



ZEROING IN on NEW OPPORTUNITIES
2022 ETHANOL INDUSTRY OUTLOOK



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absenergy.org

aceethanol.com

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**Prospective Producer Member*



ZEROING IN on NEW OPPORTUNITIES



The great American scholar and pioneer in the study of leadership, Warren Bennis, summarized his life's work with a famous quote, "Leadership is the capacity to translate vision into reality." The U.S. ethanol industry has always reflected a clear vision for the nation's energy, economic, and environmental future. From securing favorable tax policy in the 1980s to shaping the clean fuel policies of the 1990s to passage and expansion of the Renewable Fuel Standard in the 2000s, the Renewable Fuels Association has always worked tirelessly to turn that vision into reality.

Each success demanded a new vision, and indeed the U.S. ethanol industry has always looked toward the future, keeping our sights on the horizon and perpetually growing and evolving. Today, as the economy continues to emerge from the global pandemic that roiled transportation fuel markets, and as global leaders focus inexorably on reducing carbon emissions, the RFA is once again "Zeroing in on New Opportunities."

In 2021, RFA members unanimously voted to ensure ethanol achieves net-zero lifecycle greenhouse gas emissions by 2050 or sooner. We were the first to make this commitment, and others soon followed. As noted in a letter to President Biden last year, ethanol's carbon footprint continues to shrink with new technology and innovations that have improved the efficiency of the entire ethanol production process, from the field to the fuel tank. Consequently, the U.S. ethanol industry is uniquely poised to play an important role in future efforts to reduce the carbon impacts of the transportation sector.

But, importantly, today's vision for the industry demands that we look beyond ethanol's traditional use as a fuel for passenger vehicles. A world of new opportunity is emerging for new uses and markets for ethanol and its valuable coproducts. Energy, chemical, and consumer products companies around the world are beginning to recognize that ethanol's renewability, low-carbon, and low-cost attributes have value that extends far beyond the gas pump.

There are steps Congress and the Biden Administration need to take to better facilitate our industry's quest to achieve net-zero emissions and open the door to new markets. RFA will continue to encourage Congress and the administration to move forward with several key policy initiatives critical to our industry's future.

As always, this year's Ethanol Industry Outlook provides all the statistics and facts that give definition to 2021. But more importantly, this Outlook turns our eyes to the new markets and technologies that will help define our future as we translate vision into reality and **Zero In on New Opportunities.**

Sincerely,

A handwritten signature in black ink that reads "Geoff Cooper". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Geoff Cooper, President and CEO

Pledging a Net-Zero Future

In a July 2021 letter to President Joe Biden, RFA members from across the country memorialized their commitment to ensuring ethanol achieves a net-zero carbon footprint, on average, by mid-century or sooner.

Specifically, RFA's board of directors—which is exclusively composed of renewable fuel producers—unanimously committed to the following goals in what was an ethanol-industry first:

- By 2030, ensure that ethanol reduces GHG emissions by at least 70 percent, on average, when compared directly to gasoline.
- By 2050, ensure that ethanol achieves net zero lifecycle GHG emissions, on average.

RFA members firmly believe that ethanol can achieve a net-zero carbon footprint in the next three decades as the supply chain embraces new practices and technologies, such as adoption of carbon capture, utilization and sequestration (CCUS) technologies, use of more renewable electricity and biogas to power biorefineries, and expansion of carbon-efficient agricultural feedstock production practices.

To support the achievement of its goals, RFA encouraged the Biden administration and Congress to move forward with a national clean fuel standard, support for CCUS and deployment of more flex-fuel vehicles.

“Every kilowatt-hour that we use from the wind turbine has a direct effect on decarbonizing our production process.”

– Derek Peine, General Manager,
Western Plains Energy LLC

By the Numbers

Ethanol has a proven track record of cutting GHG emissions from transportation.

- The use of ethanol and other biofuels under the Renewable Fuel Standard has reduced U.S. transportation sector GHG emissions by 980 million metric tons (MT) since 2008, according to a report by Life Cycle Associates.
- In 2021 alone, the use of ethanol reduced GHG emissions by 54.5 million MT, equivalent to taking 12 million cars off the road for an entire year.

Today's corn ethanol reduces GHG emissions by half compared to gasoline.

