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Economic Impacts of the **Nebraska Ethanol** and Co-Products Industry

AGRICULTURAL ECONOMICS

BUREAU OF BUSINESS RESEARCH
College of Business

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University of Nebraska Lincoln

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Abstract

This study estimates the overall economic impact of the Nebraska ethanol industry in 2021, 2022, and 2023. The study builds on previous reports using a quantitative measure (IMPLAN) as well as fundamental economic analysis to assess the harder-to-measure outcomes of the industry. The Nebraska ethanol industry is well-developed and stable. Nebraska produced 2.036 billion gallons of ethanol in 2021, 2.018 billion gallons in 2022, and 2.008 billion gallons in 2023. The value of ethanol and co-products over these three years averaged $6.221 billion, a 58% increase compared to the prior seven years. The overall economic impact in these three years, when figuring in additional economic markers, was $7.253 billion, $8.182 billion, and $6.276 billion respectively. During this time period employment has increased as well. Ethanol plants in the state employ over 1,800 full-time employees (up from 1,460 in 2019) at an average wage (including benefits) of approximately $80,000 per year. Finally, the report juxtaposes the ethanol industry with other important agricultural production in the state, as well as a comparison to Nebraska GDP. All data and comparisons support the general importance of the industry to the state's economy and overall economic health.

Front cover and Abstract page photos of Mid America Agri Products/ Wheatland in Madrid, Nebraska, by CreativeOlsen.

Contents

Highlights 2021-2023

Economic Impacts of the Nebraska Ethanol and Co-Products Industry

Output, Employment, Labor Income, Indirect Business Taxes

	2021	2022	2023
Gallons of Ethanol Produced	2,021 Million	2,018 Million	2,008 Million
Value of Ethanol Produced	$4,589 Million	$4,788 Million	$4,164 Million
Total Value (Ethanol + Co-Products)	$5,699 Million	$6,932 Million	$6,031 Million[1]
Indirect Business Taxes	$61 Million	$76 Million	$59 Million
Employees	1,799 FTEs (2021-2022 Average)[2]		
Labor Income	$157 Million (2021-2022 Average)		

Overall Economic Impact

	2021	2022	2023
Employment	8,575 Jobs	8,969 Jobs	6,626 Jobs
Total Labor Income	$648 Million	$685 Million	$518 Million
Total Output	$7,253 Million	$8,187 Million	$6,276 Million

Economic Impact from Cumulative Investments

Employment	*Total Labor Income*	*Total Output*
1,128 Job-Years Cumulative 2021-2023	**$73.9 Million** Cumulative 2021-2023	**$148.5 Million** Cumulative 2021-2023

[1] 2023 numbers reflect low survey participation and will likely update in future reports.

[2] 2022 employment data was used as a conservative estimate for 2023. Less than 20% of plants reported employment data for 2023.

Introduction

This report estimates the overall impact of the Nebraska ethanol and co-products industry in 2021, 2022, and 2023. The report focuses on the macroeconomic impact of the industry and updates reporting from 2010-2020. 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 includes a comparison of the ethanol industry to other agricultural industries in Nebraska as well as a comparison to the overall Nebraska GDP. The report adds to prior reporting by comparing the ethanol industry to a high impact non-agricultural economic driver, the College World Series.

2010-2020 Summary

Four previous reports were conducted for the production years of 2010-2014, 2015-2017, 2018-2019, and 2020. Over this time, production of ethanol has ranged from a low of 1.77 billion gallons (2013) to a high of 2.25 billion gallons (2019).

Over the timeframe covered by these reports, the capacity of individual plants and the overall industry has steadily increased. The value of ethanol produced has varied considerably between $2.252 billion and $5.25 billion. This volatility was due to price fluctuations, and not considerable changes in physical output. While volatility remains in ethanol prices, the industry has stabilized by expanding co-product offerings.

Each successive report finds additional evidence that all plants have expanded past conventional co-products. Along with three different types of distillers grains (dried, wet, and modified), plants consistently produce corn oil and corn syrup. The 2020 report, which covered the majority of the Covid-19 economic situation, indicated the flexibility of the industry as plants produced hand sanitizer, starches, and other niche co-products.

The Nebraska ethanol industry plays a large role in the Nebraska economy. During 2022, a very "typical" year, the overall value of the ethanol and ethanol co-products averaged 68% of corn production, 50% of cattle production, and 169% of soybean production. The industry is the third largest agricultural industry in the state.

While the value of ethanol and co-product production is significant, the industry also adds to the quality of life in Nebraska by providing steady employment. The industry has steadily increased the number of full-time workers employed, from 1,301 in 2014, to 1,831 employees in 2022. The current report further establishes this trend and highlights that wages and benefits have grown at an even faster pace.

The Nebraska Ethanol Industry

Nebraska produces the second-most ethanol of any state. Despite a long history of production, capacity continues to grow. In 2014, the overall permitted capacity of ethanol production was 2.08 billion gallons per year. This capacity has continued to expand each year, with plants reporting a total capacity of 2.501 billion gallons in 2023, a 20.2% increase.

Ethanol production is an overhead intense industry, whereby near-capacity production is expected even when ethanol prices are unfavorable. Another example in the energy sector would be oil refineries, which continued to operate during the Covid-19 era despite negative oil price. Figure 1 displays actual production since 2006.

