2 million	More than 40 million and less than 60 million gallons of grain ethanol
$3 million	At least 60 million gallons of grain ethanol
$20 million	At least 20 million gallons of cellulosic ethanol
(Reference Indiana Code 6-3.1-28)	

9.2.2.4 Iowa Alternative Fuel Production Tax Credits

The Enterprise Zone Program and the High Quality Jobs Program offer state tax incentives to business projects for the production of biomass or alternative fuels. Depending on the program, incentives may include: an investment tax credit equal to a percentage of the qualifying investment, amortized over five years; a refund of state sales, service, or use taxes paid to contractors or subcontractors during construction; a doubling of the state's refundable research activities credit; additional funding for training new employees; and a local property tax exemption of up to 100 percent of the value added to the property.

9.2.2.5 Kansas Biofuel Equipment Tax Credits and Cellulosic Production incentive

A Storage and Blending Equipment Credit is available for tax years 2007 through 2011 for investment in the purchase, construction, or installation of equipment used for storing and blending petroleum-based fuel with biodiesel, ethanol, or other biofuel. The tax credit is equal to 10% of the taxpayer's qualified investment for the first $10,000,000 invested and 5 percent of the investment in excess of $10,000,000. The credit may be taken in 10 equal annual installments beginning with the year in which the equipment is placed into service. Any excess credits may be carried over for deduction from the taxpayer's income tax liability in subsequent years for a maximum of 14 years after the first installment. In order to be eligible for the tax credit, the taxpayer must continue to operate the equipment for at least 10 years.

Biofuel blenders may also be eligible for an income tax deduction based on the accelerated depreciation for storage and blending equipment. This deduction extends over a 10-year period and is equal to 55 percent of the depreciated value for the first year and 5 percent of the depreciated value for each of the nine subsequent years that the equipment remains in production. (Reference Kansas Statutes 79-232 and 79-32,251 - 79-32,255)

The Kansas Development Finance Authority (KDFA) is authorized to issue revenue bonds to cover the costs of construction or expansion of a biomass-to-energy facility. A qualifying biomass-to-energy facility includes any industrial process plant that produces at least 500,000 gallons of cellulosic alcohol fuel, liquid or gaseous fuel, or other source of energy in a quantity having a British thermal unit (BTU) value equal to, or greater than, 500,000 gallons of cellulosic alcohol fuel. In addition, any newly constructed or expanded biomass-to-energy facility is exempt from state property taxes for a period of up to 10 taxable years immediately following the taxable year in which construction or installation is completed. Expansion of an existing biomass-to-energy facility means expansion of the facility's production capacity by a minimum of 10%. (Reference Kansas Statutes 74-8949b, 79-32,233, and 79-229)

The Kansas Qualified Agricultural Ethyl Alcohol Producer Fund enables qualified agricultural ethyl alcohol (ethanol) producers to apply for a production incentive with the state Department of Revenue. If an ethanol producer who was in production prior to July 1, 2001 increases production capacity by 5,000,000 gallons over the producer's base sales, $0.075 may be collected for each gallon sold to an alcohol blender that is in excess of the producer's base sales, up to 15,000,000 gallons. Producers who began production on or after July 1, 2001, and who have sold at least 5,000,000 gallons to an alcohol blender may receive $0.075 for each gallon sold, up to 15,000,000 gallons. A producer may not collect the incentive for more than seven years. (Reference Kansas Statutes 79-34,163)

9.2.2.6 Kentucky Ethanol Production Tax Credit and Alternative Fuel Production Tax Incentives

Qualified ethanol producers are eligible for an income tax credit of $1.00 per gallon of corn- or cellulosic-based ethanol that meets ASTM standard D4806. The total credit amount for all corn and cellulosic ethanol producers is $5 million for each taxable year. Unused credits may not be carried forward and applied to a future tax return. However, unused ethanol credits from one ethanol-based cap, such as corn, may be applied to another ethanol-based cap, such as cellulosic, in the same taxable year. (Reference Kentucky Revised Statutes 141.4244 to 141.4248)

