ABF Economics
Agriculture and BioFuels Consulting, LLP

CONTRIBUTION OF THE ETHANOL INDUSTRY TO THE ECONOMY OF THE UNITED STATES IN 2018

Prepared for the Renewable Fuels Association by
John M. Urbanchuk
Managing Partner
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Despite achieving new records for total output and export volumes, the U.S. ethanol industry experienced a challenging year in 2018 due to U.S. government actions and new trade barriers that restricted demand. Ethanol production reached an estimated 16.1 billion gallons in 2018, up 1.1 percent from 2017 and marking the sixth straight year of incremental growth.

- World oil prices strengthened through the first three quarters of 2018 before dropping sharply in the last two months of the year. Nonetheless, oil prices posted a 32 percent gain for the full year., leading to higher consumer gasoline prices. The impact of higher average motor gasoline prices during 2018 offset a strong consumer economy so that gasoline consumption was essentially unchanged for the year. Domestic ethanol demand was flat because of both stagnant gasoline demand and the impact of Small Refinery Exemptions (SREs).

- Responding to record production, larger stocks, and the impact of SREs, ethanol prices generally fell from year-earlier levels throughout 2018. Ethanol stocks at year end 2018 were 2.4 percent higher than at the end of 2017. Iowa ethanol prices (FOB plant) fell 6.3 percent for all of 2018 while Omaha Rack ethanol prices were 16.4 percent lower.

- The two bright spots for the ethanol industry in 2018 were robust export markets and sharply higher DDGS prices. Ethanol exports through October 2018 were up more than 29 percent from year-earlier levels and were poised to reach a record level of more than 1.6 billion gallons for the year. Distillers dried grain prices increased more than 40 percent from depressed 2017 levels. These higher co-product prices helped offset lower ethanol prices.

- The input markets were an impediment for the ethanol industry during 2018. Corn production for the 2018/19 marketing year was virtually unchanged from 2017. Higher demand, largely from the feed sector, reduced stock levels and supported corn prices. As reported by USDA AMS Market News[1], cash market corn prices for 2018 were up 2.5 percent in Iowa and 1.1 percent in Central Illinois.

- Ethanol margins followed a typical seasonal pattern in 2018 with returns over variable costs increasing through mid-year. However, margins deteriorated through the year as profitability suffered from stable (and modestly higher) feedstock costs and lower ethanol prices. The deterioration was significant enough that many facilities were in the red in the fourth quarter leading to plant shutdowns. Iowa State University estimated a return over variable costs of 18 cents per gallon for January through November for a typical Iowa ethanol plant.[2] Returns that averaged 22 cents per gallon for the first eight months of the year fell to about 5 cents per gallon in November. The regulatory environment continued to provide challenges for the industry. On November 30, the Environmental Protection Agency (EPA) released its final rule for 2019 renewable volume obligations (RVOs) under the Renewable Fuel Standard (RFS).[3] The final rule continues the requirement for 15 billion gallons of conventional renewable fuel (e.g., corn-starch ethanol) in 2019 equal to the level established by Congress in the 2007 Energy Independence and Security Act. However, the EPA did increase the advanced biofuel requirement by 630 million gallons to 4.92 billion gallons. Within this category, EPA set the RVO for cellulosic biofuels at 418 million gallons, far short of the statutory level of 7 billion gallons, but 130 million gallons higher than the 2018 cellulosic biofuel requirement.

The major regulatory issue that affected both ethanol volumes and prices during 2018 was the continued use of SREs by the EPA. The original RFS passed in 2005 gave the EPA authority to extend a temporary exemption from biofuel mandates for small refineries. EPA reports that 48 SREs were granted

[1] https://marketnews.usda.gov/mnp/ls-report

[2] Iowa State University AgDecision Maker Ethanol Profitability available at http://www.extension.iastate.edu/agdm/energy/xls/d1-10ethanolprofitability.xlsx accessed Jan 3, 2019

[3] Federal Register/Vol. 83, No. 237/Tuesday December 11, 2018

retroactively for the 2016 and 2017 compliance years and that 22 petitions are pending for 2018.[4] Under the exemption authority, the EPA has reinstated RINs (Renewable Identification Numbers, which are essentially credits under the RFS) to small refiners.[5] Refiners granted exemptions could use these RINs to comply with the RFS requirements instead of blending physical gallons of biofuels. There is growing consensus that extension of these SREs is leading to reduced ethanol (and biodiesel) consumption and lower prices. The retroactive reinstatement of RINs likely reduced ethanol demand in 2018.

