ECONOMIC BENEFITS AND CHALLENGES TO BIOFUELS EXPANSION*

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Introduction

There is not a question of whether there will be biofuels expansion; the essential questions are: How much? Under what conditions? And with what impacts? We will focus on ethanol, which is probably at the peak of the big spurt of expansion. Ethanol prices have declined from the very high prices in early 2006 and there is a several-year backlog for plant construction. However, this enterprise is still highly profitable at current corn and petroleum prices. The extremely high ethanol prices in the first half of 2006 not only reflected high oil prices, but also shortages of oxygenate when MTBE use was being reduced. We are not likely to see that high oxygenate premium again. When considering the impacts of the current biofuel expansion in terms of benefits and challenges, there are those who see only benefits and those who see only challenges or negatives. The truth is probably somewhere in between.

How Much Biofuel and Under What Conditions?

For ethanol or soy biodiesel today, the limitation is the availability of corn and soybeans at a price that allows a profit against the cost of gasoline or diesel. The current situation is more favorable for ethanol. Soy biodiesel needs the federal subsidy of a dollar a gallon to be profitable. For ethanol today, the market provides adequate return without the subsidy. These profit levels will ultimately determine the answer to the "how much?" question. Expansion of ethanol production can continue as long as profitability remains intact.

Current ethanol capacity is 5 billion gallons. Corn use for ethanol from the 2006 crop is expected to be 2.15 billion bushels, about 20% of the crop. New ethanol plants and expansions that have broken ground or are under construction will add another 3.7 billion gallons of capacity. These 8.7 billion gallons will require 3.2 billion bushels of corn a year now, or about 25% of expected 2007 crop production. By 2010, we expect roughly 30% of the corn crop to be going to ethanol. This is comparable to the portion of the crop that we exported at the height of the export boom in the 1970s. But there will likely also be an expansion of corn acres at the expense of soybeans — in rotation changes or in actual acreage shifts. Current speculation is that we will move to 90 million acres of corn at prices in the $3 to $3.50 range. If this is the case and if petroleum prices stay in the $60 range, ethanol production will still be highly profitable and ethanol based on corn will continue to expand, but at a much slower rate in 2008 and later.

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Figure 1.

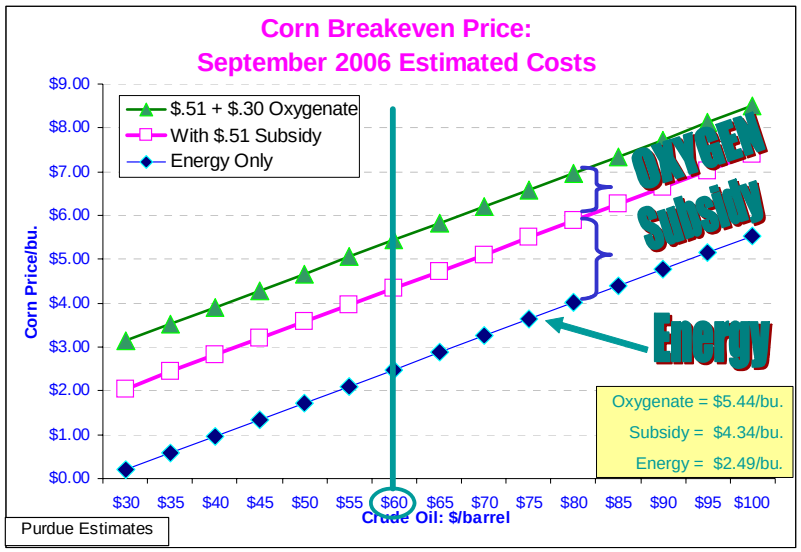


Figure 1 shows the corn breakeven price for ethanol for different petroleum and corn prices. At $60 a barrel for crude oil, the energy value of ethanol (at 70% of the value of gasoline) would allow a corn price of up to $2.49 a bushel before the ethanol plant began to loose money. With the $0.51 per gallon ethanol subsidy, the breakeven corn price (holding at $60/barrel oil) is $4.34. If you then consider an added value of $0.30 per gallon of ethanol for the oxygenate that ethanol provides in gasoline blends, then the breakeven becomes $5.44 per bushel of corn. Does this mean that ethanol plants will continue to be constructed until corn reaches and stays at $5.44 a bushel? Probably not, as that would assume that oil stays above $60 a barrel. It also assumes a continuation of an increasingly expensive $0.51 a gallon subsidy for ethanol which, at current corn and oil prices, is not essential for maintaining the ethanol industry. Without any subsidy, at $60 a barrel oil, the breakeven corn price is $3.59 with just the oxygenate credit.