- According to the Department of Energy's Argonne National Laboratory, typical corn ethanol provides a 44-52 percent GHG savings compared to gasoline.
- Similarly, researchers from Harvard, MIT, and Tufts concluded that today's corn ethanol offers an average GHG reduction of 46 percent versus gasoline.
- An analysis by USDA found that some biorefineries could produce ethanol that offers a 70 percent GHG reduction versus gasoline as soon as 2022.

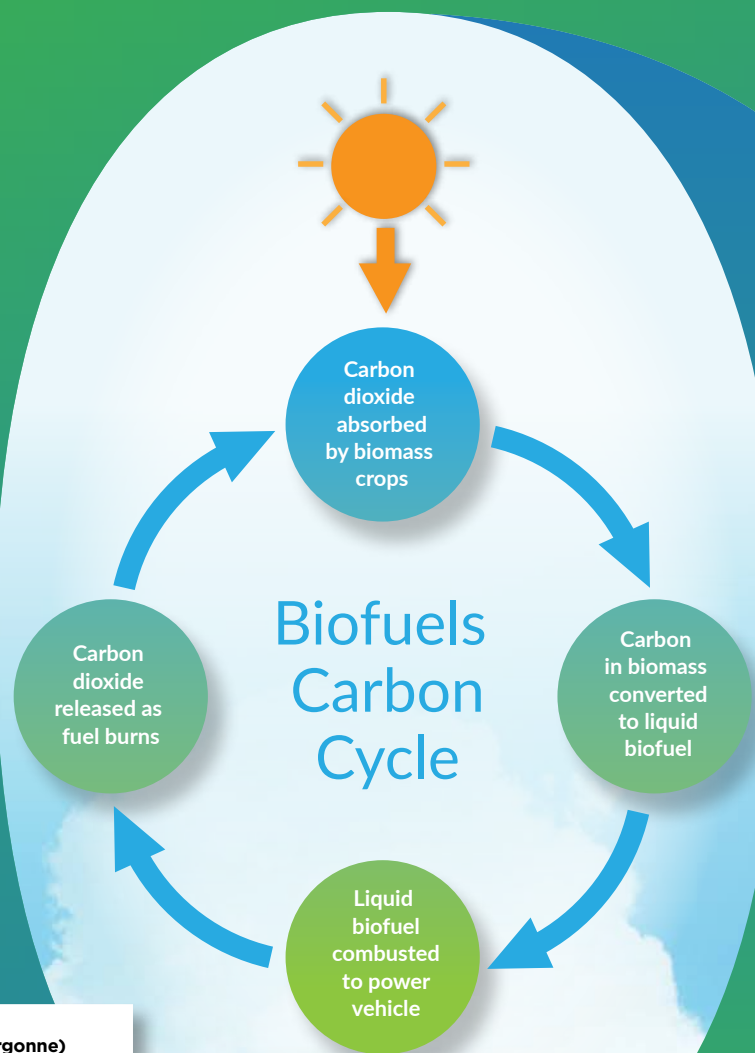
Fulfilling the Promise

RFA's member companies aren't just talking the talk about net-zero—they are walking the walk. Ethanol producers are already taking concrete steps toward net-zero emissions, including installation of on-site wind turbines and solar arrays to generate electricity, use of combined heat and power systems, and sourcing biogas to replace fossil natural gas. In addition, carbon capture, utilization, and sequestration (CCUS) projects are underway at several facilities.