Low ethanol prices have been offset by maturation of co-product markets. Previous reports highlight the maturation of distillers grains markets along with new marketable co-products such as corn oil and corn syrup. Additional niche products such as hand sanitizer and HFCS illustrate the industry's flexibility. For this report, the magnitude of the co-product industry is on display. In both 2022 and 2023, co-product production value was 45% of ethanol value. That is, for every dollar of ethanol produced/sold, $0.45 of co-products were produced and sold. See Figure 2 for a breakdown of the overall co-product composition of overall value produced.

While the price of ethanol is largely correlated with fuel prices, the markets for co-products are not. The varied portfolio of co-product offerings is not a natural hedge against fuel prices, but it does insulate the industry from the many exogenous forces that determine fuel prices. Table 1 displays a breakdown of production for 2022, which was largely representative of the period surveyed.

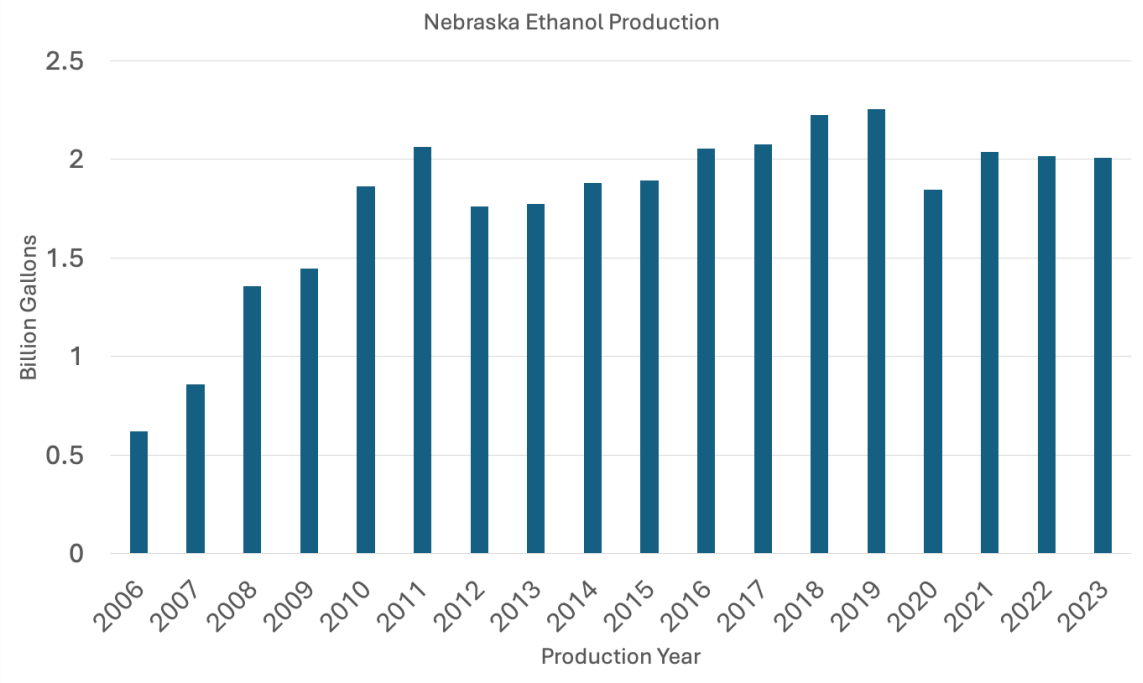

Figure 1: Overall Production

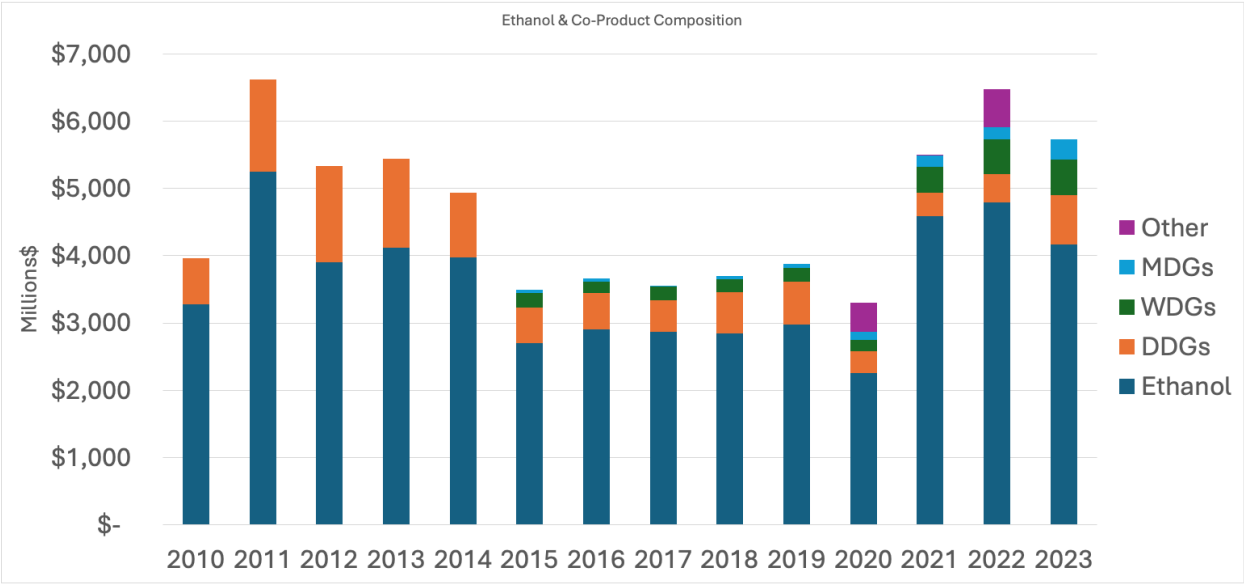

Figure 2. Breakdown of Ethanol versus Co-Products

Table 1: Value of Production for Ethanol and Co-Products, 2022

Annual Output	2022
Ethanol:	
Annual Production (mil gals)	2,019
Annual Average Price FOB Plant ($/gal)	$2.37
Value of Ethanol Production (mil $)	$4,788
Dried Distillers Grain (DDGs):	
Annual Production (mil tons)	1.642
Annual Average Price ($/ton)	$254.73
Value of DDGs Production (mil $)	$418
