

Economic Impacts of the Nebraska Ethanol and Co-Products Industry

2020

Kathleen Brooks, Tim Meyer and Cory Walters

Department of Agricultural Economics
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

Eric Thompson

Bureau of Business Research
College of Business
University of Nebraska-Lincoln



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Abstract

This study estimates the overall economic impact of the Nebraska ethanol industry in 2020. The study builds on previous reports using a quantitative measure (IMPLAN) as well as a fundamental economic analysis to assess the harder-to-measure outcomes of the industry. Nebraska ethanol industry remains important in Nebraska producing 1.85 billion gallons in 2020, resulting in a value of ethanol and coproducts production of \$3.433 billion, trailing only corn and cattle. Although the Nebraska ethanol industry has experienced weakened ethanol prices, it has shown resilience through continued expansion in total capacity and diversification of co-products. Nebraska ethanol production peaked in 2019 at 2.253 billion gallons. Due to the covid-19 pandemic, output fell to 1.847 billion gallons in 2020. Overall, the economic impact of the ethanol industry is estimated at \$4.41 billion.

Acknowledgement

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Highlights

Output, Employment, Labor Income, Indirect Business Taxes (2020)

- Ethanol Production – 1,847 million gallons
- Value of Ethanol Production – \$2,252 million
- Total Value – \$3,433 million
- Employees – 1,758 full-time equivalents (FTEs)
- Labor Income – \$146 million
- Indirect Business Taxes – \$13 million

Overall Economic Impact (2020)

- Employment – 8,000 jobs
- Total Labor Income – \$496 million
- Total Output – \$4,410 million

Economic Impact from Cumulative Investments

- Employment – 678 job-years
- Total Labor Income – \$40.9 million
- Total Output – \$102.8 million

Introduction

This report estimates the overall impact of the Nebraska ethanol and co-products industry in 2020. The report focuses on the macroeconomic impact of the industry and updates the 2018 to 2019 report¹. This report takes a scientific approach to analyzing the economic impact of ethanol and ethanol co-product production in Nebraska. IMPLAN, a research tool designed to capture multiple levels of economic activity associated with an industry, was used to calculate economic impact. The report concludes with an economic assessment of the harder-to-measure opportunities and market dynamics associated with the ethanol industry both now and in the future.

2010–2019 Summary

Three previous reports were conducted for the production years of 2010-2014, 2015-2017, and 2018-2019. Over this time, production of ethanol has ranged from a low of 1.77 billion gallons in 2013 to a high of 2.25 billion gallons in 2019. Since then, production capacity has continued to increase in the state.

While production capacity has been increasing, the overall value of both ethanol and ethanol co-products has declined. Over this last decade, the annual average ethanol prices have ranged from \$1.28 per gallon in 2018 to \$2.55 per gallon in 2011. The value of ethanol production peaked in 2011 at \$5.25 billion and declined to a low of \$2.85 billion in 2018.

The Nebraska Ethanol Industry has continued to diversify output. Each report shows added diversification to the co-products offered by ethanol plants in the state. The last report for 2018-2019 presented a more diverse portfolio including active markets in dried, wet, and modified distillers' grains and corn oil. The current 2020 report continues to reveal this co-product expansion, with income reported from new co-products such as hand sanitizer, high fructose corn syrup, and starches. The ethanol co-products markets continue to provide diversified revenue to these plants.

The Nebraska ethanol industry plays a large role in the Nebraska economy. Over the last five years (2016-2020), the overall value of the ethanol and ethanol co-products averaged 63% of corn production, 35% of cattle production, and 141% of soybean production. The industry is the third largest agricultural industry in the state.

In 2014, the ethanol industry employed 1,301 full-time employees, and rose to 1,460 employees in 2019. These jobs led to an average primary employee income of \$71 million dollars per year from 2010-2014 and \$112 million per year from 2018-2019. Proprietors' income tells a different story, as producer income averaged \$34 million from 2010-2014 and only \$12 million/year from 2018-2019, primarily due to lower prices.

¹https://agecon.unl.edu/documents/ethanol-report-2018-2019_final.pdf

Nebraska Ethanol Production — An Overview

Nebraska is the second largest ethanol producing state in the U.S. Permitted capacity for ethanol production has continued to grow over the last decade. In 2014, permitted capacity was estimated at 2.08 billion gallons per year² and has grown to over 2.37 billion gallons per year³ in 2020. As capacity has grown over the last decade, ethanol production has grown to a peak in 2019 of 2.253 billion gallons (Figure 1)⁴. Weakened ethanol prices and Covid-19 related production decreases resulted in the production of 1.847 billion gallons in 2020 (Figure 1).

The estimated value of production for ethanol and ethanol co-products for Nebraska is reported in Figure 2. The total value of production for the ethanol industry in 2020 was estimated at \$3.433 billion. Declining ethanol prices along with declines in production due to COVID related closures, explain the decline in overall value compared to prior years.

The Nebraska Ethanol Industry has continued to expand their co-products offerings. As the type of co-products has expanded, we have updated reports accordingly. Previous reports reported distillers' grains and corn oil. This 2020 report captures other co-products that were produced in 2020 based on survey results from ethanol plants. These include co-products such as hand sanitizers, starches, and high fructose corn syrup. Several plants received PPP loans that were included as other income as well. These co-products and PPP loans captured an additional \$441 million in additional value for the ethanol industry in Nebraska. These numbers may be higher as we are only reporting values of these additional co-products reported by ethanol plants who responded to a survey in January 2023.