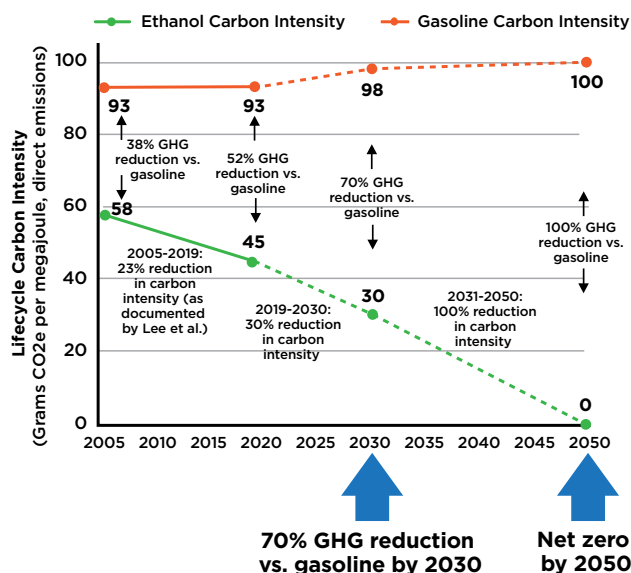


“Complex challenges call for leadership and innovative solutions. The carbon reduction goals announced by RFA today mark a bold commitment to innovation, investment, and continuous improvement in the renewable fuels sector. Ethanol producers are already producing America’s top low-carbon fuel and are eager to do their part to decarbonize our transportation sector and move our nation toward net-zero emissions.”

— RFA Chairperson
Jeanne McCaherty,
July 27, 2021



**ACTUAL 2005 and 2019 ETHANOL CARBON INTENSITY (DOE-Argonne)
AND RFA GOALS FOR 2030 AND 2050**



* Lee, U., Kwon, H., Wu, M. and Wang, M. (2021), Retrospective analysis of the U.S. corn ethanol industry for 2005-2019: implications for greenhouse gas emission reductions. *Biofuels, Bioproducts & Biorefining*.

From Recovery to Growth

Just as the nation's economy cautiously emerged from the economic chaos of the global pandemic in 2021, the U.S. ethanol industry showed strong signs of steady recovery as well. Annual ethanol production again reached 15 billion gallons as most plants returned to near-normal production levels. Domestic consumption approached 14 billion gallons as drivers returned to the road and vehicle travel increased, particularly in the second half of the year. Exports, however, remained somewhat stagnant as overseas markets have been slower to recover, and protectionism abroad continues to frustrate global trade. At approximately 1.2 billion gallons, exports were lower than even 2020 and the lowest since 2016.

Recognizing the difficulty the ethanol industry faced, the Biden Administration took several actions to help. First, the Department of Agriculture announced a \$700 million program for COVID-19 pandemic aid and \$100 million package in biofuel infrastructure funding. In addition, late in the year EPA proposed regulations to begin to put the RFS “back on track,” restoring 500 million gallons of illegally waived RFS demand from 2016, denying all of the pending small refinery exemption petitions, and setting the 2022 RFS conventional renewable fuel requirement at the statutory volume of 15 billion gallons.

The Supreme Court dealt a blow to the ethanol industry by striking a Trump-era regulation allowing 15 percent ethanol blends (E15) to benefit from the same volatility waiver as 10 percent blends (E10). That ruling set back the effort to expand the domestic ethanol market and threatened to strand significant infrastructure investments made by retail stations, ethanol producers, and state and federal government agencies. Reflecting the resiliency that has be-

come the hallmark of the U.S. ethanol industry, however, producers throughout 2021 continued to pursue technologies and opportunities that will assure growth and diversification. From sustainable aviation fuels to carbon sequestration, the ethanol industry is investing in its future.

Policy will most certainly be critical to the industry's future growth as well. The RFA is working with its industry allies, automakers, state governors, and the EPA to respond to the Supreme Court's frustrating ruling on E15, perhaps by eliminating the volatility waiver for E10 blends and thereby creating a level playing field for both E10 and E15. The RFA will also continue its advocacy efforts to develop a national low-carbon clean fuel standard to complement the RFS; support the broad deployment of CCUS; and increase production and deployment of flex-fuel vehicles.

