

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

February 2, 2023

EXECUTIVE SUMMARY

The renewable fuels industry is multifaceted, adding substantial value to agricultural commodities produced in Iowa. Based on its size and scope, the renewable fuels industry had the following impacts on Iowa's economy in 2022.

- Accounts for nearly \$7.2 billion, or about 3 percent, of Iowa GDP
- Generates \$3.5 billion of income for Iowa households; and
- Supports more than 57,000 jobs throughout the entire Iowa economy. This is equivalent to more than 3 percent of total state employment.

BACKGROUND

The U.S. renewable fuels industry continues to recover from substantial challenges and posted growth in 2022. These challenges included residual economy-wide effects of the COVID pandemic, weak economic environment, and rampant inflation. The economy rebounded in the second half from recessionary levels and posted a modest 2.2 percent real growth for all of 2022. Growth in real output was accompanied by modest gains in real disposable income. Despite a recovering economy, motor fuel demand was restrained by sharply higher crude oil and gasoline prices. However, these factors supported small increases in gasoline, diesel, ethanol and biodiesel demand during the year.

Iowa's 42 ethanol plants had operating capacity of 4.6 billion gallons at years end, 3.6 percent above 2021 capacity while Iowa's 11 operating biodiesel plant had capacity of 410 million gallons. Iowa remains the nation's leading ethanol and biodiesel producer, accounting for nearly 30 percent of U.S. ethanol and 20 percent of biodiesel capacity.

The most significant economic problem facing renewable fuels producers and consumers during 2022 was inflation, which reached a 40-year high of 8 percent for 2022. The impact of this on the ethanol industry was the sharp increase in feedstock (notably corn), natural gas, and other input costs. Iowa corn prices were up 6.1 percent in 2022. Biodiesel producers benefitted from modestly lower crude soybean oil (the largest biodiesel feedstock) prices even as prices for other biodiesel inputs increased. Higher energy prices were an impediment for renewable fuels producers illustrated by a nearly 30 percent increase in Iowa industrial natural gas prices. Consumers faced gasoline prices that increased nearly 32 percent.

The upside of inflation was that the prices of ethanol and biodiesel, as well as prices of corn dry mill co-products distillers dried grains (DDGS) and distiller's corn oil (DCO), and wet mill co-products corn gluten feed (CGF) and corn gluten meal (CGM), also surged and outpaced increases in total operating costs. Consequently, returns over operating costs for Iowa biodiesel producers turned positive in 2022, averaging an estimated \$0.81 cents per gallon while returns for ethanol producers averaged an estimated \$0.29 per gallon, 25 percent less than 2021.

On the regulatory front, one of the major positives for the ethanol industry was the emergency waiver to allow year-round use of E15 by the U.S. Environmental Protection Agency in May 2022. With E15 prices routinely averaging more than 15 cents per gallon less than standard E10 prices, many retailers reported record sales of E15 throughout the Midwest.

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 4.5 billion gallons of ethanol produced in Iowa last year utilized nearly 1.6 billion bushels of corn, or 62 percent of Iowa's 2022 2.48-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 162 million bushels of soybeans, nearly 28 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 renewable fuels production circulates throughout the entire economy several-fold. Consequently, this spending stimulates aggregate demand, supports jobs not only in biofuels production but also jobs throughout the entire economy, generates additional household income, and provides tax revenue for the state and local governments.

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 2022.¹

¹ This study estimates the impact of producing 4.5 billion gallons of ethanol and 349 million gallons of biodiesel on Iowa's economy.

- Accounts for nearly \$7.2 billion, or about 3 percent, of Iowa GDP
- Generates \$3.5 billion of income for Iowa households; and
- Supports more than 57,000 jobs throughout the entire Iowa economy. This is equivalent to more than 3 percent of total state employment.

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

Table 1
Total Economic Impact of the Renewable Fuels Industry for Iowa: 2022

	Purchases (Mil 2022\$)	GDP (Mil 2022\$)	Income (Mil 2022\$)	Employment (Jobs)
Ethanol*	\$13,110	\$6,129	\$3,024	50,007
Biodiesel	\$2,040	\$1,022	\$506	7,278
Total	\$15,149	\$7,151	\$3,531	57,285

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

Methodology

The spending associated with renewable fuels production and construction of new capacity 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 current IMPLAN software and data to estimate economic impacts of the ethanol and biodiesel industries. The IMPLAN data are based on the most recent available national benchmark input-output data and regional data published by the U.S. Bureau of Economic Analysis. As such the IMPLAN data reflect changes in the economy post-COVID. Detail regarding the IMPLAN model and how it was used is presented in Appendix A.

The treatment of industry net earnings for the ethanol industry marks a departure from previous years. In the past, we treated industry earnings as an addition to the household sector since the income is paid to owners of operating biofuel plants. This year we separated revenue by the share of ethanol and co-products accounted for by dry and wet mills and estimated the impact of net industry earnings using multipliers for the corn dry mill ethanol (other basic organic chemicals) and wet corn mill industries. Biodiesel earnings were treated the same as in previous years.

We continue 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.

