

**CONTRIBUTION OF THE RENEWABLE FUELS INDUSTRY
TO THE ECONOMY OF IOWA**

Prepared for the Iowa Renewable Fuels Association

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2014 was a record-breaking year for the renewable fuels industry despite significant challenges, and Iowa participated in the growth. The year started off with strong year-over-year gains in ethanol production as producers responded to sharply lower feedstock prices. A record 2014 corn crop continued to push feedstock prices lower throughout the year. Ethanol and co-product prices remained favorable through the third quarter and were reflected in positive industry profitability. The collapse in global oil prices in the fourth quarter helped drive both ethanol and biodiesel prices lower, and put strains on profitability that reduced output. Average Iowa cash market corn prices for 2014 were about a third lower than during 2013, while ethanol prices were only 10 percent lower for the full year. According to Iowa State University, net returns over variable costs for a typical Iowa dry mill ethanol plant increased 54 percent for all of 2014.¹

The biodiesel sector was more significantly affected by lower product prices. Biodiesel feedstock prices, notably soybean oil, animal fats and waste greases and oil, declined throughout the year and were about 17 percent below 2013 levels. However biodiesel prices fell nearly 25 percent for all of 2014 and led to a 73 percent decline in industry profitability.

On the demand side, motor gasoline consumption posted a small increase for the first 10 months of 2014 and was matched by a 1.7 percent increase in domestic ethanol use. While still small relative to domestic use, ethanol exports posted a 43.6 percent increase for the first 10 months of 2014.

The regulatory environment also added to industry uncertainty in 2014. EPA did not issue a final Renewable Volume Obligation (RVO) under the Renewable Fuel Standard (RFS) for 2014 and decided

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 14, 2015

to postpone the preliminary 2015 RVO until later in the year. Further, the biodiesel and cellulosic ethanol tax credits that expired on December 31, 2013 were not renewed by Congress until late December. The tax credits were made retroactive to January 2014 but again expired on December 31, 2014.

One of the most significant developments for 2014 was the completion of two of the nation's second-generation ethanol plants (the POET/DSM Project Liberty facility in Emmetsburg, IA and the Quad County Corn Processors plant in Galva, IA). Both facilities were completed in October 2014 and began commercial production. A third plant, DuPont's cellulosic ethanol facility in Nevada, IA is nearing completion and is expected to produce in early 2015.

Iowa's ethanol industry posted a small increase in output during 2014 with the state's 42 operating ethanol plants producing at an annual rate of about 3.9 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 10 operating biodiesel plants produced 227 million gallons of biodiesel in 2014,² slightly lower than 2013, but still accounting for about 16 percent of total U.S. biodiesel output.

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.

Ethanol consumption approached 10 percent of the motor fuel supply, but slow improvements in infrastructure continued to restrain overall growth in the availability and consumption of higher blends of ethanol. Despite this the number of refueling stations offering E-85 and E-15 in Iowa continued to expand during 2014.

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 biofuel feedstocks and the technology needed to meet the RFS targets for cellulose and advanced biofuels. The primary public

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

sector agencies underwriting investment in biofuels R&D are the 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 such as POET, DSM, DuPont and Syngenta. 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 \$ 1.8 billion in 2014, and Iowa shared in this.

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 produced primarily by Iowa farmers, and the R&D expenditures for renewable fuels provide important support for Iowa's universities. Combined, these activities make a significant contribution to the Iowa economy. Based on its size and scope, the renewable fuels industry had the following impacts on Iowa's economy in 2014.³

- Accounts for about \$5 billion, or about 3.5 percent, of Iowa GDP;
- Generates \$2.6 billion of income for Iowa households; and
- Supports nearly 47,000 jobs through the entire Iowa economy. This is equivalent to 3 percent of total State employment.

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

³ This study estimates the annualized impact of producing 3.8 billion gallons of ethanol and 228 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: 2014

	Purchases (Mil 2014\$)	GDP (Mil 2014\$)	Household Earnings (Mil 2014\$)	Employment (Jobs)
Ethanol*	\$7,676.0	\$4,445.4	\$2,276.6	42,378
Biodiesel	\$746.4	\$471.3	\$286.1	4,376
Total	\$8,422.4	\$4,916.7	\$2,562.6	46,753

* Includes agriculture, 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 IMPLAN (Impact Analysis for Planning) economic model 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 the most recent IMPLAN software and data and used to estimate economic impacts of the ethanol and biodiesel industry. The 2013 IMPLAN update contains several major revisions and improvements including an expansion of sectoral detail, incorporation of the most recent Bureau of Economic Analysis (BEA) Benchmark input-output (I-O) tables which were released in 2014; data from the latest BEA Regional Economic Accounts, the 2012 Economic Census, and the 2012 Census of Agriculture released in 2014. Detail regarding the IMPLAN model and how it was used is presented in Appendix A.