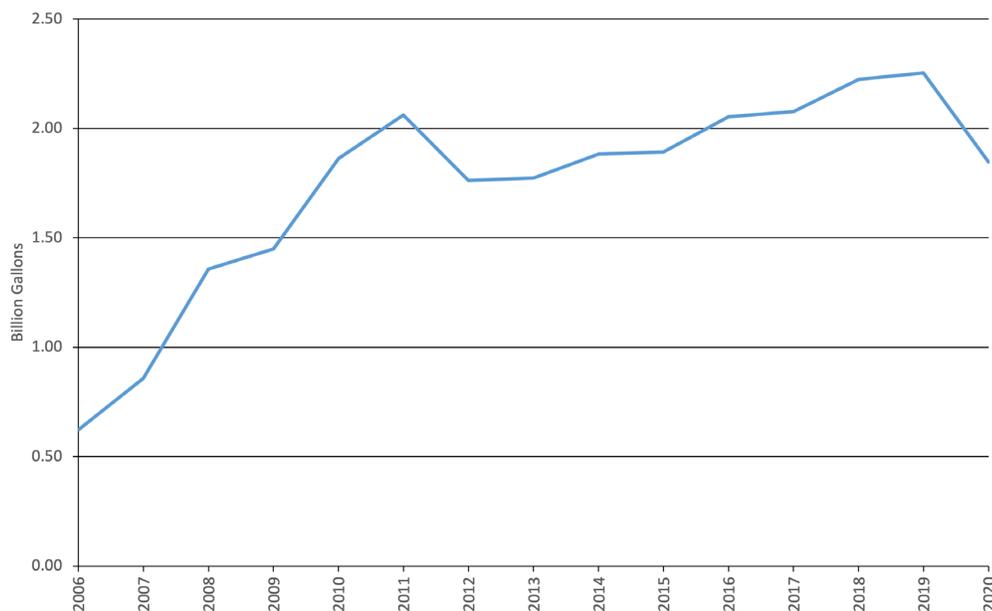


Figure 1: Ethanol Production in Nebraska, 2006-2019⁵

²<https://agecon.unl.edu/research/economic-impacts-ethanol-industry-nebraska.pdf>

³Two plants from the 2018 & 2019 report were no longer operational in 2020.

⁴Sources of data and information for all figures and tables are documented in the Appendix.

⁵Sources of data and information for all figures and tables are documented in the Appendix.

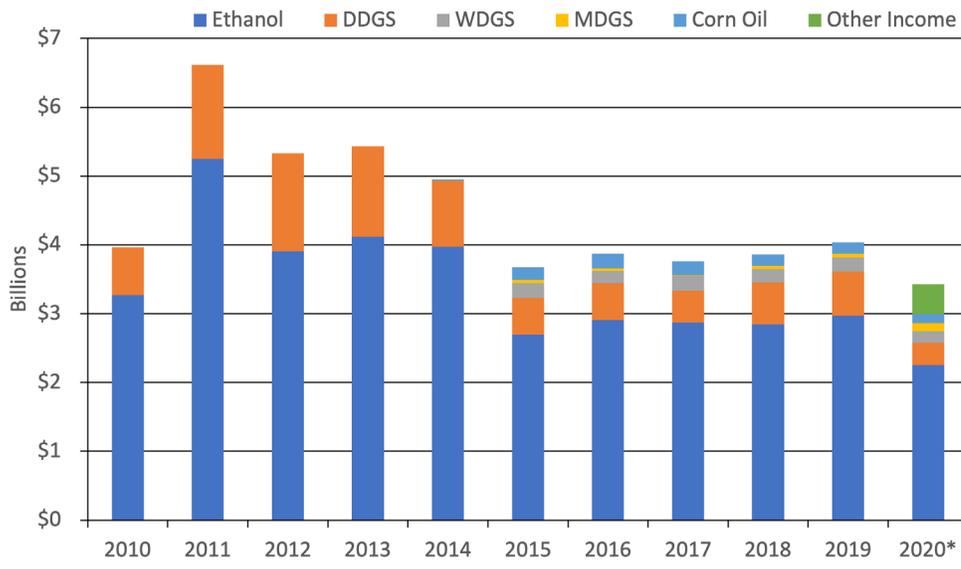


Figure 2. Value of Production for Ethanol and Co-products, 2010 - 2020⁶

Table 1: Value of Production for Ethanol and Co-Products, 2020

Annual Output		2020
Ethanol:		
Annual Production (mil gals)		1,847
Annual Average Price FOB Plant (\$/gal)		\$1.20
Value of Ethanol Production (mil \$)		\$2,252
Dried Distillers' Grain (DDGS):		
Annual Production (mil tons)		2.28
Annual Average Price (\$/ton)		\$142.48
Value of DDGs Production (mil \$)		\$325
Wet Distillers' Grain (WDGS):		
Annual Production (mil tons)		3.86
Annual Average Price (\$/ton)		\$43.77
Value of WDGs Production (mil \$)		\$169
Modified Distillers' Grain (MDGS):		
Annual Production (mil tons)		2.19
Annual Average Price (\$/ton)		\$61.61
Value of MDGs Production (mil \$)		\$117
Corn Oil:		
Annual Production (tons)		241,257
Annual Average Price (\$/ton)		\$509.96
Value of Corn Oil Production (mil \$)		\$129
Other Products:		
Value of Other Income (mil \$)		\$441
Total Value: (mil \$)		\$4,042

⁶2020 includes sources of other income (i.e., additional co-products and PPP loans)

Comparative Values of Ethanol in Nebraska

Comparisons of the production value for ethanol and ethanol co-products to the values of corn production, cattle sales, and soybean production in Nebraska are in Table 2 and Figure 3. In 2020, the value of Ethanol and co-products was 56% of corn value, 35% of cattle sales and over 130% of soybean value. These are very similar to the average of the last 5 years (63%, 35%, and 141%, respectively).