In October 2018 President Trump directed the EPA to initiate rulemaking to expand the Reid Vapor Pressure (RVP) waiver for E15. This expansion would allow E15 to be sold year-round instead of the current eight-month restriction in most geographies. EPA has not yet issued rules for expanded use.

According to the Renewable Fuels Association (RFA), at year's end the ethanol industry was comprised of approximately 210 plants in 27 states with nameplate capacity of 16.5 billion gallons. At year's end an estimated 199 plants were operating and producing at a rate of more than 16 billion gallons. Conventional feedstocks (e.g., corn and sorghum) accounted for the majority of ethanol production. At year's end, more than 300 million gallons of capacity was under expansion or construction.

This study estimates the contribution of the ethanol industry to the American economy in 2018 in terms of employment, income, and Gross Domestic Product (GDP) directly and indirectly supported by the industry.

Expenditures by the Ethanol Industry in 2018

Ethanol producers are part of a manufacturing sector that adds substantial value to agricultural commodities produced in the United States and makes a significant contribution to the American economy.

Expenditures by the ethanol industry for raw materials, other goods, and services represent the purchase of output of other industries. The spending for these purchases circulates through the local and national economy, generating additional value-added output, household income, and employment in all sectors of

[4] https://www.epa.gov/fuels-registration-reporting-and-compliance-help/rfs-small-refinery-exemptions. Accessed January 24, 2019

[5] Renewable Fuels Association. "The Impact of Small Refinery Exemptions on Ethanol Demand" November 20, 2018.

the economy.[6] Ethanol industry expenditures can be broken into three major categories: construction of new production facilities, ongoing production operations, and research and development.

1. Construction

   Industry capacity increased an estimated 295 million gallons during 2018 with much of this accounted for by expansion and "debottlenecking" of conventional ethanol and second-generation production facilities. At year's end, RFA reported more than 300 million gallons of new capacity under construction or expansion.

2. Ongoing production operations

   The industry spent an estimated $26.5 billion on raw materials, other inputs, and goods and services to produce ethanol during 2018, 0.3 percent more than a year ago. The small reduction in operating costs on a per gallon basis reflects an upward adjustment in our assumption of average ethanol yields from 2.8 to 2.85 gallons per bushel. This adjustment reflected an examination of corn demand for alcohol reported by USDA and ethanol production reported by EIA.

   Production costs were based on a model of dry mill ethanol production maintained by the author of this report. These estimates are consistent with generic dry mill ethanol costs, such as those published by Iowa State University.[7] Table 1 details the expenditures by the ethanol industry in 2018.

[6] Expenditures for feedstock and energy were estimated using 2018 calendar year average prices. Revenues were estimated using 2018 calendar year average prices for ethanol; Distiller's grains, and corn distillers' oil. Prices were provided by USDA/ERS and AMS, and EIA.

[7] See the Ethanol profitability spreadsheet maintained by Don Hofstrand "AgDecision Maker D1-10 Ethanol Profitability" available at http://www.extension.iastate.edu/agdm/energy/xls/d1-10ethanolprofitability.xlsx

Table 1
Estimated Ethanol Production Expenditures 2018

OPERATING COST	2017 Mil $	2018 Mil $	Percent Change
Feedstock (corn)	$19,137	$19,094	-0.2%
Enzymes, yeast and chemicals	$1,105	$1,151	4.1%
Denaturant	$818	$852	4.1%
Natural Gas, electricity, water	$3,051	$3,007	-1.5%
Direct labor	$1,103	$1,148	4.1%
Maintenance & Repairs	$482	$502	4.1%
Transportation	$139	$145	4.3%
GS&A	$575	$598	4.1%
Total Operating Costs	$26,411	$26,496	0.3%
$/Gallon	$1.67	$1.65	-1.2%

The largest share of spending was for corn and other feedstocks used as raw material to make ethanol. The ethanol industry used 5.65 billion bushels of corn (and corn equivalent) on a gross basis in 2018, valued at $19.1 billion. Reflecting this, the ethanol industry is a major source of support for agricultural output and farm income. Together, feedstock and energy account for nearly 85 percent of ethanol production costs.

