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Challenges to Producer Ownership of Ethanol and Biodiesel Production Facilities

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This study examines the rapidly expanding biofuels industry and identifies challenges for producer-owned biofuel projects. The U.S. ethanol industry has been growing rapidly, and biodiesel production is poised for similar growth. Producer involvement is driven by the desire to add value to farm commodities and the impact of biofuel projects on local grain prices. Local state and federal incentives have also stimulated producer interest. The long-run profitability of biofuel projects is driven by feedstock availability, access to market centers for biofuels, access to markets for coproducts, and utility costs and availability. The rapidly increasing size and scale of ethanol and biodiesel plants make it difficult for producers to fund these projects. Additionally, the development and adoption of new non-grain biofuel technologies may negate some comparative advantages of producers, such as feedstock cost and availability. The geographic expansion of biofuel projects into grain deficit regions will also create additional challenges.

Key Words: alternative energy biodiesel, ethanol, producer-owned business

JEL classifications: O13, Q42, Q55

The U.S. ethanol industry has been growing rapidly, and biodiesel production appears to be poised for similar growth. Ethanol production has increased at over 445 million gallons per year for the last five years, an annual growth rate of over 20% (Dhuyvetter, Kastens, and Boland 2005). Eighty-one plants located in 20 states produced over 3.4 billion gallons of ethanol in 2004 (Renewable Fuels Association 2005). Ethanol now represents approximately 2% of U.S. gasoline consumption. Over 12% of U.S. corn and sorghum production is now consumed by the ethanol industry. U.S. biodiesel production is at much lower level, with 2005 production estimated at 50 million gallons. However, biodiesel production is also expanding rapidly. One hundred million gallons of new capacity is scheduled to be on-line in 2006, and over 25 firms have announced new projects with a combined capacity of over 250 million gallons.

Agricultural producers have been heavily involved in the growth of the ethanol and biodiesel industries. Based on the Renewable Fuels Association's list of production facilities, over half of the currently operating ethanol plants are farmer-owned. Producers are also participating in the expansion of the biodiesel industry. For example, Minnesota Soybean Processors is completing a 30 million gallon facility in Brewster, MN, owned by 2,300 farmer-members, and SoyMor, a cooperative based in Lea, IA, with 700 farmer-members recently completed a 30 million gallon plant in Glenville, MN.

Producer involvement in biofuel projects has been driven by a number of factors. Biofuel project investment reflects producers con-

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tinued interest in "value-added" activities. Biofuel production is perceived as a means of further processing corn, sorghum, and oilseeds and generating increased returns. Feasibility projections for ethanol and biodiesel projects often have projected returns on investment of 25% or higher. After watching many producer-owned food products manufacturing projects struggle with competition, branding and market access issues, many producers perceive biofuel projects as a more attractive value-added alternative. The recent trends of low grain prices and increasing petroleum prices have further stimulated interest in grain to fuel transformation processes.

Many producers also anticipate that biofuel production will increase the demand for the grain feedstocks and lead to higher grain prices. McNew and Griffith studied corn prices surrounding 12 ethanol plants that opened between 2001 and 2002 and found an average increase of 12.5 cents/bushel. Other studies have estimated grain price impacts of 5–10 cents/bushel (Dhuyvetter, Kastens, and Boland 2005). The majority of existing ethanol and biodiesel plants has been built in areas of high grain production (Illinois, Iowa, Nebraska, Minnesota, and South Dakota). Therefore, it is not surprising that producers and the agricultural communities have viewed the price externalities associated with biofuel production as positive.

