



## **CONTRIBUTION OF THE ETHANOL INDUSTRY TO THE ECONOMY OF THE UNITED STATES**

Prepared for the Renewable Fuels Association by

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By all accounts, 2009 was a volatile year for the American economy, and the ethanol industry was no exception. The combination of unstable commodity prices and weak motor fuel demand caused by the worst recession in decades presented a significant challenge for ethanol producers. Commodity prices retreated from the record levels set during the 2008 commodity price bubble, but the effects of the bubble and its subsequent burst were felt well into 2009. The bursting of the bubble was followed by consolidation and ownership changes, as new entrants to the ethanol industry acquired plants idled by bankrupt firms. As a result, both industry capacity and production increased.

Despite the challenges to profitability, the ethanol industry continued to grow and met the Renewable Fuel Standard target of 10.5 billion gallons for 2009. Nationally, total ethanol production increased 14.7 percent to an estimated 10.6 billion gallons. At year's end, the ethanol industry comprised approximately 200 plants in 26 states with production capacity of 13.1 billion gallons. The economic challenges of 2008 and 2009 continue to leave 12 plants representing approximately 1.2 billion gallons of capacity idled<sup>1</sup>. Additionally, 11 plants representing 806 million gallons of new capacity were under construction at year's end while another 626 million gallons of capacity was being expanded to existing plants. This study estimates the contribution of the ethanol industry to the American economy in 2009

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<sup>1</sup> Estimates for idle plants and capacity represent status at year-end. Several additional plants were temporarily idle during the year but had restarted by the end of 2009.



## **Contribution of the Ethanol Industry in 2009**

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 the economy.<sup>2</sup> Ethanol industry expenditures can be broken into three major categories: production operations; construction of new production facilities; and research and development on new feedstocks and technologies for future production.

### 1. Ongoing production operations

The industry spent \$16 billion on raw materials, other inputs, goods and services to produce more than nine billion gallons of ethanol during 2009. An additional \$1.7 billion was spent to transport grain and other inputs to production facilities; ethanol from the plant to terminals where it is blended with gasoline; and co-products to end-users. The largest share of this spending was for corn and other grains used as the raw material to make ethanol. The ethanol industry used nearly 3.8 billion bushels of corn on a gross basis in 2009, valued at \$13.3 billion. Ethanol for fuel is the second largest component of corn demand after feed use, accounting for 30 percent of total gross corn utilization during the 2008/09 marketing season. The remainder of the spending by the ethanol industry for ongoing operations is for a wide range of inputs such as enzymes, yeast and chemicals; electricity, natural gas, and water; labor; and services such as maintenance, insurance, and general overhead.

### 2. New construction

The U.S. ethanol industry added about 1.0 billion gallons of net new production capacity during 2009 and an additional 1.5 billion gallons of new capacity was under construction.

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<sup>2</sup> Expenditures for feedstock and energy were estimated using 2009 calendar year average prices. Revenues were estimated using 2009 calendar year average prices for ethanol, FOB Iowa plant; Distiller's grains, corn gluten feed and meal, and corn oil. Prices were sourced from USDA/ERS and AMS, and EIA.

The construction of new ethanol plants and capital spending on expansion of existing plants also results in spending for a wide range of goods and services. Assuming that the new capacity was distributed over the entire year, this amounts to an estimated expenditure of nearly \$2.9 billion of capital expenditure by the ethanol industry. Nearly 60 percent of this (\$1.7 billion) spending was for steel pipe, tanks, machinery, and other equipment while \$579 million was spent on wages.

### 3. Research and Development Expenditures

The biofuels industry is a virtual hotbed of research and development activity. The Renewable Fuel Standard provisions of the Energy Independence and Security Act of 2007 (EISA) requires that 36 billion gallons of renewable biofuels be used in the nation's motor fuel by 2022. Since EISA caps the amount of ethanol from corn starch at 15 billion gallons by 2015, the remaining 21 billion gallons will come from "second generation" feedstocks and technologies and an estimated one billion gallons of biomass biodiesel. A significant expenditure of both public and private sector funds for R&D directly supporting future development of biofuels was made in 2009 and will continue in future years. More than \$2 billion was spent in 2009 on R&D activities directly related to new generation ethanol feedstocks and technology. The largest component of this was funded by corporate and private venture capital funds.

