

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

Prepared for the Iowa Renewable Fuels Association

John M. Urbanchuk  
Managing Partner, ABF Economics

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The renewable fuels industry recovered substantively in 2021 both in Iowa and the rest of the U.S. Despite the development and spread of new COVID variants during 2021 the economy largely reopened, and consumers responded accordingly. The impact of the pandemic, particularly on the supply of goods and services and impact on prices continued to overshadow most other issues facing the industry during the year. As the economy reopened people resumed driving and both gasoline and ethanol demand increased over 2020 levels.

Ethanol producers responded to the rise in demand by restoring idled capacity and increasing operating rates. For the year, Iowa's 40 operating ethanol plants operated at an average 96 percent capacity utilization rate and produced a record 4.4 billion gallons, 19 percent above 2020 production. Iowa remains the nation's leading ethanol producer, accounting for nearly 30 percent of U.S. production.

The biodiesel industry faced a modest reversal in 2021 in response to poor industry profitability and a relatively weak market. Biodiesel demand was restrained by weaker freight and rail activity nationwide reflecting supply chain issues. The \$1.00 per gallon federal biodiesel tax credit was extended through 2022 and helped keep biodiesel more price competitive with conventional petroleum-based diesel. Iowa is the nation's leading biodiesel manufacturer, accounting for nearly 20 percent of total U.S. production. Iowa biodiesel production fell 3.1 percent in 2021 to 340 million gallons.

The major factor that impacted the renewable fuels industry in 2021 was the sharp increase in feedstock prices and other input costs. Corn prices (No.2 Yellow, Iowa) averaged \$5.91 per bushel during 2021, 70 percent above 2020 levels despite increased production and stock levels. The price of crude soybean oil (the largest biodiesel feedstock) more than doubled in 2021. Inflation in the overall economy averaged about 5 percent during the year, more than twice the rate experienced during the previous decade. This affected all other input costs.

The upside of inflationary pressures in the economy was that the prices of ethanol and principal co-products DDGS and Distiller's corn oil (DCO) also surged and outpaced the increase in total operating costs. Revenue for Iowa's ethanol industry increased 74 percent in 2021 while operating expenses increased 61 percent. The opposite situation existed for the biodiesel industry. Operating costs doubled from 2020 levels while industry revenues grew by less than 70 percent.

On the regulatory front, the major issues revolved around gaining approval for year-round sales of E15 on a statewide basis; implementation of RFS renewable fuel requirements at the statutory volume of 15 billion gallons; and the EPA's position on denying all pending small refinery exemption (SRE) petitions based on the 2020 decision of the Tenth Circuit Court's decision

## **ECONOMIC IMPACT OF RENEWABLE FUELS ON IOWA**

Biofuels plants purchase agricultural raw materials, other inputs, and a wide range of goods and services such as industrial chemicals; electricity, natural gas, and water; labor; and services such as maintenance, insurance, and general overhead. The primary feedstock for ethanol remains corn while the biodiesel industry uses a wider variety of fats and oils as feedstocks. The 4.4 billion gallons of ethanol produced in Iowa last year utilized more than 1.5 billion bushels of corn, or 57 percent of Iowa's 2021 2.6-billion-bushel corn crop. The 1.9 billion

pounds of soybean oil used to produce biodiesel in Iowa were the equivalent of the oil from nearly 155 million bushels of soybeans, nearly 25 percent of Iowa's soybean crop.

Expenditures on these goods and services represent the purchase of output of other industries. A substantial share of these dollars is spent in Iowa, and the economic impact stays in the state. Spending associated with ethanol production circulates throughout the entire economy several-fold. Consequently, this spending stimulates aggregate demand, supports jobs not only in ethanol production but also jobs throughout the entire economy, generates additional household income, and provides tax revenue for state and local government.

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. 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 2021.<sup>1</sup>

- Accounts for nearly \$5.2 billion, or about 2 percent, of Iowa GDP
- Generates \$2.6 billion of income for Iowa households; and
- Supports nearly 46,000 jobs through the entire Iowa economy. This is equivalent to more than 2 percent of total state employment.

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

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<sup>1</sup> This study estimates the impact of producing 4.4 billion gallons of ethanol and 340 million gallons of biodiesel on Iowa's economy.