Finally, political, regulatory, and tax incentive issues have also heavily influenced ethanol and biodiesel production. The federal tax code contains four tax incentives that directly or indirectly benefit ethanol producers. These include the 5.4¢ per gallon excise tax exemption for alcohol based fuels, the 54¢ per gallon blender's tax credit, the 10¢ per gallon small ethanol producers' credit, and the income tax deduction for alcohol-fueled vehicles. Nineteen states currently have additional incentive for ethanol production in the form of state excise tax exemptions and/or production tax credits (Renewable Fuels Association 2005). Biodiesel producers are also positively impacted by federal and state tax incentives. The Renewable Fuels section of the 2005 Energy Bill also provides a 10¢ per gallon payment for small (less than 65 million gallon) producer-owned biodiesel facilities. Biodiesel blenders also receive up to $1.00 tax credit for each gallon of vegetable oil–based diesel. The U.S. Department of Agriculture (USDA) Commodity Credit Corporation also provides payments for new or expanded biodiesel capacity. A number of states also offer incentives for biodiesel production.

Regulatory issues are also playing a role in the expansion of the ethanol and biodiesel industries. Legislation by several states to eliminate methyl tertiary butyl ether (MTBE) as a fuel additive has increased demand for ethanol. EPA regulations requiring lower sulfur content in diesel fuel, which will be phased in beginning in 2006, are anticipated to have a similar impact on demand for biodiesel. The 2005 Energy Policy Act is also stimulating interest in ethanol and biodiesel. Meeting the renewable fuel production mandates contained in the legislation will require the ethanol and biodiesel industries to more than double in size by 2012.

As the ethanol, biodiesel, and other biofuels industries continue to evolve, producer-based projects will experience new challenges. Some of these challenges will relate to the geographical expansion of ethanol and biodiesel production facilities. Other challenges will relate to economies in size in biofuel manufacturing and the interrelated capitalization issues. Another major category challenge relates to the markets for the feed coproducts from ethanol and biodiesel production. Finally, technological advances in biofuel production, including cellulose-based ethanol production, could have major impacts on both existing and future biofuel projects. All of these challenges relate to central issues of the long-run structure of the biofuel industry and whether producer-owned projects can compete as least-cost producers.

As previously discussed, the ethanol industry is currently concentrated in the upper Midwest. Most of the plants located outside of the grain belt are smaller plants and/or use non-grain feedstocks (Dhuyvetter, Kastens, and Boland 2005). The biodiesel industry is somewhat more dispersed, with operating or proposed plants in 29 states (National Biodiesel Board 2005). Many of the biodiesel plants located outside of grain production areas use animal fats as a feedstock. As the biofuel industry matures, economic factors are likely to lead to a greater geographic dispersion of production.

Economic Factors Impacting Bioenergy Plant Locations

Several factors affect the economics of locating and operating an ethanol or biodiesel plant. Major factors include: feedstock availability, access to market centers for biofuels, access to markets for coproducts, utility costs and availability, and state/local incentives. In southern states, where traditional biofuel feedstocks such as corn and sorghum feedstocks for ethanol and soybean and oilseed inputs for biodiesel are more limited, the economic factors and incentives that have the greatest impacts on plant location decisions may be vastly different from those in the upper Midwest.

Feedstock

The geographic concentration of ethanol plants in the upper Midwest has been driven by abundant feedstock supply and low grain transportation costs. Likewise, most biodiesel plants have historically been located next to soybean crushing facilities in soybean-rich production areas. However, market forces are negating some of this traditional logic for future plants. Unit-train transportation has reduced the differential grain sourcing costs to the extent that regions with advantages in final product or coproduct marketing and/or more favorable utility cost can compete as a least-cost supplier. Recent ethanol projects in the Texas Panhandle and north-central Oklahoma plan to acquire the majority of their grain needs via out-of-state unit-train shipments. These plants' advantages in access to cattle feed yards and low natural gas prices will presumably offset grain acquisition costs. Recently announced biodiesel plants in south-central Oklahoma and southeast Texas (both grain-deficit regions) are pursuing similar strategies. The plants plan to ship in refined, degummed soybean oil by rail and water transportation.