The Kentucky Economic Development and Finance Authority (KEDFA) provides tax incentives to construct, retrofit, or upgrade an alternative fuel production or gasification facility that uses coal or biomass as a feedstock. The incentives may consist of: 1) a refund of up to 100 percent of the state sales tax paid on the purchase of personal property used to construct the facility; 2) a credit of up to 100 percent of an approved company's state income tax and limited liability entity tax that is generated by the project; 3) up to 4 percent of the wage assessment of employees whose jobs were created as a result of the construction, retrofit, upgrade or operation of a qualified facility; and 4) a credit for up to 80% of the coal severance tax paid for coal used as a feedstock. The incentives expire at the time of receipt of the authorized incentives or 25 years from activation of the project, whichever occurs first. Approved companies may recover up to 50 percent of their capital investment via the authorized tax incentives. The minimum capital investment for incentive eligibility is $25 million for an alternative fuel or gasification facility that uses biomass as the primary feedstock and $100 million for a facility that uses coal as the primary feedstock. (Reference Kentucky Revised Statutes 154.27-010 to 154.27-090)

9.2.2.7 Louisiana Green Jobs Tax Credit

The state offers a corporate or income tax credit for qualified capital infrastructure projects in Louisiana that are directly related to industries including but not limited to the energy efficient and advanced drive train vehicle industry and the biofuels industry. The tax credit is worth up to $1 million per state-certified green project, calculated on the base investment costs of the project, for up to a total of $5 million per year. Other restrictions may apply. (Reference House Bill 733, 2009, and Louisiana Revised Statutes 47:6035)

9.2.2.8 Maine Biofuels Production Tax Credit

A certified producer of ethanol, biodiesel, or methanol derived from biomass is allowed an income tax credit of $0.05 per gallon for the commercial production of biofuels for use in motor vehicles or otherwise used as a substitute for liquid fuels. A taxpayer claiming this credit must receive a letter from the Commissioner of the Maine Department of Environmental Protection that certifies the biofuels produced during the taxable year are eligible for the tax credit. For biofuels blended with petroleum or other non-biofuels, the credit is allowed only on the biofuels portion of that blend. Any portion of unused credits may be carried over for up to 10 taxable years. (Reference Maine Revised Statutes Title 36, Section 5219-X)

9.2.2.9 Maryland Biofuels Production Incentive

Qualified ethanol and biodiesel producers are eligible for ethanol and biodiesel production incentives in the form of per gallon credits. To be eligible for the incentive, the producer must first apply to the Renewable Fuels Incentive Board (Board) and receive certification as a producer. Credits may be offered to certified producers in Maryland for ethanol or biodiesel produced on or after December 31, 2007. The Board may not pay credits for ethanol or biodiesel produced after December 31, 2017.

Ethanol production credits are as follows: a) $0.20 per gallon of ethanol produced from small grains such as wheat, rye, triticale, oats, and hulled or hull-less barley; and b) $0.05 per gallon of ethanol produced from other agricultural products. The Board may not certify ethanol production credits for more than a total of 15 million gallons per calendar year, of which at least 10 million gallons must be produced from small grains.

Biodiesel production credits are as follows: a) $0.20 per gallon of biodiesel produced from soybean oil (the soybean oil must be produced in a facility or through expanded capacity of a facility that began operating after December 31, 2004), and b) $0.05 per gallon for biodiesel produced from other feedstocks, including soybean oil produced in a facility that began operating on or before December 31, 2004. The Board may not certify biodiesel production credits for more than a total of five million gallons per calendar year, of which at least two million gallons must be from soybean oil produced in a facility as described above. (Reference Maryland Statutes, Agriculture Code 10-1501 through 10-1507)

9.2.2.10 Minnesota Ethanol Production Incentive

Through June 30, 2010, an ethanol production incentive of $0.20 per gallon of ethanol produced may be earned by qualified facilities that began production before June 30, 2000. Annual payments are limited to $3 million to any one producer. (Reference Minnesota Statutes 41A.09)

