



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

Prepared for the Renewable Fuels Association by

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2008 was a year of unprecedented challenges for the biofuels industry. Producers were faced with a commodity boom that resulted in record grain, oilseed, and oil prices by mid-year followed by a collapse in oil, grain and ethanol prices that erased profitability by year's end. The industry also had to contend with a decline in motor fuel demand caused by the combination of record high gasoline prices in the first half of the year and emerging recession in the second half. Ethanol producers were affected by the collapse of the financial markets that made access to operating credit and capital for expansion and new construction virtually unobtainable.

At year's end, the ethanol industry comprised 172 operating plants in 25 states with production capacity of 10.6 billion gallons. The economic challenges in 2008 prompted a wave of bankruptcies including one major producer that closed 12 plants representing nearly 1.2 billion gallons of capacity. Nationwide, 23 ethanol plants accounting for 1.7 billion gallons of capacity were idled during the year. Despite the challenge to profitability the ethanol industry continued to grow. Nationally, total ethanol capacity expanded 34 percent. The ethanol industry met the Renewable Fuel Standard target of nine billion gallons for 2008 and, despite the bleak economic outlook is poised to meet future targets. This study estimates the contribution of the ethanol industry to the American economy in 2008.



## **Contribution of the Ethanol Industry in 2008**

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 circulate through the local and national economy generating additional value-added output, household income, and employment in all sectors of the economy.<sup>1</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 \$22 billion on raw materials, other inputs, goods and services to produce more than nine billion gallons of ethanol during 2008. An additional \$2.5 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 3.3 billion bushels of corn on a gross basis in 2008, valued at \$16 billion. Ethanol for fuel is the second largest component of corn demand after feed use accounting for 23.7 percent of total corn utilization during the 2007/08 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.

In addition to providing a growing and reliable domestic market for American farmers, the ethanol industry also provides the opportunity for farmers to enjoy some of the value added to their commodity by further processing. Locally-owned ethanol plants account for 23 percent of U.S. fuel ethanol plants and about 20 percent of industry capacity.

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<sup>1</sup> Expenditures for feedstock and energy were estimated using 2008 calendar year average prices. Revenues were estimated using 2008 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.

## 2. New construction

The U.S. ethanol industry added 2.9 billion gallons of new production capacity during 2008. 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. Considering that the new capacity was distributed over the entire year, we assumed that about 1.5 billion gallons of capacity were under construction during the year. At an estimated capital cost of \$2.00 per gallon for new ethanol capacity, this represents the expenditure of an additional \$2.7 billion by the ethanol industry. More than 60 percent of this (\$1.7 billion) spending was for steel pipe, tanks, machinery, and other equipment.

## 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 plus 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 2008 and will continue in future years. A review of published reports indicates that more than \$1.4 billion was spent in 2008 on R&D activities directly related to new generation ethanol feedstocks and technology. The largest component of this (\$1 billion) was funded by corporate and private venture capital funds; federal expenditures are estimated at nearly \$305 million and Universities spent an estimated \$67 million during 2008.

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>2</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 \$65.6 billion to the nation's Gross Domestic Product (GDP) in 2008.
- 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 more than 494,000 jobs in all sectors of the economy during 2008.

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<sup>2</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: 2008

	Expenditures (Mil 2008\$)	Impact		
		GDP (Mil 2008\$)	Earnings (Mil 2008\$)	Employment (Jobs)
<b>Annual Operations</b>				
Feed Grains (Corn)	\$12,040	\$16,196	\$6,418	218,953
Other basic organic chemicals	\$1,334	\$1,873	\$957	18,728
Petroleum refineries	\$579	\$588	\$315	5,592
Power generation and supply	\$453	\$651	\$272	5,033
Natural gas distribution	\$3,979	\$5,642	\$2,612	47,284
Water, sewage	\$44	\$68	\$32	676
Facilities support services	\$234	\$410	\$223	5,870
Wholesale Trade	\$2,515	\$4,067	\$2,052	43,961
Office administrative services	\$541	\$970	\$547	11,826
Earnings to households	\$314	\$419	\$209	5,524
Rail Transportation	\$1,115	\$1,750	\$879	17,680
Water Transportation	\$57	\$85	\$47	984
Truck Transportation	\$1,314	\$2,139	\$1,137	27,357
Value of ethanol production		\$19,377	\$314	
Value of co-products		\$4,525		
<b>Total Annual Operations</b>	<b>\$24,519</b>	<b>\$58,760</b>	<b>\$16,013</b>	<b>409,467</b>
<b>New capacity</b>				
Construction (labor and other)	\$991	\$1,769	\$1,050	26,028
Equip and machinery	\$1,691	\$2,586	\$1,346	29,657
<b>Total</b>	<b>\$2,683</b>	<b>\$4,355</b>	<b>\$2,396</b>	<b>55,686</b>
<b>R&amp;D spending on new technology</b>	<b>\$1,402</b>	<b>\$2,559</b>	<b>\$1,515</b>	<b>29,025</b>
<b>Grand Total</b>	<b>\$28,604</b>	<b>\$65,674</b>	<b>\$19,924</b>	<b>494,177</b>

