ABF Economics
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CONTRIBUTION OF THE RENEWABLE FUELS INDUSTRY TO THE ECONOMY OF IOWA

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The environment facing the renewable fuels industry improved modestly in 2013 and the economy of Iowa benefitted accordingly. After two consecutive years of decline motor gasoline consumption increased in 2013 and was accompanied by an increase in ethanol consumption. Perhaps the most significant development in was a substantial improvement in industry profitability resulting from declining feedstock prices and relatively strong ethanol and biodiesel prices. Early-season expectations for a good corn crop were exceeded by the largest corn crop on record and were accompanied by sharply lower corn prices. By year's end, cash market corn prices were more than 40 percent below 2012 levels. Biodiesel feedstock prices, notably soybean oil, animal fats and waste greases and oil also declined throughout the year and were about 20 percent below 2012 levels by years end. When combined with higher ethanol and strong co-product prices, net returns over variable costs for both a typical Iowa dry mill ethanol plant and increased nearly threefold in 2013 and biodiesel returns increased nearly fourfold.[1]

Importantly 2013 marked the first commercial scale production of second-generation feedstock ethanol. In particular Iowa benefitted from construction of two second-generation ethanol facilities with an aggregate capacity of 50 million gallons. This capacity is expected to come fully online in 2014.

Iowa's ethanol industry posted a small increase in output during 2013 with the state's 41 operating ethanol plants producing at an annual rate of about 3.8 billion gallons. Iowa continued to lead the nation in ethanol production accounting for nearly 30 percent of U.S. output. Iowa also is the nation's leading biodiesel producer. According to the Iowa Renewable Fuels Association (IRFA), Iowa's 12 biodiesel

[1] Iowa State University AgDecision Maker Ethanol Profitability and Biodiesel Profitability available at http://www.extension.iastate.edu/agdm/energy/xls/d1-10ethanolprofitability.xlsx and http://www.agmrc.org/renewable_energy/biodiesel/biodiesel-profitability accessed January 3, 2014

plants have rated capacity of 317 million gallons and produced 230 million gallons of biodiesel in 2013[2] accounting for about 18 percent of total U.S. biodiesel output. Iowa's biodiesel industry benefitted from reinstatement of the biodiesel blenders' tax credit and an increased RVO for biodiesel.

Both the ethanol and biodiesel industry benefitted from a diversification of feedstocks and co-products. In particular an increasing share of dry mill ethanol plants are recovering industrial corn oil and yields have increased reflecting improvements in technology. This co-product is proving to be an additional revenue stream for ethanol producers and an increasingly important feedstock for the biodiesel industry. In addition to corn oil Iowa biodiesel producers have increased the use of animal fats and waste grease and oils such as used cooking oils. Iowa livestock producers continue to benefit from increased supplies of DDGS and corn oil used as an animal feed supplement.

However, 2013 was not without challenges. Opposition to the Renewable Fuels Standard (RFS) from petroleum and some national livestock and food industry associations continued throughout the year and regulatory pressures continued to challenge the renewable fuels industry. Perhaps most significant was the USEPA's proposal to reduce the 2014 required volume obligation (RVO) for the Federal Renewable Fuel Standard (RFS) for advanced biofuels and cellulosic ethanol and refusal to increase the RVO for biomass based biodiesel. In addition, the Federal tax credits for biodiesel and cellulosic ethanol expired on December 31, 2013 and the Farm Bill – including the important Energy Title – continues to languish in Congress thereby increasing uncertainty for the investment community.

While ethanol consumption approached 10 percent of the motor fuel supply and slow improvements in infrastructure restrained overall growth in the availability and consumption of higher blends of ethanol, the number of refueling stations offering E-85 and E-15 in Iowa continued to expand.

Despite these challenges investment in research and development in biofuels continued to increase. The renewable fuels industry is a significant engine for research and development both in the public and private sectors. Much of the investment in biofuels is R&D aimed at discovering and developing advanced biofuels feedstocks and the technology needed to meet the RFS2 targets for cellulose and advanced biofuels. The primary public sector agencies underwriting investment in biofuels R&D are the

