



UNIVERSITY OF MINNESOTA EXTENSION

CENTER FOR COMMUNITY VITALITY

# Economic Contribution of Minnesota's Ethanol Industry: 2021

A report of the Economic Impact Analysis Program

Authored by Brigid Tuck



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A report of the Economic Impact Analysis Program

January 2022

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## Executive Summary: Economic Contribution of Minnesota's Ethanol Industry: 2021

Minnesota has long been a national leader in ethanol production. A mix of factors, including Minnesota's abundant annual corn crop, its history of successful farmer's cooperatives, the desire for energy independence—and increasingly, the demand for cleaner energy—has driven growth in the state's ethanol production.

Growth in the industry has also driven increased economic activity. To measure the economic contribution of the industry, the Minnesota Bio-Fuels Association partnered with University of Minnesota Extension on a study. Major findings from the analysis are included below.

**Economic Contribution in 2021:** In 2021, Minnesota's ethanol industry generated \$6.1 billion of economic activity through sales. This includes \$1.3 billion of income for Minnesota residents. The industry supported 22,810 jobs. It also contributed \$2.1 billion to the state's gross domestic product (GDP).

**Benefiting Industries:** Industries that benefited the most from ethanol production include real estate, nondurable good wholesalers (local farmer's cooperatives among them), and professional and scientific services.

**Tax Contribution:** Minnesota's ethanol industry generated an estimated \$123.0 million in state and local tax collections in 2021. Of this, \$42.8 million was in sales taxes, \$36.1 million in income taxes, and \$35.3 million in property taxes.

**Ethanol Production:** Minnesota's ethanol production increased to 1,271.5 million gallons in 2021—a 33 percent increase from 2020. Production, however, remained below 2019's reported production.

**Revenues and Expenditures:** Overall, ethanol plants experienced an increase in the net return per gallon of ethanol, to \$0.53 in 2021 from \$0.11 in 2020. Production expenditures increased, primarily driven by an increase in corn costs.

Revenues for ethanol plants also increased, particularly in the second half of 2021. Prices surged for ethanol from around \$1.25 per gallon in fall of 2019 to nearly \$3.40 per gallon by fall 2021. Corn oil also saw strong pricing through the year.

**Ethanol's Co-Products:** Ethanol plants produce fuel (ethanol), protein for animal feed (DDGS), and distillers' corn oil. Each of these products have value within the economy. Minnesota's 2021 DDGS supply supported 1.8 million cows, 2.2 million pigs, and 55.5 million turkeys and chickens. For context, Minnesota farms have 2.3 million cattle, 9.5 million pigs, and 49.5 million head of poultry.

If all of Minnesota's 2021 distillers' corn oil had been used in biodiesel production, it would have generated 43.1 million gallons of biodiesel. This represents nearly half of Minnesota 85.5 million gallons of biodiesel production capacity.

**A Year in Review:** The ethanol industry is subject to the highs and lows of consumer demand, and at no point was this clearer than during the mandated shutdowns during the COVID-19 pandemic of 2020. Production of fuel ethanol was relatively stable coming out of 2019 and into the first few

months of 2020. When demand for gasoline plummeted with stay-at-home orders, so did production of ethanol. In response, ethanol producers increased efforts to diversify their income streams, but it was not enough to offset losses.

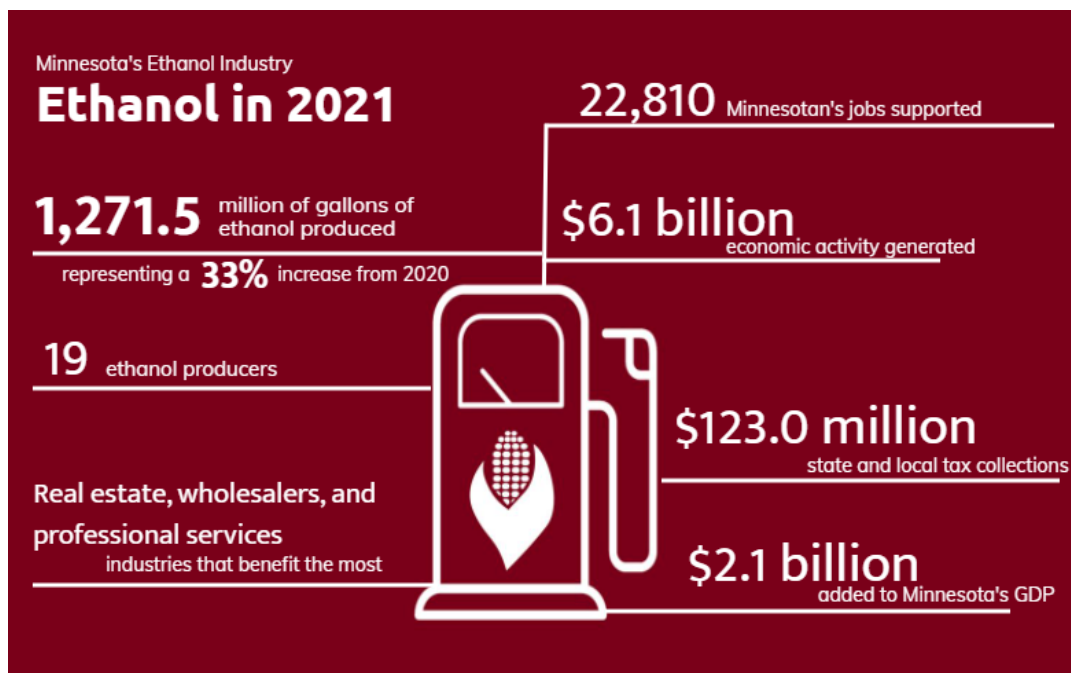
In 2021, Minnesota's ethanol industry moved into recovery. Ethanol production grew and stabilized. In addition, higher prices for ethanol and corn oil led ethanol plants nationally to report record profit margins in the fourth quarter, averaging \$1.34 per gallon. This puts the industry in a strong position headed into 2022.