- 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 \$19.9 billion into the pockets of American consumers in 2008.
- The ethanol industry more than paid for itself in 2008. The combination of increased GDP and higher household income generated an estimated \$11.9 billion in tax revenue for the Federal government and nearly \$9 billion of additional tax revenue for State and Local

governments. The estimated cost of the two major Federal incentives in 2008, the Volumetric Ethanol Excise Tax Credit (VEETC) and ethanol Small Producer Credit, totaled \$4.7 billion. *Consequently, the ethanol industry generated a surplus of \$7.1 billion for the Federal treasury.*

- 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 nine billion gallons of ethanol means that the U.S. needed to import 321.4 million fewer barrels of oil in 2008 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 \$32 billion in 2008.<sup>3</sup> This is money that stayed in the American economy.

### **Impact of the ethanol industry contraction**

The combination of recession and poor profitability caused by the collapse in commodity prices resulted in the closure of 23 ethanol plants nationwide in 2008 and the idling of 1.7 billion gallons of capacity. This represents a loss of potential economic activity and employment for the entire economy. While the impact of the plant closures on the macro-economy is muted by the relative size of the ethanol industry, the impact is felt disproportionately on the economies of the communities where the idled plants are located.

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

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<sup>3</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, 9 billion gallons of ethanol are the equivalent of 5.9 billion gallons of gasoline. Since one barrel of crude produces 18.4 gallons of gasoline, it takes 321.4 million barrels of crude to produce 5.9 billion gallons of gasoline, the amount displaced by ethanol. This oil was valued at the 2008 average price for West Texas Intermediate crude of \$99.67/bbl.

production is a manufacturing sector industry that pays above average wages.<sup>4</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.

As indicated earlier 23 ethanol plants with nearly 1.7 billion gallons of capacity were idled in 2008. This means that the average community with a typical mid-sized ethanol plant that closed was faced with a loss of direct jobs and the indirect effects on income and employment in the larger local economy that stemmed from the loss of income and spending.<sup>5</sup> 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. While most of the grain feedstock used for ethanol production is assumed to be procured from local farmers (i.e. corn produced within a 100 mile radius of the plant), closure of an ethanol plant will not likely affect corn output. The loss of a market for 618 million bushels of corn needed to produce 1.7 billion gallons of ethanol will increase corn stocks and presumably reduce prices in the short-term. This could result in a reduction in planted area and lower production in subsequent years. However, at the local level, the 27 million bushels of corn that would be used as ethanol feedstock for a 75 million gallon per year ethanol plant would likely be purchased by other nearby ethanol plants or by livestock feeders, resulting in no significant loss for the local economy. However, the local economy would lose the value of purchases of other inputs and services.

As shown in Table 2, the closure of a 75 million gallon per year dry mill ethanol plant is expected to result in the loss of nearly 1,400 jobs in the entire local (county) economy. The value of local GDP will decline \$344 million and income will be cut nearly \$71 million.

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<sup>4</sup> According to the Bureau of Labor Statistics average hourly earnings of production workers in the chemical industry that encompasses ethanol production were \$19.56 in 2008 while the average hourly wage for all private sector workers was \$18.05. <http://data.bls.govPDQ/servlet/SurveyOutputServlet>

<sup>5</sup> The impact of plant closures was estimated by calculating the economic impact of a 75 million gallon per year dry mill ethanol plant (1.7 billion bushels of idled capacity divided by 23 plants).