Wet Distillers Grain (WDGs):	
Annual Production (mil tons)	5.563
Annual Average Price ($/ton)	$92.82
Value of WDGs Production (mil $)	$516
Modified Distillers Grain (MDGs):	
Annual Production (mil tons)	1.489
Annual Average Price ($/ton)	$121.79
Value of MDGs Production (mil $)	$181
Corn Oil:	
Annual Production (mil pounds)	610.9
Annual Average Price ($/pound)	$.74
Value of Corn Oil Production (mil $)	$454.8
Other Products:	
Value of Other Income (mil $)	$573.4
Total Value: (mil $)	**$6,932**

Comparative Values of Ethanol in Nebraska

To illustrate the size of the ethanol industry, the value of ethanol and co-product production can be compared to other leading agricultural commodities produced in the state. Table 2 shows a comparison of ethanol and co-product production in 2022.

Table 2: Comparative Values

Product	2022
Ethanol & Co-products (mil $)	**$6,932**
Corn	
Corn Production (mil bu)	1,455
Annual Average Price ($/bu)	$6.83
Value of Corn Production (mil $)	$9,938
Cattle	
Sales of Cattle (mil $)	$13,677
Soybeans	
Soybean Production (mil bu)	278
Annual Average Price ($/bu)	$14.72
Value of Soybean Production (mil $)	$4,092

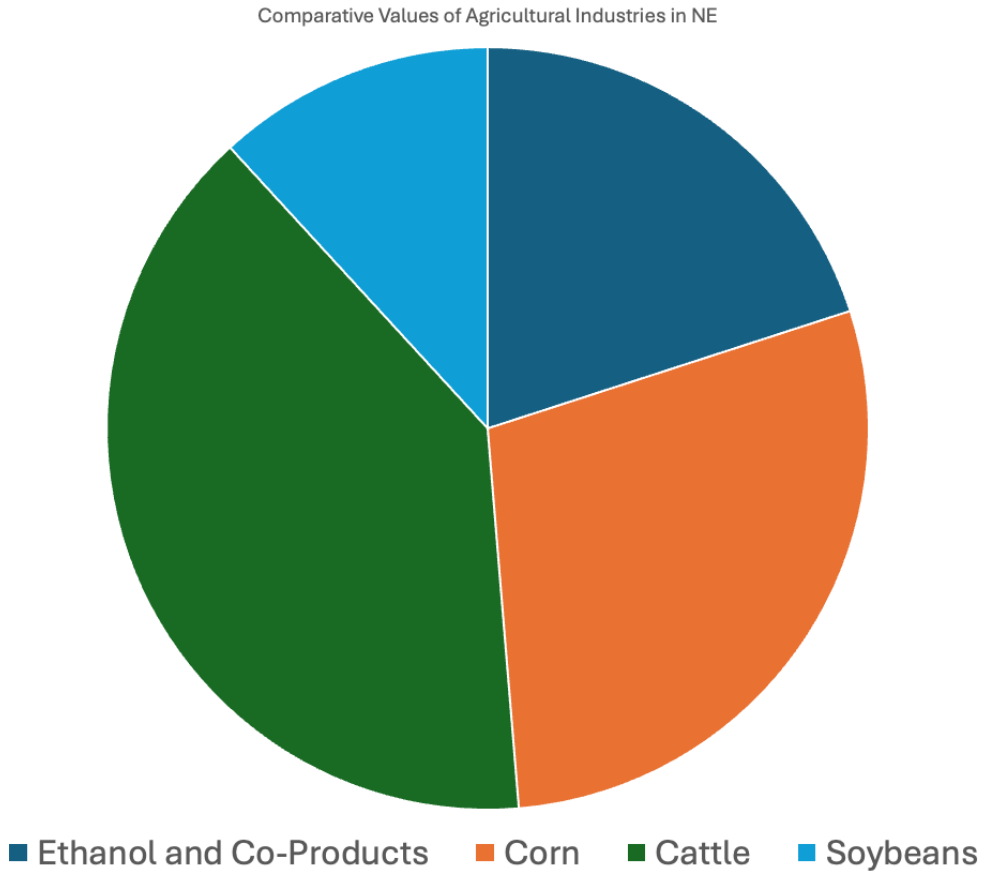

Figure 3. Visual Comparison of Ethanol vs. Corn, Cattle, and Soybeans

Put another way, for every dollar of corn, cattle, or soybeans, there is $0.68, $0.50 and $1.69 of ethanol produced. Compared to previous reports, the ethanol industry seems to be locked into the third position, although it is gaining in terms of the relative share of production.