Table 2: Comparative Values of Ethanol and Co-products to Corn, Cattle, and Soybeans

Product	2020
Ethanol & Co-products (mil \$)	\$3,433
Corn	
Corn Production (mil bu)	1,780
Annual Average Price (\$/bu)	\$3.44
Value of Corn Production (mil \$)	\$6,123
Cattle	
Sales of Cattle (mil \$)	\$9,645
Soybeans	
Soybean Production (mil bu)	299
Annual Average Price (\$/bu)	\$8.73
Value of Soybean Production (mil \$)	\$2,610

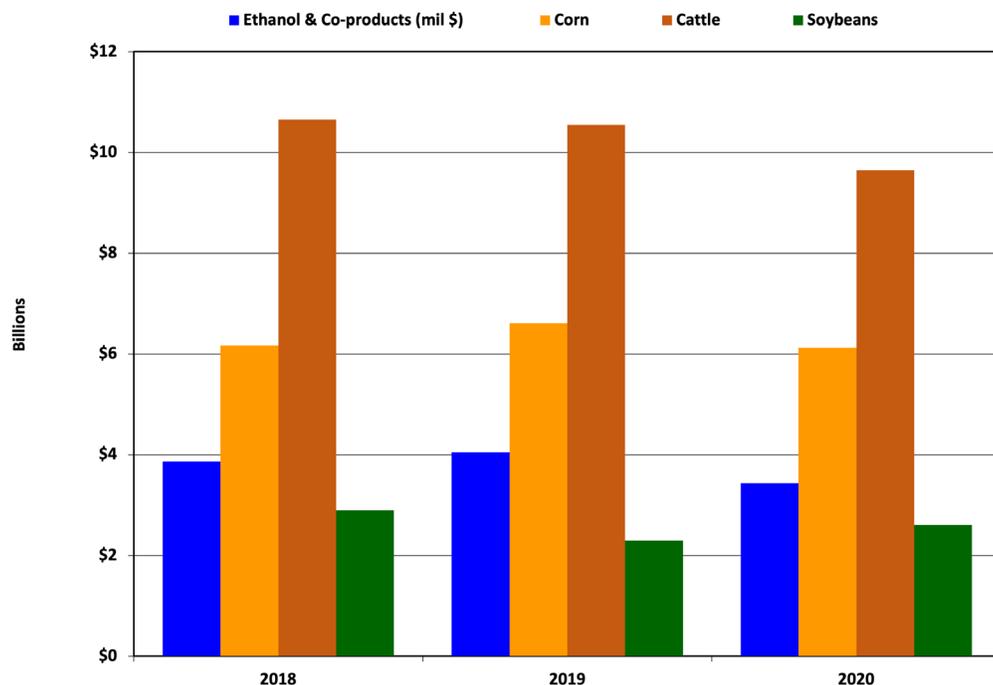


Figure 3. Comparative Values of Production

Permitted Capacity and Employment

Table 3 lists the Nebraska ethanol permitted capacities . Due to the expansion of ethanol plants, Nebraska’s reported ethanol capacity is over 2.368 billion gallons. The total state employment, measured in full-time equivalents (FTEs), is 1,758.

Table 3. Nebraska’s Ethanol Production Capacity and Facility Employment

Company	Nebraska Location	Facility Employment (FTE)	Permitted Capacity (MGY)
ADM Co. (Dry Mill) (Vantage Corn Processors)	Columbus	58	313
Archer Daniels Midland Co. (Wet Mill)	Columbus	254	100
Aurora Cooperative Ethanol LLC - West	Aurora	45	90
Bridgeport Ethanol, LLC	Bridgeport	27	54
Cargill, Inc.	Blair	400	210
Chief Ethanol Fuels Inc.	Hastings	66	70
Chief Ethanol Fuels Inc.	Lexington	51	50
E Energy Adams, LLC	Adams	59	100
Green Plains Atkinson LLC	Atkinson	55	55
Green Plains Central City LLC	Central City	63	116
Green Plains Wood River LLC	Wood River	79	130
Green Plains York LLC	York	49	55
Green Plains Ord LLC	Ord	46	65
Husker Ag, LLC	Plainview	58	109
KAAPA Ethanol Ravenna LLC	Ravenna	50	130
KAAPA Ethanol, LLC	Minden	43	85
Louis Dreyfus Norfolk LLC	Norfolk	51	54
Mid America Agri Products/Wheatland LLC	Madrid	34	55
Midwest Renewable Energy, LLC	Sutherland	28	25
Nebraska Corn Processing, Inc.	Cambridge	40	60
Flint Hills Resources Fairmont LLC	Fairmont	60	132
Siouxland Ethanol, LLC	Jackson	45	95
Trenton Agri Products, LLC	Trenton	32	50
Valero Renewable Fuels Co. LLC	Albion	65	165
Total		1,758	2.368

⁷Due to changes in ethanol plant reporting to the Nebraska Department of Environment and Energy, 2020 permitted capacity numbers are estimated by the Nebraska Ethanol Board and a survey submitted to the Renewable Fuels Nebraska and Nebraska Ethanol Board in January 2023. Facility Employment were estimated by the Nebraska Ethanol Board and provided by the survey in January 2023.

