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Biofuels

A Major Rural Economic Development Opportunity

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In recent years, a combination of forces has stimulated interest in biomass-based energy and products. Concerns about foreign oil costs and supply disruptions initially spurred interest in alternative energy sources. Environmental concerns also support development of renewable energy sources because biofuels and products derived from biomass are essentially carbon-neutral.[1]

More recently, the mandates incorporated in the Energy Independence and Security Act (EISA) of 2007 provide major support for the biofuels industry, requiring 21 billion gallons of advanced biofuels, of which 16 billion must be cellulosic, by 2022.[2] With the growing interest in biofuels and products, considerable discussion has taken place in the literature regarding conversion technologies and feedstock availability and cost.

However, one aspect of the biomass-based industry that has received very little attention is its potential as an economic development stimulus for rural areas with high biomass production potential. This publication addresses the rural economic development potential of biofuels development.

Local Economic Impact of Lignocellulosic Ethanol Production

With the growth of corn-based ethanol production, increased attention has been focused on the local economic impact of ethanol plants.[3,4,5] These studies have shown that the local impacts of corn-based facilities are moderate because the corn they utilize otherwise would be sold to other markets, and local effects arise primarily from worker payrolls and other local expenditures for supplies and utilities.

Biomass-based plants will have substantially greater impacts because the feedstocks typically will be from sources that do not have a market (for example, agricultural residues, wood wastes) or from biofuel crops grown on lands with limited alternative use (for example, Conservation Reserve Program [CRP] land).

Studies recently completed in North Dakota allow a comparison of the economic impacts of the two types of facilities. Hodur et al. examined a recently developed corn ethanol plant; the plant had a production capacity of 50 million gallons per year (MGPY), employed 40 workers and made annual expenditures of

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about $16.8 million to North Dakota entities.[5] Purchases of corn were not included in this total because the corn otherwise would have been sold to markets outside the state.

An input-output model was used to estimate secondary and total economic effects. The plant was estimated to result in total (direct plus secondary) economic impacts of approximately $45.8 million and support nearly 500 jobs in other sectors of the state economy. These impacts are somewhat larger than those reported by other studies.[4, 5] The differences arise from two sources: (1) Hodur et al. examined the economic impact or contribution to the state economy, whereas the other studies generally used the site county as their unit of analysis, and (2) the plant was fueled with North Dakota coal, so the plant's fuel costs ($8.25 million annually) represented an in-state expenditure.[5]

As part of an analysis of the economic feasibility of a biorefinery using wheat straw feedstock, Leistritz et al. estimated the economic impact of a 50 MGPY facility.[6] The base case facility was analyzed using an update of an economic-engineering model developed by the National Renewable Energy Laboratory (NREL).[7] Plant construction cost was estimated to be $176.5 million; during plant operation, $53 million of the plant's $74.6 million annual operating expenditures were estimated to be made to North Dakota entities.

By far the largest expenditure item was feedstock purchases ($36 million). The feedstock purchases represent income for local farmers, custom baling operators and people involved in transporting the feedstock to the plant. The plant directly would employ 77 workers with an estimated payroll of $2.7 million.

Input-output analysis indicated that the $53 million of direct expenditures would result in secondary impacts totaling $130 million for a total contribution to the state economy of $183 million annually. The economic activity generated by the plant would support more than 2,400 jobs in various sectors of the state economy, including people involved in baling and transporting feedstock.

Rural Economic Development Implications of Meeting EISA Mandates

The recently enacted Energy Independence and Security Act (EISA) of 2007 established a Renewable Fuel Standard (RFS) of 36 billion gallons by 2022, of which 21 billion gallons must be advanced biofuels, with a minimum of 16 billion gallons being cellulosic biofuels. If the 16 billion gallon cellulosic mandate is to be met exclusively from domestic production, a substantial number of new biorefineries will need to be developed. If these facilities are assumed to have an annual production capacity of 50 MGPY, 320 new plants would be needed.

While many questions remain about the conversion technologies and feedstock sources that will find the greatest success, one aspect of the industry's development seems virtually assured: The conversion facilities will be as close as possible to reliable feedstock sources. The potential development of the cellulosic-based industry can be illustrated by assuming that conversion facilities are located in proportion to potential supplies of major feedstocks.

