Economic Impacts of the Nebraska Ethanol and Ethanol Co-Products Industry 2015 - 2017

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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Contents

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Highlights

Output, Employment, Labor Income, Indirect Business Taxes (2017)

- **Ethanol Production** - 2.076 billion gallons
- **Value of Ethanol Production** - $2.872 billion
- **Total Value** - $3.764 billion
- **Employees** - 1,453 full-time equivalents (FTEs)
- **Labor Income** - $109 million
- **Indirect Business Taxes** - $13 million

Overall Economic Impact (2017)

- **Employment** - 5,166 FTEs
- **Total Labor Income** - $370 million
- **Total Output** - $4.154 billion

Economic Impact from Cumulative Investments

- **Employment** - 4,599 FTEs
- **Total Labor Income** - $234 million
- **Total Output** - $584 million

Introduction

The objective of this report is to estimate the overall economic impact of the Nebraska ethanol industry from 2015 to 2017. It focuses on the macroeconomic impact of the industry and is an update of a 2014 report.[1] 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 now and in the future.

2010-2014 Summary

A similar study for production years 2010-2014 was used for comparison. The report surmised the ethanol industry had entered a period of maturity in 2010 after 15 years of rapid growth. The production volume over those years ranged from a low of 1.77 billion gallons in 2013 to a high of 2.06 billion gallons in 2011. The price of ethanol over this period ranged from $1.76 per gallon in 2010 to $2.55 per gallon in 2011. The price of ethanol exhibits more volatility than production so both measurements are important to evaluate in any year.

According to the 2014 study, the value of ethanol production equaled 67 percent of the value of corn production and 57 percent of cattle sales. Ethanol production values exceeded soybean production values at 166 percent. Production facilities employed the equivalent of 1,301 full-time employees.

Each year, these jobs led to $71 million dollars of employee income and $34 million of proprietors' income. The other primary effect of ethanol production was tax revenue of $15 million. The 2010-2014 report also used IMPLAN to understand the true economic impact of the industry.

Beyond the primary employment impact, the industry indirectly created approximately 3,200 jobs per year. These jobs led to an annual income of approximately $230 million. This income had a positive impact on tax revenue, increasing tax receipts by $29 to $34 million each year.

[1] https://agecon.unl.edu/research/economic-impacts-ethanol-industry-nebraska.pdf

Ethanol Production in Nebraska – An Overview

Nebraska is the nation's second largest ethanol producer. Ethanol production in Nebraska has grown over the last five years. Total production in 2017 was 2.076 billion gallons (Figure 1) surpassing the previous peak in 2011 of 2.062 billion gallons.

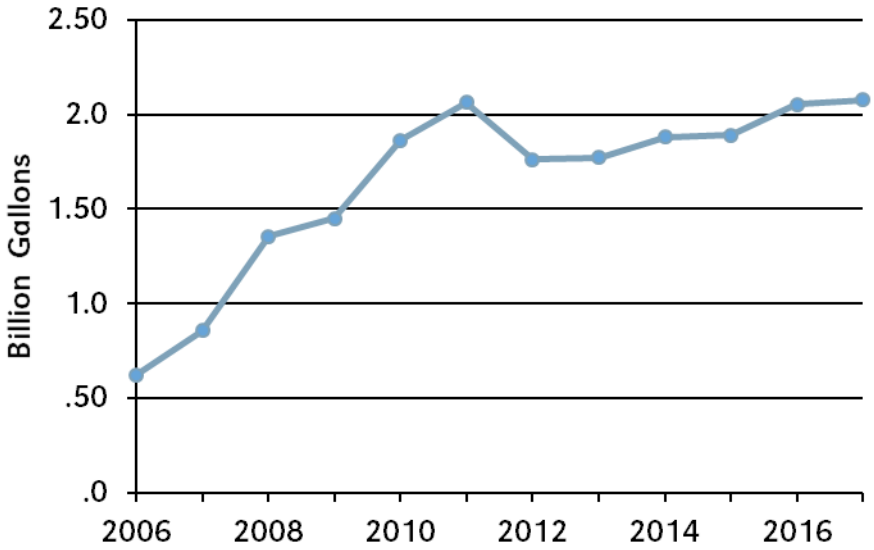

Figure 1. Ethanol Production in Nebraska, 2006 - 2017[2]