Corn Price Impacts

Ethanol plants provide a demand source for corn that causes the local market price for corn to find a new equilibrium. Recent work by Harthoorn (2022)⁸, who investigated the value of ethanol to Nebraska producers' corn price, found higher farm gate prices by delivering to ethanol plants. Harthoorn (2022) observed the farm gate price effect to depend upon three factors: farm location, ethanol plant size and time of year. For farm location, Harthoorn (2022) found producers could travel further (to the ethanol plant) and still receive a higher farm gate price than otherwise. For plant capacity, ethanol plants with higher capacity provide not only a greater value but also a greater value over a larger area. For time of the year, spring sales to ethanol plants provides the greatest price differential (Harthoorn, 2022). Overall, Harthoorn (2022) notes an average increase of \$0.09/bu from selling corn to an ethanol producer.

Aggregate Economic Characteristics

Two other direct components are employment and associated labor income. Ethanol production is a capital and input-intensive process. This means billions of dollars of production is possible with a limited number of employees. In 2020, there were an estimated 1,758 full-time equivalent employees at the 24 Nebraska plants.

The 1,758 FTE employees earned an estimated \$136 million of labor income directly due to their ethanol production employment. The estimated proprietor's income was \$10 million. The total labor income was \$146 million in 2020. Indirect business taxes were estimated at \$13 million per year.

Almost all of Nebraska's ethanol and a significant share of many coproducts is exported from the state. This means most production results in a net positive impact for the state. The sales outside of Nebraska represent a direct economic impact to the state by bringing new money into Nebraska's economy.

A survey of Nebraska ethanol producers in 2015 and 2016 found that 94 percent of Nebraska ethanol production was exported outside of the state. An updated survey was conducted and found that thirty-eight percent of dried distillers' grain was exported in 2020. Most wet distillers' grain remained in the state with just four percent being exported in 2020. Nineteen percent of modified distillers' grain was exported in 2020 while forty-six percent of corn oil was exported out of state in that year. Eighty-six percent of other products produced during 2020 were exported out of state according to the survey.

⁸Harthoorn, A. (2022). "What is the Value of Ethanol to Nebraska Corn Producers?" M.S. Thesis. University of Nebraska-Lincoln.

Table 4: Annual Output, Employment, Labor Income and Indirect Business Taxes

Annual Output	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Ethanol										
Annual Production (mil gals)	2,062	1,763	1,773	1,887	1,892	2,053	2,076	2,223	2,253	1,847
Annual Average Price FOB Plant (\$/gal)	\$2.55	\$2.21	\$2.32	\$2.11	\$1.42	\$1.42	\$1.38	\$1.28	\$1.32	\$1.20
Value of Ethanol Production (mil \$)	\$5,251	\$3,904	\$4,118	\$3,982	\$2,695	\$2,905	\$2,872	\$2,845	\$2,974	\$2,252
Dried Distillers' Grain (DDGS)										
Annual Production (mil tons)	6.54	5.59	5.62	5.98	3.60	4.31	4.15	4.28	4.46	2.28
Annual Average Price (\$/ton)	\$209.22	\$255.58	\$234.74	\$161.44	\$148.68	\$125.17	\$111.28	\$142.69	\$143.69	\$142.48
Value of DDGs Production (mil \$)	\$1,367	\$1,428	\$1,319	\$966	\$535	\$539	\$462	\$611	\$641	\$325
Wet Distillers' Grain (WDGS)										
Annual Production (mil tons)	-	-	-	-	4.09	3.90	4.77	4.19	4.24	3.86
Annual Average Price (\$/ton)					\$50.98	\$44.17	\$44.56	\$46.62	\$48.42	\$43.77
Value of DDGs Production (mil \$)					\$209	\$172	\$213	\$195	\$205	\$169
Modified Distillers' Grain (MDGS)										
Annual Production (mil tons)	-	-	-	-	0.72	0.75	0.25	0.66	0.81	2.19
Annual Average Price (\$/ton)					\$70.91	\$60.39	\$52.42	\$67.67	\$67.99	\$61.61
Value of DDGs Production (mil \$)					\$51	\$45	\$13	\$45	\$55	\$117
Corn Oil										
Annual Production as of 03/2015 (tons)	-	-	-	22,314	271,173	302,792	310,643	330,808	335,857	241,275
Annual Average Price (\$/ton)				\$739.48	\$682.69	\$703.26	\$657.91	\$509.83	\$496.17	\$509.96
Value of Corn Oil Production (mil \$)				\$17	\$185	\$213	\$204	\$169	\$167	\$129
Other Products										
Value of Other Income (mil \$)	-	-	-	-	-	-	-	-	-	\$441
Total Value: (mil \$)	\$6,619	\$5,332	\$5,437	\$4,964	\$3,675	\$3,875	\$3,764	\$3,865	\$4,042	\$3,433
Employees										
	1,429	1,222	1,229	1,301	1,453	1,453	1,453	1,460	1,460	1,758
Labor Income (mil \$)										
	\$116	\$99	\$100	\$106	\$103	\$112	\$109	\$123	\$125	\$146
Wages & Salaries including Benefits (mil \$)	\$78	\$67	\$67	\$72	\$93	\$99	\$99	\$111	\$113	\$136
Proprietors' Income (mil \$)	\$38	\$32	\$33	\$35	\$10	\$13	\$10	\$12	\$12	\$10
Indirect Business Taxes, IBT, Effects (mil \$)										
	\$15	\$15	\$14	\$13	\$13	\$13	\$13	\$13	\$13	\$13

NOTE: See value of production ethanol table 2018-2019

2020 prices based on weighted average of plants reporting to 2020 UNL Survey

Other products in 2020 includes, but not limited to, PPP Loans, RIN Market and other co-products reported in 2020 UNL Survey

2020 values are estimated annual production sold

Economic Impact Analysis and IMPLAN

The above aggregate economic characteristics are the first part of estimating the total economic impact on Nebraska. An additional multiplier impact occurs as money brought into the economy circulates within the state and leads to business sales, labor income and employment. These multiplier impacts are in two forms: indirect impacts and induced impacts.