**Industry Challenges:** Despite overall profitability, 2021 provided some challenges for ethanol producers. Early in the year, Minnesota's ethanol producers continued to pivot to meet shifts due to COVID-19. While several moved toward producing industrial alcohol, hand sanitizers, and cleaners during the early months in the pandemic, many found the increased demand for these products to be relatively short-lived and moved back into traditional production of ethanol, DDGS, and corn oil.

As summer and harvest 2021 approached, many ethanol producers also had concerns about the effect of the summer's drought on corn production. Timely rains later in the season averted major drops in corn yields; however, some areas of the state did see decreased yields, causing short-term shortages for some plants.

National policies remain a concern for ethanol producers. There are continued concerns about the use of Small Refinery Exemptions (SREs). SREs provide biofuel blending exemptions for small refineries. These exemptions lead to decreased demand for ethanol. There are also concerns surrounding national policies to move away from liquid fuels — for example, shifts toward electric vehicles. At the national level, ethanol producers also continue to advocate for increased exports.

The national economy also provides some concerns for the ethanol industry. Ethanol plants have increased production to capture the increased profitability, which may lead to oversupply issues in 2022. Further, the Federal Reserve is signaling increases in the interest rate, which could affect financing costs. Finally, COVID-19 continues to introduce uncertainty in the economy.

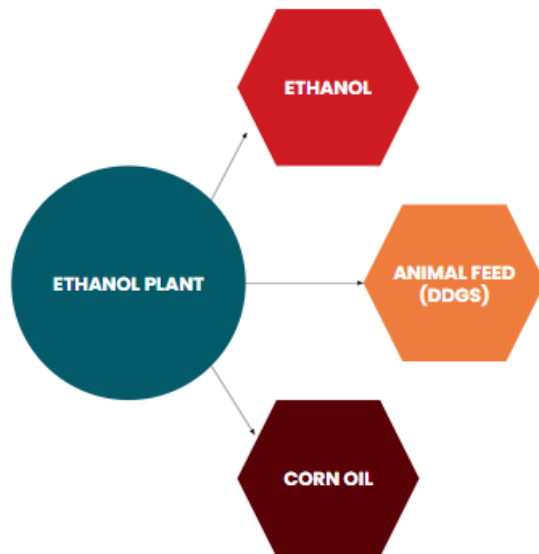


## Introduction

Minnesota has long been a national leader in ethanol production. A mix of factors, including Minnesota’s abundant annual corn crop, its history of successful farmer’s cooperatives, the desire for energy independence, and increasingly, the demand for cleaner energy, has driven growth in the state’s ethanol production. In 1987, Minnesota’s ethanol plants produced less than 1 million gallons. By 2021, this figure increased to slightly more than 1 billion. Minnesota is currently home to 19 ethanol plants.

Ethanol plants produce ethanol as an alternative to petroleum-based fuels. The ethanol plants ferment and distill simple sugars from biological sources. In Minnesota, the primary source (often referred to as a feedstock) in ethanol production is corn. In addition to ethanol, many plants also produce Dried Distillers’ Grains (DDGS), which farmers feed as a protein to their livestock. Ethanol plants in Minnesota also produce corn oil.<sup>1</sup> These byproducts—DDGS and corn oil—diversify revenue streams for ethanol producers (Chart 1).