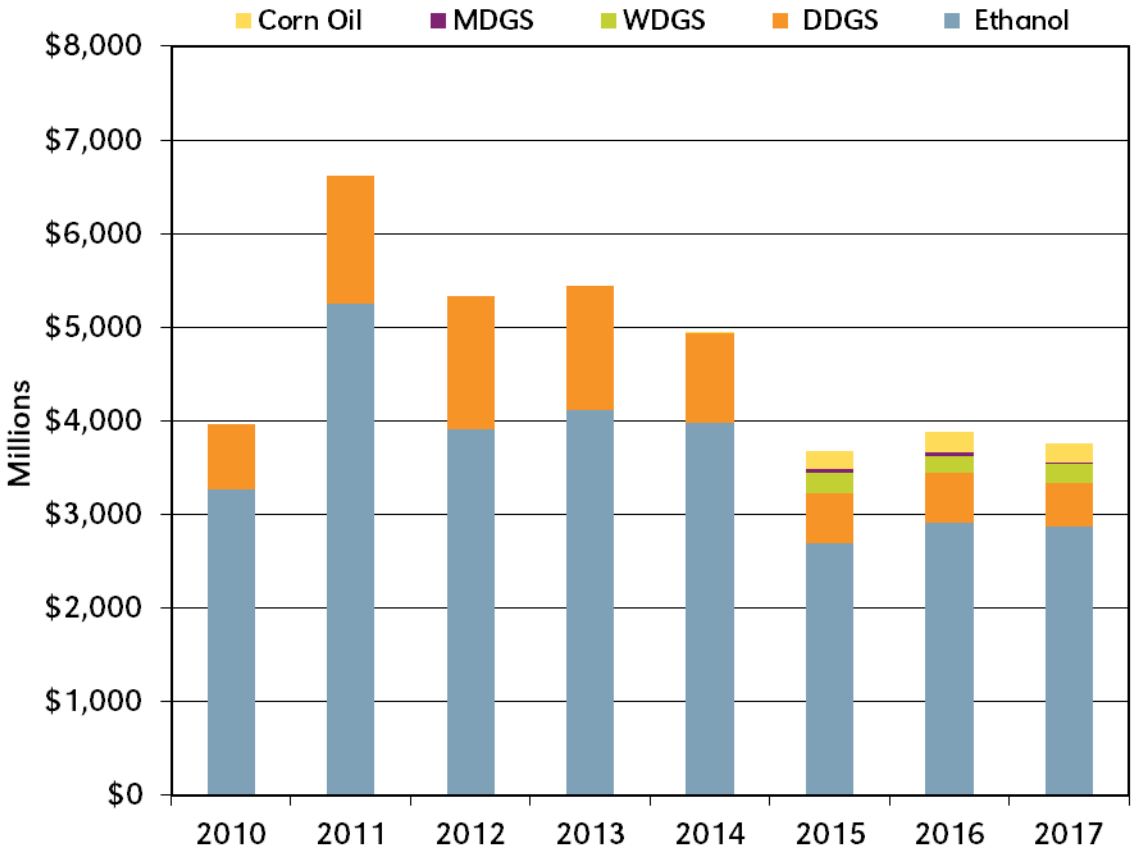

Figure 2. Value of Production for Ethanol and Co-products, 2010 - 2017

[2]Sources of data and information for all tables and figures are documented in Appendix 2.

Nebraska's value of production for ethanol and co-products has varied over the last several years. As shown in Figure 2 and Table 1, the value of production peaked in 2011 at over $6.6 billion.[3] It softened in the following years due to declining ethanol production and declining ethanol prices thereafter. Although total ethanol and ethanol co-products production increased in 2016 and 2017, ethanol and co-products prices declined, leading to reduced overall production values. Table 1 shows the total annual output with values of production for the ethanol industry for the past three years.

Table 1. Value of Production for Ethanol, Distillers' Grains and Corn Oil

Annual Output	2015	2016	2017
Ethanol			
Annual Production (mil gals)	1,892	2,053	2,076
Annual Average Price FOB Plant ($/gal)	$1.42	$1.42	$1.38
Value of Ethanol Production (mil $)	$2,695	$2,905	$2,872
Dried Distillers' Grain (DDGS)			
Annual Production (mil tons)	3.60	4.31	4.15
Annual Average Price ($/ton)	$148.68	$125.17	$111.28
Value of DDGs Production (mil $)	$535	$539	$462
Wet Distillers' Grain (WDGS)			
Annual Production (mil tons)	4.09	3.90	4.77
Annual Average Price ($/ton)	$50.98	$44.17	$44.56
Value of DDGs Production (mil $)	$209	$172	$213
Modified Distillers' Grain (MDGS)			
Annual Production (mil tons)	0.72	0.75	0.25
Annual Average Price ($/ton)	$70.91	$60.39	$52.42
Value of DDGs Production (mil $)	$51	$45	$13
Corn Oil			
Annual Production as of 03/2015 (tons)	271,173	302,792	310,643
Annual Average Price ($/ton)	$682.69	$703.26	$657.91
Value of Corn Oil Production (mil $)	$185	$213	$204
Total Value (mil $)	$3,675	$3,875	$3,764

[3]Values for 2010 to 2014 are based on previous report

[4]Ethanol plants continue to assimilate technology that increases efficiency and diversifies the production portfolio. The production and sale of these products increase revenue and adds additional value to the grain processed at ethanol plants. Newer technologies such as carbon dioxide and other co-products of ethanol production are not included in the economic impacts report.