The spending associated with current ethanol production, spending on new plant capacity, and R&D activities circulates throughout the entire economy several fold stimulating aggregate demand, supporting the creation of new jobs and additional household income. Finally, and importantly, expanded economic activity generates tax revenue for government at all levels.

The impact of the ethanol industry on the American economy was estimated by applying the appropriate final demand multipliers for value added output, earnings, and employment for the relevant supplying industry calculated by the U.S. Bureau of Economic Analysis (BEA) to the



estimates of spending described above.<sup>3</sup> The final demand multipliers for value added, earnings, and employment for the selected industries are shown in Appendix Table 1.

The following summarizes the economic contribution of the American ethanol industry. These impacts are detailed by industry segment in Table 1.

- The full impact of the spending for annual operations, ethanol transportation, capital spending for new plants under construction, and R&D spending added \$53.3 billion to the nation's Gross Domestic Product (GDP) in 2009. This is about 3 percent of the value added by the manufacturing sector.
- New jobs are created as a consequence of increased economic activity caused by ethanol production. The increase in economic activity resulting from ongoing production, construction of new capacity, and R&D supported nearly 400,000 jobs in all sectors of the economy during 2009.
- Increased economic activity and new jobs result in higher levels of income for American households. The economic activities of the ethanol industry put an additional \$16 billion into the pockets of American consumers in 2009.
- The ethanol industry more than paid for itself in 2009. The combination of increased GDP and higher household income generated an estimated \$8.4 billion in tax revenue for the Federal government and nearly \$7.5 billion of additional tax revenue for State and Local governments. The estimated cost of the two major Federal incentives in 2009, the VEETC and ethanol Small Producer Credit, totaled \$5.0 billion. *Consequently, the ethanol industry generated a surplus of \$3.4 billion for the Federal treasury.*

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<sup>3</sup> The multipliers used in this analysis are the detailed industry RIMS II multipliers for the United States estimated by the Bureau of Economic Analysis, U.S. Department of Commerce.



Table 1  
Economic Contribution of the Ethanol Industry: 2009

	Expenditures (Mil 2009\$)	Impact		
		GDP (Mil 2009\$)	Earnings (Mil 2009\$)	Employment (Jobs)
<b>Annual Operations</b>				
Feedstock (corn)	\$10,041	\$13,507	\$5,353	180,111
Enzymes and chemicals	\$1,052	\$1,477	\$755	14,564
Denaturants	\$443	\$450	\$241	4,220
Electricity	\$398	\$571	\$239	4,358
Natural gas	\$1,144	\$1,623	\$751	13,413
Water	\$130	\$200	\$93	1,959
Maintenance	\$276	\$482	\$262	6,809
Wholesale Trade	\$2,127	\$3,440	\$1,736	36,677
Management & Administration	\$212	\$380	\$214	4,573
Earnings to households	\$218	\$291	\$145	3,786
Transportation	\$1,654	\$2,650	\$1,389	31,247
Value of ethanol production		\$17,490	\$218	
Value of co-products		\$2,761		
<b>Total Annual Operations</b>	<b>\$17,695</b>	<b>\$45,323</b>	<b>\$11,397</b>	<b>301,718</b>
<b>New capacity</b>				
Construction (labor and other)	\$1,215.5	\$2,169	\$1,287	31,828
Equip and machinery	\$1,423.4	\$2,176	\$1,133	24,895
<b>Total</b>	<b>\$2,639</b>	<b>\$4,345</b>	<b>\$2,420</b>	<b>56,724</b>
<b>R&amp;D spending on new technology</b>	<b>\$2,000</b>	<b>\$3,651</b>	<b>\$2,162</b>	<b>40,842</b>
<b>Grand Total</b>	<b>\$22,334</b>	<b>\$53,319</b>	<b>\$15,978</b>	<b>399,283</b>

- Ethanol reduces our dependence on imported oil and reduces the U.S. trade deficit. The production and use of ethanol displaces crude oil needed to manufacture gasoline. According to the Energy Information Administration imports account for more than 65 percent of our crude oil supplies and oil imports are the largest component of the expanding U.S. trade deficit. The production of 10.6 billion gallons of ethanol means that the U.S. needed to import 364 million fewer barrels of oil in 2009 to manufacture gasoline, or

roughly the equivalent of five percent of total U.S. crude oil imports. The value of the crude oil displaced by ethanol amounted to \$21.3 billion in 2009.<sup>4</sup> This is money that stayed in the American economy.