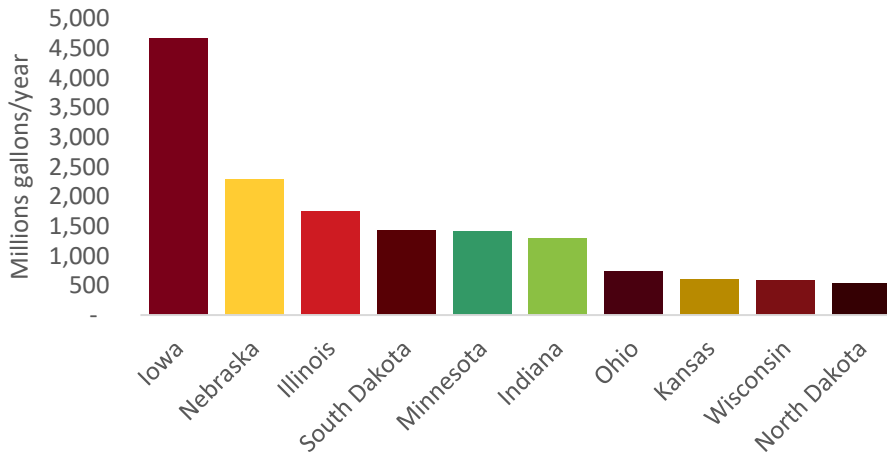
**Chart 1: Ethanol Plant Products**



Minnesota is the fifth-largest ethanol producer in the United States, as measured by production capacity. Iowa leads the nation with production capacity of 4.5 billion gallons per year (Chart 2). Minnesota has capacity to produce 1.4 billion gallons annually.

<sup>1</sup> Learn more about ethanol production at <https://www.mda.state.mn.us/environment-sustainability/ethanol-basics-and-faqs>

**Chart 2: Top 10 States: Fuel Ethanol Production Capacity, January 2021, Source: U.S. Energy Information Administration**



**The Ethanol Industry in 2021**

The ethanol industry is subject to the highs and lows of consumer demand, and at no point was this clearer than during the mandated shutdowns during the COVID-19 pandemic of 2020. Production of fuel ethanol in the Midwest region was relatively stable coming out of 2019 and into the first few months of 2020. When demand for gasoline plummeted with stay-at-home orders, so did production of ethanol for fuel. In response, ethanol producers increased efforts to diversify their income streams, but it was not enough to offset losses.

In 2021, Minnesota’s ethanol industry showed signs of recovery, as demonstrated by regional trends. In the Midwest, fuel ethanol production was at 991 thousand barrels per day at the end of the third week of December. This compares to 984 for the same week in December 2019 (Chart 3).

**Chart 3: Weekly Midwest Plant Production of Fuel Ethanol, 2016-2021, Source: U.S. Energy Information Administration**



In Minnesota, ethanol production increased to 1,271.5 million gallons in 2021—a 33 percent increase from 955.5 million gallons in 2020 (Table 1)<sup>2</sup>. Production, however, remained below 2019’s reported production of 1,315.0 million gallons.

Overall, Minnesota’s ethanol plants experienced an increase in the net return per gallon of ethanol, from \$0.11 in 2020 to \$0.53 in 2021. Production expenditures increased, primarily driven by an increase in corn costs. In fact, spending by ethanol plants for corn more than doubled in 2021 compared to the previous year.

Revenues for ethanol plants also increased, particularly in the second half of 2021. Prices surged for ethanol from around \$1.25 per gallon in fall of 2019 to nearly \$3.40 per gallon by fall 2021 (Chart 4). Corn oil also saw strong pricing through the year. In fall of 2019, prices were around \$0.25 per pound. At the end of 2021, the price was about 2.5 times higher.

These higher prices led ethanol plants nationally to report record profit margins in the fourth quarter, averaging \$1.34 per gallon.<sup>3</sup> This puts the industry in a strong position headed into 2022.

In 2021, an estimated 454.1 million bushels of corn went into ethanol production in Minnesota, representing 31 percent of the 1.5 billion bushels harvested in the state in 2021.

For information on how Extension estimated revenues, expenditures, and returns, please see Appendix 1.

**Table 1: Minnesota’s Ethanol Industry Statistics**

<b>Category</b>	<b>2020</b>	<b>2021</b>	<b>Percent change</b>
Production (mill gallons)	955.5	1,271.5	33%
Feedstock/corn (millions)	\$1,090.6	\$2,454.2	125%
Operation costs per gallon	\$1.55	\$2.40	55%
Revenue per gallon	\$1.65	\$2.93	77%
Net returns per gallon	\$0.11	\$0.53	382%