Comparative Values of Ethanol in Nebraska

Table 2 and Figure 3 show comparisons of the production value for ethanol and co-products to the values for corn production, cattle sales and soybean production in Nebraska. Ethanol and co-products continue to exceed the value of soybean production. However over the past three years, the ethanol industry production value averaged 64 percent of all corn produced but only 32 percent of cattle sales. The value of ethanol production compared to cattle sales has declined compared to 2014. This is due to the declining value of production in the ethanol industry and an increasing production value in the cattle industry.

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

Product	2015	2016	2017
Ethanol, DDGS & Corn Oil (mil $)	$3,675	$3,875	$3,764
Corn			
Corn Production (mil bu)	1,693	1,700	1,683
Annual Average Price ($/bu)	$3.75	$3.42	$3.32
Value of Corn Production (mil $)	$6,348	$5,814	$5,589
Cattle			
Sales of Cattle (mil $)	$12,552	$10,975	$11,165
Soybeans			
Soybean Production (mil bu)	306	314	326
Annual Average Price ($/bu)	$9.18	$9.15	$9.07
Value of Soybean Production (mil $)	$2,806	$2,874	$2,957

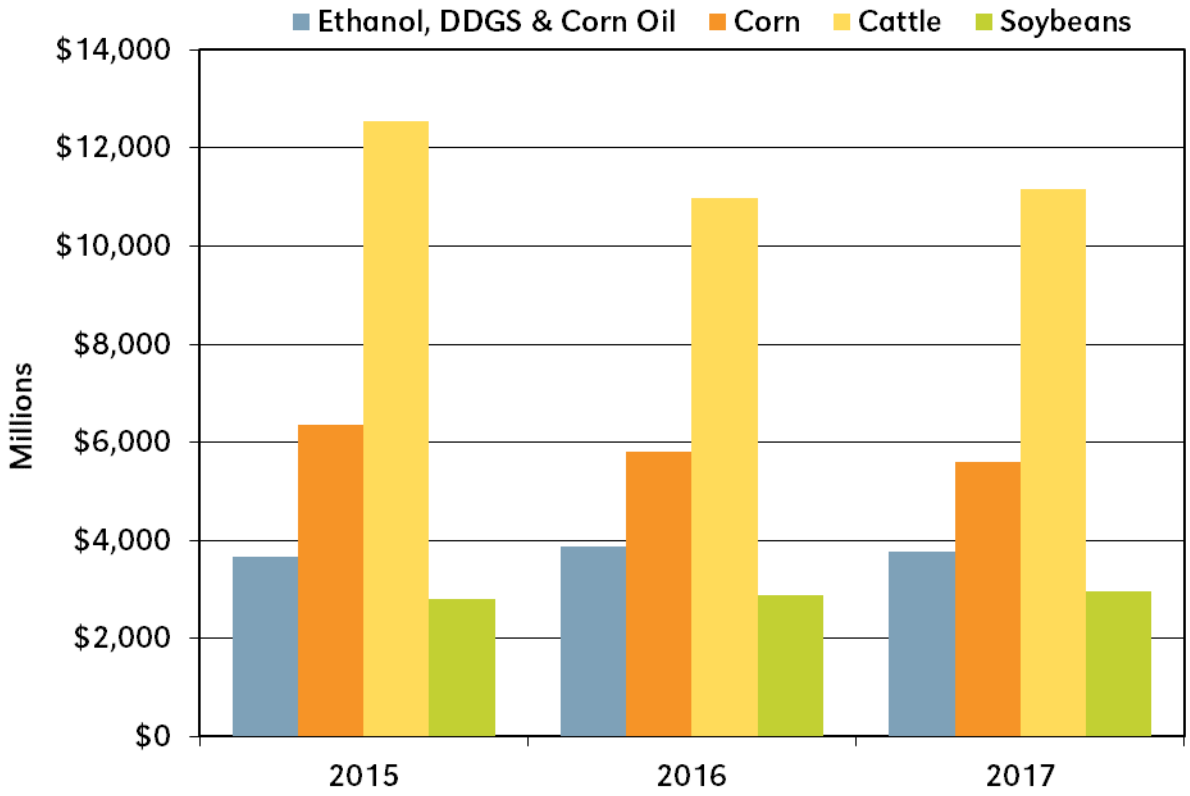

Figure 3. Comparative Values of Production.