A recent NREL study analyzed feedstock availability and determined that agricultural and forest sources accounted for 97 percent of total biomass resources.[8] Agricultural feedstocks (crop residues and energy crops from CRP land) were estimated to total 241 million tonnes nationwide, while forest resources totaled 92 million tonnes, if only the unused portion of primary mill wastes are included.

The states in the North Central region account for 60 percent of total available biomass (75 percent of agricultural biomass and 20 percent of wood). (The North Central region is a group of agricultural states comprising the Corn Belt and northern Great Plains regions. It stretches from Ohio and Michigan to Kansas and the Dakotas *[see Table 1]*.) If 60 percent of the 16 billion gallons of production capacity were in the North Central region, 9.6 billion gallons of capacity would be built. If capacity were proportional to feedstock by state, Iowa would be the leading state with 1.7 billion gallons of capacity, followed by Illinois (1.3 billion) and Minnesota (1.2 billion).

Development of a cellulosic-based industry on this scale could have major rural economic development implications. A 9.6 billion GPY industry would be equivalent to 192 plants with 50 MGPY capacity. Assuming that the values reported by Leistritz et al. are representative of likely investment costs and operating expenditures, the initial investment in 192 50 MGPY plants would be nearly $34 billion and their annual direct expenditures

to local and regional economies would total nearly $10 billion.[6]

The processing facilities directly would employ nearly 15,000 workers, as well as support many thousand additional jobs in feedstock harvest and transportation. Feedstock payments also could represent a substantial income supplement for agricultural producers; nearly half of a plant's annual operating expenditures are estimated to be for feedstock.

To put the magnitude of the potential development in perspective, if development were to occur proportionally to potential feedstock supplies, North Dakota could be the home of 16 plants with production capacity of 826 million GPY. If development were to occur on this scale, the cellulosic ethanol industry's annual contribution to the state economy would exceed that of the state's substantial coal mining and conversion industry.[9]

Table 1. Biomass Resource Availability, North-central States and U.S., 2005

State	Crop Residue	Switchgrass from CRP	Wood Wastes[1]	% of Total	U.S.
	million dry tonnes				
Illinois	19.6	5.3	2.1	27.0	8.3
Indiana	9.0	1.6	1.7	12.3	3.7
Iowa	23.6	10.2	0.7	34.5	10.4
Kansas	7.6	6.3	0.5	14.4	4.3
Michigan	3.6	1.5	2.6	7.7	2.3
Minnesota	14.2	7.9	2.9	25.0	7.5
Missouri	6.0	8.5	2.7	17.2	5.3
Nebraska	10.9	3.3	0.3	14.5	4.4
North Dakota	6.6	10.5	0.1	17.2	5.2
Ohio	5.0	1.6	2.2	8.8	2.6
South Dakota	5.1	4.8	0.2	10.1	3.0
Wisconsin	4.4	3.1	2.7	10.2	3.1
North-central Region	115.6	64.6	18.6	198.8	59.8
U.S.	157.2	83.6	91.7	332.5	100.0
North-central Region as % of U.S.	73.5	77.3	20.2	59.8	

[1] Includes only the unused portion of primary mill residues.

Source: Milbrandt[8]

Implications

The potential economic development contributions of an emerging biofuels industry are particularly significant because many of the areas where such an industry could concentrate have been facing adverse economic and demographic trends in the not-so-distant past. The rural, agricultural counties of the western Corn Belt and northern Great Plains have experienced long-term trends of farm consolidation, leading to fewer and larger farms. In the absence of major nonfarm employers, many counties have experienced substantial out-migration and population losses.[10, 11, 12] Farm households also have become more dependent on off-farm employment.

In North Dakota during the period 1993-2007, the off-farm wages and salaries of farm households more than doubled, growing from $6,847 in 1993 to more than $16,000 in 2007.[13] An emerging biofuels industry could offer the new jobs and economic stimulus that many agriculturally dependent areas have been seeking and also could change the economic and demographic makeup of some Midwest and Great Plains counties substantively.

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