9.2.2.11 Montana Renewable Energy Property Tax Incentive and Ethanol Production Incentive

Property tax rate abatements are available for new investments in facilities that manufacture, research, or develop products related to biodiesel, biomass, biogas, coal-to-liquid fuels, ethanol, pipelines carrying "clean" products, renewable energy manufacturing plants, and research and development equipment for renewable energy. These incentives last for 15 years after facility start-up or the related equipment is purchased. The total time of the qualifying period may not exceed 19 years. (Reference Montana Code Annotated 15-24-3111)

Montana based ethanol producers are entitled to a tax incentive of $0.20 per gallon of ethanol solely produced from Montana agricultural products, or if the ethanol was produced from non-Montana agricultural products when Montana products were unavailable. The amount of the tax incentive for each gallon is reduced proportionately, based upon the amount of agricultural or wood products not produced in Montana that are used in the production of the ethanol. The tax incentive is available to a facility for the first six years from the date that production begins. Ethanol eligible for the incentive must be blended with gasoline for sale as ethanol-blended gasoline in Montana, exported from Montana for sale as ethanol-blended gasoline, or used in the production of ethyl tertiary butyl ether for use in reformulated gasoline. An ethanol distributor is not eligible to receive the tax incentive unless at least 20 percent of Montana product is used to produce ethanol at the facility in the first year of production, 25 percent of Montana product is used the second year, and the amount of Montana product used each year thereafter must increase by 10 percent annually. (Reference Montana Code Annotated 15-70-522)

9.2.2.12 Nebraska Ethanol Production Tax Credit

A new ethanol facility that is in production after September 1, 2001, and produces a minimum of 100,000 annual gallons, before denaturing, may be eligible for a tax credit, in the form of transferable motor vehicle tax credit certificate, of $0.18 per gallon of ethanol produced. This credit is available to the facility for 96 consecutive months beginning with the first calendar month of eligibility and ends no later than June 30, 2012. Credits are available for up to 15,625,000 gallons of ethanol produced annually at each facility, and for up to 125,000,000 gallons of ethanol produced at each facility by the end of the 96-month period. Credits are only available for ethanol produced at a plant in Nebraska at which all fermentation, distillation, and dehydration takes place. Applications for credits must be made to the Nebraska Department of Revenue within three years of the date the ethanol was produced, or by September 30, 2012, whichever occurs first. (Reference Nebraska Statutes 66-1344)

9.2.2.13 New Mexico Biofuels Tax Deduction

The cost associated with purchasing biomass materials used for processing into biofuels, biopower, or bio-based products may be deducted in computing the compensating tax due under the Gross Receipts and Compensating Tax Act. Biofuels include biomass converted to liquid or gaseous fuels such as ethanol, methanol, methane, and hydrogen. (Reference New Mexico Statutes 7-9-98)

9.2.2.14 New York Biofuel Production Tax Credit

Biofuel producers in New York State are eligible for a state tax credit of $0.15 per gallon of biodiesel (B100) or ethanol produced after the production facility has produced, and made available for sale, 40,000 gallons of biofuel per year. The maximum credit available is $2.5 million per taxpayer per taxable year for no more than four consecutive taxable years per production facility. Additional requirements may apply. (Reference New York Tax Law 28*2 and 187-c)

9.2.2.15 North Carolina Biofuel Production Facility Tax Credit

A tax credit is available for the processing of biodiesel, ethanol, or ethanol/gasoline blends consisting of at least 70% ethanol. The credit is equal to 25 percent of the cost of constructing and equipping the facility and a facility must be placed in service before January 1, 2011. The credit must be taken in seven equal annual installments beginning with the taxable year in which the facility is placed in service. In lieu of this credit, a taxpayer that constructs and places into service three or more commercial facilities for processing renewable fuel in North Carolina and invests at least $400 million in total in the facilities is allowed a credit equal to 35 percent of the cost to the taxpayer of constructing and equipping the facilities. To claim the credit, the taxpayer must obtain a written determination from the Secretary of Commerce that the taxpayer is expected to invest at least $400 million in three or more facilities within a five-year period. (Reference North Carolina General Statutes 105-129.15 and 105-129.16D)