Macroeconomic Intrastate Comparisons

The term "economic impact" is used to describe different sectors of the economy, but events as well. In many cases, the impact is in multiple millions or billions of dollars. As stated later in the report, monetary "impact" goes beyond initial production.

Often, impact studies are done to estimate the true economic benefit of economic activity. A non-agriculture example would be the College World Series, an NCAA sporting event held each summer in Omaha. In cases like this, economic impact reports are a vital piece of information to help policymakers gain support for publicly supported projects like the construction of TD Ameritrade Park.

Just recently, Visit Omaha conducted an economic impact study and determined the overall impact of the College World Series was $88.3 million in 2019 and $115 million in 2024. Over the four-year period from 2020-2023, the economic impact of the Nebraska ethanol industry averaged $6.5 billion. Visually, this difference is staggering, as seen in Figure 4.

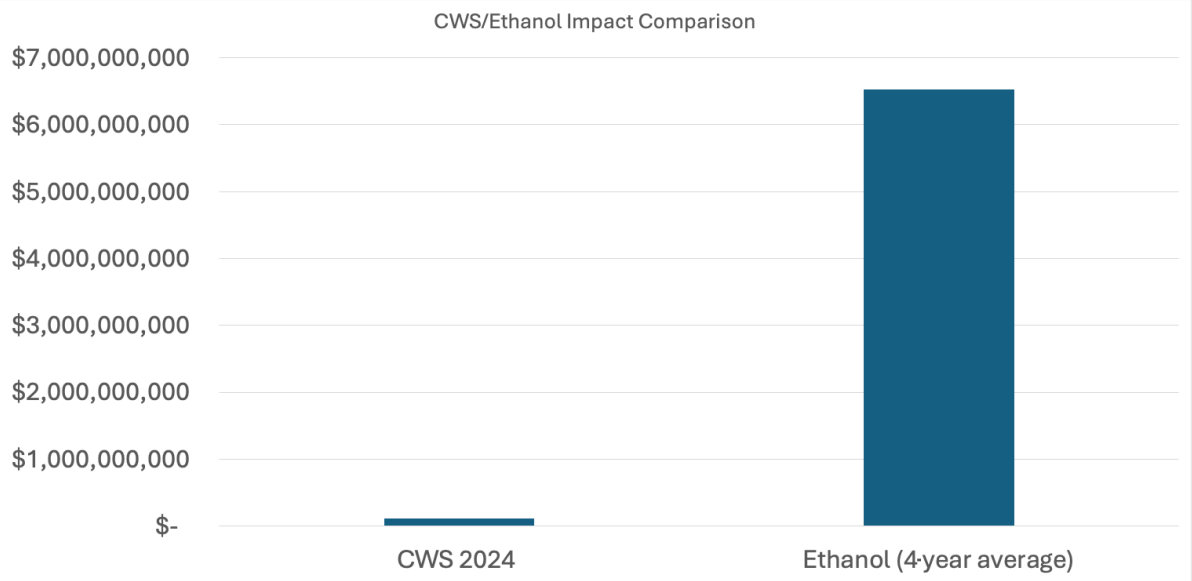

Figure 4: CWS Impact

Clearly, ethanol provides an enormous amount of economic impact to the state, especially when juxtaposed against other major economic drivers such as the College World Series.

To further establish this, Figure 5 illustrates the size of the ethanol industry, the GDP of the Nebraska economy, and the overall value of agricultural products produced. Figure 5 illustrates these three values for production year 2022.