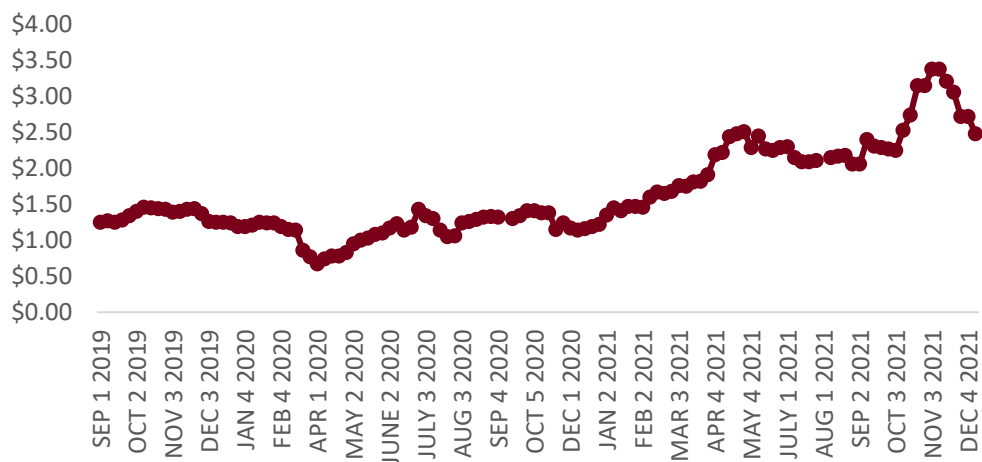
Sources: Minnesota Bio-Fuels Association, Iowa State Ethanol report, USDA Economic Research Service, Extension estimates

<sup>2</sup> Based on industry data collected via a survey of ethanol producers by the Minnesota Bio-Fuels Association.

<sup>3</sup> <https://www.mnbiofuels.org/cobank-ethanol-enters-2022-with-considerable-momentum>



**Chart 4: Minnesota Ethanol Prices, Fall 2019-Winter 2021 (Date Format is Month, Week, Year); Source: USDA, Agricultural Marketing Service**



Despite overall profitability, 2021 provided some challenges for ethanol producers. Early in the year, Minnesota’s ethanol producers continued to pivot to meet shifts due to COVID-19. While several moved toward producing industrial alcohol, hand sanitizers, and cleaners during the early months in the pandemic, many found the increased demand for those products to be relatively short-lived and moved back into traditional production of ethanol, DDGS, and corn oil.

As summer and harvest 2021 approached, many ethanol producers also had concerns about the effect of the summer’s drought on corn production. Timely rains later in the season averted major drops in corn yields; however, some areas of the state did see decreased yields, causing short-term shortages for some plants.

National policies remain a concern for ethanol producers. There are continued concerns about the use of Small Refinery Exemptions (SREs). SREs provide biofuel blending exemptions for small refineries. These exemptions lead to decreased demand for ethanol. There are also concerns surrounding national policies to move away from liquid fuels—for example, shifts toward electric vehicles. At the national level, ethanol producers also continue to advocate for increased exports.

The national economy also provides some concerns for the ethanol industry. Ethanol plants have increased production to capture the increased profitability, which may lead to oversupply issues in 2022. Further, the Federal Reserve is signaling increases in the interest rate, which could affect financing costs. Finally, COVID-19 continues to cause economic uncertainty.<sup>4</sup>

Looking to 2022, ethanol producers will be eligible for \$800 million in federal support from USDA. Of this, \$700 million will be for pandemic relief via direct payments from the Biofuel Producer Program. The remaining \$100 million will go for infrastructure, including blender pumps, refueling and distribution facilities, and upgrading infrastructure.<sup>5</sup>

<sup>4</sup> <https://www.mnbiofuels.org/cobank-ethanol-enters-2022-with-considerable-momentum>

<sup>5</sup> <http://ethanolproducer.com/articles/18814/usda-announces-800-million-in-support-for-biofuels>

## Economic Contribution

Ethanol production creates economic activity in the state of Minnesota. An economic contribution analysis can quantify that activity. Economic contribution includes direct, indirect, and induced effects. The direct effect of an industry is the spending by the industry to operate. In this analysis, it is spending by ethanol producers on items such as corn, enzymes and yeasts, utilities, and employee wages. As the ethanol producers purchase these items, they cause their suppliers to increase production, creating additional economic activity. Ethanol producers also pay their workers, who in turn, spend their incomes, generating even more economic activity. These are indirect and induced effects.

Economists use input-output models to measure economic contribution. The models measure the flow of goods and services within an economy. Once that flow is established, the model can determine how a change in one sector of the economy (say manufacturing) affects other sectors of the economy (say construction). Extension used the input-output model IMPLAN with the Type SAM multipliers for this analysis.

### Direct Effect

As mentioned, the direct effect of the ethanol industry is the producer's expenditures for operations. In 2021, Minnesota's ethanol producers spent an estimated \$3.1 billion to operate (Table 2). The most significant expenditure was for the corn at \$2.5 billion (or 80 percent of expenditures). Other expenditures include utilities, enzymes and yeasts, and labor. Total operating costs were \$2.40 per gallon.