Productive Capacity and Employment

Table 3 lists the 24 Nebraska ethanol plants and their permitted capacity on record with the Nebraska Department of Environmental Quality. Nebraska's ethanol capacity at the end of 2017, recorded on March 1, 2018, was 2.558 billion gallons. This is an increase of 481 million gallons compared to 2014 due to the expansion of ethanol plants. The total state employment, measured in full-time equivalents (FTEs), is 1,453, an increase of over 152 FTEs since 2014.

Table 3. Nebraska ethanol plants and their permitted capacities

		2014		2017	
Company	Nebraska location	Permitted Capacity (mpgy)	Facility Employment (FTE)	Permitted Capacity (mgpy)	Facility Employment (FTE)
Abengoa Bioenergy Corp.	Ravenna	80	62	135.0	50
Abengoa Bioenergy Corp.	York	55	58	60.0	43
ADM Corn Processing	Columbus	400	285	546.0	425
Aventine (Nebraska Energy)	Aurora	50	43	55.0	40
Aventine Aurora West, LLC	Aurora	113	50	116.3	45
Bridgeport Ethanol, LLC	Bridgeport	54	22	54.4	27
Cargill, Inc.	Blair	198	68	180.0	30
Chief Ethanol Fuels	Hastings	69	60	80.0	64
Cornhusker Energy	Lexington	50	50	84.0	51
E Energy Adams, LLC	Adams	55	43	58.7	52
Flint Hills Resources	Fairmont	115	45	132.3	60
Green Plains, LLC	Atkinson	44	30	52.5	43
Green Plains, LLC	Central City	100	47	135.0	50
Green Plains, LLC	Ord	50	35	62.5	41
Green Plains, LLC	Wood River	115	50	118.0	59
Husker Ag, LLC	Plainview	78	47	112.0	53
KAAPA Ethanol, LLC	Minden	59	34	82.0	43
Louis Dreyfus Commodities	Norfolk	53	40	54.1	51
Midwest Renewable Energy, LLC	Sutherland	25	30	26.3	28
Nebraska Corn Processing, Inc.	Cambridge	44	38	61.2	35
Siouxland Ethanol, LLC	Jackson	60	34	82.1	37
Standard Ethanol, LLC	Madrid	55	36	55.0	34
Trenton Agri Products, LLC	Trenton	45	34	50.0	32
Valero Renewable Fuels	Albion	110	60	165.5	60
Total		**2,077**	**1,301**	**2,558**	**1,453**

Does not include E-3 Biofuels, 25 million gallons per year, at Mead, NE

Note: ADM Corn Processing Facility Employment in 2017 includes all employees, not just those tied to the processing facility.

Corn Price Impacts

Ethanol production influences the local corn market cash price through higher demand for corn. This can translate into higher prices for producers in the immediate area. To a lesser extent, producers outside the immediate area who feed corn into the ethanol plant through their local elevator may see higher prices. This value is not reflected in IMPLAN, therefore additional benefits exist from ethanol production beyond those presented in overall economic impact numbers.

To identify the impacts on the local cash price in the immediate area, we investigated the difference in basis (the difference between the local cash price and the futures price) for locations with ethanol production and locations without. To identify the impact of ethanol on the local corn price we relied on Nebraska corn basis data found in Groskopf and Walters (2018).[5]

The dataset contained the basis for 41 Nebraska locations, including four locations with an ethanol plant. Average basis values were calculated for the locations with and without ethanol production. We evaluated two different periods which provides a more complete picture of whether basis changes over time. For the first period, we evaluated average basis from 2010 to 2017. For the second period, we focused on 2015 to 2017. Results for the longer time period identified an average increase of $0.058 per bushel in basis for locations with ethanol production. For the shorter time period, we found a slightly smaller average of $0.052 per bushel.

Results suggest a consistently positive impact on local basis from ethanol production. A producer near an ethanol facility producing 220 bushels of corn per acre would receive an additional $11.44 per acre each year. If this producer grew 1000 acres of corn, the farm would receive $11,440 more in annual revenue. Producers farther away from ethanol plants face higher transportation costs and would net a smaller amount. Ethanol production has a positive influence on corn producers in the surrounding area.

[5]Groskopf, J.J. and Walters, C., 2018. 2018 Updated Tables and Figures for EC 846 Nebraska Cash Corn Prices and Basis Patterns. https://digitalcommons.unl.edu/ageconfarmmgmt/11/

Net Returns

Figure 4 shows the estimated net returns for a representative ethanol plant for the last five years. Net returns include the revenue from the sale of ethanol and dried distillers' grain, less the cost of corn and variable and fixed costs. Ethanol net returns were briefly over $1 per gallon in 2014. However, from 2015 to 2017, net returns fluctuated from $-0.20 per gallon to $0.20 per gallon. Due to the variability of prices, net returns for an ethanol plant can change rapidly from month to month. Returns in ethanol industry are highly dependent on both input (corn) and output prices (ethanol). The industry has little control over these factors. Over the last several years, ethanol plants have added diverse revenue sources to their co-product mix to mitigate some of this market risk. However, these co-products represent a small part of the value of production portfolio (See Table 2).