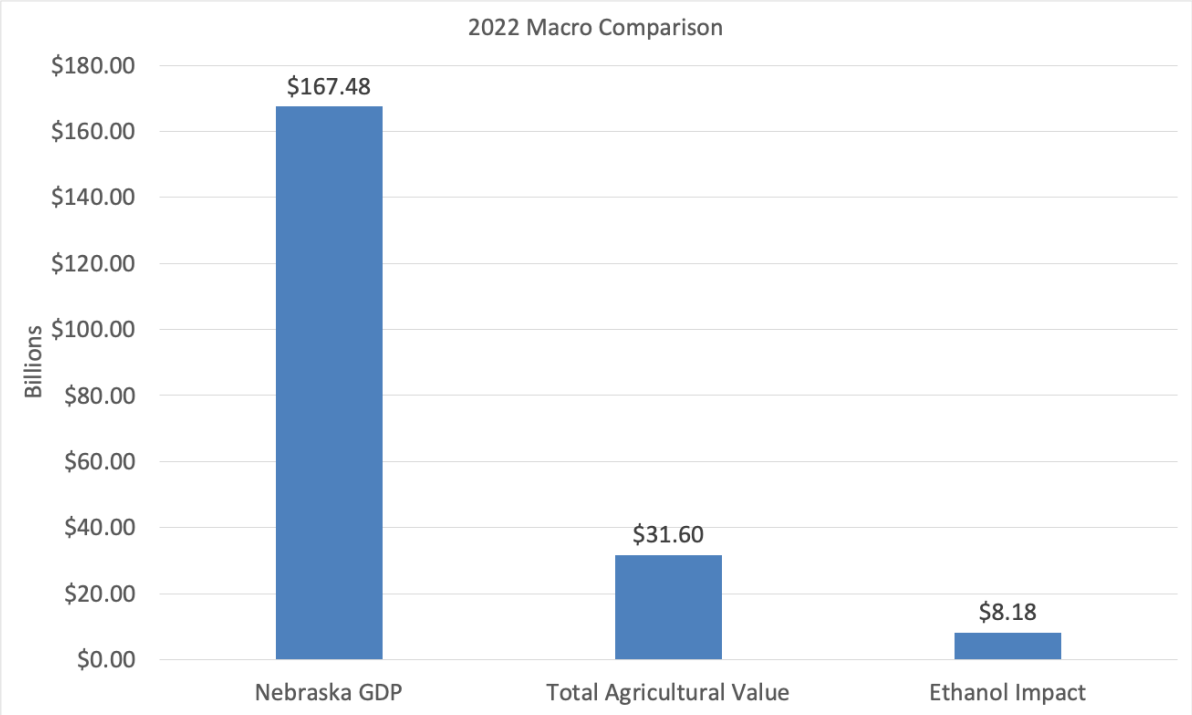

Figure 5. Ethanol Impact Comparison to Overall GDP and Total Agricultural Value

Photo of Mid America Agri Products/ Wheatland in Madrid, Nebraska, by CreativeOlsen.

Permitted Capacity and Employment

Table 3 lists the Nebraska ethanol permitted capacities for 2022. Due to the expansion of ethanol plants, Nebraska's reported ethanol capacity is over 2.385 billion gallons. The total state employment, measured in full-time equivalents (FTEs), is 1,831. Permitted capacity in 2023 is 2.501 million gallons, the highest capacity ever recorded.

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	57	313
Archer Daniels Midland Co. (Wet Mill)	Columbus	254	100
Aurora Cooperative Ethanol LLC - West (now KAAPA Partners Aurora, LLC)	Aurora	45	90
Bridgeport Ethanol, LLC	Bridgeport	27	60
Cargill, Inc.	Blair	430	210
Chief Ethanol Fuels Inc.	Hastings	63	70
Chief Ethanol Fuels Inc.	Lexington	51	50
E Energy Adams, LLC	Adams	60	100
Green Plains Atkinson LLC (now Sandhills Renewable Energy LLC)	Atkinson	54	55
Green Plains Central City LLC	Central City	76	116
Green Plains Wood River LLC	Wood River	102	130
Green Plains York LLC	York	57	55
GreenAmerica Biofuels Ord LLC	Ord	46	65
Husker Ag, LLC	Plainview	58	109
KAAPA Ethanol Ravenna LLC	Ravenna	50	135
KAAPA Ethanol, LLC	Minden	43	85
Louis Dreyfus Norfolk LLC (now CIE Norfolk GNS, LLC)	Norfolk	51	55
Mid America Agri Products/Wheatland LLC	Madrid	34	55
Midwest Renewable Energy, LLC	Sutherland	28	25
Nebraska Corn Processing, Inc.	Cambridge	40	60
POET Bioprocessing - Fairmont	Fairmont	60	132
Siouxland Ethanol, LLC	Jackson	46	95
Trenton Agri Products, LLC	Trenton	34	55
Valero Renewable Fuels Co. LLC	Albion	65	165
Total		**1,831**	**2,385**

Aggregate Economic Characteristics

Table 4 shows the annual value of ethanol, distillers grain, corn oil, and other co-products production during the 2021-2023 period. The value of production reached $5.70 billion in 2021, $6.93 billion in 2022, and $6.03 billion in 2023[3].

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. During the 2021-2023 period, there were an estimated 1,766 to 1,831 full-time equivalent employees at Nebraska plants.

There was an estimated $169 million to $171 million of wages and salary income associated with those jobs. The estimated proprietors' income was $11 million each. The total labor income was $180 million to $182 million during the 2021-2023 period. Indirect business taxes were estimated at $13 million per year.

Almost all of Nebraska's ethanol and a significant share of many co-products are 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 38 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 46 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. Few respondents to surveys about 2021 to 2023 production reported information on the share of sales that were exported to other states. As a result, the 2020 results will continue to be used for the 2021 to 2023 period.

[3] 2023 numbers reflect low survey participation and will likely update in future reports.