Taxpayers who construct, purchase, or lease renewable energy property, are eligible for a tax credit equal to 35 percent of the cost of the property. Renewable energy property includes equipment that uses renewable biomass resources to produce ethanol, methanol, biodiesel, or methane produced via anaerobic biogas, utilizing agricultural and animal waste or garbage; and related devices for converting, conditioning, and storing the liquid fuels and gas produced with the biomass equipment. The credit must be taken in five equal installments beginning with the taxable year in which the property is placed in service. There is a maximum funding amount of $2.5 million per installation which applies to renewable energy property placed in service for any purpose other than residential. Property must be placed in service before January 1, 2011. (Reference North Carolina General Statutes 105-129.15 and 105-129.16A)

9.2.2.16 Ohio Ethanol Production Investment Tax Credits

An Ohio taxpayer that invests in a certified ethanol production plant may receive a tax credit against the state corporation franchise tax and income taxes. The credit is equal to 50 percent of the investment, up to $5,000 per taxpayer per certified plant. Credits against the corporation franchise tax are available through 2013 and credits against income taxes are available through 2012. (Reference Ohio Revised Code 5733.06, 5733.46, 5747.02, and 5747.75)

9.2.2.17 Oklahoma Ethanol Production Tax Credit

For tax years beginning before January 1, 2013, an ethanol production facility is allowed a tax credit in the amount of $0.20 per gallon of ethanol produced, for 60 months beginning with the first month in which the facility is eligible to receive such credit. The credit may only be claimed if the ethanol facility maintains an average production rate of at least 25 percent of its nameplate design capacity for at least six months after the first month for which it is eligible to receive the credit, on or before December 31, 2010. Producers are also eligible for an expansion credit of $0.20 per gallon of ethanol produced in excess of the original nameplate capacity that results from expansion of the facility before December 31, 2008. This tax credit can be used for up to 60 months beginning with the first month for which production from the expanded facility is eligible and ending before January 1, 2013. Beginning January 1, 2013, an ethanol facility is eligible for a credit of $0.075 per gallon of ethanol, before denaturing, for new production for a period not to exceed 36 consecutive months. To be eligible for this credit, the facility must not have received credits prior to January 1, 2013, or must have expanded the capacity by at least 2 million gallons, first placed into service after January 1, 2013. Additional restrictions apply. (Reference Oklahoma Statutes 68-2357.66)

9.2.2.18 Oregon Alternative Fuel Production and Infrastructure Tax Credit

Business owners and others who invest in alternative fuel production and fueling infrastructure projects in Oregon may be eligible for a tax credit of up to 50 percent of eligible project costs through the Business Energy Tax Credit. Some projects (e.g., propane, compressed natural gas, liquefied natural gas) may only qualify for a tax credit of 35 percent of eligible costs. The tax credit is filed over five years. For projects with eligible costs of $20,000 or less, the tax credit may be taken in one year. Unused credits can be carried forward up to eight years. (Reference Oregon Revised Statutes 316.116, 317.115, 469.160-469.180, and 469.185-469.225)

9.2.2.19 Pennsylvania Alternative Fuel Production Tax Credits

The Alternative Energy Production Tax Credit Program provides a credit of 15 percent of the net cost of projects related to the production of alternative fuels, as well as the research and development of technology to provide alternative fuels, for up to $1 million per taxpayer. An eligible applicant must develop or construct an alternative energy production project located in Pennsylvania that has a useful life of at least four years. (Reference Title 73 Pennsylvania Statutes 1649.701-1649.711)

9.2.2.20 South Carolina Biofuels Production Tax Credit

Qualified corn-based ethanol and soy-based biodiesel producers are eligible for an income tax credit of $0.20 per gallon of fuel produced for taxable years beginning after 2006 and before 2017. Producers using feedstocks other than corn or soy oil are eligible for $0.30 per gallon tax credit. An eligible production facility must be operating at a production rate of at least 25 percent of its name plate design capacity and must maintain that production rate for at least six month, before denaturing, on or before December 31, 2011. The credit is allowed for up to 60 months beginning with the first month for which the facility is eligible to receive the credit and ending not later than December 31, 2016. Beginning January 1, 2017, the credit changes to $0.075 per gallon of fuel produced. (Reference South Carolina Code of Laws 12-6-3600)