Revenues, meanwhile, were an estimated \$3.7 billion. Ethanol itself accounted for 76 percent of the ethanol plants' revenue. Ethanol producers also earned income from DDGS and corn oil sales.

All in all, revenues more than exceeded costs in 2021, and ethanol producers earned \$0.53 per gallon of net returns over costs.

**Table 2: Direct Effects of Minnesota's Ethanol Industry: 2021**

<b>Operating Costs</b>	<b>2021 (Millions)</b>
Production (mill gallons)	1,271.5
Feedstock (corn)	\$2,454.2
Enzymes, yeasts and chemicals	\$88.1
Denaturant	\$59.3
Utilities	\$217.2
Direct labor	\$81.4
Maintenance and repairs	\$31.8
Transportation	\$9.5
General & administrative expenses	\$112.7
Total operating costs	\$3,054.1
\$/Gallon	\$2.40



Revenues	2021 (Millions)
Ethanol	\$2,817.0
Dried Distillers' Grain (DDGS)	\$728.5
Corn oil	\$182.8
Total revenue	\$3,728.2
Net return over operating costs	\$674.1
\$/Gallon	\$0.53

Sources: Minnesota Bio-Fuels Association, Iowa State Ethanol Production Profitability report, USDA Economic Research Service, Extension estimates

### Indirect and Induced Effects

As mentioned, a business or industry creates indirect and induced effects when they make direct expenditures. Indirect effects are associated with the spending for goods and services used as inputs into the industry. For example, when an ethanol plant purchases enzymes and chemicals, those manufacturers have to increase their production, thus triggering increases across the supply chain. These are often called business-to-business effects.

Induced effects are associated with spending by the ethanol plant's workers. Workers earn income and then spend that money for housing, health care, and at local places such as restaurants and grocery stores. These are often called consumer-to-business effects.

The next section will present the data for the indirect and induced effects of Minnesota's ethanol industry.

### Total Economic Contribution

In total, Minnesota's ethanol industry created \$6.1 billion of economic activity in 2021 (Table 3). This includes labor income of \$1.3 billion. The industry supported 22,810 jobs.

**Table 3: Total Economic Contribution of Minnesota's Ethanol Industry: 2021, Dollar Values Are All in Millions**

Category	Employment	Output	Gross Domestic	
	(FTE)		Product	Labor Income
Direct	7,640	\$3,054.1	\$574.0	\$359.2
Indirect	9,630	\$1,979.0	\$965.2	\$570.1
Induced	5,540	\$1,026.6	\$593.5	\$345.2
Total	22,810	\$6,059.7	\$2,132.7	\$1,274.5

Sources: Extension estimates

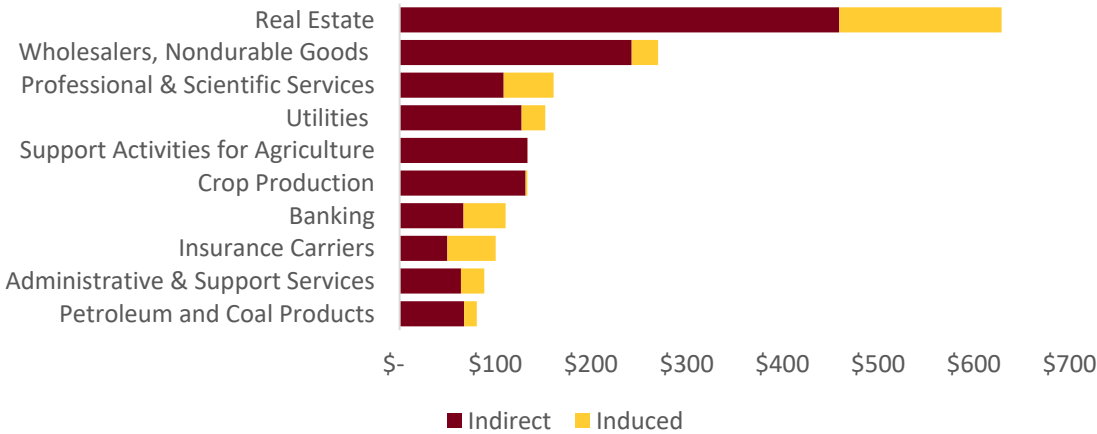
Ethanol production generates significant indirect (or business-to-business) impacts. Indirect impacts are often higher for industries which add value to a product produced within the state. This is because the spending by the ethanol producers is largely captured in Minnesota, particularly by corn producers.

Of the \$6.1 billion of economic activity created by the industry, \$3.0 billion is at businesses other than the ethanol plants. Chart 5 shows the industries that receive the largest economic benefits of ethanol production. These industries include real estate, nondurable goods wholesalers, and professional and scientific services.