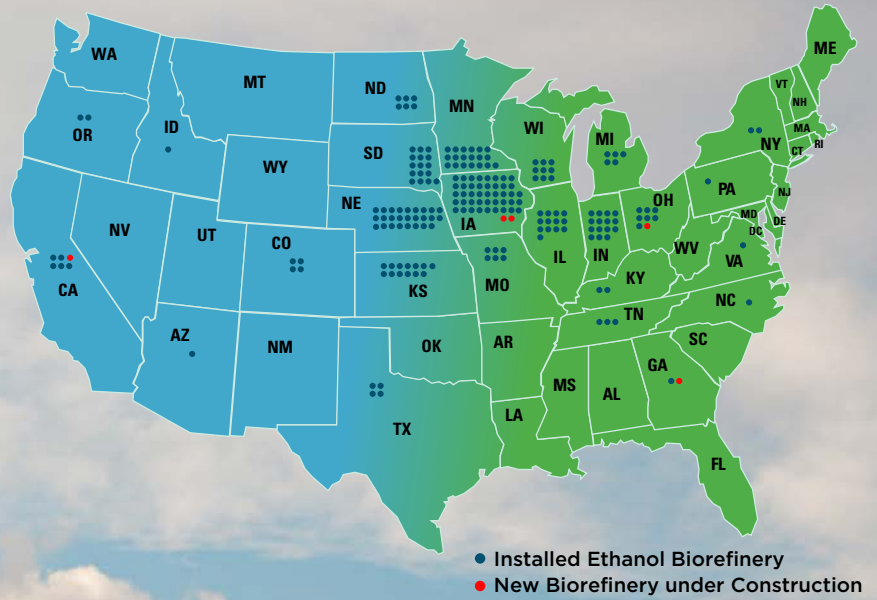
Rest assured, whatever 2022 may bring, the RFA and its member companies will be zeroing in on the opportunities to assure future growth and prosperity.



U.S. ETHANOL BIOREFINERIES BY STATE

“Mr. President, biofuels are a readily available energy solution that deserve full consideration—not only for helping to stem the recent increase in fuel prices, which has subsequently accelerated inflation—but to serve as a foundational source of transportation emission reductions as part of your energy and environmental agenda. We call on your administration to utilize the full capacity of American agriculture to deliver on both fronts.”

— From an October 2021 letter to President Biden from nine Midwest U.S. senators



U.S. ETHANOL PRODUCTION CAPACITY BY STATE (Million Gallons per Year)

	Existing Production Capacity	Capacity Under Constr./Expansion	Installed Ethanol Biorefineries	Biorefineries Under Constr./Expansion
Iowa	4,678	80	43	2
Nebraska	2,351	-	26	-
Illinois	1,912	-	14	-
Minnesota	1,371	-	19	-
Indiana	1,388	-	15	-
South Dakota	1,253	-	16	-
Ohio	716	25	7	1
Kansas	602	-	14	-
Wisconsin	596	-	9	-
North Dakota	547	-	6	-
Texas	345	-	4	-
Michigan	350	-	5	-
Missouri	277	-	6	-
Tennessee	232	-	3	-
California	222	45	5	1
New York	165	-	2	-
Colorado	143	-	4	-
Georgia	120	10	1	1
Pennsylvania	120	-	1	-
Idaho	60	-	1	-
North Carolina	60	-	1	-
Arizona	55	-	1	-
Kentucky	50	-	2	-
Oregon	40	-	2	-
Virginia	2	-	1	-
TOTAL U.S.	17,655	160	208	5

Source: RFA



Energizing the Economy

The economic recovery from the chaos created by the COVID pandemic has been frustratingly sporadic. But as mobility returns, demand increases, and consumer confidence grows, recovery is the reality. Indeed, evidence of the recovery can be seen in the ethanol industry's performance in 2021.

With record ethanol production capacity of 17.7 billion gallons, the industry once again reached 15 billion gallons of production. While that is still only an 86 percent utilization rate, it reflects significant growth from 2020. Total production rose 7.6 percent over the previous year, and both output and demand continue to grow—suggesting that 2022 will be higher still.