Table 2  
Annual Local Economic Impact  
Closure of a 75 MGY Dry Mill Ethanol Plant

	Expenditures (Mil 2008\$)	Impact		
		GDP (Mil 2008\$)	Earnings (Mil 2008\$)	Employment (Jobs)
<b>Annual Operations</b>				
Feed Grains (Corn)	\$0.0	\$0.0	\$0.0	0
Other basic organic chemicals	\$0.0	\$0.0	\$0.0	0
Petroleum refineries	\$0.0	\$0.0	\$0.0	0
Power generation and supply	\$3.9	\$5.6	\$2.3	43
Natural gas distribution	\$34.1	\$48.4	\$22.4	405
Water, sewage	\$0.4	\$0.6	\$0.3	6
Facilities support services	\$2.0	\$3.5	\$1.9	50
Wholesale Trade	\$36.4	\$58.9	\$29.7	637
Office administrative services	\$4.6	\$8.3	\$4.7	101
Earnings to households	\$2.7	\$3.6	\$1.8	47
Rail Transportation	\$4.9	\$7.6	\$3.8	77
Water Transportation	\$0.3	\$0.5	\$0.3	5
Truck Transportation	\$1.2	\$1.9	\$1.0	24
Value of ethanol production		\$166.1	\$2.7	
Value of co-products		\$38.8		
<b>Total Annual Operations</b>	<b>\$90.5</b>	<b>\$343.7</b>	<b>\$70.9</b>	<b>\$1,397.0</b>

### Long-Term Economic Impact of the Ethanol Industry

As shown above, the ethanol industry makes a significant contribution to the American economy. This contribution will grow as the industry expands and incorporates new production technologies and feedstocks. The Renewable Fuel Standard provision of the Energy Independence and Security Act of 2007 (EISA 2007) requires that 36 billion gallons of renewable fuels be used in the nation's motor fuel supply by 2022, a three-fold increase from the 10.5 billion gallons required this year. Under EISA ethanol from corn starch is capped at 15 billion gallons in 2015 and biodiesel use is targeted at one billion gallons. The remaining 20 billion gallons are expected to come from cellulose and other advanced biofuel feedstocks.

Achieving the target of 36 billion gallons by 2022 will require a significant investment in research and development and production capacity. Capital and operating costs for conventional corn starch ethanol are well understood and documented. Equivalent costs for cellulose and other

advanced biofuel feedstocks are less well known. Recent estimates published in the academic literature estimate 2006 capital costs for cellulose ethanol of \$3.92 per gallon and operating costs of \$1.30 per gallon.<sup>6</sup> Capital costs for cellulose ethanol are higher than for dry mill corn ethanol in large part because of the equipment needed for feedstock pretreatment while operating costs are expected to be lower. Cellulose ethanol is expected to benefit from the availability of cheap(er) crop residue feedstocks and the ability to use cellulose waste streams to cogenerate electricity and sell excess electricity back to the grid, generating an additional revenue stream.

In order to estimate the economic impact of ethanol production through 2022 we made several key assumptions. The year-by-year assumptions are shown in Appendix Table 2.

- The RFS target of 36 billion gallons will be met with corn ethanol capped at 15 billion gallons in 2015; ethanol from advanced biofuel feedstocks including cellulose increasing from 100 million gallons in 2009 to 21 billion gallons by 2022; and biodiesel production of one billion gallons.
- Capital costs for new corn and cellulose ethanol increase at the rate of inflation.
- Corn based ethanol operating costs are tied to corn prices and average \$1.73 per gallon between 2009 and 2022; cellulose operating costs remain below corn costs and average \$1.48 per gallon over the same period.

Using these estimates, restated to 2008 dollars as a starting point and assuming that the RFS target of 36 billion gallons is achieved, capital spending for new corn based ethanol capacity is expected to average about \$1.6 billion between 2009 and 2015 with little or no new capacity added after 2015. Capital spending on cellulose ethanol capacity is projected to increase from \$713 million in 2009 to \$16.7 billion in 2021.

The economic impact of achieving the RFS target of 36 billion gallons of renewable fuels by 2022 is summarized in Table 3.

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<sup>6</sup> Solomon, Barry D., Justin R. Barnes, and Kathleen E. Halversen. "Grain and cellulosic ethanol: History, economics, and energy policy". *Biomass and Bioenergy*. 31 (2007) 416-525.

Table 3  
Economic Impact of Producing 36 Billion Gallons of Renewable Fuels by 2022