A taxpayer that constructs and places into service a commercial facility for the production of renewable fuel is eligible for a tax credit of up to 25 percent of the cost of constructing or renovating a building and equipping the facility. Production of renewable fuel includes intermediate steps such as milling, crushing, and handling feedstock and the distillation and manufacturing of the final product. The entire credit must be taken in seven equal annual installments beginning with the taxable year in which the facility is placed in service. Renewable fuel is defined as liquid non-petroleum based fuel that can be placed in motor vehicle fuel tanks and used to operate on-road vehicles, including all forms of fuel commonly or commercially known or sold as biodiesel and ethanol. (Reference South Carolina Code of Laws 12-63-3610)

9.2.2.21 South Dakota Ethanol Production Incentive

Qualified ethanol producers are eligible for a $0.20 per gallon production incentive for ethanol that is fully distilled and produced in South Dakota. To be eligible for this incentive, the ethanol must be denatured and blended with gasoline to create an ethanol blend, and the producer must have produced ethanol on or before December 31, 2006. Cumulative annual production incentives paid out may not exceed $7 million. (Reference South Dakota Statutes 10-47B-162-163)

9.2.2.22 Washington Biofuels Production Tax Exemption

Qualifying buildings, equipment, and land used in the manufacturing of alcohol fuel, biodiesel, or biodiesel feedstocks are exempt from state and local property and leasehold excise taxes for a period of six years from the date the facility or addition to the existing facility becomes operational. (Reference Revised Code of Washington 82.29A.135 and 84.36.635)

9.2.3 State Mandates

Currently ten States – Florida, Hawaii, Iowa, Louisiana, Minnesota, Missouri, Montana, Oregon, Pennsylvania, and Washington – have ethanol mandates in place. In most cases these mandates act as means for achieving state objects such as climate initiatives or emission reductions by requiring a proportion of motor gasoline contain ethanol. For example, Minnesota, Montana, Missouri and Hawaii require motor gasoline to contain at least 10 percent ethanol while Washington requires two percent ethanol and Iowa's renewable fuel standard requires 23 percent. Provided below provide is a list of currently implemented mandates by state:

9.2.3.1 Florida

Beginning December 31, 2010, all gasoline sold or offered for sale in the state by a terminal supplier, importer, blender, or wholesaler must contain 9-10 percent ethanol by volume (E10). The fuel mandate does not apply to fuel used in aircrafts or watercrafts, fuel sold to a blender, or fuel sold for use in collector vehicles, off-road vehicles, motorcycles, or small engines. If a terminal supplier, importer, blender, or wholesaler is unable to obtain ethanol fuel or E10 at the same or lower price as unblended gasoline, then the covered entity may apply for a waiver. (Reference Florida Statutes 526.201-526.207)

9.2.3.2 Hawaii

At least 85 percent of Hawaii's unleaded gasoline must be fuel blends containing at least 10 percent ethanol (E10). Gasoline blended with an ethanol-based product, such as ethyl tertiary butyl ether, will be considered to be in conformance with this requirement. Retail fuel distributors must meet this requirement and report to the state Petroleum Commissioner (the Administrator of the Energy, Resources, and Technology Division of the Department of Business, Economic Development, and Tourism) on a monthly basis. (Reference Hawaii Revised Statutes 486J-10 and Hawaii Administrative Rules Title 15, Department of Business, Economic Development and Tourism, Chapter 35)

9.2.3.3 Iowa

The goal of the Iowa Renewable Fuel Standard is to replace 25 percent of gasoline in the state with biofuels (ethanol or biodiesel) by January 1, 2020. One provision of the standard is to require retailers to sell a certain percentage of renewable fuels as part of their total gasoline sales. Both ethanol and biodiesel count towards meeting the RFS schedule which increased from 6 percent in 2009 and 2001 to 14 percent by 2015 for retailers selling less than 200, 000 gallons per year. Larger retailers (more than 200,000 gallons per year) are required to sell 11 percent renewable fuels in 2009, 11 percent in 2010, increasing to 23 percent by 2018. (Reference Iowa Code 422.11N)