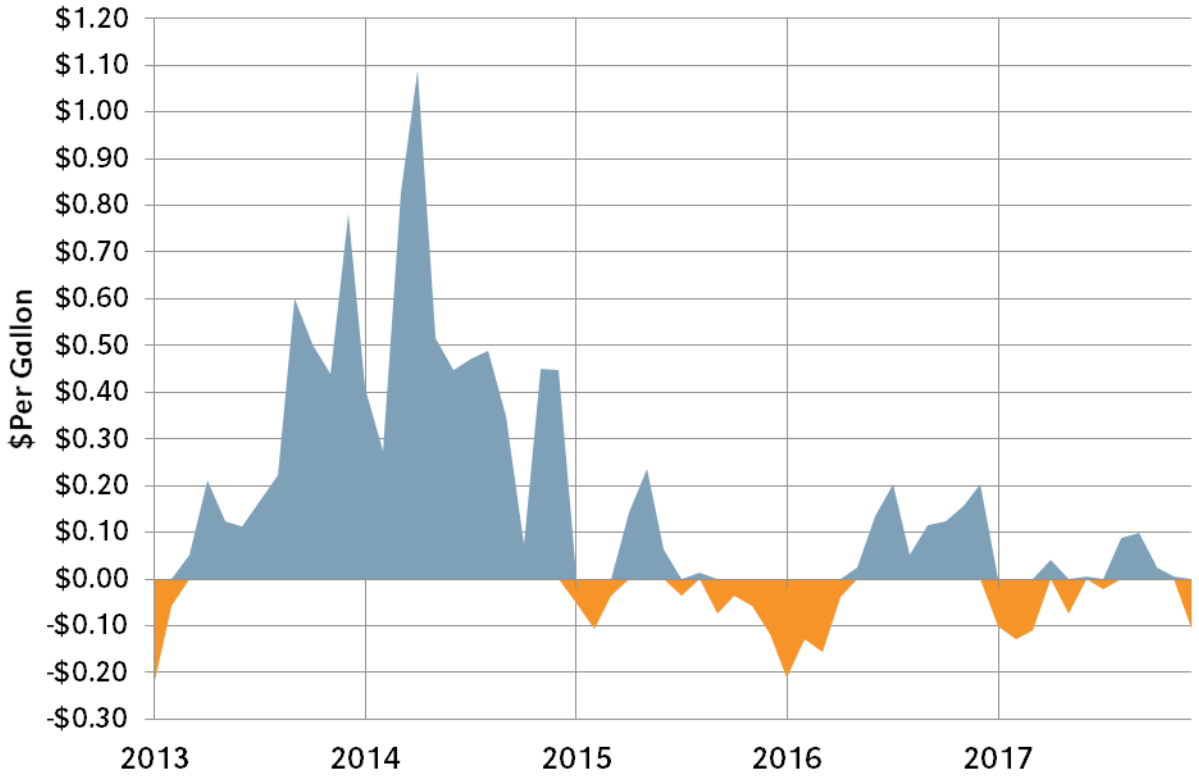

Figure 4. Net Returns for Ethanol and DDGS, January 2013 to December 2017

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. Between 2015 and 2017, there were an estimated 1,453 full-time equivalent employees at the 24 Nebraska plants.

Every second year the Nebraska Ethanol Board surveys ethanol plant operators. The survey asks about employment estimates, prevailing wages, salary and benefit information. The last survey was in 2016, so that year's estimates are also used for 2015 and 2017. In 2016, Nebraska ethanol plants employed 1,453 people. There was between $93 and $99 million of labor income associated with those jobs. The estimated proprietors' income was between $10 and $13 million. The total labor income was $103 million in 2015, $112 million in 2016 and $109 million in 2017. Indirect business taxes were estimated at $13 million per year.

Almost all of Nebraska's ethanol, dried distillers' grain and corn oil production is exported. 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.

The survey of Nebraska ethanol producers found that 94 percent of 2015 and 2016 Nebraska ethanol production was exported. Fifty-one percent of dried distillers' grain was exported in 2015 and 44 percent in 2016. Most wet distillers' grain remained in the state with just three percent being exported in 2015 and 2016. Fourteen percent of modified distillers' grain was exported in 2015 and 13 percent in 2016. Fifty-six percent of corn oil was exported out of state in 2015 and 57 percent in 2016. Averages of 2015 and 2016 values are used for 2017.