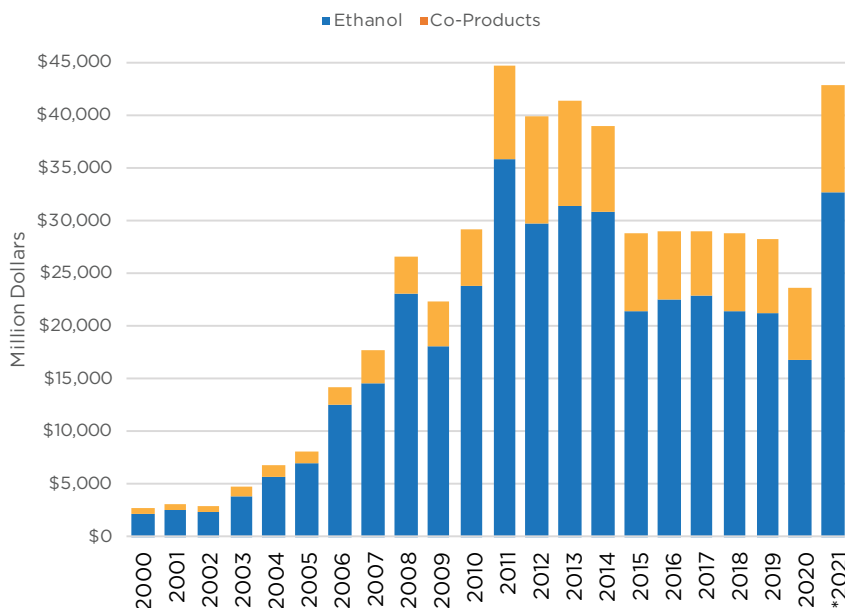
More importantly, profitability returned to the ethanol industry in 2021. Average ethanol prices in 2021 were more than 80 percent above average prices in 2020. Similarly, average prices for distillers grains were 27 percent higher than a year earlier. It is instructive to note this profitability in the ethanol industry occurred at a time of robust corn prices. Corn averaged \$5.93 per bushel in 2021, up 68 percent from 2020 as demand from China and other feed markets put upward pressure on prices. As U.S. ethanol producers processed more than 5.1 billion bushels of corn

into high octane fuel and feed products last year, they added more than \$30 billion to the farm economy, solidifying ethanol's role as the most important value-added market for farmers.

With rebounding production and higher production values, ethanol made an invaluable contribution to the national economy, adding \$52 billion to our national Gross Domestic Product, \$10.4 billion in federal, state and local taxes; and supporting more than 407,000 direct, indirect and induced jobs across the economy. Those jobs added \$28.7 billion in income for workers across the country.

As more and more are vaccinated around the globe and the economic recovery from COVID gains ground, the future for ethanol looks bright. We anticipate increased ethanol production and expanded market opportunities for ethanol in 2022. That's good news for consumers and farmers alike. Consumers will benefit from increased availability of lower-priced, lower-carbon ethanol. Farmers will continue to benefit from an important value-added market. And the economy will benefit from ethanol's job creation, tax revenue, and trade value with every gallon produced.

GROSS VALUE OF U.S. ETHANOL INDUSTRY OUTPUT

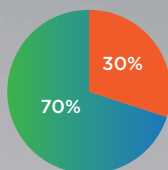


Source: RFA based on U.S. Dept. of Agriculture data * Estimated

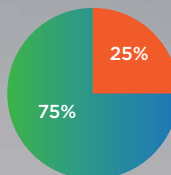
ETHANOL INDUSTRY WORKFORCE DEMOGRAPHICS

	Ethanol Industry	Petroleum Fuels Industry	National Workforce
Male	70%	75%	52%
Female	30%	25%	48%
55 & Over	23%	19%	23%
Unionized	5%	6%	6%
Military Veterans	18%	9%	6%
Average Hours/Week	39.8	41.5	34.8

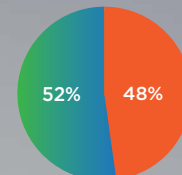
■ Male ■ Female



■ Male ■ Female



■ Male ■ Female



Sources: Energy Futures Initiative, National Association of State Energy Officials, U.S. Bureau of Labor Statistics

Ethanol's Value-Added Proposition

Based on average prices and product yields in 2021, a typical dry mill ethanol plant was adding approximately \$2.42 of additional value—or 40%—to every bushel of corn processed.

Corn Cost per Bushel

\$ 5.93



Value of Outputs per Bushel

Ethanol	\$ 6.54
Distillers Grain	\$ 1.52
Corn Distillers Oil	\$ 0.45
TOTAL	\$ 8.51

Ethanol and the 2021 Economy

Direct Jobs..... 73,193
 Indirect/Induced Jobs 334,220
 Household Income \$28.7 billion
 GDP Contribution \$52.1 billion

Making a Global Mark

As U.S. ethanol production recovered in 2021, our nation's share of global output rebounded to a pre-pandemic level of 55 percent. On the other hand, Brazilian ethanol production declined further and was roughly half of U.S. volume, as a result of adverse sugarcane-growing conditions, industry economics, and the lingering effects of the pandemic. The European Union accounted for 5 percent of global output, on par with 2020. No other country had more than a 3-percent share, even though India registered a notable increase in production.