There are proposals in Congress for replacing the fixed ethanol subsidy with a variable subsidy that would come into play only when oil prices dropped below a certain amount set relative to corn price fluctuations. This would both continue to protect the investment in ethanol capacity and remove much of the extra incentive to continue to build ethanol plants when it is not economic to do so based on market prices.

Alternatives such as cellulosic conversion, coal liquefaction, and oil from tar sands, may, in fact, set the competition that ethanol will have to meet. If coal liquefaction can be accomplished for $45 a barrel, tar sand oil for $40 and cellulosic ethanol for less than corn-based ethanol, this will drag down both the price of gasoline and of ethanol over time. If petroleum stays at $60 or more for a few years and/or something like the proposed variable subsidies or an oil price floor guarantee are given to the coal liquids, tar sands, and cellulosic ethanol producers, we would expect these various substitutes to develop. They would then limit the growth of corn-based ethanol when it is a higher priced alternative.

What is the bottom line? Looking into the uncertain future, we might see 10 to 11 billion gallons of ethanol being produced with 3.7 to over 4.1 billion bushels of corn in 2010. This might be a peak of production for ethanol from corn. By 2010 to 2012, if oil prices stayed high enough to encourage this continued growth of ethanol production we should begin to have growing production of oil from tar sands, coal liquefaction, and cellulosic ethanol.

What Impacts?
What kinds of impacts are we going to see from what kinds of biofuels? We do not see a tremendous expansion of biofuel use as a heat producing fuel beyond the kinds of uses that are common today. We will continue to see the wood industry burn wood waste to power their operations and maybe sell some electricity. We will not see any great expansion of co-firing biomass with coal. Biomass materials are hard to harvest, assemble, and store. They obtain higher value as a chemical feedstock than merely as a fuel for heat.

We will see expansion of biodiesel, but the potential replacement impact of biodiesel against the amount of diesel fuel we use is less than the potential replacement of ethanol for gasoline. Biodiesel is also a more expensive replacement relative to ethanol. Where biodiesel may have an important niche is as a B2 (2%) blend with conventional diesel fuel. As of now the new EPA diesel fuel requirements reduce the lubricity in oil-based diesel to the point where engines are damaged. A 2% biodiesel blend adds lubricity. What this indicates is a potential premium for biodiesel like the oxygenate premium for ethanol.

Transportation
One impact that few considered initially with the development of ethanol was the shift required in logistics and transportation. Such shifts would be as great or greater moving to large utilization of cellulose biomass. Corn that had storage and transport systems developed to move to the gulf ports or the Southeast from the Midwest would now stay in the Midwest and new transportation is needed to move ethanol to East and West Coast urban centers where most of the gasoline is consumed. The volumes involved are large. One ethanol plant of 100 million gallon capacity in Linden, Indiana will require 10,000 rail cars of corn a year that would have gone to export or the Southeast to feed hogs or poultry. These adjustments are substantial and there are winners and losers. Some terminal grain elevators that stored and shipped grain out of the corn surplus areas will become origination facilities for ethanol plants.

Distillers' Grains and Animal Industries
There is increased discussion of the food versus fuel trade-off for both ethanol and biodiesel. With respect to livestock feed, the response to this has been that increased ethanol production yields increased amounts of high protein dry distillers' grains (DDG) that could replace soybeans in animal rations and thus limit the impact of soybean acreage going to corn. The real question is how much DDG can be successfully used in livestock rations. Beyond that is the question of the impact on the livestock industry of potential increases in feed prices doe to ethanol's demand for corn.