Indirect economic impacts reflect additional economic activity due to business purchases. An example is the spending by ethanol plants on supplies and services. Induced economic impacts reflect additional economic activity due to household purchases. For example, workers at ethanol plants spend their wages and salaries at businesses throughout the economy. The IMPLAN model is used to estimate indirect and induced economic impacts.

The sum of the direct, indirect and induced economic impacts is the total economic impact. Appendix 1 provides a more complete discussion of the economic impact methodology

Input-Output Multipliers

Table 5 shows the relative size of the direct, indirect and induced impacts for the key economic concepts of output (sales), employment, labor income (wages, salaries, benefits and proprietor income) and indirect business taxes (primarily property taxes). Specifically, the table shows the impact associated with \$1 million in industry sales. Data are displayed for the year 2020, the year of analysis.

The indirect economic impact from industry output is approximately 16.2 percent as large as the direct economic impact from output (see the Output row and the Indirect column entry of 0.1620 for 16.2 percent). The induced economic impact is approximately 8.3 percent of the direct economic impact. These relatively small indirect and induced impacts reflect the fact that corn is the primary input in producing ethanol. The impact flowing from corn utilized in Nebraska ethanol plants is not reflected in the economic multipliers below. However, the impact from additional corn grown in Nebraska due to ethanol plants in the state is addressed in Table 7 later in the report.

As noted for Table 4, ethanol production is a capital and input-intensive industry so there are relatively little employment and wages for each \$1 million of production. There is approximately \$42,600 in labor income (Table 5, Labor Income row and Direct column multiplier of 0.0426 times \$1 million) associated with each \$1 million in ethanol plant sales. Likewise, there is one job associated with each \$1.9 to \$2.0 million in ethanol plant sales. The indirect labor income impact is \$1.26 in labor income for each \$1 in direct income. The induced impact is approximately \$0.62 for each \$1 in direct income. Therefore, each dollar of direct labor income impact has a total labor income impact of \$2.89.

The employment multiplier is similar. There are ten total jobs associated with each three direct jobs in an ethanol plant. Large employment and labor income multipliers are common in high-wage, capital-intensive manufacturing industries like ethanol production.

Table 5. Input-Output Multipliers Derived for Nebraska Ethanol Plants 2020

Multipliers ^a	Direct	Indirect	Induced	Total	Type I ^b	Type SAM ^c
Output (mil \$)	1.0000	0.1620	0.0831	1.2451	1.1620	1.2451
Employment	0.5122	0.7056	0.5101	1.7279	1.2178	1.7279
Labor Income (mil \$)	0.0426	0.0537	0.0266	0.1229	0.0963	0.1229
Indirect Business Taxes (mil \$)	0.0038	0.0081	0.0024	0.0143	0.0119	0.0143

Multipliers are calculated from the Nebraska IMPLAN Model

^a Direct, Indirect, Induced and Total effects per million dollars of output

^b Type I = (Direct + Indirect) / Direct

^c Type SAM = (Direct + Indirect + Induced) / Direct

Direct Effects

Table 6 shows the estimated economic impacts of Nebraska’s ethanol industry. These 2020 figures are based on the aggregate economic characteristics in Table 4 and the input-output multipliers in Table 5. The impacts estimated for 2011 to 2019 are from previous reports.

In Table 6 under the row of Output Effects, the Direct Output figures represent out-of-state sales of ethanol, distillers’ grain and corn oil. For example, the Direct Output figure of \$2,716 million in 2019 is 80 percent of the Total Value: Ethanol, Distillers’ Grain, and Corn Oil of \$3,433 million reported in Table 4. This is because the vast majority of ethanol, roughly 38 percent of dried distillers’ grain and 46 percent of corn oil produced in Nebraska were sold out of state, as well as 19 percent of modified distillers’ grain and 4 percent of wet distiller’s grain. In a similar manner, the figures in the rows for Direct Employment, Direct Labor Income and Direct Indirect Business Taxes show their portion of respective effects supported by out-of-state sales.

Total Output

In addition to the direct effects described above for Direct Output, the indirect and induced effects were estimated by applying the respective multipliers, such as those in Table 5, to the Direct Output figures in Table 6. For example, the Indirect, Output effect in 2020 was \$440 million and the Induced, Output effect was \$226 million. Combining the direct, indirect and induced effects results in a Total Output effect of \$3,382 in 2020. From 2011 to 2020, the Total Output effect ranged from \$3,382 to \$6,701 mainly due to the underlying variability in prices for ethanol distillers’ grain and corn oil.