This analysis estimates both the total production effect and the crop price (farm income) effects of ethanol production on agriculture based on a structural model of U.S. agriculture maintained by the author. The impact of demand for corn to produce ethanol on farm income was adjusted so as to not overstate the impact of ethanol demand on revenue for the corn sector.

The remainder of spending by the ethanol industry for ongoing operations is for a range of inputs such as enzymes, yeast and chemicals; electricity, natural gas, and water; labor; transportation; and services such as maintenance, insurance, and general overhead.

3. Research and Development

The renewable fuels industry is a significant engine for research and development (R&D) both in the public and private sectors. Much of the R&D activity in the biofuels industry is aimed at discovering and developing advanced biofuels feedstock and the technology needed to meet RFS2 targets for cellulosic and advanced biofuels. The primary public-sector agencies underwriting R&D in biofuels are the U.S. Departments of Energy (USDOE), Agriculture (USDA), and Defense (DOD). In addition to the federal government, many states are funding R&D in feedstock development as well as infrastructure. These public funds are being leveraged significantly by private sector firms undertaking research in a wide range of biofuels activities. We have assumed that R&D spending on biofuels continued to expand during 2018. Reflecting this we estimated that industry R&D expenditures grew at the overall rate of inflation and totaled an estimated $905 million in 2018.[8]

4. Co-product value

Most ethanol is produced by dry mills that also produce valuable co-products in the form of distillers dried grains (DDGS) and industrial corn oil (ICO).[9] The ethanol industry produced an estimated 48 million short tons of DDGS and nearly 3.6 billion pounds of ICO in 2018 with an aggregate market value of $8.3 billion. In large part the 38 percent increase in co-product revenue is attributable to sharply higher DDGS prices. It is notable that these co-products are produced with little additional expenditure.

[8] Estimates of the amount of R&D spending on biomass and biofuels vary substantially. For a discussion of R&D spending on biofuels see "Agricultural Preparedness and the Agriculture Research Enterprise". President's Council of Advisors on Science and Technology. Washington DC, December 2012. A 2013 study prepared by Mary Solecki, Anna Scodel and Bob Epstein at E2 Environmental Entrepreneurs. "Advanced Biofuel Market Report 2013" suggests that R&D spending on biofuels approaches $1.7 billion. A (relatively) new report on federal spending on R&D in energy published by EIA ("Direct Federal Financial Interventions and Subsidies in Energy in Fiscal year 2013", March 2015) estimates Federal R&D expenditures for biomass of $300 million in FY 2013. This study does not include estimates for corporate (private sector) R&D.

[9] DDGS and corn distillers oil production is reported monthly in the USDA Grain Crushings and Co-Products Production report. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1899

Spending associated with current ethanol production, new and expansion construction, and R&D circulates and re-circulates throughout the entire economy several-fold, stimulating aggregate demand, and supporting jobs and household income. The economic activity associated with export activity adds to this impact. In addition, expanded economic activity generates tax revenue for government at all levels.

Methodology

We estimate the impact of the ethanol industry on the American economy by applying expenditures by the relevant supplying industry to the appropriate final demand multipliers for value added output, earnings, and employment.

To understand how the economy is affected by an industry such as ethanol production, it is necessary to understand how different sectors or industries in the economy are linked. For example, in the renewable fuels production sector, the ethanol industry buys corn from the agriculture sector; which in turn, buys inputs from other suppliers such as fertilizer and pesticide producers that also purchase products from a range of other industries. These are referred to as backward linkages. Natural gas production and transmission industries are linked through both forward and backward linkages to other economic sectors in each state's economy.

The household sector is linked to all sectors as it provides the labor and management resources. In turn, changes that affect incomes of the household sector typically have significant impacts compared to a change in the sales of other sectors. This is because households typically spend most of their income on both retail and service goods and this is a critical component of the national economy.