[2] http://www.iowarfa.org/biodiesel_refineries.php

Departments of Energy (USDOE), Agriculture (USDA), and Defense (DOD) and a good share of these public funds are funneled through land-grant universities such as Iowa State. These public funds are leveraged by investments made by private sector firms undertaking research in a wide range of biofuels activities. Reflecting Iowa's importance both as a feedstock and renewable fuels producer many of these firms are investing and spending in Iowa. Based on a review of publically available data we estimate that investment in R&D for biofuels in the U.S. amounted to about $1.7 billion in 2013 and Iowa's share is roughly a quarter of that.[3]

The renewable fuels industry is multifaceted. Ethanol and biodiesel producers are part of a manufacturing sector that adds substantial value to agricultural commodities produced in Iowa. The first and second-generation feedstocks used to produce renewable fuels are largely produced by Iowa farmers, and the R&D expenditures for renewable fuels provide important support for Iowa's schools and universities. Combined, these activities make a significant contribution to the Iowa economy. Based on the size and scope year-end the renewable fuels industry had the following impacts on Iowa's economy in 2013.[4]

- Accounted for nearly $5.6 billion, or about 4 percent, of Iowa GDP;
- Generates $4.1 billion of income for Iowa households; and
- Supports more than 62,000 jobs through the entire Iowa economy. This is equivalent to 4 percent of total State employment.

The annualized contribution of the ethanol and biodiesel industries is summarized in Table 1.

[3] For a discussion of R&D spending on biofuels see "Agricultural Preparedness and the Agriculture Research Enterprise". President's Council of Advisors on Science and Technology. Washington DC, December 2012 and Mary Solecki, Anna Scodel and Bob Epstein. "Advanced Biofuel Market Report 2013". E2 Environmental Entrepreneurs

[4] This study estimates the annualized impact of producing 3.8 billion gallons of ethanol and 230 million gallons of biodiesel on Iowa's economy. These figures reflect the capacity of ethanol and biodiesel plants operating at year's end.

Table 1
Total Economic Impact of the Renewable Fuels Industry for Iowa: 2013

	Purchases (Mil 2013$)	GDP (Mil 2013$)	Household Earnings (Mil 2013$)	Employment (Jobs)
Ethanol*	$10,620.5	$5,038.4	$3,738.0	55,161
Biodiesel	$884.1	$519.2	$313.2	7,073
Total	$11,504.6	$5,557.6	$4,051.2	62,234

* Includes construction and investment in R&D

Methodology

The spending associated with renewable fuels production, construction, and R&D circulates throughout the entire Iowa economy several fold. Consequently this spending stimulates aggregate demand, supports the creation of new jobs, generates additional household income, and provides tax revenue for State and local governments. We estimate the impact of the renewable fuels industry on the Iowa economy by applying expenditures by the relevant supplying industry to the appropriate final demand multipliers for value added output, earnings, and employment.

This study utilizes an economic model known as IMPLAN (Impact Analysis for Planning) to develop this understanding of the economy, including the sectors that support the ethanol industry, the links between them, and the level of economic activity. IMPLAN is a commonly used economic input-output (I-O) model. I-O models are constructed based on the concept that all industries within an economy are linked together; the output of one industry becomes the input of another industry until all final goods and services are produced. I-O models can be used both to analyze the structure of the economy and to estimate the total economic impact of projects or policies. For this analysis, a model for the Iowa economy was constructed using current IMPLAN software and data and used to estimate economic impacts of the ethanol and biodiesel industry. Detail regarding the IMPLAN model and how it was used is presented in Appendix A.

Contribution of the Renewable Fuels Industry

The contribution of the renewable fuels industry to the economy of Iowa is detailed in Table 2.

Table 2

Contribution of the Renewable Fuels Industry to Iowa: 2013

	GDP (Mil 2013 $)	Employment (Jobs)	Income (Mil 2013 $)
Ethanol Manufacturing			
Direct	$221.8	2,253	$204.5
Indirect	$665.0	6,885	$333.2
Induced	$257.7	4,022	$143.2
Subtotal	$1,144.5	13,161	$680.8
Biodiesel Manufacturing			
Direct	$35.4	792	$35.6
Indirect	$302.4	3,487	$178.1
Induced	$181.4	2,794	$99.6
Subtotal	$519.2	7,073	$313.2
Agriculture			
Direct	$558.2	13,729	$540.1
Indirect	$2,022.8	7,570	$1,729.5
Induced	$1,042.4	16,397	$575.6
Subtotal	$3,623.4	37,696	$2,845.3
New Construction			
Direct	$100.5	1,841	$93.6
Indirect	$17.7	237	$11.8
Induced	$41.6	631	$22.7
Subtotal	$159.8	2,709	$128.1
Research and Development			
Direct	$61.4	820	$54.6
Indirect	$21.8	359	$14.2
Induced	$27.5	417	$15.0
Subtotal	$110.7	1,595	$83.8
Total Impact			
Direct	$977.2	19,434	$928.4
Indirect	$3,029.8	18,538	$2,266.8
Induced	$1,550.6	24,262	$856.0
Total	**$5,557.6**	**62,234**	**$4,051.2**