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

Annual Output	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Ethanol:										
Annual Production (mil gals)	1,887	1,892	2,053	2,076	2,223	2,253	1,847	2,036	2,019	2,008
Annual Average Price FOB Plant ($/gal)	$2.11	$1.42	$1.42	$1.38	$1.28	$1.32	$1.20	$2.25	$2.37	$2.07
Value of Ethanol Production (mil $)	$3,982	$2,695	$2,905	$2,872	$2,845	$2,974	$2,252	$4,590	$4,788	$4,164
Dried Distillers Grain (DDGs):										
Annual Production (mil tons)	5.98	3.60	4.31	4.15	4.28	4.46	2.28	1.62	1.64	3.11
Annual Average Price ($/ton)	$161.44	$148.68	$125.17	$111.28	$142.69	$143.69	$142.48	$214.59	$254.73	$235.52
Value of DDGs Production (mil $)	$966	$535	$539	$462	$611	$641	$325	$348	$418	$374
Wet Distillers Grain (WDGs):										
Annual Production (mil tons)	-	4.09	3.90	4.77	4.19	4.24	3.86	5.07	5.56	5.46
Annual Average Price ($/ton)		$50.98	$44.17	$44.56	$46.62	$48.42	$43.77	$75.49	$92.82	$96.53
Value of WDGs Production (mil $)		$209	$172	$213	$195	$205	$169	$383	$516	$527
Modified Distillers Grain (MDGs):										
Annual Production (mil tons)	-	0.72	0.75	0.25	0.66	0.81	2.19	1.81	1.49	2.13
Annual Average Price ($/ton)		$70.91	$60.39	$52.42	$67.67	$67.99	$61.61	$94.73	$121.79	$142.42
Value of MDGs Production (mil $)		$51	$45	$13	$45	$55	$117	$172	$181	$304
Corn Oil:										
Annual Production as of 03/2015 (tons)	22,314	271,173	302,792	310,643	330,808	335,857	241,275	375,042	610,955	500,912
Annual Average Price ($/ton)	$739.48	$682.69	$703.26	$657.91	$509.83	$496.17	$509.96	$527.84	$744.47	$601.48
Value of Corn Oil Production (mil $)	$17	$185	$213	$204	$169	$167	$129	$198	$455	$301
Other Products:										
Value of Other Income (mil $)	-	-	-	-	-	-	$441	$9	$573	-
Total Value: (mil $)	**$4,964**	**$3,675**	**$3,875**	**$3,764**	**$3,865**	**$4,042**	**$3,433**	**$5,699**	**$6,932**	**$6,031**

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Employees	**1,301**	**1,453**	**1,453**	**1,453**	**1,460**	**1,460**	**1,758**	**1,767**	**1,831**	**1,831**
Labor Income (mil $)	$106	$103	$112	$109	$123	$125	$146	$180	$182	$182
Wages & Salaries including Benefits (mil $)	$72	$93	$99	$99	$111	$113	$136	$169	$171	$171
Proprietors' Income (mil $)	$35	$10	$13	$10	$12	$12	$10	$11	$11	$11
Indirect Business Taxes, IBT, Effects (mil $)	$13	$13	$13	$13	$13	$13	$13	$13	$13	$13

NOTE: See value of production ethanol table 2021-2023
2021 to 2023 Prices based on weighted average of plants reporting to UNL Survey
Other products includes other co-products reported in UNL Survey
2021 to 2023 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 in 2023 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 is displayed for the year 2023, the last year of analysis. Multiplier values are similar in 2021 and 2022.

The indirect economic impact from industry output is approximately 13.9 percent as large as the direct economic impact from output (see the Output row and the Indirect column entry of 0.1389 for 13.9 percent). The induced economic impact is approximately 5.2 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 was noted for Table 4, ethanol production is a capital and input-intense industry, so there are relatively little employment and wages for each $1 million of production. There is approximately $30,200 in labor income (Table 5, Labor Income row and Direct column multiplier of 0.0302 times $1 million) associated with each $1 million in ethanol plant sales. Likewise, there is one job associated with each $4.5 million in ethanol plant sales. The indirect labor income impact is $1.44 in labor income for each $1 in direct income. The induced impact is approximately $0.53 for each $1 in direct income. Therefore, each dollar of direct labor income impact has a total labor income impact of $2.97.

The employment multiplier is similar. There are three total jobs associated with each one direct job 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 2023

Multipliers[a]	Direct	Indirect	Induced	Total	Type I[b]	Type SAM[c]
Output (mil $)	1.0000	0.1389	0.0517	1.1907	1.1389	1.1907
Employment	0.3379	0.5046	0.2820	1.1245	2.4931	3.3276
Labor Income (mil $)	0.0302	0.0435	0.0161	0.0898	2.4407	2.9748
Indirect Business Taxes (mil $)	0.0022	0.0110	0.0023	0.0155	6.1018	7.1791