This study uses the IMPLAN (Impact Analysis for Planning) multiplier database to develop a model of the national economy, including sectors that support the ethanol industry, the links between them, and the level of national economic activity. IMPLAN is a commonly used economic input-output (I-O) model. I-O models are constructed based on the concept that all industries in an economy are linked together; and the output (i.e., sales) of one industry becomes the input of another industry until all final goods and services are produced. I-O models can be used both to analyze the structure of the economy and to estimate the total economic impact of projects or policies. For this analysis, a model for the U.S. economy was constructed using current IMPLAN software and data.

As in the past, we continue to treat the share of industry earnings accounted for by locally owned firms as an addition to the household sector since the income is paid to local owners. The result of this is that their impact is estimated using multipliers for the household sector rather than those for conventional corporate income.

IMPLAN models provide three economic measures that describe the economy: value added, income, and employment.

- Value added is the total value of the goods and services produced by businesses in the country and is generally referred to as gross domestic product (GDP). It is equivalent to the sum of labor income, taxes paid by the industry, and other property income or profit.

- Labor income is the sum of employee compensation (including all payroll and benefits) and proprietor income (income for self-employed work). In the case of this analysis, demand for corn and other feedstock to produce ethanol supports farm income through higher crop receipts than would be the case without ethanol production.

- Employment represents the annual average number of employees, whether full or part-time, of businesses producing output. Value added including labor income and employment represent the net economic benefits that accrue to the nation because of increased economic output.

There are three types of effects measured with a multiplier: direct, indirect, and induced effects. Direct effects are the known or predicted changes in the economy associated with the industry directly involved (in this case, ethanol). Indirect effects are the business-to-business transactions required to produce direct effects (i.e., increased output from businesses providing intermediate inputs). Finally, induced effects are derived from spending on goods and services by people working to satisfy direct and indirect effects (i.e., increased household spending resulting from higher personal income).

We also continue to reflect the additional value of output of co-products (DDG and industrial corn oil) in the analysis. Since these are co-products, and the backward linkages for their production is accounted for in the expenditures for ethanol production, the value for DDG and ICO was treated as income and value added only, and we applied income multipliers to the employee compensation portion to avoid double counting.

As was the case in our previous studies, we incorporated the explicit impact of ethanol and DDGS exports in the economic impact analysis. The methodology for estimating the impact of trade differs from that used for industry output.[10] We estimated the impact of ethanol and DDGS exports by applying USDA Agricultural Trade multipliers for output and employment to the estimated value of exports for 2018 reported in the USITC trade databases. Since ethanol and DDGS are outputs of the organic chemical industry we used the USDA trade multipliers for the other organic chemicals industry. The USDA multipliers have three major components (or margins): production, transportation and warehousing, and wholesale/retail trade. Since IMPLAN already incorporates the impact of ethanol and DDGS production, to avoid double counting impacts we only applied the margins for transportation and trade to the value of exports. This represents the post-production (or ex-plant) impacts from exports.

Results

Table 2 summarizes the impact of ethanol industry production and exports on the U.S. economy in 2018. The full impact of the spending for annual operations of ethanol production, co-product output, exports, and R&D is estimated to have contributed more than $45 billion to the nation's GDP in 2018, 4.4 percent more than provided in 2017. A significant component of this is from agriculture, reflecting the importance of ethanol demand to total corn utilization, the aggregate value of crop production, and crop receipts and farm income. The manufacturing activity of ethanol production alone contributed nearly $14.5 billion to the U.S. economy.