Fuel Utilization

Market access and market potential are also important considerations in plant location decisions. Market access relates to the ability of a biofuel plant to successfully integrate its biofuel production into the local/regional fuel distribution system, either through its own marketing efforts or through contracts with existing petroleum refineries, distributors, or retail fuel marketers. Gasoline consumption in the United States is highest in the West Coast, East Coast, and Gulf Coast regions (Department of Energy [DOE], 2001), while the largest concentration of refineries is along the Gulf Coast. Final product marketing costs contribute to the economic rationale to locate biofuels facilities outside of the corn belt.

The most common factors driving market potential are regulatory requirements for replacing methyl tertiary butyl ether (MTBE) as an oxygenate in gasoline and low/no-sulfur diesel. As more states establish laws to reduce emissions and replace MTBE, the potential for biofuels producers to access new and growing markets increases. These changes also create more challenges for the utilization of coproducts from biofuel production.

Coproduct Markets

The most common coproducts associated with biofuel production are distiller's grains with solubles (DGs) from ethanol plants and oilseed meal generated in the production of oils for biodiesel refining. Each bushel of corn used in ethanol production yields approximately 17 pounds of dry distiller's grain with solubles (DDGS). The DDGS coproduct represents roughly 30% of the feedstock by weight. Distiller's grain functions as a mid-level source of protein and provides some energy in livestock rations. The marketing of distiller's grain coproducts provides 10–20% of the total revenue of an ethanol plant (Coltrain 2004). Marketing wet distiller's grain with solubles (WDGS), which is usually targeted toward cattle feedlots and dairies, eliminates drying costs. Distiller's grains must be dried before they can be incorporated in swine and poultry diets.

Depending on the oilseed used, the feed byproduct from oilseed-based biodiesel production represents 60–80% of the feedstock weight. While protein content varies across oilseeds, oilseed meals are considered a high-level protein source suitable for both ruminant and nonruminant livestock.

Biofuel-generated additional coproducts have significant value in certain markets. For example, ethanol plants generate carbon dioxide (CO_2) that can be captured and sold to companies involved in a number of activities, from coolant in the manufacturing of refrigerated-frozen foods to oilfield recovery. Biodiesel production generates glycerin, which may be used in a variety of manufacturing activities, including the production of soap and the development of films and casing materials.

Utility Costs

Rising prices for natural gas and electricity have also had an impact on the future locations of biofuel plants. Ethanol plants utilize considerable amounts of natural gas, especially if the plants market DDGs. Thus, the availability of low-cost natural gas becomes an important determinant of plant location, as does the potential to market WDGs. Biodiesel plants are relatively low-utility operations compared to ethanol plants, but the crushing facilities typically colocated with a biodiesel refinery utilize significant amounts of electricity.

Incentives

As previously mentioned, state incentives have contributed to the rapid expansion of the biofuel industry in the upper Midwest. For example, Minnesota provides both production incentives and consumption mandates for ethanol and biodiesel. However, state-level biofuel incentives are also expanding geographically. Anxious to participate in the perceived value-added returns, agricultural producers outside of the grain belt have pushed for similar biofuel production incentives. Oklahoma and Texas have both created production incentives for ethanol and biodiesel despite the fact that corn and soybean usage already far exceeds in-state production.

Future Markets for Feed Coproducts

The large projected increase in ethanol production over the next 5–10 years has led to speculation that the supply of distiller's grain will outpace demand (Cooper 2005). The majority of the U.S. soybean crop is currently used by the crushing industry. Increased soybean-based biodiesel production will therefore impact soybean oil markets but will not impact the protein meal markets. However, biodiesel projects in the southern plains and other regions are predicated on a production shift to canola, rapeseed, sunflower, and other oilseed crops. To the extent that biodiesel production stimulates soybean production and/or increases production of other oilseed crops, it will also contribute to the oversupply of the protein market.