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. The 2023 figures are based on the aggregate economic characteristics in Table 4 and the input-output multipliers in Table 5. The 2021 and 2022 figures are based on data in Table 4 and multipliers for those same two years (not shown). The impacts estimated for 2014 to 2020 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, corn oil, and other co-products. For example, the Direct Output figure of $4,425 million in 2023 is 73 percent of the Total Value: Ethanol, Distillers Grain, Corn Oil, and Other Co-Products of $6,031 million reported in Table 4. This is because the vast majority of ethanol co-products—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 four percent of wet distillers 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 2023 was $615 million and the Induced Output effect was $229 million. Combining the direct, indirect, and induced effects results in a Total Output effect of $5,269 in 2023. From 2015 to 2023, the Total Output effect ranged from $3,382 to $6,473 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	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Employment Effects										
Direct Employment (FTE)	1,150	1,185	1,196	1,206	1,160	1,158	1,391	1,597	1,598	1,495
Indirect Employment	1,777	1,415	1,271	1,246	1,882	2,100	1,916	2,365	2,790	2,233
Inducted Employment	1,516	1,141	1,074	1,056	1,102	1,374	1,386	1,336	1,463	1,248
Total Employment (FTE)	**4,443**	**3,741**	**3,541**	**3,508**	**4,143**	**4,632**	**4,693**	**5,298**	**5,851**	**4,976**
Labor Income Effects (mil $)										
Direct Labor and Proprietors' Income	$93	$82	$89	$88	$99	$99	$116	$146	$143	$134
Indirect Labor Income	$167	$133	$142	$139	$111	$165	$146	$203	$239	$192
Induced Labor Income	$59	$40	$44	$43	$50	$64	$72	$76	$84	$71
Total Labor Income (mil $)	**$319**	**$255**	**$275**	**$270**	**$259**	**$328**	**$334**	**$425**	**$466**	**$397**
Output Effects (mil $):										
Direct Output	$4,377	$2,918	$3,104	$3,041	$3,070	$3,206	$2,716	$4,612	$5,436	$4,425
Indirect Output	$460	$368	$392	$384	$327	$413	$440	$652	$768	$615
Induced Output	$157	$139	$149	$147	$163	$206	$226	$245	$268	$229
Total Output (mil $)	**$4,994**	**$3,425**	**$3,645**	**$3,572**	**$3,560**	**$3,825**	**$3,382**	**$5,508**	**$6,473**	**$5,269**
Indirect Business Taxes Effects (mil $)										
Direct Indirect Business Taxes	$12	$10	$10	$11	$10	$10	$10	$10	$12	$10
Indirect Indirect Business Taxes	$22	$13	$14	$13	$23	$20	$22	$50	$59	$49
Indirect Induced Business Taxes	$7	$6	$6	$8	$11	$10	$7	$11	$12	$10
Total Indirect Business Taxes (mil $)	**$41**	**$29**	**$30**	**$30**	**$44**	**$41**	**$39**	**$71**	**$83**	**$68**

Indirect Business Taxes, Labor Income, and Employment

In the 2021-2023 period, the ethanol industry contributed $68 million to $83 million annually to indirect business taxes in Nebraska. The ethanol industry also creates a substantial annual impact on the Nebraska labor market, with the largest impact occurring in 2022. From 2021 through 2023, the total labor income impact ranged from $397 million to $466 million. This income was earned by 4,976 to 5,851 workers.

The average annual earnings per job was $79,800 in 2023. 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 2014-2023 period, the annual labor income impact varied between $255 and $466 million per year, and the employment impact varied between 3,541 and 5,851 jobs. The largest employment impact of 5,851 jobs occurred in 2022, a year with higher commodity prices. While impacts were higher in years with higher prices, results for the range of impact 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 researchers have developed estimates.

Specifically, a 2016 study identified the response of corn and total crop acres to the location of nearby ethanol plant capacity.[4] The study suggests that doubling regional ethanol production capacity would yield a seven 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.[5] The latter finding is important since economic impact estimates need to reflect a change in crop mix.

Using these estimates, 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 of corn production but an equivalent reduction in acres devoted to other crops. 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.

[4]Changes 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.

[5]The 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 2021 through 2023 are reported in Table 7. The additional Nebraska corn acres led to 3,277 jobs in 2021 but fell to 1,650 by 2023 as agricultural commodity prices moderated, particularly the price of corn. This is the total employment impact, including the direct impact and the multiplier impact. There is also an additional $1.74 billion output impact in 2021 which fell to $1.01 billion in 2023. The labor income impact was $223 million in 2021 and $121 million in 2023. 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 economic impact from ethanol plant operations in Table 6 are added to the economic impacts from the reallocation of Nebraska acres to corn production. The result is the total annual economic impact. The total annual impact peaked in 2022 at $8.19 billion of output, $685 million in labor income and an estimated 8,969 jobs. The impact fell in 2023, as commodity prices normalized, to a $6.28 billion output impact, and a $518 million labor income impact earned in 6,626 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	2021	2022	2023
Employment Effects								
Ethanol Plant Operations	3,509	3,476	4,143	4,632	4,693	5,298	5,851	4,976
Rotation of Cropland into Corn	1,628	1,690	1,710	1,594	3,307	3,277	3,118	1,650
Total	5,137	5,166	5,853	6,226	8,000	8,575	8,969	6,626
Labor Income Effect								
Ethanol Plant Operations	$275	$270	$259	$328	$334	$425	$466	$397
Rotation of Cropland into Corn	$90	$100	$87	$116	$162	$223	$219	$121
Total	$365	$370	$346	$443	$496	$648	$685	$518
Output								
Ethanol Plant Operations	$3,645	$3,572	$3,560	$3,825	$3,382	$5,508	$6,473	$5,269
Rotation of Cropland into Corn	$509	$581	$769	$693	$1,028	$1,744	$1,714	$1,008
Total	$4,169	$4,154	$4,154	$4,329	$4,410	$7,253	$8,187	$6,276
Indirect Business Taxes								
Ethanol Plant Operations	$29	$30	$30	$44	$39	$71	$83	$68
Rotation of Cropland into Corn	-$3	-$8	-$6	-$16	-$29	-$10	-$7	-$9
Total	$26	$22	$24	$28	$10	$61	$76	$59

Economic Impact from Investments

Job creation due to investment is an important part of the economic impact of any industry. This is especially true of a capital-intensive industry like ethanol. The industry supports construction jobs, and there are also multiplier impacts at businesses that 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 2021 through 2023. However, respondents reported combined capital expenditures of $78.9 million in 2021 and reported capital expenditures of $75.0 million in 2023. No capital expenditures were reported for 2022. 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 that last one year, or 2,000 jobs that last six months.