[10] https://www.ers.usda.gov/data-products/agricultural-trade-multipliers.aspx

Table 2
Economic Impact of the Ethanol Industry: 2018

	2018 GDP (Mil 2018$)	2018 Employment FTE Jobs	2018 Income (Mil 2018$)
Ethanol Production	**$14,448**	**84,956**	**$7,576**
Direct	$5,021	10,000	$2,199
Indirect	$5,086	30,141	$2,893
Induced	$4,341	44,816	$2,484
Construction	**$791**	**7,814**	**$522**
Direct	$263	2,720	$205
Indirect	$233	1,983	$147
Induced	$296	3,111	$169
Agriculture	**$23,505**	**244,906**	**$12,561**
Direct	$4,347	55,654	$1,947
Indirect	$12,110	115,097	$6,581
Induced	$7,048	74,155	$4,033
R&D Expenditures	**$1,371**	**11,951**	**$884**
Direct	$472	2,993	$345
Indirect	$400	3,705	$252
Induced	$500	5,253	$286
Exports (Total)	**$6,278**	**16,257**	**$3,327**
Total Ethanol	**$46,393**	**365,883**	**$24,869**
Direct	$10,102	71,367	$4,696
Indirect	$24,107	167,182	$13,201
Induced	$12,184	127,334	$6,973

Employment

Jobs are created from the economic activity supported by ethanol production. While ethanol production is not a labor-intensive industry (accounting for about 10,000 full time equivalent direct jobs nation-wide)[11], the economic activity of supporting industries generates a substantial number of jobs in the nation.

[11] The Census Bureau does not report employment in ethanol production. This analysis conservatively assumes the average ethanol plant employs approximately 50 full-time equivalent employees.

When the direct, indirect and induced jobs supported by ethanol production, construction activity, agriculture, exports, and R&D are included, the ethanol industry supported nearly 366,000 jobs in 2018.

Since ethanol production is more capital intensive rather than labor intensive, the number of direct jobs supported by the ethanol industry is relatively small and is concentrated primarily in manufacturing and agriculture. Most agriculture jobs supported by the ethanol industry are jobs in support activities related to crop production, ranging from farm managers and bookkeepers to farm equipment operators. In addition, jobs supported by income generated and spent by employees supports a significant number of jobs in seemingly unrelated sectors such as retailers and service sectors. In general, as the impact of the direct spending by the ethanol industry expands throughout the economy, the employment impact expands significantly and is spread over a large number of sectors. The number of jobs supported by ethanol and DDGS exports is estimated at more than 16,200. Most of these jobs are concentrated in transportation and export trade related administrative and financial industries.

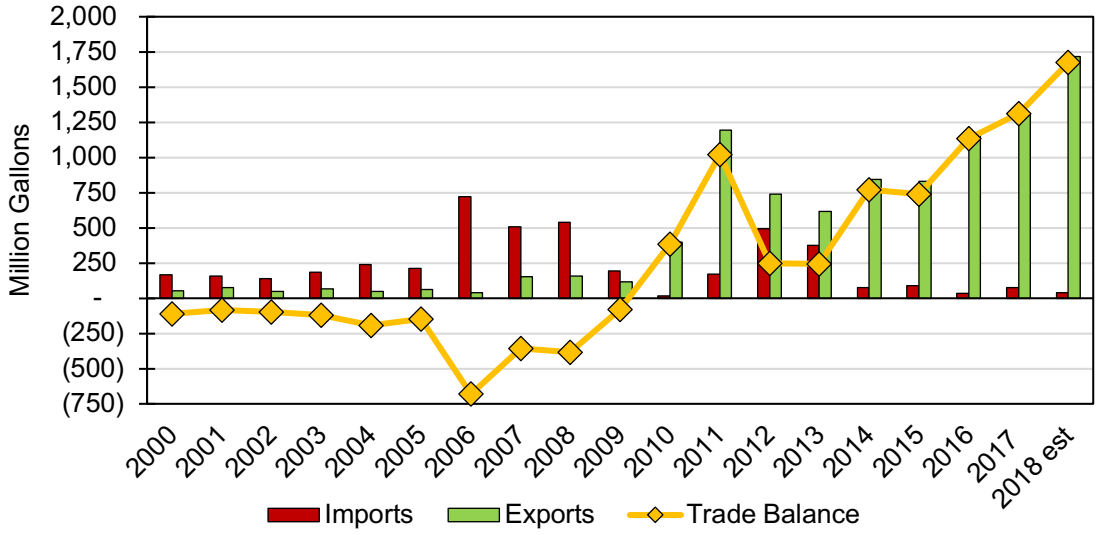
Income

Economic activity and associated jobs produce income for American households. The economic activities of the ethanol industry put nearly $25 billion into the pockets of Americans in 2018. As is the case with employment, the direct impact on income by the ethanol industry is largely concentrated in manufacturing and services. In many respects, this mirrors the employment structure of the American economy. The most significant impact of the ethanol industry continues to be increased income to farmers who benefit from the demand for feedstock, which leads to both increased production and increased prices as well as earnings from locally-owned ethanol plants.