Table 2
Contribution of the Renewable Fuels Industry to Iowa: 2022

	GDP (Mil 2022\$)	Jobs (FTE)	Income (Mil 2022\$)
Ethanol Manufacturing *			
Direct	\$1,018	2,572	\$372
Indirect	\$614	6,147	\$371
Induced	\$284	3,488	\$151
Subtotal	\$1,915	12,207	\$894
Biodiesel Manufacturing			
Direct	\$306	1,212	\$115
Indirect	\$555	4,100	\$305
Induced	\$161	1,966	\$86
Subtotal	\$1,022	7,278	\$506
Agriculture			
Direct	\$1,945	7,919	\$581
Indirect	\$920	13,877	\$768
Induced	\$519	5,612	\$278
Subtotal	\$3,384	27,409	\$1,626
New Construction			
Direct	\$96	1,450	\$94
Indirect	\$26	232	\$15
Induced	\$42	498	\$22
Subtotal	\$163	2,179	\$131
Exports	\$667	8,213	\$373
Total			
Direct	\$3,364	13,153	\$1,161
Indirect	\$2,781	32,568	\$1,832
Induced	\$1,005	11,564	\$537
Grand Total	\$7,151	57,285	\$3,531
Change from 2021	37.8%	24.8%	33.3%

* Includes R&D

The renewable fuels industry provides a significant contribution to the Iowa economy, with ethanol producers spending more than \$13.1 billion on raw materials, other inputs, goods, and services to produce 4.5 billion gallons of ethanol. Biodiesel producers spent \$2.0 billion to produce 349 million gallons of biodiesel. The largest share of this spending is for corn used as the raw material to make ethanol and co-products, and soybean oil and other fats and oils to produce biodiesel.

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.

The remainder of the spending 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. For example, the Iowa ethanol industry used 1.6 billion bushels of corn, or 62 percent of Iowa's corn crop.² This amounts to more than \$11.2 billion of revenue to Iowa corn farmers.

Every dollar spent by an ethanol (or biodiesel) producer on feedstocks, electricity, natural, gas, labor, and other inputs produced in Iowa represents demand for goods and services produced by Iowa farmers and firms. This demand provides the maximum economic impact since most of the value stays in Iowa. To the extent that goods used by Iowa biofuels producers are

² The 4.56 billion gallons of ethanol production required 1.6 billion bushels of corn. This amounts to 62 percent of the 2022 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.

procured from out-of-state the Iowa economy still benefits because these goods generally reflect activity by the wholesale sector.

Reflecting this, the sharp increase in ethanol's contribution to Iowa GDP, jobs and income is in large part directly the result of ethanol producers spending a great deal more to buy corn from Iowa farmers in 2022.

Most ethanol produced in Iowa (86 percent) is by dry mills that also produce valuable co-products in the form of DDGS and DCO.³ Iowa's corn wet mill plants produce corn gluten feed (CGF), corn gluten meal (CGM) and edible corn oil as co-products. The Iowa ethanol industry produced an estimated 11.1 million short tons of DDGS, nearly 1.1 billion pounds of DCO, 1.3 million tons of CGF and 270,000 tons of CGM in 2022 with an aggregate market value of nearly \$3.8 billion. These co-products are 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 more nearly \$15 billion at 2022 prices. Based on the IMPLAN model, the ethanol and supporting agriculture industries account for \$6.1 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 nearly 2,600 fulltime-equivalent direct jobs in Iowa⁴, the economic activity resulting from the full activities of the ethanol industry supports a much larger number of jobs in the overall economy. The direct jobs supported by the ethanol industry are concentrated primarily in manufacturing and agriculture.

³ 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>.

⁴ 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.

When the indirect and induced effects of ethanol manufacturing are considered, the industry accounts for more than 9,500 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 more than 7,900 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 many sectors. The indirect and induced jobs supported by the agriculture output used by renewable fuels amount to an additional 19,500 jobs throughout the entire Iowa economy for a total impact from agriculture of nearly 27,409 jobs.

Increased economic activity and new jobs result in higher levels of income for Iowa households. The ethanol and supporting agriculture industry generated nearly \$3 billion of income for Iowans in 2022.

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 had capacity of 410 million gallons of biodiesel in 2022.⁵

The Iowa biodiesel industry spent \$2 billion on raw materials, other inputs, goods, and services in 2022. The largest share of this spending is for fats and oils used as the raw material to make

⁵ http://www.iowarfa.org/biodiesel_refineries.php

biodiesel. The Iowa biodiesel industry used more than 2.6 billion pounds of fats and oils to produce 349 million gallons of B100. The Iowa biodiesel industry used 1.87 billion pounds of soybean oil in 2022 to produce biodiesel, accounting for 71 percent of total feedstock use. Animal fats was the second largest biodiesel feedstock in 2022 at 290 million pounds. Smaller amounts of canola, distillers corn oil, and used cooking oil were also used. Most of the feedstocks for Iowa biodiesel production are 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 jobs, generating additional household income, and creating tax revenue. The following summarizes the economic contribution of the Iowa biodiesel industry at the end of 2022.

- The gross value of the biodiesel and glycerin produced in Iowa totaled more than \$2.3 billion. When the impact of manufacturing is considered, the biodiesel industry accounts for more than \$1.0 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 nearly 7,300 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 \$506 million of household income for Iowans.

Conclusion

The renewable fuels industry continued to make a significant contribution to the Iowa economy in terms of GDP, job creation, and income. The importance of the renewable fuels industry to agriculture and rural economies such as Iowa is particularly notable. Growth and expansion of the biofuels industry through the application of new technologies and feedstocks will enhance the industry's ability to support American energy independence and solidify its position as the original creator of green jobs while enabling America to make further strides toward reducing greenhouse gas emissions and positively dealing with climate change.

Further, policy and regulatory actions taken by Iowa, and other Midwestern states, to boost the use of biofuels locally, particularly statewide use of E15 and higher blends, provide substantial support for this important industry.

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 economic data from IMPLAN (Impact Analysis for Planning) to develop a model of the Iowa economy, including sectors that support the ethanol and biodiesel industries, 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 data. These data are based on the most recent available national input-output data and regional data published by the U.S. Bureau of Economic Analysis.

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.
- 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.

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 income).