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

	Cumulative Impact		
Year	**2021**	**2022**	**2023**
Employment Effects (Job-Years)			
Direct Employment (FTE)	357	0	338
Indirect Employment (0.282 of Direct)	101	0	95
Induced Employment (0.342 of Direct)	122	0	116
Total Employment (FTE)	**580**	**0**	**548**
Labor Income Effects (mil $)			
Direct Labor Income	$23.2	$0	$21.9
Indirect Labor Income (0.347 of Direct)	$8.0	$0	$7.6
Induced Labor Income (0.290 of Direct)	$6.7	$0	$6.4
Total Labor Income Effects	**$38.0**	**$0**	**$35.9**
Output Effects (mil $)			
Direct Output	$79.3	$0	$75.0
Indirect Output (0.339 of Direct)	$26.9	$0	$25.5
Induced Output (0.271 of Direct)	$21.5	$0	$20.3
Total Output	**$127.7**	**$0**	**$120.8**

The total economic impact resulting from the $78.3 million investment in 2021 is $127.7 million. The total economic impact in 2023 is $120.8 million. The multiplier impact, which is the sum of the indirect and induced impact, is $0.61 in business activity in industries throughout the economy for each $1 investment in the ethanol industry. Roughly 29 percent of the business sales is devoted to labor income, that is, the wages, salaries, and benefits earned by workers or proprietor income. In 2021, the direct labor income impact is $23.2 million, while the multiplier impact is $14.8 million, and the total cumulative impact on labor income is $38.0 million. The cumulative labor income is earned in the years when investment activity took place. The labor income supported a total of 580 job-years of employment in 2021. The employment multiplier was 0.62, indicating approximately two indirect or induced job-years for every three direct job-years. The labor income impact in 2023 was $35.9 million. This labor income was earned in 548 job-years.

Summary

This study evaluated the economic impact of the Nebraska ethanol industry from 2021 to 2023. The study discovered that output and the value of the industry have returned to pre Covid-19 levels and continue to show promise for future growth.

Further economic analysis compares the ethanol industry favorably to the arguably higher-profile College World Series, as well as comparing the ethanol industry to Nebraska's overall GDP over the three years included in the study.

In short, the study indicates the Nebraska ethanol industry is a vital component of both the agricultural sector as well as the overall Nebraska economy. It is both a mature industry, and one that continually exhibits innovation and flexibility to achieve the highest and best use of Nebraska natural and human resources.

Photo of Mid America Agri Products/ Wheatland in Madrid, Nebraska, by CreativeOlsen.

Appendix 1: Economic Impact Methodology

The basic framework for analysis was the IMPLAN model of the Nebraska economy. The most recent year of IMPLAN data is available for 2023. 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 co-products. 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 businesses 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/sites/unl.edu.ianr.casnr.agricultural-economics/files/media/file/economic-impacts-ethanol-industry-nebraska-2014.pdf

2015 to 2017 Numbers

Economic Impacts of the Nebraska Ethanol and Ethanol Co-Products Industry: 2015-2017: https://agecon.unl.edu/sites/unl.edu.ianr.casnr.agricultural-economics/files/media/file/UNL_economic_impact_study_2015-2017.pdf

2018 to 2019 Numbers

Economic Impacts of the Nebraska Ethanol and Ethanol Co-Products Industry: 2018-2019: https://agecon.unl.edu/sites/unl.edu.ianr.casnr.agricultural-economics/files/media/file/ethanol-report-2018-2019_final.pdf

2020 Numbers

Nebraska Department of Environmental Quality
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 Production and Distillers Grain Production

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

Prices of Ethanol

USDA, AMS, Nebraska Ethanol Corn and Co-Products Processing Values NW_GR213
Custom report from: https://www.ams.usda.gov/market-news/custom-reports

Prices of Distillers Grain

USDA, AMS, Corn Belt Feedstuffs Report SJ_GR115
Custom report from: https://www.ams.usda.gov/market-news/custom-reports

Prices of Corn Oil

USDA, AMS Weekly Crude Corn Oil Summary GX_GR115
Custom report from: https://www.ams.usda.gov/market-news/custom-reports

Table 2 and Figure 3. Nebraska, 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

Sales of Cattle
https://quickstats.nass.usda.gov

Soybean Production and Prices (calendar year months)
https://quickstats.nass.usda.gov

Figure 4. CWS/Ethanol Impact Comparison
https://cwsomaha.com/sports/2023/3/13/economic- impact.aspx#:~:text=A%20new%20economic%20impact%20research,%243.5%20million%20in%20local%20taxes.

Figure 5. Nebraska GDP vs Ethanol Impact
U.S. Bureau of Economic Analysis

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

Nebraska Department of Environmental Quality: 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.