## **Impact of ethanol to the local economy**

The ethanol industry has arguably been one of the most significant economic development tools for rural communities in the past several decades. The majority of ethanol plants are located in rural communities where the local economy is dominated by agriculture. As indicated earlier, ethanol production is a manufacturing sector industry that pays above average wages.<sup>5</sup> Further, since most ethanol plants source the majority of their feedstock (corn) from and sell their co-product (Distillers grains) to farmers within a relative close proximity to the plant, the majority of the economic impact stays in the local economy.

The contribution of an ethanol plant to a local economy can be estimated in the same manner as for the national economy described above with two exceptions. First, the amount of inputs sourced outside of the local economy must be accounted for and multipliers for the specific county that reflect the composition and nature of the local economy should be used. The most significant input for an ethanol plant is the feedstock. Most of the grain feedstock used for ethanol production, particularly for a Mid-west plant, is likely to be procured from local farmers (i.e. corn produced within a 100 mile radius of the plant). Location of a typical individual ethanol plant is unlikely to have a significant impact on *local* corn prices in a major corn producing state.<sup>6</sup> According to RFA

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<sup>4</sup> Ethanol directly competes with and displaces gasoline as a motor fuel. According to EIA one 42 gallon barrel of crude oil produces 18.4 gallons of gasoline. Ethanol has a lower energy content (84,400 btu/gal) than gasoline (124,000 btu/gal) so it takes 1.46 gallons of ethanol to provide the same energy as a gallon of gasoline. Therefore, 10.6 billion gallons of ethanol are the equivalent of 7 billion gallons of gasoline. Since one barrel of crude produces 18.4 gallons of gasoline, it takes 364 million barrels of crude to produce 7 billion gallons of gasoline, the amount displaced by ethanol. This oil was valued at the 2009 average composite acquisition cost of crude oil by refiners of \$58.17/bbl.

<sup>5</sup> According to the Bureau of Labor Statistics average hourly earnings of production workers in the chemical industry which includes ethanol production were \$24.06 in 2009 while the average hourly wage for all private sector workers in manufacturing was \$18.21. <http://data.bls.gov/PDQ/servlet/SurveyOutputServlet>

<sup>6</sup> Critics of economic impact analysis aim their criticism at the assumption that the ethanol plant takes the economic credit for the corn that it uses. Clearly, on an individual basis if the corn used by one ethanol plant were not present, farmers would be able to sell their corn to other markets and would not likely suffer a loss, However, without the demand for corn provided by the aggregate ethanol industry farmers would likely plant fewer acres to corn, purchase fewer inputs, and produce a smaller crop, thereby reducing the economic contribution provided by the corn industry.



statistics, the average size of an ethanol plant in 2009 was 65 million gallons per year. A plant of this size would use approximately 23 million bushels of corn annually. The average plant size in Iowa, the nation's leading ethanol producer, is 86 million gallons and would require about 30 million bushels of corn per year. In addition to increased demand for corn, most of the other inputs for ethanol production such as water, utilities, labor, etc. will either be sourced locally or be handled by local suppliers.

The impact of an ethanol plant on a local community can be illustrated by examining an average sized plant in Iowa. Iowa State University publishes one of the most detailed and comprehensive estimates of ethanol cost of production and profitability on a monthly basis.<sup>7</sup> The ISU ethanol model is calibrated for a typical 100 MGY northern Iowa dry mill corn ethanol plant.

In order to estimate the economic impacts for an Iowa community we applied the average ISU assumptions for 2009 on a per gallon basis to an 85 million gallon plant and RIMS II multipliers for Iowa. For purposes of this analysis we assume that all of the grain feedstock used for ethanol production is procured from local farmers (i.e. corn produced within a 100 mile radius of the plant) and that other inputs such as enzymes, yeast, chemicals and denaturant are produced by suppliers outside of the local community.

As shown in Table 2, annual expenditures for goods and services for an 85 MGY ethanol plant are estimated at \$130.5 million (2009 dollars).