In addition to using the updated IMPLAN data discussed above several changes were made to the approach used in the 2014 analysis. The most significant of these was to recognize the impact of income generated by locally owned renewable fuels firms. All corporations earn income that directly impacts GDP. However the income earned by firms owned by lowans largely stays in Iowa and has a more significant impact on the State economy than earnings that are transferred to firms domiciled outside of Iowa. A review of ownership of ethanol and biodiesel firms based on information provided by IRFA suggests that more than half of Iowa's ethanol and biodiesel plants are locally owned. The earnings of locally owned firms are treated as an addition to the household sector since the income is paid to lowans and their impact is estimated using multipliers for the household sector. The earnings by firms domiciled outside of Iowa are treated as direct additions to GDP.

Contribution of the Renewable Fuels Industry

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

Ethanol and Agriculture

The ethanol industry provides a significant contribution to the Iowa economy, spending more than \$7.7 billion on raw materials, other inputs, goods and services to produce 3.9 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 58 percent of Iowa's corn crop.⁴ At 2014 Iowa farm gate prices, this amounts to \$5.4 billion of revenue to Iowa corn farmers. Reflecting lower prices, expenditures for feedstocks (corn) by Iowa ethanol producers fell 34 percent from 2013 levels.

⁴ The 3.8 billion gallons of ethanol production required 1.3 billion bushels of corn. This amounts to 58 percent of the 2.37 billion bushels of corn harvested in Iowa in 2014. 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.

Table 2
Contribution of the Renewable Fuels Industry to Iowa: 2014

	GDP	Jobs	Income
Ethanol Manufacturing			
Direct	\$617.9	2,100	\$435.2
Indirect	\$1,329.7	6,562	\$506.6
Induced	\$402.9	5,448	\$196.6
Subtotal	\$2,350.5	14,111	\$1,138.5
Biodiesel Manufacturing			
Direct	\$40.0	330	\$38.0
Indirect	\$278.8	2,051	\$157.5
Induced	\$71.8	973	\$35.1
Subtotal	\$390.6	3,355	\$230.6
New Construction			
Direct	\$30.6	468	\$29.8
Indirect	\$10.0	100	\$5.1
Induced	\$14.2	191	\$6.9
Subtotal	\$54.8	759	\$41.8
Agriculture			
Direct	(\$3.9)	7,570	\$176.1
Indirect	\$1,484.1	12,580	\$598.9
Induced	\$317.9	4,294	\$155.0
Subtotal	\$1,798.1	24,444	\$930.0
R&D			
Direct	\$145.9	1,912	\$130.9
Indirect	\$101.6	1,158	\$54.2
Induced	\$75.3	1,015	\$36.7
Subtotal	\$322.7	4,085	\$221.8
Total			
Direct	\$830.5	12,380	\$810.1
Indirect	\$3,204.2	22,451	\$1,322.2
Induced	\$882.0	11,922	\$430.3
Grand Total	\$4,916.7	46,753	\$2,562.6

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 nearly half of Iowa fuel ethanol plants and 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 \$10.3 billion. Based on the IMPLAN model, the ethanol and supporting agriculture industries accounts for nearly \$4.1 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 2,100 full time equivalent direct jobs in Iowa⁵, 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 induced effects of ethanol manufacturing are considered, the industry accounts for nearly 14,000 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 7,570 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

⁵ 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.

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 16,900 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 \$2.1 billion of income for Iowans in 2014.

Construction and R&D

2014 was highlighted by construction of new cellulosic ethanol capacity. As pointed out earlier, Poet-DSM completed the 25 MGY Project Liberty cellulosic ethanol plant in Emmetsburg, and Quad County Corn Processors opened a 2.5 MGY cellulosic plant in Galva in October 2014. DuPont is nearing completion of a 30 MGY cellulosic ethanol plant in Nevada, IA. These plants will utilize locally procured corn stover and cobs. Construction activities and expenditures for these plants began prior to 2013 and concluded 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 \$105 million for 2014 in our analysis. Construction activities accounted for nearly \$55 million of GDP and supported about 760 jobs throughout the Iowa economy.

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 \$1.8 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 amount to about 20 percent of total national R&D expenditures. This amounts to about \$355 million. When evaluated in the context of IMPLAN this generates nearly \$323 million of GDP and supports more than 4,000 jobs. Further we have assumed that three quarters of R&D expenditures are devoted to ethanol (largely cellulosic and second generation feedstocks and technology) with the remainder devoted to biomass biodiesel.