By the fall of 2007, Indiana ethanol plants will be producing an estimated 1.5 million short tons of DDGs. This is a feed resource that can substitute for corn and soybean meal in animal diets depending upon the specific distillers' product and the species. Recommended inclusion rates are highest for beef and dairy cattle and much lower for hogs and poultry. Unfortunately, animal numbers in the Eastern Corn Belt and southeastern United States are heavily biased toward hogs and poultry. Using generous acceptance rates for Indiana, only about 1 million tons of the distillers grains might be used in the state; thus, large portions will need to be exported out of the state even by the fall of 2007.

Since cattle can best utilize distillers' co-products, expansion of cattle in Indiana could be one of the potential outcomes. Having cattle close to the ethanol plant is an additional economic advantage if the distillers' grains do not have to be dried. Cattle feeding is probably the highest single value for the distillers' grains. Stimulation of cattle feeding in Indiana remains a possibility if environmental and "neighbor" concerns can be managed. Dairy expansion may also result, although high phosphorus content in the distillers' grains, the potential for high mycotoxin levels, and wide quality variability of the feed

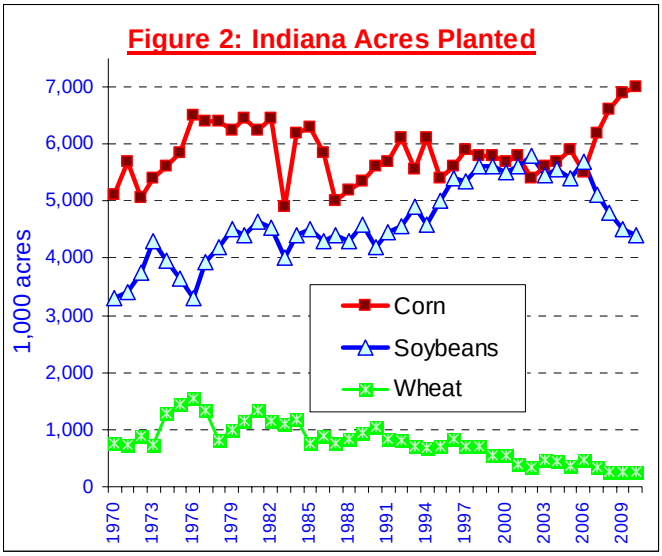
product remain concerns. Indiana dairy cow numbers have been expanding by about 5% per year and could be further stimulated by the growth of ethanol production.

Overall, the animals industry will probably be net losers from the growth in corn use for ethanol. The main reasons are that ethanol demand will drive corn prices higher and most species will not be able to get sufficient cost-lowering advantages from distillers' grains to offset the higher corn prices. The exception to this may be cattle on feed if distillers' grains can largely replace corn in diets. The animal industry ranking from those least harmed to most harmed is: cattle on feed, beef cattle, dairy, hogs, and poultry.

Not enough is known yet of how to feed distillers' grains to hogs and poultry and the impacts on growth rates, performance, and meat quality. This is an area that needs a large amount of research. Universities and others are gearing up to help find the answers too many of these questions.

Agronomic Implications

There are many agronomic implications as well. Figure 2 shows the potential impact on Indiana planted acres if ethanol continues to expand. Currently, one plant at South Bend is in production and uses about 38 million bushels of corn per year at capacity. There are five plants under construction at Renesselear, Clymers, Marion, Linden, and Portland. These five plants will have the capacity to produce an additional 355 million gallons of ethanol and require an additional 130 million bushels or 15% of the 2006 crop.



Beyond these plants, the Indiana State Department of Agriculture is working with an additional 7 plants with capacity of 750 million gallons of ethanol that would use about an additional 280 million bushels of corn. As shown above, there is a long list of plants even beyond these that are considering an ethanol facility. The point is that there will be a huge growth in the demand for corn in coming months that will cause corn prices to be high relative to soybeans giving the incentive to plant more corn acres.

As illustrated in Figure 2, Indiana corn acres could rise to nearly 7 million acres by 2010 with soybean acres dropping to 4.4 million and wheat down to 250,000. While no one knows for sure the exact acreage, these rough estimates would result in Indiana's primary crops being 60% corn, 38% soybeans, and only 2% wheat. The drive for more corn acres would move the state in the direction of a corn-dominant monoculture. There are major implications for the ability to maintain yields under increased threats of disease, insect, and weed pests due to reduced rotations. In addition, the environmental

consequences of much more corn would have to be examined as corn uses more synthetic fertilizers, herbicides, pesticides, and insecticides.