Indirect effects are high in the real estate sector. Ethanol plants themselves typically require a significant amount of land and building space. In addition, one of the largest inputs into the production of corn is land.

Indirect effects are also high at nondurable good wholesalers. Wholesalers sell product in bulk to businesses. In the agricultural industry, your local farmer’s cooperative—which both buys and sells corn and also supplies chemicals and other inputs—is a major nondurable good wholesaler.

**Chart 5: Top Industries Impacted, Minnesota's Ethanol Industry, 2021 (Indirect and Induced Effects)**



**State and Local Tax Collections**

Minnesota’s ethanol industry generated an estimated \$123.0 million in state and local tax collections in 2021 (Table 4). Of this, \$42.8 million was in sales taxes, \$36.1 million in income taxes, and \$35.3 million in property taxes.

**Table 4: State and Local Tax Contribution of Minnesota’s Ethanol Industry: 2021, Dollar Values Are All in Millions**

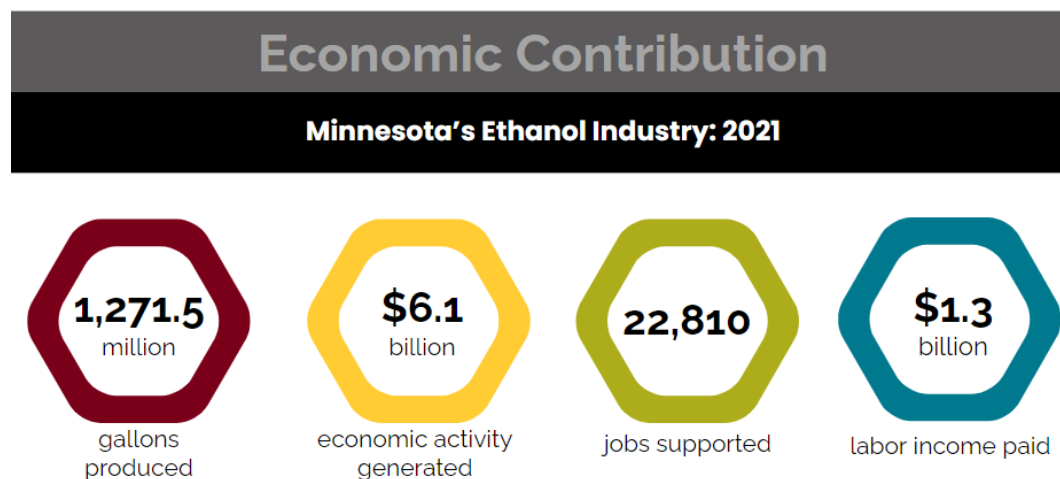
Category	Taxes
Property	\$35.3
Sales	\$42.8
Income	\$36.1
Other	\$8.8
<b>Total</b>	<b>\$123.0</b>

Sources: Extension estimates



In summary, Minnesota’s ethanol plants produced 1,271.5 million gallons of ethanol in 2021, generated \$6.1 billion in economic activity, and supported 22,810 jobs (Chart 6).

**Chart 6: Summary Statistics, Minnesota’s Ethanol Industry in 2021**



Given the major influence of corn production in the economic contribution of the industry, it can be valuable to examine the impact of individual industry components.

**Impact of Ethanol Production (Excluding Corn)**

Ethanol producers spent an estimated \$599.9 million on inputs other than corn in 2021, including \$81.4 million in labor income (Table 5).

This direct spending generated \$1.2 billion of economic activity in the state. Ethanol production (excluding corn production) supported 3,610 workers in Minnesota who received \$255.4 million in income.

**Table 5: Economic Contribution of Minnesota’s Ethanol Production (Excluding Corn): 2021 Dollar Values Are All in Millions**

Category	Employment	Output	Gross Domestic	
			Product	Labor Income
Direct	1,120	\$599.9	\$213.2	\$81.4
Indirect	950	\$274.8	\$134.1	\$78.1
Induced	1,540	\$285.5	\$165.1	\$95.9
<b>Total</b>	<b>3,610</b>	<b>\$1,160.2</b>	<b>\$512.4</b>	<b>\$255.4</b>

Sources: Extension estimates

**Impact of Corn Production**

As mentioned, corn growing is a major driver of the economic impact of ethanol production. Extension estimates more than 6,500 farmers and their workers sold \$2.4 billion of corn to ethanol plants. This created nearly \$5.0 billion of economic activity in the state and supported 19,200 workers (Table 6).