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

Annual Output	2010	2011	2012	2013	2014	2015	2016	2017
Ethanol								
Annual Production (mil gals)	1,863	2,062	1,763	1,773	1,882	1,892	2,053	2,076
Annual Average Price FOB Plant ($/gal)	$1.76	$2.55	$2.21	$2.32	$2.11	$1.42	$1.42	$1.38
Value of Ethanol Production (mil $)	$3,271	$5,251	$3,904	$4,118	$3,971	$2,695	$2,905	$2,872
Dried Distillers' Grain (DDGS)								
Annual Production (mil tons)	5.91	6.54	5.59	5.62	5.97	3.60	4.31	4.15
Annual Average Price ($/ton)	$117.18	$209.22	$255.58	$234.74	$161.44	$148.68	$125.17	$111.28
Value of DDGs Production (mil $)	$692	$1,367	$1,428	$1,319	$963	$535	$539	$462
Wet Distillers' Grain (WDGS)								
Annual Production (mil tons)	-	-	-	-	-	4.09	3.90	4.77
Annual Average Price ($/ton)						$50.98	$44.17	$44.56
Value of DDGs Production (mil $)						$209	$172	$213
Modified Distillers' Grain (MDGS)								
Annual Production (mil tons)	-	-	-	-	-	0.72	0.75	0.25
Annual Average Price ($/ton)						$70.91	$60.39	$52.42
Value of DDGs Production (mil $)						$51	$45	$13
Corn Oil								
Annual Production as of 03/2015 (tons)	-	-	-	-	22,314	271,173	302,792	310,643
Annual Average Price ($/ton)					$739.48	$682.69	$703.26	$657.91
Value of Corn Oil Production (mil $)					$17	$185	$213	$204
Total Value (mil $)	$3,963	$6,619	$5,332	$5,437	$4,951	$3,675	$3,875	$3,764
Employees	1,291	1,429	1,222	1,229	1,301	1,453	1,453	1,453
Labor Income (mil $)	$105	$116	$99	$100	$106	$103	$112	$109
Wages & Salaries including Benefits (mil $)	$71	$78	$67	$67	$72	$93	$99	$99
Proprietors' Income (mil $)	$34	$38	$32	$33	$35	$10	$13	$10
Indirect Business Taxes, IBT, Effects (mil $)	$15	$15	$15	$14	$13	$13	$13	$13

Economic Impact Analysis and IMPLAN

The preceding 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. As 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 2016, the midpoint of the 2015 through 2017 period. Multiplier information varies little between 2016 and 2015 and 2017.

The indirect economic impact from industry output is approximately 12.6 percent as large as the direct economic impact from output (see the Output row and the Indirect column entry of 0.1263 for 12.6 percent). The induced economic impact is approximately 4.8 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. Ethanol plant corn purchases have a very little economic impact on the state because most land used to grow corn would have grown corn or other crops even in the absence of demand from ethanol plants. The indirect impact estimates, therefore, primarily reflect purchases of other inputs such as water, enzymes or chemicals.

As 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 $29,000 in labor income (Table 5, Labor Income row and Direct column multiplier of 0.0288 times $1 million) associated with each $1 million in ethanol plant sales. Likewise, there is one job associated with each $2.5 to $2.7 million in ethanol plant sales. The indirect labor income impact is $1.58 in labor income for each $1 in direct income. The induced impact is approximately $0.49 for each $1 in direct impact. Therefore, each dollar of direct labor income impact has a total labor income impact of $3.07.

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.

Table 5. Input-Output Multipliers Derived for Nebraska Ethanol Plants 2016

Multipliers[a]	Direct	Indirect	Induced	Total	Type I[b]	Type SAM[c]
Output (mil $)	1.0000	0.1263	0.0481	1.1744	1.1263	1.1744
Employment	0.3750	0.4096	0.3458	1.1304	0.7846	1.1304
Labor Income (mil $)	0.0288	0.0457	0.0140	0.0885	0.0745	0.0885
Indirect Business Taxes (mil $)	0.0034	0.0044	0.0020	0.0097	0.0077	0.0097

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 2015 to 2017 figures are based on the aggregate economic characteristics in Table 4 and the input-output multipliers in Table 5. The impacts estimated for 2010 to 2014 are from the previous report.

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 $3,104 million in 2016 is 82 percent of the Total Value: Ethanol, Distillers' Grain, and Corn Oil of $3,875 million reported in Table 4. This is because 94 percent of the ethanol, 44 percent of dried distillers' grain, 13 percent of modified distillers' grain, 3 percent of wet distiller's grain and 57 percent of corn oil produced were sold out-of-state during 2016. 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.