Ethanol and Agriculture

The ethanol industry provides a significant contribution to the Iowa economy, spending more than $10 billion on raw materials, other inputs, goods and services to produce 3.8 billion gallons of ethanol. The largest share of this spending is for corn and other grains used as the raw material to make ethanol, distiller's grains and industrial corn oil. The Iowa ethanol industry currently uses more than 1.3 billion bushels of corn, or about 60 percent of Iowa's corn crop.[5] At 2013 Iowa farm gate prices this amounts to $8.3 billion of revenue to Iowa corn farmers. In addition to providing a growing and reliable domestic market for Iowa farmers, the ethanol industry also provides the opportunity for farmers to enjoy some of the value added to their commodity by further processing. Locally owned ethanol plants account for more than half of Iowa fuel ethanol plants and nearly half of production capacity.

The remainder of the spending by the ethanol industry is for a wide range of inputs such as industrial chemicals; electricity, natural gas, and water; labor; transportation and services such as maintenance, insurance, and general overhead. Spending for these goods and services represents the purchase of output of other industries, mostly in Iowa. The price assumptions used in estimating the value of expenditures for both ethanol and biodiesel are shown in Appendix Table 1.

- The gross value of the ethanol industry output (ethanol and co-products) amounts to $11.8 billion. Based on the IMPLAN model, the ethanol and supporting agriculture industries accounts for nearly $4.8 billion of Iowa GDP.

- Jobs are created from the economic activity supported by ethanol production. While ethanol production is not a labor-intensive industry, accounting for about 2,000 full time equivalent direct jobs in Iowa[6], the economic activity resulting from the full activities of the ethanol industry supports a much larger number of jobs in the economy. The direct jobs supported by the ethanol industry are concentrated primarily in manufacturing and agriculture. When the indirect and

[5] The 3.8 billion gallons of ethanol production required 1.3 billion bushels of corn. This amounts to 62 percent of the 2.16 billion bushels of corn harvested in Iowa in 2013. Without the demand for corn provided by the ethanol industry Iowa farmers would likely plant fewer acres to corn, purchase fewer inputs, and produce a smaller crop, thereby reducing the economic contribution provided by the corn industry.

[6] The Census Bureau does not report employment in ethanol production. The number of direct jobs associated with ethanol production is based on an estimated industry average of 50 jobs per plant.

induced effects of ethanol manufacturing are considered, the industry accounts for more than 13,160 full time equivalent jobs throughout the entire economy.

- Since renewable fuels production uses feedstocks produced by Iowa farmers, the ethanol and biodiesel industry has the largest impact on agriculture, supporting nearly 14,000 direct farm and farm-related jobs. Most of the agriculture jobs supported by the ethanol industry are farm workers and laborers associated with grain production. However, a wide range of jobs in support activities related to crop production ranging from farm managers and bookkeepers to farm equipment operators are supported by ethanol production. As the impact of the direct spending by the ethanol and biodiesel industry expands throughout the economy, the employment impact expands significantly and is spread over a large number of sectors. The indirect and induced jobs supported by the agriculture output used by renewable fuels amount to an additional 24,000 jobs throughout the entire Iowa economy.

- Increased economic activity and new jobs result in higher levels of income for Iowa households. The ethanol and supporting agriculture industry accounted for $3.5 billion of income for Iowans in 2012.

Construction and R&D

2013 was highlighted by construction of both new conventional corn ethanol and cellulosic ethanol capacity. DuPont is constructing a 30 MGY cellulosic ethanol plant in Nevada, IA and Poet-DSM is nearing completion of a 20 MGY cellulosic ethanol plant in Emmetsburg. Both of these plants will utilize locally procured corn stover and cobs. Construction activities and expenditures for these plants began prior to 2013 and will conclude in 2014. Further about 60 percent of construction expenditures reflect purchases of equipment, machinery, tanks, pipes and other materials produced in other states. Reflecting these factors we included construction expenditures of $76 million for 2013.[7] Construction activities accounted for nearly $160 million of GDP and supported more than 2,700 jobs throughout the Iowa economy.