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<sup>7</sup> Hofstrand, D. January 2010 "AgMRC Renewable Energy Newsletter" "Ag Decision Maker, D1-10 Ethanol Profitability". Agricultural Marketing Resource Center Iowa State University Extension. Available at [http://www.agmrc.org/renewable\\_energy/](http://www.agmrc.org/renewable_energy/)

Table 2  
Annual Economic Impact of an  
85 MGY Dry Mill Iowa Ethanol Plant

Industry	Purchases (Mil 2009\$)	GDP (Mil 2009\$)	Impact	
			Earnings (Mil 2009\$)	Employment (Jobs)
Feed Grains (Corn)	\$74.0	\$65.7	\$22.6	918
Enzymes, chemicals	\$8.1	\$5.6	\$2.9	62
Denaturant	\$3.3	\$1.1	\$0.6	13
Natural gas	\$8.7	\$5.5	\$2.4	48
Electric, water, sewer	\$4.1	\$4.1	\$1.5	32
Repair & maintenance	\$2.1	\$2.7	\$1.4	42
Wholesale Trade	\$19.0	\$21.4	\$10.2	260
Administration	\$1.7	\$2.1	\$1.1	30
Earnings	\$1.7	\$1.3	\$0.6	21
Transportation	\$7.9	\$8.4	\$4.0	114
Value of ethanol production		\$134.6	\$1.7	
Value of co-products		\$21.5		
<b>Subtotal Operations</b>	<b>\$130.5</b>	<b>\$274.0</b>	<b>\$49.2</b>	<b>1,540</b>

- An 85 MGY ethanol plant is expected to operate at a 96 percent utilization rate and would use 29 million bushels of corn annually. Feedstocks account for about two-thirds of annual operational spending. If all grain is sourced locally, the economic impact is maximized.
- An 85 MGY ethanol plant will add nearly \$275 million annually to the size of the State economy measured by Gross Domestic Product. That is, the State economy will, be larger as a result of the operations of the ethanol plant.
- New jobs are created as a consequence of increased economic activity caused by ethanol production. Since there are few economies of scale in dry mill ethanol production, the number of direct jobs in a 100 MGY ethanol plant is only marginally larger than for a 85 MGY operation. ISU estimates that a 100 MGY plant will directly employ 39 full time workers. The total employment impact from an ethanol plant based on expenditures is estimated at an additional 1,500 jobs in the entire State economy for a total impact of 1,540 jobs in all sectors of the economy.





- Increased economic activity and new jobs results in higher levels of income. The ongoing annual operations of an 85 MGY plant will increase household income by nearly \$50 million annually.

### **Conclusion**

The renewable fuels industry is recovering from the commodity price shocks of 2008 and severe recession. The ethanol industry continues to make a significant contribution to the economy in terms of final demand, job creation, generation of tax revenue, and displacement of imported crude oil. Continued expansion of the ethanol industry will confirm the industry's position as the original creator of green jobs and will enable America to break its dependence on fossil fuels.

**Appendix Table 1**

**BEA RIMS II Final Demand Multipliers, U.S.<sup>8</sup>**

	<b>Value Added</b>	<b>Household Earnings</b>	<b>Employment (Jobs)</b>
<b>Construction</b>	1.7842	1.0587	27.5088
<b>Annual Operations</b>			
Feed Grains (Corn)	1.3452	0.5331	19.0559
Other basic organic chemicals	1.4038	0.7174	14.7073
Petroleum refineries	1.0153	0.5440	10.1118
Power generation and supply	1.4367	0.6004	11.6477
Natural gas distribution	1.4180	0.6565	12.4527
Water, sewage	1.5420	0.7141	16.0236
Facilities support services	1.7491	0.9519	26.2480
Wholesale Trade	1.6171	0.8160	18.3175
Office administrative services	1.7943	1.0112	22.9157
Households	1.3340	0.6645	18.4186
Scientific R&D services	1.8256	1.0808	21.6939
Rail Transportation	1.5702	0.7881	16.6178
Water Transportation	1.5008	0.8188	18.1009
Truck Transportation	1.6278	0.8651	21.8101

*Source: Regional Input-Output Modeling System (RIMS II)*

*Regional Economic Analysis Division, BEA.*

*Multipliers based on 1997 Benchmark I-O Table; 2006 regional data.*

<sup>8</sup> The multipliers represent the effect on output, income and employment of every \$1 million of expenditures.