**Table 6: Economic Contribution of Minnesota’s Corn Produced for Ethanol: 2021, Dollar Values in Millions**

Category	Employment	Output	Gross Domestic	
			Product	Labor Income
Direct	6,520	\$2,454.2	\$360.8	\$277.8
Indirect	8,680	\$1,704.2	\$831.1	\$492.0
Induced	4,000	\$741.2	\$428.5	\$249.3
Total	19,200	\$4,899.6	\$1,620.4	\$1,019.1

Sources: Extension estimates

## The Role of Ethanol’s Co-Products

Ethanol plants produce fuel (ethanol), protein for animal feed (DDGS), and distillers’ corn oil. Each of these products have value within the economy.

### DDGS as Animal Protein

In 2021, Minnesota’s ethanol plants produced an estimated 3.7 million tons of dried distillers’ grain. Due to its high content of fiber and protein, DDGS’ primary use is in feeding livestock. For beef cattle, research shows DDGS have 95 percent of the energy value of corn grain.<sup>6</sup>

In the United States, cattle farmers use nearly 80 percent of the DDGS.<sup>7</sup> Farmers also feed DDGS to swine and poultry. Producers can generally replace between 10 and 20 percent of their animal’s daily ration with DDGS.<sup>8</sup> One cow can eat 1.5 tons of DDGS in a year, thus a ton can support two-thirds a cow (Chart 7). One ton of DDGS can also provide a valuable food source for four pigs or 250 turkeys.

**Chart 7: Animal’s Potential Annual Use of One Ton of Dried Distillers’ Grains (DDGS),**

Source: USDA, Economic Research Service



<sup>6</sup> <https://extension.umn.edu/beef-feedlot/feeding-distillers-grains-beef-cattle>

<sup>7</sup> <https://ethanolrfa.org/ethanol-101/ethanol-co-products>

<sup>8</sup> [https://www.ers.usda.gov/webdocs/outlooks/36471/12563\\_fds11i01\\_2\\_.pdf?v=8519](https://www.ers.usda.gov/webdocs/outlooks/36471/12563_fds11i01_2_.pdf?v=8519)

Based on those ratios, Minnesota's 2021 DDGS supply supported 1.8 million cows, 2.2 million pigs, and 55.5 million turkeys and chickens. For context, Minnesota farms have 2.3 million cattle, 9.5 million pigs, and 49.5 million head of poultry.<sup>9</sup>

### **Distillers' Corn Oil**

Distillers' corn oil is the final major co-product made by ethanol plants. In 2021, Minnesota's ethanol plants produced 332.3 million pounds of corn oil. The corn oil is mostly used for biodiesel production, but is also blended into poultry and swine feed.<sup>10</sup>

If all of Minnesota's 2021 distillers' corn oil had been used in biodiesel production, it would have generated 43.1 million gallons of biodiesel.<sup>11</sup> This represents nearly half of Minnesota 85.5 million gallons of biodiesel production capacity.<sup>12</sup>

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<sup>9</sup>[https://www.nass.usda.gov/Statistics\\_by\\_State/Minnesota/Publications/Annual\\_Statistical\\_Bulletin/index.php](https://www.nass.usda.gov/Statistics_by_State/Minnesota/Publications/Annual_Statistical_Bulletin/index.php)

<sup>10</sup>[https://onlinelibrary.wiley.com/doi/abs/10.1002/047167849X.bio007.pub2#:~:text=Distillers%20corn%20oil%20\(DCO\)%20is,a%20valuable%20poultry%20feed%20ingredient](https://onlinelibrary.wiley.com/doi/abs/10.1002/047167849X.bio007.pub2#:~:text=Distillers%20corn%20oil%20(DCO)%20is,a%20valuable%20poultry%20feed%20ingredient)

<sup>11</sup> [https://www.fsa.usda.gov/Internet/FSA\\_File/2002factorsnformulas.pdf](https://www.fsa.usda.gov/Internet/FSA_File/2002factorsnformulas.pdf)

<sup>12</sup> <https://www.mda.state.mn.us/environment-sustainability/minnesota-biodiesel>



## Appendix 1: Methodology

This appendix outlines the basic methods and data sources used to arrive at the ethanol expenditures and revenues found in Tables 1 and 2.

### Production

The Minnesota Bio-Fuels Association conducted a survey of ethanol producers to determine total production in 2021. They provided the figures to Extension. Production data for 2019 and 2020 comes from a previous analysis of the ethanol industry completed on behalf of the Minnesota Bio-Fuels Association and was collected in a similar manner.

### Revenues

Extension calculated revenues from ethanol production primarily by using Iowa State's ethanol plant prices report.<sup>13</sup> In authoring this report, University of Minnesota Extension used the average monthly price of ethanol per gallon for Minnesota, weighted for production by month. This approach yielded an average price of \$2.22 per gallon for the year.

Iowa State's report also provides a price for DDGS and corn oil. Extension used that data to estimate DDGS and corn oil revenues in Minnesota, also weighting for monthly production. The average DDGS price using this model was \$194.44 per ton and corn oil was \$0.55 per pound.