[7] We assumed capital expenditures of $2 per gallon for conventional corn ethanol capacity and $4 per gallon for cellulosic capacity.

As pointed out earlier there has been a significant amount of investment by both the public sector and private industry in the renewable fuels industry. Much of this is represented by research and development aimed at discovering and developing advanced biofuels feedstocks and the technology needed to meet the RFS2 targets for cellulose and advanced biofuels. Based on a review of published reports we estimate that total investment in renewable fuels amounts to about $1.7 billion. While it is difficult to accurately assess how much of this is accounted for by Iowa institutions and firms, we assumed that Iowa's share would approximate the share of national biofuel production, or about 25 percent. This amounts to about $435 million. When evaluated in the context of IMPLAN this generates nearly $111 million of GDP and supports nearly 1,600 jobs.

Biodiesel

The Iowa biodiesel industry is not as mature as the ethanol industry but also makes sizeable contributions to the Iowa economy. According to the Iowa Renewable Fuels Association (IRFA), Iowa's 12 biodiesel plants have rated capacity of 317 million gallons and produced 230 million gallons of biodiesel in 2013[8] accounting for about 18 percent of total U.S. biodiesel output.

The Iowa biodiesel industry spent more than $880 million on raw materials, other inputs, goods and services to produce 184 million gallons of biodiesel. The largest share of this spending is for fats and oils used as the raw material to make biodiesel. The Iowa biodiesel industry used more than one billion pounds of soybean oil in 2013 to produce biodiesel totaling nearly two-thirds of total feedstock use. In addition Iowa biodiesel producers used approximately 508 million pounds of animal fats, 58 million pounds of used cooking oil, and 14 million pounds of industrial corn oil as biodiesel feedstock in 2013. The majority of the raw material for biodiesel production in Iowa is procured locally. The remainder of the spending by the biodiesel industry is for a wide range of inputs such as industrial chemicals; electricity, natural gas, and water; labor; and services such as maintenance, insurance, and general overhead. As with ethanol, spending for these goods and services represents the purchase of output of other industries.

[8] http://www.iowarfa.org/biodiesel_refineries.php

The spending associated with biodiesel production also circulates throughout the entire Iowa economy stimulating aggregate demand, supporting the creation of new jobs, generating additional household income, and creating new tax revenue. The following summarizes the economic contribution of the Iowa biodiesel industry at the end of 2013.

- The gross value of the biodiesel and glycerin produced in Iowa totaled nearly $1.1 billion and the biodiesel industry accounts for nearly $520 million of Iowa GDP.

- New jobs are created as a consequence of increased economic activity caused by biodiesel production. The increase in economic activity generated by biodiesel production supports nearly 7,100 full time equivalent jobs in all sectors of the Iowa economy.

- Increased economic activity and new jobs result in higher levels of income for Iowa households. The biodiesel industry accounts for $313 million of household income for Iowans.

Challenges for 2014

The most significant challenge facing the renewable fuels industry in 2014 is presented by the regulatory environment. As pointed out earlier EPA reduced the 2014 RVO for ethanol and kept the RVO for biomass-based biodiesel at 2013 levels. Failure to increase the RVO will send a negative signal to the investment community that will further restrain growth in new capital expenditures particularly for second-generation biofuels capacity.

Meeting the challenge of improving infrastructure for higher blends of ethanol by expanding investment in blender pumps will continue to be a challenge for the biofuels industry. E-15 has been approved for motor vehicles manufactured after 2001 and E-85 is approved for flex-fuel vehicles. However, unless more of this fuel is available for consumers, consumption will lag and the industry will continue to face the artificial blend wall.

APPENDIX A

IMPLAN Methodology

We estimate the impact of the ethanol industry on the economy of Iowa by applying expenditures by the relevant supplying industry to the appropriate final demand multipliers for value added output, earnings, and employment.

To understand how the economy is affected by an industry such as renewable fuels production, it is necessary to understand how different sectors or industries in the economy are linked. For example, in the renewable fuels production sector, the ethanol industry buys corn from the agriculture sector; which in turn, buys inputs from other suppliers such as fertilizer and pesticide producers that also purchase products from a range of other industries. These are referred to as backward linkages. Use by other sectors of natural gas as an input, such as manufacturing operations, is a forward linkage. Natural gas production and transmission industries are linked through both forward and backward linkages to other economic sectors in each state's economy.