Farm Management, Marketing, and Farm Incomes

From a farm management standpoint, producers will be challenged to plant more acres of corn in the same "optimum" corn planting window, as well as to harvest more corn in the optimum harvest window. Handling and storage capacities may have to increase by about 15% by 2010 to handle the extra corn production.

The large growth in corn demand will result in higher corn prices, which will stimulate more corn acres. These added corn acres will draw land away from other crops, particularly soybeans, and soft wheat in the Eastern Corn Belt. This means that prices of those competitive crops also will rise over time. If corn is $3 to $3.50 per bushel as an example, this means that soybeans might be about $6.75 to $7.90 if soybeans maintain a 2.25/1.0 price ratio over corn. Over the past 15 years that ratio has been closer to 2.5/1.0, but will likely be lower in coming years as the market tries to stimulate more corn acres relative to soybeans.

Higher crop prices mean that farm incomes will improve in coming years. However, incomes will rise for cropping enterprises and generally fall for animal enterprises. Since Indiana farm receipts are about 2/3 crops and 1/3 animals, the gain in crop incomes will more than offset reductions in animal enterprise incomes. Hog and poultry producers in Indiana are expected to suffer the largest negative income consequences, especially in 2007 and 2008. By 2009, hog and poultry inventories will likely move lower across the country due to poor margins. This, in turn, will result in reduction in the national supply and then retail and farm level prices will be higher, probably by 2009. Beef cow and dairy operations are also expected to see deteriorating incomes, while cattle feeders will not be as strongly affected as higher feed prices are offset by lower purchase prices for incoming calves. In addition, distillers' grains can be used to maximum benefit in feedlot cattle.

Crop incomes will not grow by the same amounts that crop prices rise, at least in the initial move from the low prices that have been experienced in recent years. The reason is that federal government programs have supported farm incomes with payments when prices were low. As crop prices rise, the higher market prices are offset by lower government supports. Average annual cash prices in Indiana have to rise above roughly $2.45 per bushel for corn and $5.45 for soybeans before farm revenues really begin to rise. This occurred starting in September and October 2006.

Input Prices

Higher cropping incomes will likely be "bid" into the inputs that producers buy. This includes the tendency to bid up prices for machinery, labor, fertilizer, seed (especially corn seed), land values, and cash rents. Costs of production, especially land, will be expected to rise in coming years to match the higher crop prices. In many cases, landowners will ultimately be the major beneficiaries of increased corn and soybean prices.

Summary

Biofuels are going to change the face of Indiana agriculture in the next year as five new ethanol plants come on line. These new plants, plus the one existing plant, will utilize about 20% of the state's 2006 corn crop. Many more plants are on the drawing board, but only time will tell how many of these will be built. Ethanol is clearly in the lead, but soy biodiesel is emerging as well, and potential plans for a large plant in Kosciusko County in 2008 could also alter the Indiana soybean sector.

By October 2007, the national ethanol capacity will reach 8.7 billion gallons and consume about 3.2 billion bushels of corn, or 26% of the expected national production. The current rate of growth will likely slow considerably in 2008 as constraints begin to set in, such as higher corn prices, higher construction costs, lower crude oil prices, and reduced ethanol values as MTBE is largely replaced by ethanol. However, it appears likely that the industry will reach at least 10 to 11 billion gallons by 2010. Beyond 2010, there can only be moderate growth of the ethanol industry from corn grain feedstock. The hope is that cellulosic ethanol extraction can be perfected and become cost effective. If so, a continuation of major changes will face Indiana agriculture — even the very crops that are produced. Beyond 2010 there may also be competition in the liquid fuels market from tar sands and coal liquefaction.