Exports

As pointed out earlier, U.S. ethanol exports have expanded significantly over the last decade and are projected to total over 1.6 billion gallons for all of 2018 with an export value of $2.4 billion. The projected 11.9 million tons of DDGS that are exported were valued at nearly $1.9 billion. Exportable supplies of ethanol have grown over the past several years as production exceeded domestic use. Moreover, the ethanol industry is generating a trade surplus and helping to reduce the nation's trade deficit. Figure 1 illustrates the growth in ethanol exports, imports and trade balance.

Figure 1
U.S. Ethanol Trade



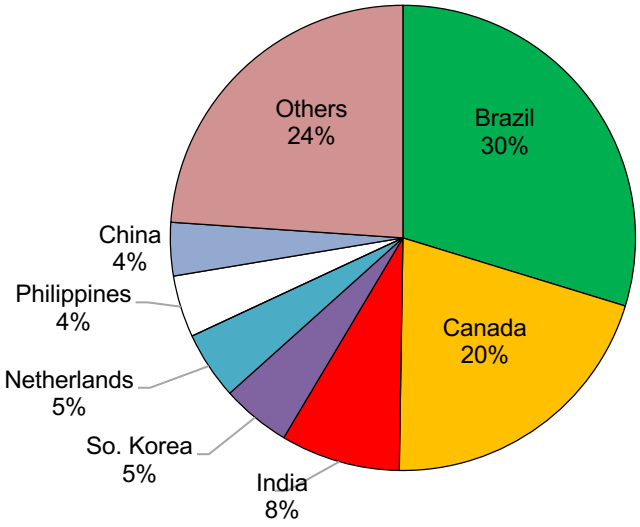
Source: Foreign Agricultural Service. Global Agricultural Trade System (GATS)

Exports of ethanol and distillers' grains generate economic activity largely through the requirements to transport output from plants to ports and final destinations. This largely involves rail, barge, and ocean shipping. Additional impacts are generated by labor, administrative and financial requirements necessary to support export activity. These impacts are categorized as indirect since they are subordinate to production. Using the USDA Trade Multipliers suggests that the $4.2 billion of export value added $6.3 billion to GDP and supported more than 16,200 jobs in all sectors of the economy.

The growth in U.S. ethanol exports reflects not only larger exportable supplies but also global expansion of renewable fuel use. A recent FAPRI forecast indicates that world ethanol production is projected to grow 2.7 percent in 2018. As indicated earlier production in the U.S., the world's largest producer, increased 1.1 percent in 2018 while output in Brazil, the world's second largest producer recovered from two consecutive years of decline to grow by more than 15 percent. Nevertheless, Brazil is the leading importer of ethanol from the U.S. accounting for nearly 30 percent of U.S. exports through October 2018. Canada has continued to be a leading export market for ethanol. Exports to Canada totaled 293 million gallons through October 2018, or 20 percent of U.S. exports. India was the third largest market for U.S. ethanol followed by South Korea, the Netherlands, Philippines and China. Exports to China have

dropped sharply over the past two and a half years because of tariffs placed on U.S. ethanol. As shown in Figure 2, seven markets account for three-quarters of total U.S. ethanol exports.