	<b>Total Renewable Fuels (Mil Gal)</b>	<b>Total Ethanol (Mil Gal)</b>	<b>Ethanol from Corn (Mil Gal)</b>	<b>Biodiesel (Mil Gal)</b>	<b>ETOH Capital Spending (Mil \$)</b>	<b>ETOH Operations Spending (Mil \$)</b>
2009	11,100	10,600	10,500	500	\$3,012	\$20,163
2010	12,950	12,300	12,000	650	\$2,356	\$22,282
2011	13,950	13,150	12,600	800	\$4,252	\$23,040
2012	15,200	14,200	13,200	1,000	\$4,784	\$25,122
2013	16,550	15,550	13,800	1,000	\$6,057	\$27,582
2014	18,150	17,150	14,400	1,000	\$9,780	\$30,403
2015	20,500	19,500	15,000	1,000	\$7,061	\$34,277
2016	22,250	21,250	15,000	1,000	\$8,768	\$36,785
2017	24,000	23,000	15,000	1,000	\$10,243	\$39,796
2018	26,000	25,000	15,000	1,000	\$10,472	\$43,195
2019	28,000	27,000	15,000	1,000	\$10,709	\$46,051
2020	30,000	29,000	15,000	1,000	\$16,400	\$49,156
2021	33,000	32,000	15,000	1,000	\$16,684	\$54,330
2022	36,000	35,000	15,000	1,000	\$11,289	\$57,132
<b>2009-22</b>	<b>307,650</b>	<b>294,700</b>	<b>196,500</b>	<b>12,950</b>	<b>\$121,868</b>	<b>\$509,312</b>

	<b>GDP (Mil 2000\$)</b>	<b>Income (Mil 2000\$)</b>	<b>Jobs</b>	<b>Tax Receipts</b>		<b>Crude Oil Displaced (Mil bbl)</b>	<b>Crude Oil Value (Mil \$)</b>
				<b>Federal (Mil 2000\$)</b>	<b>State/Local (Mil 2000\$)</b>		
2009	\$52,940	\$14,178	358,359	\$9,582	\$7,200	396	\$25,149
2010	\$52,574	\$14,703	371,651	\$9,516	\$7,150	462	\$37,914
2011	\$60,164	\$16,520	429,750	\$10,890	\$8,182	498	\$45,566
2012	\$64,046	\$17,830	472,294	\$11,592	\$8,710	542	\$55,572
2013	\$67,437	\$19,821	538,665	\$12,206	\$9,171	590	\$64,890
2014	\$80,811	\$23,831	671,445	\$14,627	\$10,990	647	\$78,083
2015	\$84,284	\$23,226	657,748	\$15,255	\$11,463	731	\$93,020
2016	\$90,015	\$25,266	735,676	\$16,293	\$12,242	794	\$104,477
2017	\$95,860	\$27,297	814,850	\$17,351	\$13,037	856	\$116,425
2018	\$102,738	\$28,517	868,264	\$18,596	\$13,972	927	\$131,105
2019	\$105,858	\$29,409	914,277	\$19,160	\$14,397	999	\$144,487
2020	\$117,748	\$34,173	1,100,290	\$21,312	\$16,014	1,070	\$159,756
2021	\$127,116	\$36,149	1,180,025	\$23,008	\$17,288	1,177	\$180,771
2022	\$128,017	\$33,277	1,084,313	\$23,171	\$17,410	1,284	\$203,613
<b>2009-22</b>	<b>\$1,229,610</b>	<b>\$344,198</b>	<b>1,180,025</b>	<b>\$222,559</b>	<b>\$167,227</b>	<b>10,972</b>	<b>\$1,440,827</b>

Note: Jobs impact reflect the maximum number created between 2009 and 2022



Increasing ethanol production to meet the RFS target of 36 billion gallons of renewable fuels by 2022 will expand the economy, create new green jobs, and generate additional revenue at all levels of government. Further, the use of 35 billion gallons of ethanol will represent a significant step toward improving America's energy security by reducing dependence on petroleum-based motor fuels. Specifically, producing 35 billion gallons of ethanol by 2022 as outlined above will provide the following economic impacts:

- The \$631 billion of expenditures to build and produce 35 billion gallons of ethanol will add nearly \$1,230 billion (2000\$) to real GDP by 2022.
- Real household income will increase an average of \$24.6 billion (2000\$) per year between 2009 and 2022.
- As many as 1.18 million jobs will be supported in all sectors of the economy by the expanding ethanol industry.
- Federal tax revenue will increase \$222.6 billion (2000\$) between 2009 and 2022 while State and local tax revenues will increase \$167.2 billion (2000\$).
- Ethanol will account for nearly 30 percent of motor fuel use by 2022.
- Ethanol will displace the equivalent of 10.97 billion barrels of crude between 2009 and 2022 with an aggregate value of \$1,441 billion.

## **Conclusion**

The renewable fuels industry is experiencing many of the same problems as other industries as a consequence of the recession and collapse of oil and commodity prices. Nonetheless, the ethanol industry is making a significant contribution to the economy in terms of final demand, job creation, generation of tax revenue, and displacement of imported crude oil. 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>7</sup>

	Value Added	Household Earnings	Employment (Jobs)
<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>7</sup> The multipliers represent the effect on output, income and employment of every \$1 million of expenditures.