Table 6. Estimated Economic Impacts Associated with Nebraska's Ethanol Industry

Effect	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Employment Effects										
Direct Employment (FTE)	1,268	1,026	1,058	1,150	1,185	1,196	1,206	1,160	1,158	1,391
Indirect Employment	1,960	1,585	1,634	1,777	1,415	1,271	1,246	1,882	2,100	1,916
Induced Employment	1,672	1,352	1,394	1,516	1,141	1,074	1,056	1,102	1,374	1,386
Total Employment (FTE)	4,900	3,963	4,086	4,443	3,741	3,541	3,508	4,143	4,632	4,693
Labor Income Effects (mil \$)										
Direct Labor and Proprietors' Income	\$103	\$83	\$86	\$93	\$82	\$89	\$88	\$99	\$99	\$116
Indirect Labor Income	\$184	\$149	\$153	\$167	\$133	\$142	\$139	\$111	\$165	\$146
Induced Labor Income	\$65	\$53	\$55	\$59	\$40	\$44	\$43	\$50	\$64	\$72
Total Labor Income (mil \$)	\$352	\$285	\$294	\$319	\$255	\$275	\$270	\$259	\$328	\$334
Output Effects (mil \$):										
Direct Output	\$5,873	\$4,476	\$4,679	\$4,377	\$2,918	\$3,104	\$3,041	\$3,070	\$3,206	\$2,716
Indirect Output	\$617	\$470	\$492	\$460	\$368	\$392	\$384	\$327	\$413	\$440
Induced Output	\$211	\$161	\$168	\$157	\$139	\$149	\$147	\$163	\$206	\$226
Total Output (mil \$)	\$6,701	\$5,107	\$5,338	\$4,994	\$3,425	\$3,645	\$3,572	\$3,560	\$3,825	\$3,382
Indirect Business Taxes Effects (mil \$)										
Direct Indirect Business Taxes	\$13	\$13	\$12	\$12	\$10	\$10	\$11	\$10	\$10	\$10
Indirect Indirect Business Taxes	\$25	\$24	\$23	\$22	\$13	\$14	\$13	\$23	\$20	\$22
Indirect Induced Business Taxes	\$9	\$8	\$8	\$7	\$6	\$6	\$8	\$11	\$10	\$7
Total Indirect Business Taxes (mil \$)	\$47	\$45	\$43	\$41	\$29	\$30	\$30	\$44	\$41	\$39

Indirect Business Taxes, Labor Income and Employment

In 2020, the ethanol industry contributed \$39 million in indirect business taxes to Nebraska. The ethanol industry also creates a substantial annual impact on the Nebraska labor market. In 2020, the total labor income impact was \$334 million. This income was earned by workers in an estimated 4,693 jobs shown as total employment, for average annual earnings of \$71,100. The average earnings include direct jobs in the ethanol industry as well as multiplier jobs throughout the economy. Most of these jobs also are created in non-metropolitan Nebraska. Over the entire 2011 to 2020 time period, the annual labor income impact varied between \$259 and \$352 million per year, and the employment impact varied between 3,508 and 4,900 jobs. The results confirm that the ethanol industry provides a sustained impact on the labor market.

Changes in Agricultural Production

The annual economic impact estimates of ethanol plant operation exclude any impact from corn production providing feedstock for the plants. This is because Nebraska was a significant corn production center prior to ethanol production.

However, increased ethanol production in Nebraska has increased local demand for corn. Ethanol is also an important part of the reason corn acreage has expanded in Nebraska in recent decades. It is difficult to determine the exact contribution of ethanol to increased corn acreage, but a recent study attempted to do so⁹ This study identified the response of corn and total crop acres to the location of nearby ethanol plant capacity.

The study suggests that doubling regional ethanol production capacity would yield a 7 percent increase in the number of acres in corn production. However, it would not increase the number of acres devoted to crop production in general.¹⁰ It is important to note that an increase in corn production would come at the expense of other crops such as soybeans or hay (including alfalfa).

Using this estimate, a 350 percent increase in ethanol capacity since 2006 would yield a 25 percent increase in Nebraska corn acres. Based on 7.75 million harvested acres of corn, this translates to about 1.93 million more acres. This increase in corn acres came at the expense of production of other crops on the 1.93 million acres. Based on Nebraska crop patterns, we estimate soybeans would account for two-thirds of lost production. The remaining one-third would come from hay acres, including alfalfa. Matching these changes in acres with statewide average yields and prices gives the estimate of changes in values of production. Economic multiplier analysis was used to find the total economic impact of converting soybean and hay acres into corn acres.

⁹Changes in Agricultural Production 6 Motamed, Mesbah, Lihong McPhail, and Ryan Williams, 2016. "Corn Area Response to Local Ethanol Markets in the United States: A Grid cell Level Analysis," *American Journal of Agricultural Economics*, 98(3): 726-743.

¹⁰The estimate is based on elasticity response of corn production for nearby ethanol capacity at the 50 percent, 75 percent and 90 percent quintile of county corn acreage. These higher percentages are used because Nebraska is a major corn producing state, particularly in the regions of Nebraska where ethanol plants are most common.

Estimates of the economic impact for 2020 are reported in Table 7. The additional Nebraska corn acres led to 3,307 jobs in 2020. This is the total employment impact, including the direct impact and the multiplier impact. There is also an additional \$1.03 billion output impact in 2020 and \$162 million in labor income. There is a decline in indirect business tax revenue as soybean production generates more indirect business tax revenue than corn production per acre.

In Table 7, the total economic impacts from Table 6 are added to the total economic impacts from the reallocation of Nebraska acres to corn production. The total output impact for 2020 rises to \$4.41 billion, including \$496 million in labor income and 8,000 jobs. Overall, the additional economic impact due to changes in crop production makes a significant contribution to the annual economic impact of Nebraska's ethanol production industry.