Regardless of the outcomes of cellulosic ethanol, the implications for Indiana agriculture in the next few years are many. Transportation infrastructure will have to be modernized to fit the new model product flows. Massive supplies of distillers' grains will be available for livestock, but associated challenges remain in product quality, concerns for phosphorus content, potential mycotoxin levels, impacts on meat quality, and low inclusion rates for poultry and hogs. Agronomic implications include shifting to much larger corn acreage in the state with concerns about reductions in rotations and environmental consequences of intensive corn production.

Higher corn acreage means farmers will need to plant much more corn in the same number of days in the "optimum" spring planting window. Grain handling and storage issues at harvest are magnified as well. Farm incomes for crop producers will expand in the next two years while incomes for animal producers will decline. Overall state farm income will rise, however, since crop revenues are about twice the volume of animal revenue in Indiana. Higher cropping incomes will likely result in bidding up prices for major farm production inputs such as machinery, labor, land prices, and cash rents.

While the future suggests much change, the continued growth of biofuels industries has vulnerabilities as well. Some of these include the possibility of much lower crude oil prices, potential changes in governmental supports for biofuels, changes in consumer attitudes with regard to biofuels, development of other fuel sources such as coal liquefaction, and (of course) much higher corn and soybean prices that will narrow or eliminate biofuel margins.

Indiana Ethanol Plants

	Operating Plant	City	County	Capacity MGY	Capacity Million bu.	Type	Approximate Announcement
1	New Energy Corp.	South Bend	St. Joe	***102***	***38***	Dry	
	Under Construction (RFA)*						
2	AS Alliances Biofuels, LLC-Cargill	Linden	Montgomery	100	37	Dry	
3	Iroquois Bio-Energy Company, LLC	Rensselaer	Jasper	40	15	Dry	
4	Central Indiana Ethanol, LLC	Marion	Grant	45	17	Dry	
5	The Andersons Clymers Ethanol, LLC	Clymers	Cass	110	41	Dry	
6	Premier Ethanol, LLC (Broin Companies)	Portland	Jay	60	22	Dry	6/1/06
				355	**131**		
	State Announcement-Working with ISDA						
7	Putnam Ethanol, LLC	Cloverdale	Putnam	60	22	Wet	6/29/05
8	Rush Renewable Energy, LLC	Rushville	Rush	60	22	Dry	12/19/05
9	AS Alliances Biofuels, LLC-Cargill	Tipton	Tipton	100	37	Dry	5/1/06
10	Central States Enterprises, Inc.	Montpelier	Blackford	110	41	Dry	5/2/06
11	Cardinal Ethanol	Harrisville	Randolph	100	37	Dry	5/4/06
12	AS Alliances Biofuels, LLC-Cargill	Mt. Vernon	Posey	100	37	Dry	6/13/06
13	CGB, Inc./Aventine Renewable Energy	Mt. Vernon	Posey	220	81	Dry	8/11/06
				750	**278**		
	Considering to Rumored						
14	Hartford Energy LLC	Hartford City	Blackford	63	23	Wet	9/18/05
15	Indiana Bio-Energy, LLC	Bluffton	Wells	100	37	Dry	10/1/05
16	Indiana Ethanol, LLC		Randolph	50	19	Dry	10/1/05
17	Maize AgriProducts	Fowler	Benton	50	19	Dry	2/2/06
18	Louis Dreyfus Group	Claypool	Kosciusko	100	37	Dry	3/8/06
19	The Andersons, Inc.	Dunkirk	Jay	100	37	Dry	4/7/06
20	Indiana Renewable Fuels, LLC	Near "County Line Landfill"	Fulton	100	37	Dry	4/21/06
21	Morning State Energy	Pittsboro	Hendricks	100	37	Dry	6/6/06
22	U.S. Ethanol Holdings, LLC	Muncie	Delaware	100	37	Dry	9/14/06
23				*100*	37	*Dry*	*Pre-Announcement*
				863	**320**		

*According to Renewable Fuels Association
http://www.ethanolrfa.org/industry/locations/

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This information is not official. It is from local newspapers and other sources believed to be accurate. However, there may be discrepancies for a number of reasons. Some plants are merely proposals and will not be built.

How Much of Indiana's 2006 Production?

	% 06 Prod
Existing	4.3%
Under Construction	14.9%
State Announced-Working with ISDA	31.5%
Considering to rumored	36.2%
Sum	86.9%