Table 1  
Total Economic Impact of the Renewable Fuels Industry for Iowa: 2021

	Purchases (Mil 2021\$)	GDP (Mil 2021\$)	Income (Mil 2021\$)	Employment (Jobs)
Ethanol*	\$10,753	\$3,967	\$2,199	39,401
Biodiesel	\$1,918	\$1,223	\$450	6,513
Total	\$12,671	\$5,190	\$2,648	45,913

\* Includes agriculture, construction, investment in R&D, and exports

## 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 the 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 IMPLAN software and data to estimate economic impacts of the ethanol and biodiesel industries. 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, we continued 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 Iowans 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 Iowans 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.

We continued to incorporate the explicit impact of ethanol and DDGS exports into the analysis using updated USDA Agricultural Trade multipliers for output and employment in the biofuels industry to estimate the impact of exports. These results were added to the IMPLAN results. Since Iowa is the nation's largest ethanol producer, the Iowa industry participates in the export market. Reflecting this, we applied Iowa's share of total production to the total national export impact.

## **Contribution of the Renewable Fuels Industry**

The contribution of the renewable fuels industry to the economy of Iowa is detailed in Table 2. The ethanol industry provides a significant contribution to the Iowa economy, spending more than \$10.7 billion on raw materials, other inputs, goods and services to produce 4.4 billion gallons of ethanol. The largest share of this spending is for corn and other grains used as the raw material to make ethanol, distillers' grains and distiller's corn oil.

The impact of renewable fuels for the Iowa economy is detailed in Table 2.

Table 2  
Contribution of the Renewable Fuels Industry to Iowa: 2021

	<b>GDP (Mil 2021\$)</b>	<b>Jobs (FTE)</b>	<b>Income (Mil 2021\$)</b>
<b>Ethanol Manufacturing</b>			
Direct	\$611	2,000	\$139
Indirect	\$356	3,301	\$646
Induced	\$416	5,212	\$249
<b>Subtotal</b>	<b>\$1,383</b>	<b>10,513</b>	<b>\$1,033</b>
<b>Biodiesel Manufacturing</b>			
Direct	\$341	330	\$18
Indirect	\$575	3,736	\$332
Induced	\$307	2,447	\$99
<b>Subtotal</b>	<b>\$1,223</b>	<b>6,513</b>	<b>\$450</b>
<b>Agriculture</b>			
Direct	\$388	7,098	\$165
Indirect	\$1,391	11,794	\$562
Induced	\$298	4,026	\$145
<b>Subtotal</b>	<b>\$2,078</b>	<b>22,918</b>	<b>\$872</b>
<b>R&amp;D</b>			
Direct	\$34	281	\$25
Indirect	\$23	256	\$16
Induced	\$22	276	\$13
<b>Subtotal</b>	<b>\$79</b>	<b>813</b>	<b>\$55</b>
<b>Infrastructure CAPEX</b>	<b>\$0</b>	<b>0</b>	<b>\$0</b>
<b>Exports</b>	<b>\$427</b>	<b>5,156</b>	<b>\$239</b>
<b>Total</b>			
Direct	\$1,374	9,709	\$347
Indirect	\$2,773	24,244	\$1,795
Induced	\$1,043	11,961	\$506
<b>Grand Total</b>	<b>\$5,190</b>	<b>45,913</b>	<b>\$2,648</b>
<b>Change from 2020</b>	31.1%	23.8%	44.5%

As pointed out earlier, export volumes declined modestly in 2021 but due to higher prices values increased. Exports provided a positive market for Iowa's biofuels industry and contributed an estimated \$427 million to Iowa GDP and supported about 5,100 jobs in all sectors of the economy in 2021.

## Ethanol

The ethanol industry provides an attractive domestic market for Iowa farmers as well as 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, 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 Iowa ethanol industry used 1.5 billion bushels of corn, or 57 percent of Iowa's corn crop.<sup>2</sup> This amounts to more than \$8.9 billion of revenue to Iowa corn farmers. The sharp increase in GDP, jobs and income is in large part directly the result of ethanol producers buying a lot of \$6/bushel corn from Iowa farmers.