Iowa State gets its price data from USDA's daily ethanol report, produced by the Agricultural Marketing Service.

### Expenditures

Extension calculated ethanol plant expenditures primarily using Iowa State's ethanol plant profitability model and its estimates of costs per gallon of ethanol produced. Extension used Iowa State's corn prices, again weighting for production by month, resulting in an average corn price of \$2.12 per gallon of ethanol. Given the ever changing landscape of employment and wages in Minnesota, Extension used an average salary/wage plus benefits (across all employee categories) of \$80,000. Minnesota's average weekly wage (not including benefits) in the manufacturing industry was about \$1,380 (or \$72,000 annually) in 2021.

### Corn Production

This is an economic contribution study, so it examines the relationships and supply chain related to the production of ethanol. Thus, Extension included the impact of corn production. An economic impact study would take a different methodological approach.

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<sup>13</sup> <https://www.extension.iastate.edu/agdm/energy.html>



## Appendix 2: Definitions and Terms

Special models, called input-output models, exist to conduct economic contribution analysis. There are several input-output models available. IMPLAN (IMPact Analysis for PLANning) is one such model. Many economists use IMPLAN for economic contribution analysis because it can measure output and employment impacts, is available on a county-by-county basis, and is flexible for the user. IMPLAN has some limitations and qualifications, but it is one of the best tools available to economists for input-output modeling. Understanding the IMPLAN tool, its capabilities, and its limitations helps ensure the best results from the model.

One of the most critical aspects of understanding economic contribution analysis is the distinction between the local and non-local economy. The local economy is identified as part of the model-building process. Either the group requesting the study or the analyst defines the local area. Typically, the study area (the local economy) is a county or a group of counties that share economic linkages. In this study, the study area is the entire state of Minnesota.

This distinction is important because the model will only capture the impact of spending within the defined region. If an ethanol producer, for example, buys items outside the state of Minnesota, this will not generate ripple effects.

A few definitions are essential to properly read the results of an IMPLAN analysis. These terms and their definitions are provided below.

### Output

Output is the quantity of goods or services produced in a given time period by a firm, industry, or county, whether consumed or used for further production. The concept of national output is essential in the field of macroeconomics.

Output represents the value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are listed in producer prices. Output is measured in dollars and is equivalent to total sales.

Output measures all sales in the economy, and therefore, can in essence double-count. Corn is a good example of this. A farmer sells corn to a local farmer's cooperative. This is one sale, and the value of the corn is counted in output. The farmer's cooperative then grinds that corn into dairy cattle feed and sells to the local dairy farmer. That is a second sale, and the final price again includes the value of the corn. The dairy farmer, in turn, sells the milk produced from the cow fed with the feed. The value of the corn is built into that sale price too.

Output is the figure most commonly reported in economic contribution studies.

### Gross Domestic Product (GDP)

GDP is similar to output, however, it eliminates the double counting by only counting the value at final demand (or final use of the product).

### Employment

In this report, employment is listed in full-time equivalents. Because employment is measured in jobs and not in dollar values, it tends to be a very stable metric. This is particularly true in times of



accelerating inflation—one employee produces the same amount of output, even if the value of that output is rising.

## **Labor Income**

Labor income includes all forms of employment income, including employee compensation (wages, salaries, and benefits) and proprietor income. Labor income measures the value added to the product by the labor component.

## **Direct Impact**

Direct impact is equivalent to the initial activity in the economy. In this study, it is the expenditures of the ethanol producers.

## **Indirect Impact**

The indirect impact is the summation of changes in the local economy that occur due to spending for inputs (goods and services) by the industry or industries directly impacted. For instance, if employment at the ethanol plant increases by 100 jobs, this implies a corresponding increase in output by the plant. As the plant increases output, it must also purchase more inputs, such as electricity, enzymes, and equipment. As the plant increases its purchase of these items, its suppliers must also increase production, and so forth. As these ripples move through the economy, they can be captured and measured. Ripples related to the purchase of goods and services are indirect impacts.

## **Induced Impact**

The induced impact is the summation of changes in the local economy that occur due to spending by labor; that is, spending by employees in the industry or industries directly impacted. For instance, if employment in an ethanol plant increases by 100 jobs, the new employees will have more money to purchase housing, buy groceries, and go out to dinner. As they spend their new income, more activity occurs in the local economy. This can be quantified and is called the induced impact.

## **Input-Output, Supply and Demand, and Size of Market**

Care must be taken when using regional input-output models to ensure they are being used in the appropriate type of analysis. If input-output models are used to examine the impact or the contribution of an industry that is so large that its expansion or contraction results in such major shifts in supply and demand that prices of inputs and labor change, input-output can overstate the impacts or contributions. This may be a concern in this study, as ethanol producers do have the potential to change commodity prices.