Still, U.S. exports remained subdued, with volumes falling to their lowest level in five years. Canada remained the top destination, taking nearly one-third of U.S. ethanol shipments, an increase from 2020. Meanwhile, export sales to South Korea grew substantially, beating out India as our second-largest destination. Another bright spot was the return of China as a customer, with the country making sizable purchases of U.S. ethanol for the first time since 2018, although volumes tapered off in the second half of the year.

While India and Mexico remained key markets, shipments to both fell in 2021 after growing significantly in 2020, when industrial alcohol was in high demand. However, the main cause of lower total exports was a further sharp drop in shipments to Brazil, which occurred after a 20-percent tariff was applied to all imports from the U.S. Brazil purchased moderate amounts of U.S. ethanol during its sugarcane inter-harvest period, but otherwise volumes were negligible.

U.S. ethanol imports declined in 2021 as well, due to lower production and higher prices of Brazilian ethanol, declining prices of California Low Carbon Fuel Standard credits, and volatile RFS credit (RIN) price dynamics.

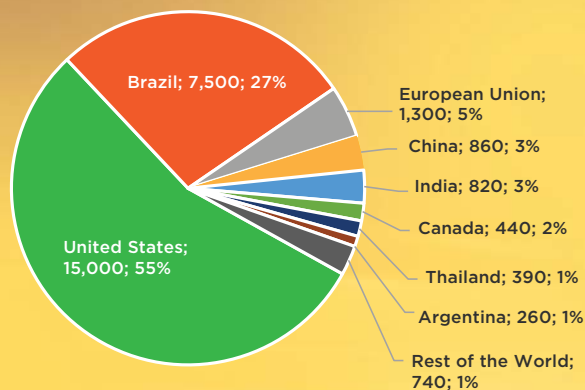
U.S. ETHANOL EXPORTS AND IMPORTS



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
*Estimated based on Jan.-Nov. 2021 data

2021 GLOBAL FUEL ETHANOL PRODUCTION

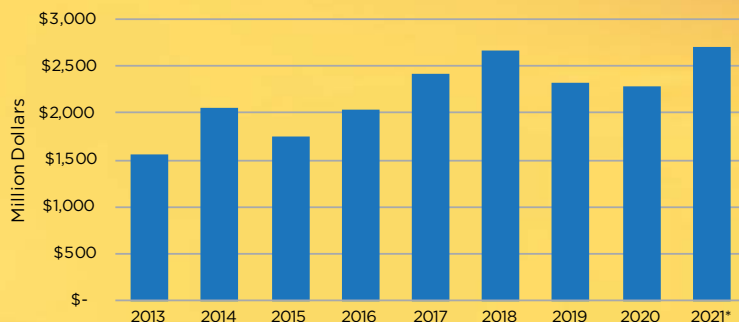
Region; million gallons; share of global production



Global fuel ethanol production rebounded to 27 billion gallons in 2021. The United States remained the largest producer, accounting for over half of global output.

