Analysis of the US Fuel Ethanol Industry and Market Expectations

Dr. Art Wiselogel, Jeff Kistner, and Kyle Althoff
BBI International

ABSTRACT

From humble beginnings as part of Henry Ford's vision of an agricultural based transportation industry and a rebirth as a fuel additive, ethanol is quickly approaching a 10% share of the US gasoline market. Fuel ethanol is currently found in over 50% of the gasoline sold in the US and the ethanol market is expanding at a rapid rate. Ethanol production has increased from 1.6 billion gallons in 2000 to a current capacity of over 8 billion gallons/year with almost 4.4 billion under construction.

Several events have led to a rapid change in the Ethanol Industry: the development of the modern dry mill; cheap corn; politics and policy; and market forces. How will near-term market forces and legislation impact the ethanol industry and the development of new cellulosic technologies?

Keywords: ethanol, biofuels, cellulosic, biodiesel, biomass

1 INTRODUCTION

Fuel ethanol is the most widely used biofuel in the US. From humble beginnings as part of Henry Ford's vision of an agricultural based transportation industry and a rebirth as a fuel additive for oxygen content, ethanol is quickly approaching a 10% share of the 140 billion gallon/year US gasoline market.

The properties of fuel ethanol have facilitated an almost transparent integration into the existing US gasoline based transportation fuel infrastructure. Ethanol's production technologies are well established and cost competitive with gasoline. It is the only alternative fuel that can presently be produced in amounts that make a significant dent in our use of petroleum derived gasoline. Ethanol easily mixes with gasoline, can be used in the current gasoline distribution system, and existing automobile engines have been shown to perform well with blends up to 30%.

Few industries have grown as fast as the US Fuel ethanol industry has in the past two years. There are currently 138 commercial fermentation ethanol production facilities in operation in the U.S. with a combined production capacity of about 7.3 billion gallons per year. Fifty-eight new plants are under construction adding about 4.4 billion gallons of annual production capacity. Total production capacity in the U.S. should exceed 8.4 billion gallons per year by the middle of 2008.

2 FUEL ETHANOL MARKET DRIVERS

In the U.S., ethanol has multiple uses. It serves as an octane enhancer for gasoline, a source of oxygen for more complete fuel combustion, and as a fuel extender reducing dependence on imported oil. To encourage use of a non-petroleum additive in gasoline by the oil industry Congress established an incentive in the form of a tax credit. The tax incentive is paid to the blender (the company that mixes the ethanol with gasoline) and is set to expire in 2010.

Several factors play important roles in the U.S. fuel ethanol market.

- Federal Renewable Fuels Standard (RFS)
- Ethanol price relative to crude oil (or gasoline)
- Clean octane
- Oxygenate for RFG program & MTBE Phase-out (largely complete)
- Gasoline extender (refinery capacity)
- Local economic development
- New government policies to increase the use of ethanol

2.1 Renewable Fuels Standard

The RFS established a market floor for biofuels of 36 billion gallons by 2022, and has provisions for several types of biofuels. They are conventional biofuels, advanced biofuels, cellulosic biofuels, and biomass-based diesel.

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Conventional biofuels are defined as ethanol derived from corn starch. Conventional ethanol facilities that commence construction after the date of enactment must achieve a 20 percent greenhouse gas (GHG) emissions reduction compared to baseline lifecycle GHG emissions.

Advanced biofuels are defined as renewable fuels other than ethanol derived from corn starch that are derived from renewable biomass, and achieve a 50 percent GHG emissions reduction requirement. The definition – and the schedule – of advanced biofuels include cellulosic biofuels (made from plant materials) and biomass-based diesel.

Cellulosic biofuels are defined as renewable fuels derived from any cellulose, hemicellulose, or lignin (Cellulose, hemicellulose, and lignin are molecular structures that make up plant cell walls and hold them together) that is derived from renewable biomass, and achieve a 60 percent GHG emission reduction requirement.

Biomass-based diesel is defined as renewable fuel that is biodiesel as defined in section 312(f) of the Energy Policy Act of 1992 (42 U.S.C. 13220(f)) and achieves a 50 percent GHG emission reduction requirement. Notwithstanding the preceding sentence, renewable fuel derived from co-processing biomass with a petroleum feedstock is considered an advanced biofuel if it meets advanced biofuel requirements, but is not biomass-based diesel.

In addition to the 36 billion gallon RFS, the energy bill authorizes $500 million annually from FY2008 to FY2015 for the production of advanced biofuels that have at least an 80 percent reduction in lifecycle greenhouse gas (GHG) emissions relative to current fuels. It also authorizes $25 million annually for FY2008 to FY2010 for R&D and commercial application of biofuels production in states with low rates of ethanol and cellulosic ethanol production; and a $200 million grant program for FY2008 to FY2014 for the installation of refueling infrastructure to support E-85.