Table 7: Overall Annual Economic Impact of Nebraska's Ethanol Industry Including Changes in Crop Production

	2016	2017	2018	2019	2020
Employment Effects					
Ethanol Plant Operations	3,509	3,476	4,143	4,632	4,693
Rotation of Cropland into Corn	1,628	1,690	1,710	1,594	3,307
Total	5,137	5,166	5,853	6,226	8,000
Labor Income Effect					
Ethanol Plant Operations	\$275	\$270	\$259	\$328	\$334
Rotation of Cropland into Corn	\$90	\$100	\$87	\$116	\$162
Total	\$365	\$370	\$346	\$443	\$496
OUTPUT					
Ethanol Plant Operations	\$3,645	\$3,572	\$3,560	\$3,825	\$3,382
Rotation of Cropland into Corn	\$509	\$581	\$769	\$693	\$1,028
Total	\$4,169	\$4,154	\$4,154	\$4,329	\$4,410
Indirect Business Taxes					
Ethanol Plant Operations	\$29	\$30	\$30	\$44	\$39
Rotation of Cropland into Corn	-\$3	-\$8	-\$6	-\$16	-\$29
Total	\$26	\$22	\$24	\$28	\$10

Economic Impact from Investments

Job creation due to investment is an important part of the economic impact of any industry. This is especially true for a capital-intensive industry like ethanol. The industry supports construction jobs and there are also multiplier impacts at businesses which provide construction materials and support services and the businesses where construction workers spend their paychecks.

Some survey respondents elected not to answer questions about firm investments. As a result, it is not feasible to estimate the full economic impact of ethanol industry investment for 2020. However, several respondents did report their 2020 investment spending, which was \$65.3 million. Table 8 shows the cumulative economic impact of these industry investments. Employment impacts are listed by job-years since the jobs and related worker income were earned during the years when the investments took place. So, for example, 1,000 job-years of employment could mean 1,000 jobs which last one year or 500 jobs which last two years.

Table 8. Estimated Economic Impacts from Cumulative Investment in Nebraska’s Ethanol Industry

	Cumulative Impact
Employment Effects (Job-Years)	
Direct Employment (FTE)	443
Indirect Employment (0.199 of Direct)	88
Induced Employment (0.332 of Direct)	<u>147</u>
Total Employment (FTE)	678
Labor Income Effects (mil \$)	
Direct Labor Income	\$26.6
Indirect Labor Income (0.240 of Direct)	\$6.4
Induced Labor Income (0.296 of Direct)	<u>\$7.9</u>
Total Labor Income Effects	\$40.9
Output Effects (mil \$)	
Direct Output	\$57.4
Indirect, Output (0.358 of Direct)	\$20.6
Induced, Output (0.432 of Direct)	<u>\$24.8</u>
Total Output	\$102.8

Note that the direct economic impact in terms of output (i.e., business sales) is \$57.4 million. This is because a portion of investment costs go to equipment and software rather than construction, site preparation, or construction engineering services. Only the wholesale mark-up portion of equipment and software spending is counted towards economic impact, given that equipment and software developed around the nation and world. The cumulative direct economic impact from investments in the Nebraska ethanol industry is \$57.4 million.

The cumulative economic impact resulting from the \$57.4 million in investment is \$102.8 million. The multiplier impact, which is the sum of the indirect and induced impact, is \$0.79 in business activity in industries throughout the economy for each \$1 investment in the ethanol industry. Roughly 46 percent of the business sales is devoted to labor income, that is, the wages, salaries and benefits earned by workers or proprietor income. The direct labor income impact is \$26.6 million while the multiplier impact is \$14.3 million and the total cumulative impact on labor income is \$40.9 million. The cumulative labor income is earned in the years when investment activity took place. The labor income supported a total of 678 job-years of employment. The direct employment impact from investment was 443 job-years. The multiplier impact, which is the sum of the indirect and induced impact, was 235 job years. The employment multiplier was 0.53, indicating approximately one indirect or induced job-years for every two direct job-years.

Summary

This study evaluated the economic impact of the Nebraska ethanol industry for the state of Nebraska in 2018 and 2019. While the value of production for the ethanol and co-product industry was lower in 2018 and 2019 than during the first half of the decade, both ethanol capacity and employment increased over the years of study, indicating a positive long-term outlook. This future outlook could be bolstered by the new E15 rules.

Since the 2014 study, ethanol producers have continued to diversify production to take advantage of new market opportunities and safeguard against unexpected adverse ethanol market movements. The Nebraska ethanol and co-products industry continues to provide a positive economic impact on the state of Nebraska. Since ethanol producers persisted through a period of low prices in the second half of the last decade, it is the opinion of the authors that ethanol will continue to be a large driver of economic impact in the state of Nebraska for quite some time.

Appendix 1: Economic Impact Methodology

The basic framework for analysis was the IMPLAN model of the Nebraska economy. For this analysis, IMPLAN data for 2020 was used. IMPLAN is a widely-used input-output analysis software package and database. It can provide a detailed picture of the economy for any state and sub-state region. IMPLAN can model the economic impact of nearly 500 industries. Economic impact analysis includes the direct economic impact, the indirect economic impact, and the induced economic impact. The direct economic impact refers to out-of-state sales of ethanol or coproducts. Out-of-state sales bring new revenue into Nebraska and support jobs, wages, and business activity. The direct economic impact from Nebraska ethanol plants is nearly as large as total industry sales.

The indirect and induced economic impacts reflect additional economic activity in Nebraska as money attracted to the state (through the direct impact) circulates further within the state economy. The indirect economic impact is the additional economic activity driven by the purchases of the business sector. Ethanol plants, in particular, buy inputs and services such as water, energy, chemicals and accounting services from within Nebraska. These purchases provide revenue to other Nebraska businesses and generate indirect impacts on Nebraska's economy. There are also additional rounds of indirect economic impact as these suppliers in the water, energy, chemicals and accounting, industries, for example, buy their own goods and services from other Nebraska businesses. The summation of these additional rounds of indirect impact is estimated using the IMPLAN model. The IMPLAN model, utilizing its detailed accounting of the industries and businesses within the Nebraska economy, can model the cumulative impact of indirect purchases.