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

Effect	2010	2011	2012	2013	2014	2015	2016	2017
Employment Effects								
Direct Employment (FTE)	1,147	1,268	1,026	1,058	1,150	1,185	1,196	1,206
Indirect Employment	1,772	1,960	1,585	1,634	1,777	1,415	1,271	1,246
Inducted Employment	1,511	1,672	1,352	1,394	1,516	1,141	1,074	1,056
Total Employment (FTE)	**4,430**	**4,900**	**3,963**	**4,086**	**4,443**	**3,741**	**3,541**	**3,508**
Labor Income Effects (mil $)								
Direct Labor and Proprietors' Income	$93	$103	$83	$86	$93	$82	$89	$88
Indirect Labor Income	$166	$184	$149	$153	$167	$133	$142	$139
Induced Labor Income	$59	$65	$53	$55	$59	$40	$44	$43
Total Labor Income (mil $)	**$319**	**$352**	**$285**	**$294**	**$319**	**$255**	**$275**	**$270**
Output Effects (mil $)								
Direct Output	$3,519	$5,873	$4,476	$4,679	$4,377	$2,918	$3,104	$3,041
Indirect Output	$370	$617	$470	$492	$460	$368	$392	$384
Induced Output	$126	$211	$161	$168	$157	$139	$149	$147
Total Output (mil $)	**$4,015**	**$6,701**	**$5,107**	**$5,338**	**$4,994**	**$3,425**	**$3,645**	**$3,572**
Indirect Business Taxes Effects (mil $)								
Direct Indirect Business Taxes	$13	$13	$13	$12	$12	$10	$10	$11
Indirect Indirect Business Taxes	$25	$25	$24	$23	$22	$13	$14	$13
Induced Indirect Business Taxes	$9	$9	$8	$8	$7	$6	$6	$8
Total Indirect Business Taxes (mil $)	$47	$47	$45	$43	$41	$29	$30	$30

Total Output

In addition to the direct effects described 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 8. For example, the Indirect, Output effect in 2016 was $392 million and the Induced, Output effect was $149 million. Combining the direct, indirect and induced effects results in a Total Output effect of $3,645 in 2016. From 2010 to 2017, the Total Output effect ranged from $3,572 to $6,701 due to the underlying variability in prices for ethanol distillers' grain and corn oil.

Indirect Business Taxes, Labor Income and Employment

In 2016, the ethanol industry contributed $30 million in indirect business taxes to Nebraska. The ethanol industry also creates a substantial annual impact on the Nebraska labor market. In 2016, the total labor income impact was $275 million. This income was earned by an estimated 3,509 jobs shown as total employment (FTE), for an average annual earnings of $78,300. 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 2010 to 2017 time period, the annual labor income impact varied between $255 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 economic 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 so.6 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.7 The latter finding is important since it implies that additional corn production would occur at the expense of other crops such as soybeans or hay (including alfalfa).

Using this estimate, a 348 percent increase in ethanol capacity since 2006 would yield a 25 percent increase in Nebraska corn acres. Based on 77.5 million harvested acres of corn, this translates to about 1.93 million more acres.

This increase accounts for all the increase in corn acres in Nebraska between 2006 and 2017. As noted before, 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.

[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.

[7]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 2015 through 2017 are reported in Table 7. The additional Nebraska corn acres led to 1,690 jobs in 2017. This is the total employment impact, including the direct impact and the multiplier impact. There is also an additional $581 million output impact in 2017 and $100 million in labor income. There is a small decline in indirect business tax revenue as soybean production generates more indirect business tax revenue than corn production per acre.

There are similar impacts for 2015 and 2016. 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 2017 rises to $4.15 billion, including $370 million in labor income and 5,166 jobs. There are similar impacts in 2015 and 2016, although the crop impact is somewhat larger in 2015 due to higher corn prices in that year. 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

	2015	2016	2017
Employment Effects			
Ethanol Plant Operations (FTE)	3,710	3,509	3,476
Rotation of Croplands into Corn (FTE)	2,189	1,628	1,690
Total Employment (FTE)	**5,898**	**5,137**	**5,166**
Labor Income Effects (mil $)			
Ethanol Plant Operations (mil $)	$255	$275	$270
Rotation of Croplands into Corn (mil $)	$131	$90	$100
Total Labor Income (mil $)	**$386**	**$365**	**$370**
Output Effects (mil $)			
Ethanol Plant Operations (mil $)	$3,425	$3,645	$3,572
Rotation of Croplands into Corn (mil $)	$744	$509	$581
Total Output (mil $)	**$4,169**	**$4,154**	**$4,154**
Indirect Business Taxes Effects (mil $)			
Ethanol Plant Operations (mil $)	$29	$30	$30
Rotation of Croplands into Corn (mil $)	-$3	-$8	-$6
Total Indirect Business Taxes (mil $)	$26	$22	$24

Economic Impact from Investments

Job creation due to investment is an important part of the economic impact of any industry. This is especially true 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.