9.2.3.4 Louisiana

Within six months following the point at which cumulative monthly production of denatured ethanol produced in Louisiana equals or exceeds a minimum annual production volume of 50 million gallons, 2 percent of the total gasoline sold by volume in the state must be denatured ethanol. Ethanol is defined an ethyl alcohol that has a purity of at least 99 percent, exclusive of added denaturants, meets BATF and ASTM specification D4806, and is produced from domestic agricultural or biomass products. This requirement will not be effective until six months after the average wholesale price of a gallon of Louisiana-manufactured ethanol, less any federal tax incentives or credits, is equal to or below the average wholesale price of a gallon of regular unleaded gasoline in Louisiana for a period of not less than 60 days, as determined by the Louisiana Biofuel Panel. The Legislature urges the Louisiana Department of Agriculture and Forestry not to implement the minimum ethanol requirements if the requirements raise the price of gasoline by more than $0.02 per gallon.

Within six months following the point at which cumulative monthly production of biodiesel produced in the state equals or exceeds a minimum annual production volume of 10 million gallons, 2 percent of the total diesel sold by volume in the state must be biodiesel. Biodiesel is defined as a fuel comprised of mono-alkyl esters of long chain fatty acids derived from domestic, renewable resources and meeting the requirements of ASTM specification D6751, or a diesel fuel substitute produced from non-petroleum renewable resources such as vegetable oils and animal fats that meet U.S. Environmental Protection Agency fuel and fuel additive requirements.

Alternatively, these requirements may be met through the production of an alternate renewable fuel, defined as a liquid fuel that is domestically produced from renewable biomass, can be used in place of ethanol or biodiesel, and meets the definition of renewable fuel in the Energy Policy Act of 2005. Within six months following the point at which cumulative monthly production of an alternate renewable fuel produced in the state equals or exceeds a minimum annual production volume of 20 million gallons, 2 percent of the total motor fuel sold by volume in the state must be the alternate renewable fuel produced from domestically grown feedstock. This requirement may not exceed 2 percent of the total motor fuel sold by volume by owners or operators of fuel distribution terminals.

Blenders and retailers will have six months to meet the new minimum ethanol, biodiesel, or alternate renewable fuel content requirements, unless the Department of Weights and Measures determines there is an insufficient supply of ethanol or biodiesel in the state. Any combination of alternative fuels, including but not limited to denatured ethanol, biodiesel, and alternative renewable fuel may be used to meet these requirements. Fuels containing ethanol or biodiesel will not be required to be sold in ozone non-attainment areas. The Department of Agriculture and Forestry will adopt rules and regulations requiring incentives to compensate for any costs associated with achieving the minimum ethanol and biodiesel standards.

To further encourage the production of biodiesel from renewable resources, Louisiana restaurants are encouraged to provide their waste fats, oils, and grease to biodiesel production facilities and store their waste fats, oils, and grease in a manner that facilitates the use of these products in a biodiesel production facility. (Reference House Bill 624, 2009, and Louisiana Revised Statutes 3:4674, 3:4674.1, and 3:3712)

9.2.3.5 Minnesota

All gasoline sold or offered for sale in Minnesota must contain at least 10% ethanol by volume (E10), or the maximum percent of denatured ethanol by volume authorized in a waiver granted by the U.S. Environmental Protection Agency. Gasoline-ethanol blends must comply with ASTM specification D4814-08b. Effective August 30, 2013, all gasoline sold or offered for sale in the state must contain at least 20 percent ethanol by volume (E20), unless, by December 31, 2010, ethanol has already replaced 20 percent of all motor vehicle fuel sold in the state or federal approval has not been granted for the use of E20. Certain exemptions apply. (Reference Senate File 743, 2009, House File 1122, 2009, and Minnesota Statutes 239.761 and 239.791)