The household sector is linked to all sectors as it provides the labor and management resources. In turn, changes that affect incomes of the household sector typically have significant impacts compared to a change in the sales of other sectors. This is because households typically spend most of their income on both retail and service goods and this is a critical component of the economy

This study uses an economic model known as IMPLAN (Impact Analysis for Planning) to develop understanding model of the national economy, including sectors that support the ethanol industry, the links between them, and the level of national economic activity. IMPLAN is a commonly used economic input-output (I-O) model. I-O models are constructed based on the concept that all industries in an economy are linked together; and the output (i.e., sales) of one industry becomes the input of another industry until all final goods and services are produced. I-O models can be used both to analyze the structure of the economy and to estimate the total economic impact of projects or policies. For this analysis, a model for the Iowa economy was constructed using current IMPLAN software and the most recent data available.

IMPLAN models provide three economic measures that describe the economy: value added, income, and employment.

- Value added is the total value of the goods and services produced by businesses in the country and is generally referred to as GDP. It is equivalent to the sum of labor income, taxes paid by the industry, and other property income or profit.

- Labor income is the sum of employee compensation (including all payroll and benefits) and proprietor income (income for self-employed work). In the case of this analysis, demand for corn and other feedstock to produce ethanol supports farm income through higher crop receipts than would be the case without ethanol production.

- Employment represents the annual average number of employees, whether full or part-time, of businesses producing output. Value added including labor Income and employment represent the net economic benefits that accrue to the nation as a result of increased economic output.

There are three types of effects measured with a multiplier: direct, indirect, and induced effects. Direct effects are the known or predicted changes in the economy. Indirect effects are the business-to-business transactions required to produce direct effects (i.e., increased output from businesses providing intermediate inputs). Finally, induced effects are derived from spending on goods and services by people working to satisfy direct and indirect effects (i.e., increased household spending resulting from higher personal income).

Appendix Table 1. 2013 Prices

	Corn Farm IA ($/bu)	Corn No 2. Yel Central Ill ($/bu)	Distillers Grains 10% Iowa ($/ton)	Distillers Grains 65% Iowa ($/ton)	Ethanol FOB Plant Iowa ($/gal)
Jan	$6.92	$7.16	$260.60	$89.56	$2.24
Feb	$7.00	$7.18	$264.88	$93.38	$2.32
Mar	$7.13	$7.27	$261.63	$93.00	$2.52
Apr	$7.10	$6.57	$232.00	$84.63	$2.47
May	$7.06	$6.82	$223.05	$79.20	$2.56
Jun	$7.09	$6.94	$228.13	$78.25	$2.54
Jul	$6.91	$6.60	$231.00	$77.40	$2.38
Aug	$6.32	$5.98	$221.00	$72.25	$2.36
Sep	$5.66	$4.77	$211.88	$69.88	$2.28
Oct	$4.60	$4.21	$200.00	$62.00	$1.98
Nov	$4.39	$4.10	$207.38	$62.38	$2.07
Dec	$4.30 (p)	$4.12	$213.13	$65.50	$2.28
Average	$6.21	$5.98	$229.55	$77.28	$2.33

	Crude Soy Oil Iowa (cents/lb)	Industrial Corn Oil Iowa (cents/lb)	Choice W. Grease Central US (cents/lb)	Yellow Grease Midwest (cents/lb)	B100 FOB Plant Iowa ($/gal)
Jan	49.00	39.32	40.09	36.00	$4.31
Feb	49.37	38.93	41.50	35.63	$4.49
Mar	49.09	38.95	43.23	36.25	$4.67
Apr	49.25	37.20	41.41	36.00	$4.75
May	49.52	37.10	40.43	34.33	$4.87
Jun	48.04	36.50	45.14	36.72	$4.94
Jul	45.20	37.00	42.78	38.47	$5.01
Aug	42.38	37.31	37.41	35.63	$4.90
Sep	42.04	37.01	37.53	35.91	$4.88
Oct	40.46	28.67	28.71	27.25	$4.55
Nov	39.36	28.33	28.06	23.00	$4.12
Dec	37.85	30.14	30.03	23.25	$3.90
Average	45.13	35.54	38.03	33.20	$4.61

Source: USDA/AMS/NASS