Dhuyvetter, Kastens, and Boland examined potential distiller's grain consumption based on U.S. livestock inventories. The total potential market for distiller's grain was projected at 56.1 million ton/yr, while production was forecast to reach 24 million tons/yr by 2012. Cooper estimated a lower level of potential demand at 42 million tons/yr. Neither study considered the impact of the shift to distiller's grain products on the markets for the roughly 40 million tons of oilseed meal that is produced in the United States each year. The regional demand for protein feeds could have substantial impacts on the viability and location of future biofuels projects. Dhuyvetter, Kastens, and Boland analyzed the density of potential distiller's grain consumption in tons per square mile. The analysis documented the high density of distiller's grain demand in the Midwest (presumably served by existing ethanol plants); it also identified a region composed of western Oklahoma, southwest Kansas, and northwest Texas as high-demand density. The remainder of the potential consumption was fairly evenly dispersed across the eastern half of the United States.

Scale Economies and Capital Constraints

The average size of new (dry milling process) ethanol plants has grown consistently from 10–15 million gallons in 1990 to 30 million gallons by 2002. By 2004, a 100 million gallon/yr plant was on-line in South Dakota, and 15 other 100 million gallon/yr plants were announced. Mirroring this trend has been the shift away from farmer ownership. Based on announced plant developments, farmer-owned projects represent only 26% of new capacity. Morris (2005) predicts that within three years 75% of ethanol production will come from nonfarmer-owned plants. This trend is being driven both by the willingness of outside investors to participate in the biofuel industries and the difficulties of farmer groups in supplying the capital and grain deliveries required by cooperative business structures.

Dhuyvetter, Kastens, and Boland suggest that this shift in ownership structure will mean that the benefit of biofuel on crop producers will be reflected in grain crop demand as opposed to value-added returns. While this may be the case in the grain belt, a shift toward large, nonfarmer-owned plants has greater implications for other regions. In grain deficit areas, where an increase in grain prices is perceived as a negative externality, the development of investor-owned biofuel plants could actually have a negative impact on the agricultural community. The projected domination of the biofuels industry by large, investor-owned plants coupled with concern over whether the industries will become overbuilt, raises concerns about whether current producer investors are underestimating the risk of the biofuels industries.

Issues Impacting Producer-Owned Bioenergy Facilities in Grain-Deficit States

The biofuels industry is expanding into grain-deficit regions to locations where the proximity to fuel markets and feed coproduct markets and/or utility savings offset grain-sourcing costs. Producer groups attempting to organize biofuel projects outside of the traditional grain production regions face additional challenges. The challenge of establishing producer support and investment is logistically greater since grain producers are spread over a larger geographic region of production. While feedstock shortfalls can be offset with imported grain, that structure also decreases producer interest. The biofuel project becomes just another off-farm investment opportunity rather than a means of adding value to the farm commodity.

In a grain-deficit region, the impact of the biofuel project on local grain prices also becomes more controversial. In the grain-rich Midwest, any increase in the local grain basis is viewed as a positive externality. Livestock producers in grain-deficit areas view biofuel plants as competitors (Markham 2005; Urbanchuk 2003).

Commodity groups in grain-deficit states may even oppose biofuel development efforts over fears that the efforts may result in increased input costs for and/or decreased production of their commodities. For example, the Oklahoma Cattlemen's Association (OCA) publicly voiced opposition to a proposed ethanol plant over concerns that the increase in local corn prices would result in higher feed prices. Similarly, the Oklahoma Wheat Grower's Association refused to support a proposed canola processing/biodiesel venture because adoption of canola would likely result in fewer planted wheat acres.

Producers in many regions of the United States are continually searching for alternative crops with higher returns. Biofuels projects predicated on the adoption of a new crop or increased local production of a locally grown feedstock face a separate set of challenges. Cropping shifts often involve a trial-and-error learning period and an associated lag time in increasing production. This makes it difficult to develop a critical mass of planted acres and producer investment to support a processing facility. The biofuel project faces the "chicken and egg" scenario, in which it is difficult to establish a plant without a stable feedstock production history, and it is difficult to stimulate feed stock production without an attractive local market.