2.2 Octane

Ethanol is a great source for “Clean Octane.” Octane is a measurement of gasoline’s auto-ignition resistance that prevents the firing of pistons after the engine is shut off (knocking). High compression automobile engines require fuels that are not as flammable and thus have a high octane number. The octane number gives the percentage by volume of iso-octane in a mixture of iso-octane and n-heptane that has the same anti-knocking characteristics as the fuel under consideration. For example, gasoline with a 90 octane rating has the same ignition characteristics as a mixture of 90% iso-octane and 10% heptane. Lead was one of the original sources of octane in gasoline. Ethanol has an octane number of 116 which means it is the highest-octane compound that does not have dire negative human or environmental effects available in sufficient quantities to the US petroleum industry.

2.3 Oxygenate

Oxygen in transportation fuel helps the fuel burn more completely and reduces carbon monoxide emissions. Pre-2005, Methyl tertiary butyl ether (MTBE) was the most widely used oxygenate in the US, but it was discovered to be a carcinogen with an affinity for water. By 2005 at least 17 states had MTBE bans and the 2005 RFS did not provide protection for the petroleum industry from class action law suits over MTBE contamination of drinking water. Both these factors resulted in a rapid move away from MTBE to ethanol as an oxygenate source in EPA designated non-attainment areas for carbon monoxide. The resulting increase in ethanol demand rapidly drove prices to the $5/gallon range which ultimately was the impetus for the rapid development of the industry. The MTBE oxygenate replacement is complete, and any future growth in this sector is dependent on population growth.

2.4 Discretionary Blending

Discretionary blending of ethanol extends the supply of transportation fuel. While ethanol does not displace gasoline gallon for gallon because of a difference in energy content, it does reduce the amount of petroleum based gasoline used in the US. This application is dependent on profit incentives associated with blending ethanol into gasoline. Currently, a blender can blend 9 gallons of $2.50 gasoline with one gallon of $2.30 ethanol plus gets an additional 51¢ blender tax credit. The blender then sells the blended gasoline for $2.50 a gallon. This works out to a 7.1¢ a gallon profit on top of blender's normal profit margin. The profit margin for using ethanol is a major reason the petroleum industry is rapidly expanding its use.

3 ETHANOL MARKET

Under the current expansion, it is possible that essentially every gallon of gasoline in the US will

contain 10% ethanol in the next couple of years which is a head of the RFS time table. This puts a ceiling of 14 billion gallons on the fuel ethanol market. E85, the other certified ethanol based fuel, market is growing at a slow rate. Current E85 use is approximately 50 million gallons a year and it is not expected to have significant major market penetrations in the near-term even with the RFS funding provisions.

So, how will fuel ethanol be used in the transportation fuel market once the 10% blending wall has been reached? The EPA is currently evaluating mid-level blends of ethanol (E15 and E20). Early testing of these blends indicates enhanced handling characteristics and automobile engine performance. More stringent testing is still underway and the EPA has not indicated when it will make any decisions the use of E15 and E20.

Another alternative being explored is the blender pump that mixes gasoline and ethanol at the pump. These pumps have gain favor in Brazil where ethanol has been a major component of their transportation fuels since the 1970's. The pump allows the consumer to decide how much ethanol to mix with gasoline. Several test pumps in the US have shown high customer acceptance. Of course, using ethanol in current conventional automobile engines above 10% is voids most manufacture's warranties.

Finally, there are efforts to increase the use of E85. E85 faces the "chicken and the egg" syndrome. Without enough flex fuel vehicle (FFVs) vehicles that can use E85 concentrated in a particular area, service stations providing the fuel do not make a suitable profit. Auto manufactures complain that without an E85 distribution infrastructure in place it doesn't make sense to manufacture FFVs because the public does not perceive an opportunity to use the fuel. Without legislation and/or action on the Executive side of the political aisle the Fuel Ethanol Industry will stop growing and there will not be room in the ethanol market for the much touted cellulosic ethanol.

Not everyone sees the expansion of the ethanol market as a "good thing." The petroleum industry views ethanol above the 10% blending level as direct competition with gasoline in the transportation fuel market. While they're making profits from the use of ethanol under current government policies there is no interest on their part to see an expanded ethanol market at the expense of gasoline. Animal producers, in general, feel ethanol demand for corn has increased the price of their feed stuffs (corn and soybeans) that has reduced their profit margins. Environmentalist fear that expanded demand for corn and soybeans will result in increased water pollution from fertilizers and carbon release from changes in land use (conversion of natural prairie and forest to intensive production farm land). These groups have brought up issues of energy sustainability and content, greenhouse gas reduction benefits, pollution, and food vs. fuel which the fuel ethanol industry and grain farmers counter as unfounded smoke screens for continued business as usually.

It is true that first generation biofuels (corn ethanol and biodiesel from the transesterfication of fats and oils) have limitations and their production as well as the production of their feedstocks needs to be done using "best practices" to avoid doing more harm than good. This is true as well for the next generation of biofuels to be produced from biomass instead of starch, sugar, fats, and oils. Renewable biofuels are not a silver bullet, as long as we use the internal combustion engine with liquid fuels for transportation there will be issues with fuel production, fuel availability, fuel performance, and air and water pollution.

The current expectations are that fuel ethanol will play a major role in the US transportation fuel mix and will grow as outlined in the RFS. How this will actually occur however is yet to be determined. It is very possible that the growth of the industry will not be consistent and may be punctuated with periods of rapid growth and down turns as the free market, lenders, and investors respond to government policy, technology development, global economics, and public opinion.

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