9.2.3.6 Missouri

All gasoline sold or offered for sale at retail stations within the state must contain 10 percent ethanol. This requirement is waived only if a distributor is unable to purchase ethanol or ethanol-blended gasoline at the same or lower price as unblended gasoline. Premium gasoline is exempt from this requirement. Ethanol fuel is defined as meeting ASTM specification D4806. (Reference Missouri Revised Statutes 414.255)

9.2.3.7 Montana

All gasoline sold to consumers for use in motor vehicles operating on public roads must be blended with 10 percent by volume, agriculturally derived, denatured ethanol, within one year after the Montana Department of Transportation has certified that the state has produced 40 million gallons of ethanol and has maintained that level of production on an annualized basis for at least three months. If the production of ethanol in Montana drops below 20 million gallons on an annualized basis, the 10 percent blend requirement does not apply. All gasoline sold as E10 may not contain more than trace amounts of the additive methyl tertiary butyl ether. (Reference Montana Code Annotated 82-15-121)

9.2.3.8 Oregon

All gasoline sold in the state must be blended with 10 percent ethanol. This requirement goes into effect within three months after retailers are notified by the Oregon Department of Agriculture (ODA) that Oregon ethanol production has reached 40 million gallons per year. Gasoline containing at least 9.2 percent agriculturally derived ethanol that meets the standards for ethanol adopted by the ODA, complies with the mandate. For the purpose of the mandate, the ethanol must meet ASTM specification D4806. The governor may suspend the renewable fuels mandate for ethanol if the Oregon Department of Energy finds that ethanol is not available. Beginning in January 2010, gasoline with an octane rating of 91 or above is exempt from this mandate. (Reference House Bill 3463 and 3497, 2009, and Oregon Revised Statutes 646.913 and 646.921-646.923)

All gasoline sold within the Portland city limits must contain a minimum of 10% ethanol (E10), and diesel fuel must contain a minimum of 5 percent biodiesel (B5) and must meet ASTM D6751 standards. (Reference Portland Policy Documents ENN-6.02)

9.2.3.9 Pennsylvania

All gasoline sold in Pennsylvania must contain at least 10 percent cellulosic ethanol by volume one year after in-state production of cellulosic ethanol reaches 350 million gallons. (Reference Title 73 Pennsylvania Statutes 1650.3 and 1650.4)

9.2.3.10 Washington

At least 2 percent of all diesel fuel sold in Washington must be biodiesel or renewable diesel. This requirement will increase to 5 percent 180 days after the Washington Department of Agriculture determines that in-state feedstocks and oil-seed crushing capacity can meet a 3 percent requirement. Renewable diesel is defined as a diesel fuel substitute produced from non-petroleum renewable sources, including vegetable oils and animal fats, meets the federal registration requirements for fuels and fuel additives and ASTM specification D975.

Additionally, at least 2 percent of the total gasoline sold in the state must be denatured ethanol. The ethanol requirement may be increased if the Department of Ecology determines that this increase would not jeopardize continued attainment of federal Clean Air Act standards and the Department of Agriculture determines that the state can economically support the production of higher ethanol blends.

All state agencies with jurisdiction over renewable fuel infrastructure, specifically storage, blending, and dispensing equipment, are required to expedite related application and permitting processes. The governor may suspend these requirements by Executive Order if the standard is temporarily technically or economically infeasible, or poses a significant risk to public safety. (Revised Code of Washington 19.112.010 and 19.112.110-19.112.180)

Chapter 10

CONCLUSION

The ethanol industry has experienced significant growth over the past twenty-five years and is poised for additional growth. The conventional ethanol industry which uses corn as the primary feedstock will peak by 2015 with future growth to come from new technologies and feedstocks.

Federal and State policies have been a major contributor to the development of the ethanol industry and will play a key role in ensuring the flow of capital necessary for the development of second-generation ethanol production necessary to meet RFS mandates. Moving forward, uncertainty surrounding reauthorization of the major Federal ethanol tax incentive and the willingness of the financial community to invest in new biofuel technology are two of the main challenges the industry will face

Chapter 11

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