Most ethanol produced in Iowa is by dry mills that also produce valuable co-products in the form of DDGS and Distiller's Corn Oil (DCO).<sup>3</sup> The Iowa ethanol industry produced an estimated 10.6 million short tons of DDGS and 1,000 million pounds of DCO in 2021 with an

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<sup>2</sup> The 4.4 billion gallons of ethanol production required 1.5 billion bushels of corn. This amounts to 57 percent of the 2020 Iowa corn crop. 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.

<sup>3</sup> DDGS and DCO production is reported monthly in the USDA Grain Crushings and Co-Products Production report. <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1899>.

aggregate market value of nearly \$2.6 billion. A share of these co-products is used by Iowa livestock producers and the Iowa biodiesel industry. It is notable that these co-products are produced with little additional expenditure.

The value of the ethanol industry output (ethanol and co-products) amounts to about \$12.5 billion at 2021 prices. Based on the IMPLAN model, the ethanol and supporting agriculture industries account for about \$4 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 fulltime-equivalent direct jobs in Iowa<sup>4</sup>, 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 more than 10,500 fulltime-equivalent jobs throughout the entire economy.

Since renewable fuels production uses feedstocks produced by Iowa farmers, the ethanol and biodiesel industries have the largest impact on agriculture, supporting 7,100 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 industries 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

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<sup>4</sup> The Census Bureau does not report employment in ethanol production. The number of direct jobs associated with ethanol production is based on a conservative estimated industry average of 50 jobs per plant.



used by renewable fuels amount to an additional 15,800 jobs throughout the entire Iowa economy for a total impact from agriculture of nearly 23,000 jobs.

Increased economic activity and new jobs result in higher levels of income for Iowa households. The ethanol and supporting agriculture industry generated nearly \$2.2 billion of income for Iowans in 2021.

## **Biodiesel**

The Iowa biodiesel industry also makes sizable contributions to the Iowa economy. According to the Iowa Renewable Fuels Association (IRFA), Iowa's 11 operating biodiesel plants produced 340 million gallons of biodiesel in 2021, 3.1 percent less than in 2020.<sup>5</sup>

The Iowa biodiesel industry spent \$1.2 billion on raw materials, other inputs, goods and services in 2021. 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 2.6 billion pounds of fats and oils to produce 340 million gallons of B100. The Iowa biodiesel industry used 1.93 billion pounds of soybean oil in 2021 to produce biodiesel, accounting for 73 percent of total feedstock use. Canola oil eclipsed Distiller's corn oil (supplied largely by Iowa ethanol producers) as the second largest biodiesel feedstock in 2021 at 297 million pounds. Smaller amounts of animal fats and used cooking oil were also used. 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.

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<sup>5</sup> [http://www.iowarfa.org/biodiesel\\_refineries.php](http://www.iowarfa.org/biodiesel_refineries.php)

The spending associated with biodiesel production also circulates throughout the entire Iowa economy stimulating aggregate demand, supporting jobs, generating additional household income, and creating tax revenue. The following summarizes the economic contribution of the Iowa biodiesel industry at the end of 2021.

- The gross value of the biodiesel and glycerin produced in Iowa totaled nearly \$1.8 billion. When the impact of manufacturing is considered, the biodiesel industry accounts for \$1.2 billion of Iowa GDP.
- 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 6,500 fulltime-equivalent jobs in all sectors of the Iowa economy.
- Increased economic activity and jobs result in higher levels of income for Iowa households. The biodiesel industry accounts for about \$450 million of household income for Iowans.

## Conclusion

Despite challenges created by the COVID pandemic, policy and trade environment, the renewable fuels industry continues to make a significant contribution to the Iowa economy in terms of job creation, household earnings, and state and local tax revenue. The importance of the biofuels industry to agriculture and rural economies is particularly notable. Continued growth and expansion of the renewable fuels industry through new technologies and feedstocks will enhance the industry's position as the original creator of green jobs and will ensure America's ability to maintain and expand energy independence.

Further, policy and regulatory actions taken by Iowa, and other Midwestern states, to boost the use of biofuels locally, particularly statewide use of E15, will provide a buffer from the uncertainty of federal policy and export demand.

## 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 (GDP), 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 feedstocks to produce ethanol and biodiesel supports farm income through higher crop receipts than would be the case without ethanol and biodiesel 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).