A good example of this situation is winter canola, which is being promoted as an alternative crop and biodiesel feedstock for the wheat-producing regions of the southern plains (Kansas, Oklahoma, and Texas). The crop production cycle and necessary inputs closely match those for wheat, making canola an excellent rotational crop. However, a study by Kenkel et al. highlights the difficulties in developing a biofuel industry around a new crop. The study examined the relative profitability of canola versus winter wheat using a database of over 70,000 fields and incorporated historic patterns of technology adoption. The authors concluded that, even if predictions of canola profitability were accurate, less than 6% of Oklahoma's "wheat belt" acres would be converted in the first year. The peak adoption (approximately 30% of wheat acres) would require five years. The study concluded that a canola crushing/biodiesel plant would be challenged to reach break-even volume in the early years of adoption.

Impact of New Technologies

Long-term competitiveness in the biofuels industry is dependent upon the ability to be least-cost producers of fuel and marketable coproducts (Bothast 2005). Technical advances have made grain-based ethanol and biodiesel plants less expensive to build and more efficient to operate (Crooks and Dunn 2005). Future technologies to transform nontraditional biomaterials into ethanol and biodiesel will impact the competitiveness of existing biofuel facilities. While these new technologies may create new opportunities for producers in nongrain-producing regions they may also create risk factors for existing producer-owned biodiesel projects.

Developing technologies for creating ethanol from cellulose-based biomass, such as switchgrass or even wood (Hettenhaus; Mielenz 2001; Nalley and Hudson 2003), may someday negate the competitive advantages of corn-based ethanol plants and shift production to timberland or grassland regions. Technologies for in-field production of ethanol from crops such as sweet sorghum (Parrish and Cundiff 1985; Rains, Cundiff, and Vaughan 1990; Worley and Cundiff 1991) could lead to similar regional shifts. New technologies for biodiesel are also possible that allow for production of biodiesel from livestock and poultry processing waste (Wyatt et al. 2005).

Future technologies for biofuel production using nongrain feedstocks may decrease producer groups' comparative advantage in developing biofuel projects. In the past, the producer's comparative advantage has been the preexisting production, ownership, and control of feedstock sources. In the future, biofuel project development may depend on the ability to assemble, transport, and store plant material or waste from livestock operations. The success of other future biofuel technologies may depend on the adoption of alternative energy crops. It remains to be seen if producer groups can compete as project owner/organizers in these new playing fields.

Conclusions and Implications

The biofuels industries, primarily ethanol and biodiesel, have witnessed rapid expansion and have, for a period of time, represented a success story for farmer-owned value-added efforts. However, the dominance of producer ownership appears to be waning as the scale of projects continues to increase. In addition to being larger, it appears that future plants will be more geographically dispersed. While grain acquisition costs have driven the location of current plants, the long-run cost structure will be impacted by grain and coproduct prices as well as utility costs and transportation economics on both the input and output side. The marketing of feed coproducts may become a limiting factor for the success of future biofuel facilities.

The diversification of the biofuel industry outside of the grain belt will also generate additional challenges to producer groups who are attempting to organize and develop successful biofuel projects. Producer investment is likely to be more difficult to obtain, and support for biofuel projects within the agricultural community may be more limited. Biofuel projects involving cropping system changes will face challenges in predicting and managing the crop adoption process. The development of new biofuel technologies based on nongrain feedstocks may also decrease the comparative advantages of producer groups in biofuel project development. These issues do not imply that producer groups should not or cannot play a role in tomorrow's biofuel industry. However, the challenges for producer-owned projects appear to be increasing. As in other industries, the biofuel industry will eventually be dominated by low-cost suppliers. Producer groups interested in entering tomorrow's biofuel industry will need a clear understanding of their comparative advantages and strategies for mitigating a new set of risk factors.

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