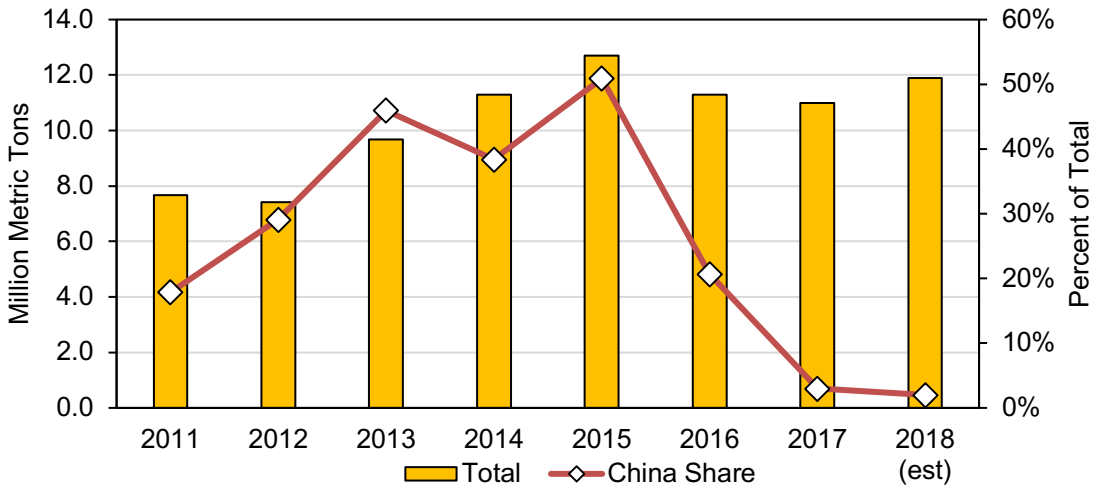
Figure 2
U.S. Ethanol Exports, Jan-Oct 2018



Source: EIA

DDGS exports through October 2018 are up 8.7 percent from year earlier levels and are projected to approach 11.9 million metric tonnes for all of 2018. When combined with sharply higher DDGS prices, export revenue increased 37 percent to nearly $1.9 billion. The biggest story for DDGS export markets has been the collapse of the China market. As shown in Figure 3, China's share of U.S. exports decreased from 6.5 million metric tons as recently as 2015 (51 percent of total) to about 215,600 metric tons in 2018, or 2 percent of total U.S. exports. The reason for the sharp drop is the imposition of anti-dumping and anti-subsidy taxes in 2017 and continuing trade dispute with the U.S.

Figure 3
U.S. DDGS Exports



Source: USDA Foreign Agricultural Service Global Agricultural Trade System (GATS).

Tax revenue

The combination of GDP and household income supported by the ethanol industry contributed an estimated $4.8 billion in tax revenue to the Federal Treasury in 2018. State and local governments also benefit from the economic activity supported by the ethanol industry, earning $4 billion in 2018. The impact of the Trump tax cuts in 2018 reduced tax revenue despite higher value-added output and income. Ethanol producers and consumers were able to keep a larger share of the benefits generated by the ethanol industry.

Crude oil displacement

Ethanol also plays a positive role in reducing our dependence on imported oil, expands the supply of motor gasoline, reduces the U.S. trade deficit, and reduces greenhouse gas emissions relative to conventional gasoline.

Ethanol displaces crude oil needed to manufacture gasoline and expands the volume of motor gasoline available to consumers. According to the Energy Information Administration (EIA), U.S. dependence on imported oil and refined products has dramatically declined since peaking in 2005. The use of domestic

biofuels (ethanol and biodiesel) continues to be a contributor to the steady decline in oil import dependence. EIA reports that the share of petroleum products provided by imports through November 2018 fell to 12.8 percent from 18.9 percent in 2017 and a peak of 60.3 percent in 2005.[12] World crude oil prices have increased 32 percent during 2018 and higher prices continue to stimulate U.S. oil production. The production of 16.1 billion gallons of ethanol displaced 550 million barrels of crude oil needed to produce gasoline in 2018. If applied to imports, the value of the crude oil displaced by ethanol increased to $36 billion in 2018.[13] This money stays in the American economy and, when combined with the GDP generated by ethanol production, is helping make America great again.

State Level Impacts of Ethanol Production

The ethanol industry has diversified geographically in recent years. At the end of 2018, RFA reports that ethanol plants in 27 states had an aggregate capacity of 16.5 billion gallons. Each of these plants is essentially a bio refinery that is an integral part of the other organic chemicals industry in the U.S. manufacturing sector. As such, the expenditures on feed grains and other feedstocks and inputs generates economic activity, income and supports job creation.