Most survey respondents elected not to answer questions about firm investments. As a result, it is not feasible to estimate the economic specific impact of ethanol industry investment for 2015, 2016 and 2017. However, the Nebraska Ethanol Board collected a variety of press announcements about recent Nebraska ethanol industry investment investments. This can be used to produce a partial estimate of the cumulative impact of ethanol investments in Nebraska, at least over recent years. In particular, the Nebraska Ethanol Board helped identify a series of investment by KAAPA, Chief, Siouxland, Novozymes, Evonik, Flint Hills and E-Energy. These estimates totaled about $466 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 200 jobs which last five years.

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

	Cumulative Impact
Employment Effects (Job-Years)	
Direct Employment (FTE)	3,056
Indirect Employment (0.15169 of Direct)	464
Induced Employment (0.35292 of Direct)	1,079
Total Employment (FTE)	**4,599**
Labor Income Effects (mil $)	
Direct Labor Income	$161
Indirect Labor Income (0.17831 of Direct)	$29
Induced Labor Income (0.27335 of Direct)	$44
Total Labor Income Effects	**$234**
Output Effects (mil $)	
Direct Output	$356
Indirect, Output (0.23729 of Direct)	$85
Induced, Output (0.40254 of Direct)	$143
Total Output	**$584**

Note that the direct economic impact in terms of output (i.e., business sales) is less than $466 million. This is because a portion of investment costs go to equipment rather than construction, site preparation, or construction engineering services. Only the wholesale mark-up portion of equipment spending is counted towards economic impact, given that equipment is constructed around the nation and world. The cumulative direct economic impact from investments in the Nebraska ethanol industry is $356 million.

The cumulative economic impact resulting from the $466 million in investment is $584 million. The multiplier impact, which is the sum of the indirect and induced impact, is $0.64 in business activity in industries throughout the economy for each $1 investment in the ethanol industry. Roughly 40 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 $161 million while the multiplier impact is $73 million and the total cumulative impact on labor income is $234 million. The cumulative labor income is earned in the years when investment activity took place. The labor income supported a total of 4,599 job-years of employment. The direct employment impact from investment was 3,056 job-years. The multiplier impact, which is the sum of the indirect and induced impact, was 1,543 job years. The employment multiplier was 0.50, indicating one indirect or induced job-years for every two direct job-years.

Summary

This study evaluated the economic impacts of the Nebraska ethanol industry for the state of Nebraska from 2015 to 2017. While the value of production for the ethanol and co-product industry was lower over the last three years compared to previous years, both ethanol capacity and employment increased over the years of study, indicating a positive long-term outlook. 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 continue to provide a positive economic impact on the state of Nebraska. Since ethanol producers persisted through this recent period of low prices, it is the opinion of the authors' 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 2016 was used, as this is the most recently available. 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 also model the economic impact of over 400 industry sectors.

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 ethanol sales. 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/research/economic-impacts-ethanol-industry-nebraska.pdf

2015 to 2016 Numbers

Nebraska Department of Environmental Quality
Nebraska Ethanol Board

Figure 2 and Table 1. Value of Production for Ethanol, Distillers' Grain and Corn Oil

Ethanol Production and Distillers' Grain Production

Nebraska Department of Environmental Quality
Nebraska Ethanol Board

Corn Oil Production

Estimated by the authors using 0.78 pounds of corn oil per bushel of corn used. University of Nebraska-Lincoln survey of plants revealed on average plants that reported stated they produced 0.78 pounds of corn oil per bushel of corn used in 2016, therefore this was used for all three years.

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

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/F0894DA2-02F2-3AB4-AB4F-A077397039A0
https://quickstats.nass.usda.gov/results/CD15EAB6-2772-33F0-BB96-DF7B4A78F17D

Sales of Cattle

https://quickstats.nass.usda.gov/results/B4B16939-6AC9-3548-88F0-D3E68E3FA245

Soybean Production and Prices (calendar year months)

https://quickstats.nass.usda.gov/results/DF5E5A11-5F6E-3F53-A8E7-B472EEEC29EF
https://quickstats.nass.usda.gov/results/CBFC99C6-9B42-34DD-A801-46283F6BBC3E

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

Nebraska Department of Environmental Quality: http://www.deq.state.ne.us/
Nebraska Ethanol Board

Figure 4. Net Returns for Ethanol and DDGS, January 2013 to December 2017

Estimated by the authors based on Nebraska prices for ethanol and distiller' grain and using the Iowa State University plant model for tracking ethanol profitability.
https://www.extension.iastate.edu/agdm/articles/hof/HofJan08.html

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."

Table 5. Input-Output Multipliers Derived for Nebraska Ethanol Plants 2016

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.