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 10 operating biodiesel plants have rated annual capacity of more than 300 million gallons, and produced 227 million gallons of biodiesel in 2014,⁶ accounting for about 16 percent of total U.S. biodiesel output.

The Iowa biodiesel industry spent nearly \$750 million on raw materials, other inputs, goods and services in 2014. 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 1.3 billion pounds of soybean oil in 2014 to produce biodiesel, totaling 80 percent of total feedstock use. In addition Iowa biodiesel producers used approximately 310 million pounds of animal fats, 41 million pounds of industrial corn oil (supplied largely by Iowa ethanol producers) and 31 million pounds of used cooking oil. 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, 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.

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 2014.

- The gross value of the biodiesel and glycerin produced in Iowa totaled nearly \$790 million. When the impact of manufacturing and R&D are combined the biodiesel industry accounts for more than \$471 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 more than 4,300 full time equivalent jobs in all sectors of the Iowa economy.

⁶ http://www.iowarfa.org/biodiesel_refineries.php

- Increased economic activity and new jobs result in higher levels of income for Iowa households. The biodiesel industry accounts for \$286 million of household income for Iowans.

Challenges for 2015

The most significant challenges facing the renewable fuels industry in 2015 are likely to result from an uncertain regulatory environment and competitive pressures from falling world oil and refined product prices. As pointed out earlier, EPA failed to release a final 2014 RVO and preliminary 2015 RVO for ethanol and biomass-based biodiesel. The delays in announcing RVO targets sends a negative signal to the investment community that will continue to restrain growth in new capital expenditures, particularly for second-generation biofuels capacity. Further, 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. Unless more of this fuel is available for consumers, consumption will lag and the industry will continue to face the artificial blend wall.

The competitive environment for renewable fuels has deteriorated as refined product prices continue to fall along with world oil prices. As of this writing, crude oil prices have fallen more than 50 percent from their mid-2014 highs. Crude oil prices are now below the breakeven price for most new oil wells in North America. As the oil industry adjusts production in response to falling prices, and supply and demand for petroleum comes into balance, the market for renewable fuels is expected to recover.

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 a 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. 2014 Prices					
	Corn Price Farm IA (\$/bu)	Corn Price No 2. Yel Iowa (\$/bu)	Distillers Grains 10% Iowa (\$/ton)	Distillers Grains 65% Iowa (\$/ton)	Ethanol FOB Plant Iowa (\$/gal)
Jan	\$4.43	\$4.27	\$169.00	\$53.60	\$2.07
Feb	\$4.43	\$4.44	\$208.38	\$55.75	\$1.94
Mar	\$4.55	\$4.67	\$241.25	\$60.63	\$2.48
Apr	\$4.76	\$4.86	\$228.00	\$61.30	\$2.79
May	\$4.71	\$4.78	\$203.75	\$58.88	\$2.24
Jun	\$4.49	\$4.45	\$165.50	\$63.25	\$2.22
Jul	\$4.06	\$3.80	\$133.00	\$59.25	\$2.10
Aug	\$3.61	\$3.54	\$117.50	\$54.38	\$2.10
Sep	\$3.51	\$3.34	\$125.00	\$56.88	\$1.84
Oct	\$3.62	\$3.26	\$103.70	\$49.10	\$1.56
Nov	\$3.63	\$3.51	\$108.94	\$48.38	\$2.00
Dec		\$3.77	\$143.88	\$64.56	\$2.02
Average	\$4.16	\$4.06	\$162.32	\$57.16	\$2.11

	Crude Soy Oil Iowa (cents/lb)	Distillers Corn Oil Iowa (cents/lb)	Choice W. Grease Central US (cents/lb)	Yellow Grease Midwest (cents/lb)	B100 FOB Plant Iowa (\$/gal)
Jan	35.08	30.21	24.90	23.00	\$3.34
Feb	37.95	31.25	29.81	26.50	\$3.36
Mar	41.32	33.81	35.28	28.63	\$3.73
Apr	41.89	34.33	36.10	30.33	\$3.77
May	40.98	36.05	40.13	32.67	\$3.76
Jun	40.60	34.67	37.56	33.50	\$3.75
Jul	38.38	32.50	37.53	35.29	\$3.63
Aug	35.19	29.60	34.22	27.00	\$3.52
Sep	34.46	28.00	30.96	26.00	\$3.34
Oct	35.47	28.56	26.40	23.88	\$3.15
Nov	34.28	30.67	26.63	23.00	\$3.17
Dec	32.81	29.60	28.85	24.67	\$3.06
Average	37.37	31.60	32.36	27.87	\$3.46