State-level economic activity estimates were developed by estimating production for each state based on the state's share of U.S. ethanol capacity as reported by RFA. Estimates of GDP, income and employment were calculated by multiplying the appropriate IMPLAN multiplier for the Other Basic Organic Chemical Manufacturing industry (of which ethanol is a part) to operating expenditures per gallon by state. It is important to note that with the exception of Iowa and Minnesota, for which independent analyses were conducted, the estimates represent only the impact of ethanol production and exclude an allocation of new construction activity, exports and R&D. Table 3 details these results for states with at least 100 million gallons of production capacity.

[12] EIA. Monthly Energy Review December 2018. Table 3.3a Petroleum Trade: Overview.

[13] Ethanol directly competes with and displaces gasoline as a motor fuel. According to the EIA, one 42-gallon barrel of crude oil produced 19.7 gallons of gasoline in 2018. Ethanol has a lower energy content (76,700 btu per gallon LHV) than gasoline (114,000 btu per gallon LHV), and thus it takes 1.48 gallons of ethanol to provide the same energy as one gallon of gasoline. Therefore, 16.1 billion gallons of ethanol are the equivalent of 10.6 billion gallons of gasoline. Since one barrel of crude produces 19.7 gallons of gasoline, it takes 550 million barrels of crude to produce 10.6 billion gallons of gasoline, the amount displaced by ethanol. This oil was valued at the 2018 year-to-date average composite acquisition cost of crude oil by refiners of $66/bbl.

Table 3
Contribution of Ethanol Production to Individual State Economies, 2018

	Capacity	Capacity	GDP	Employment	Income
	(Mil Gal)	Share	((Mil $)	Jobs	(Mil $)
Iowa	4,479	27.2%	$4,739	43,697	$2,231
Nebraska	2,229	13.5%	$3,902	29,610	$2,036
Illinois	1,787	10.8%	$3,128	23,738	$1,633
Minnesota	1,343	8.2%	$2,181	19,532	$1,647
Indiana	1,173	7.1%	$2,053	15,582	$1,072
South Dakota	1,080	6.6%	$1,891	14,347	$987
Ohio	630	3.8%	$1,103	8,369	$576
Wisconsin	583	3.5%	$1,021	7,745	$533
Kansas	516	3.1%	$903	6,855	$471
North Dakota	480	2.9%	$840	6,376	$439
Michigan	351	2.1%	$614	4,663	$321
Texas	385	2.3%	$674	5,114	$352
Missouri	276	1.7%	$483	3,666	$252
Tennessee	225	1.4%	$394	2,989	$206
California	223	1.4%	$390	2,962	$204
New York	150	0.9%	$263	1,993	$137
Colorado	127	0.8%	$222	1,687	$116
Georgia	120	0.7%	$210	1,594	$110
Pennsylvania	110	0.7%	$193	1,461	$100

As might be expected, the impact on a state's economy is generally proportional to ethanol production. The results in Table 3 are generalized impacts. That is, the structure of each state economy is unique and economic impact multipliers reflect this difference. Additionally, there are regional differences in feedstock costs, ethanol and DDGS prices, and other input costs that, with the exception of Iowa and Minnesota, have not been explicitly considered. Relatively few states procure all of their feedstock inputs locally. Consequently, the analysis does not factor in leakages (spending that takes place out-of-state such as for corn imported from a neighboring state). This means, for example, that the impacts may be overstated for a corn-deficient state like California or Texas to the extent that the dollars spent for corn

imported from other states represent income for farmers in supplying states and are not netted out of the analysis. Finally, the analysis does not allocate R&D expenditures or exports on a state-by state basis since these are not likely equally distributed over all states.

Having said that, the ethanol industry has the largest relative impact on the economies of Iowa (3 percent of state GDP), South Dakota (2.6 percent of GDP) and Nebraska (2.2 percent of GDP). This is a reflection both of the size of the ethanol industry as well as the importance of agriculture to the state economy.

Conclusion

The ethanol industry continues to make a significant contribution to the economy in terms of job creation, generation of tax revenue, and displacement of crude oil and petroleum products. The importance of the ethanol industry to agriculture and rural economies is particularly notable. Continued growth and expansion of the ethanol industry through new technologies and feedstocks will enhance the industry's position as the original creator of green jobs and will enable America to make further strides toward energy independence.