The induced economic impact reflects the additional economic activity in the household sector. Ethanol facilities are a capital-intensive business, but each facility does provide dozens of high paying jobs. Additional economic activity is created in the state as well-paid ethanol plant employees spend their wages and salaries throughout the economy. Spent wages and salaries become revenue for businesses which provide the household goods and services, such as grocery stores, auto dealers, gasoline service stations, retail outlets, health care providers, insurance agencies, restaurants, and other recreation and entertainment businesses. This spending, in turn, supports part of the wages of employees at these businesses yielding additional rounds of the induced impact. The cumulative impact of these rounds of induced household spending also is captured in the IMPLAN model and referred to as the induced impact.

The total economic impact is the sum of the direct, indirect and induced economic impact. The indirect and induced impact also are collectively known as the multiplier impact. This report presents the economic impact of output, labor income, employment and indirect business taxes. The output is the increased sales (business receipts) of businesses in Nebraska. These businesses could be ethanol plants or businesses which have sales as the result of the indirect or induced impacts. The labor income impact refers to the wages, salaries and benefits earned by employees or the proprietors' income. The employment numbers (both direct and multiplier) reflect full-year jobs in a number of industries. Like jobs in the overall economy, most jobs generated due to the economic impact are full-time jobs. However, there is some part-time employment in industries like retail or entertainment and recreation. Indirect business taxes primarily refer to the property taxes paid by ethanol plants or by businesses with additional sales due to the indirect and induced impacts.

Appendix 2: Sources of Data and Information for Tables and Figures

Figure 1. Ethanol Production in Nebraska

2010 to 2014 Numbers

2014 Economic Impacts of the Ethanol Industry in Nebraska Report:

<https://agecon.unl.edu/research/economic-impacts-ethanol-industry-nebraska.pdf>

2015 to 2017 Numbers

Economic Impacts of the Nebraska Ethanol and Ethanol Co-Products Industry: 2015-

2017: <https://agecon.unl.edu/research/2019-nebraska-ethanol-industry-report.pdf>

2018 to 2019 Numbers

Economic Impacts of the Nebraska Ethanol and Ethanol Co-Products Industry: 2018-

2019: https://agecon.unl.edu/documents/ethanol-report-2018-2019_final.pdf

2020 Numbers

Nebraska Department of Environment and Energy

Nebraska Ethanol Board

University of Nebraska, Department of Agricultural Economics, Ethanol Survey administered by the Nebraska Ethanol Board and Renewable Fuels Nebraska

Figure 2 and Table 1. Value of Production for Ethanol and Co-Products

Ethanol Co-Products Production & Value

Nebraska Department of Environment and Energy

Nebraska Ethanol Board

University of Nebraska, Department of Agricultural Economics, Ethanol Survey administered by the Nebraska Ethanol Board and Renewable Fuels Nebraska

PPP Loan Data:

<https://www.sba.gov/funding-programs/loans/covid-19-relief-options/paycheck-protection-program/ppp-data>

Figure 3 and Table 2. Comparative Values of Ethanol, Distillers' Grains & Corn Oil to Corn, Cattle and Soybeans

Corn Production and Prices (calendar year months)

<https://quickstats.nass.usda.gov/results/D7DC95B1-3E29-3FEC-AE05-48EF4B003FE9>

Sales of Cattle

<https://quickstats.nass.usda.gov/results/68FFB9F4-861F-3DE7-832E-8852512193AC>

Soybean Production and Prices (calendar year months)

<https://quickstats.nass.usda.gov/results/ECA8D70C-649F-3BAF-AF83-23665AB673FF>

Table 3. Nebraska’s Ethanol Production Capacity and Facility Employment

Nebraska Department of Environment and Energy: <http://www.deq.state.ne.us/>
Nebraska Ethanol Board
University of Nebraska, Department of Agricultural Economics, Ethanol Survey administered by the Nebraska Ethanol Board and Renewable Fuels Nebraska

Table 4. Annual Output, Employment, Labor Income and Indirect Business Taxes

Labor Income Effects estimated by the authors based on a survey of Nebraska ethanol producers.
Indirect Business Taxes, IBT, Effects estimated using data from a report by the Nebraska Department of Revenue Property Assessment Division, “Nebraska Ethanol and Bio-Fuels Plant Valuations Compiled from Assessment Records for Tax Years 2010 – 2011 and updated Community Redevelopment Tax Increment Financing Projects for Tax Year 2016,” Nebraska Department of Revenue.

Table 5. Input-Output Multipliers Derived for Nebraska Ethanol Plants 2019

Calculated using data from the Nebraska IMPLAN model.

Table 6. Estimated Economic Impacts Associated with Nebraska’s Ethanol Industry

Computed from the data in Tables 4 and 5, and from the Nebraska IMPLAN input-output model.

Table 7. Overall Annual Economic Impact of Nebraska’s Ethanol Industry Including Changes in Crop Production

Computed from the data in 6 and estimates from Motamed, Mesbah, Lihong McPhail, and Ryan Williams (2016) and crop production data from the National Agricultural Statistics Service of the United States Department of Agriculture.

Table 8. Estimated Economic Impacts from Cumulative Investment in Nebraska’s Ethanol Industry