**Appendix Table 2  
Assumptions for Long-Term Ethanol Economic Impact**

	<b>ETOH Capacity (MGY)</b>	<b>Net New Capacity (MGY)</b>	<b>Capacity Utilization (Pct)</b>	<b>Corn ETOH Production (MGY)</b>	<b>RFS (MGY)</b>	<b>Advanced Biofuels (MGY)</b>	<b>Cellulose (MGY)</b>	<b>Undif Adv Biomass (MGY)</b>	<b>Biomass Diesel (MGY)</b>
2009	12,333	1,298	90%	10,500	11,100	600	0	100	500
2010	13,632	1,053	95%	12,000	12,950	950	100	200	650
2011	14,684	1,316	95%	12,600	13,950	1,350	250	300	800
2012	16,000	1,421	95%	13,200	15,200	2,000	500	500	1,000
2013	17,421	1,684	95%	13,800	16,550	2,750	1,000	750	1,000
2014	19,105	2,474	95%	14,400	18,150	3,750	1,750	1,000	1,000
2015	21,579	1,842	95%	15,000	20,500	5,500	3,000	1,500	1,000
2016	23,421	1,842	95%	15,000	22,250	7,250	4,250	2,000	1,000
2017	25,263	2,105	95%	15,000	24,000	9,000	5,500	2,500	1,000
2018	27,368	2,105	95%	15,000	26,000	11,000	7,000	3,000	1,000
2019	29,474	2,105	95%	15,000	28,000	13,000	8,500	3,500	1,000
2020	31,579	3,158	95%	15,000	30,000	15,000	10,500	3,500	1,000
2021	34,737	3,158	95%	15,000	33,000	18,000	13,500	3,500	1,000
2022	37,895	2,105	95%	15,000	36,000	21,000	16,000	4,000	1,000

	<b>Farm Corn Price CY \$/bu</b>	<b>Distillers Grains Price \$/ton</b>	<b>Ethanol Price \$/gal</b>	<b>Inflation (EIA)</b>	<b>Corn Ethanol Capital (\$/gal)</b>	<b>Corn Ethanol Prod Cost \$/gal</b>	<b>Cellulose Ethanol Capital (\$/gal)</b>	<b>Cellulose Ethanol Prod Cost (\$/gal)</b>	<b>Imported Crude Oil Price (\$/bbl)</b>
2009	\$3.88	\$127.91	2.50	1.9%	\$2.04	\$1.84	\$4.20	\$1.39	\$63.53
2010	\$3.69	\$121.79	2.00	0.9%	\$2.06	\$1.75	\$4.23	\$1.40	\$82.09
2011	\$3.56	\$117.34	2.30	1.3%	\$2.08	\$1.68	\$4.29	\$1.42	\$91.59
2012	\$3.59	\$118.42	2.25	1.7%	\$2.12	\$1.69	\$4.36	\$1.43	\$102.52
2013	\$3.65	\$120.50	2.08	2.1%	\$2.16	\$1.71	\$4.46	\$1.45	\$109.94
2014	\$3.71	\$122.30	2.40	2.1%	\$2.21	\$1.73	\$4.55	\$1.46	\$120.63
2015	\$3.74	\$123.55	2.44	2.3%	\$2.26	\$1.74	\$4.65	\$1.48	\$127.23
2016	\$3.72	\$122.91	2.44	2.3%	\$2.31	\$1.73	\$4.76	\$1.50	\$131.67
2017	\$3.77	\$124.36	2.45	2.2%	\$2.36	\$1.74	\$4.87	\$1.51	\$136.02
2018	\$3.81	\$125.68	2.57	2.2%	\$2.42	\$1.76	\$4.97	\$1.53	\$141.39
2019	\$3.76	\$124.06	2.52	2.3%	\$2.47	\$1.73	\$5.09	\$1.55	\$144.69
2020	\$3.74	\$123.37	2.59	2.1%	\$2.52	\$1.71	\$5.19	\$1.56	\$149.32
2021	\$3.79	\$124.95	2.66	1.7%	\$2.57	\$1.73	\$5.28	\$1.58	\$153.60
2022	\$3.76	\$124.20	2.72	1.5%	\$2.60	\$1.71	\$5.36	\$1.59	\$158.59

Corn and DDG price forecast from J.M. Urbanchuk January 2009 Baseline

Inflation rate, ethanol price and crude oil price from EIA Annual Energy Outlook 2009 Early Release

Corn capital cost estimated at \$2.00/gal increased at rate of inflation

Cellulose capital and operations costs from Solomon et. al. Biomass and Bioenergy 31 (2007) 416-425 increased at rate of inflation