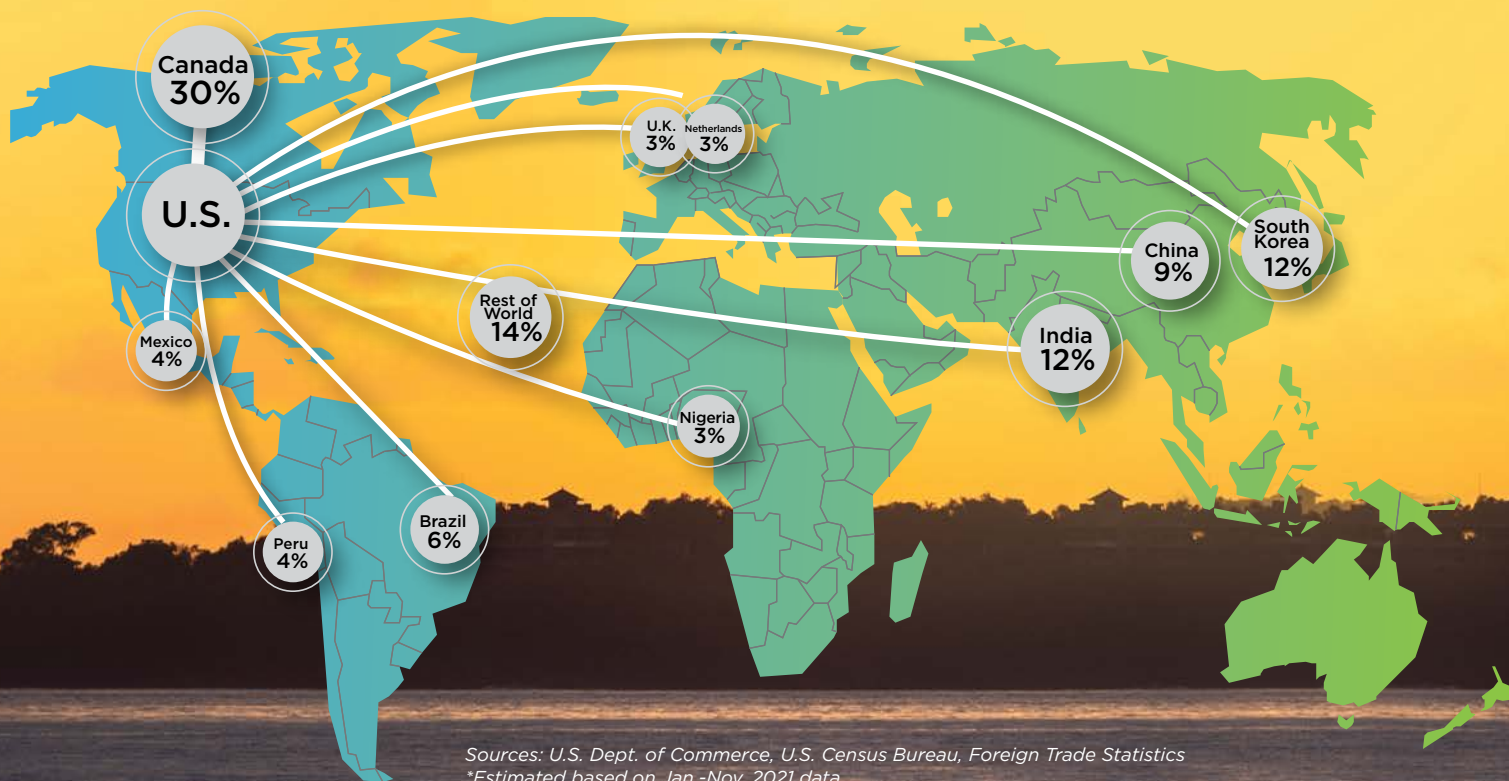
Sources: RFA analysis of public and private data sources

VALUE OF U.S. ETHANOL EXPORTS



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
*Estimated based on Jan.-Nov. 2021 data

TOP DESTINATIONS FOR U.S. ETHANOL EXPORTS IN 2021



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
*Estimated based on Jan.-Nov. 2021 data

Fueling the Future

Six hydrogen atoms, two carbon atoms, and one oxygen atom come together to form one of the world's greatest molecules: ethanol. In fact, because of its simplicity, ethanol is one of the oldest organic chemicals known to man. And while many know ethanol for its use in alcoholic beverages or as a gasoline substitute, they may not know that ethanol is an important chemical involved in the manufacture of many other products. As an industrial raw material, ethanol can be used to make adhesives, cosmetics, detergents, explosives, inks, chemicals, hand creams, plastics, paints, textiles, vinegar, and other products. Ethanol's use as a key ingredient for sanitizers and disinfectants also gained notoriety in 2020 and 2021, as global demand for hand sanitizer surged due to COVID-19.

As policymakers and others focus on climate change and the need to rapidly decarbonize, they are turning to ethanol again. All eyes are now focused on the role ethanol can play in new areas such as sustainable aviation fuel, offroad and heavy-duty equipment, and even generating low-carbon electricity.

In September 2021, RFA joined other industry leaders and officials from the Biden administration for a White House roundtable discussion on the future of sustainable aviation fuel, or SAF. In conjunction with the event, the White House announced a goal to achieve 3 billion gallons of

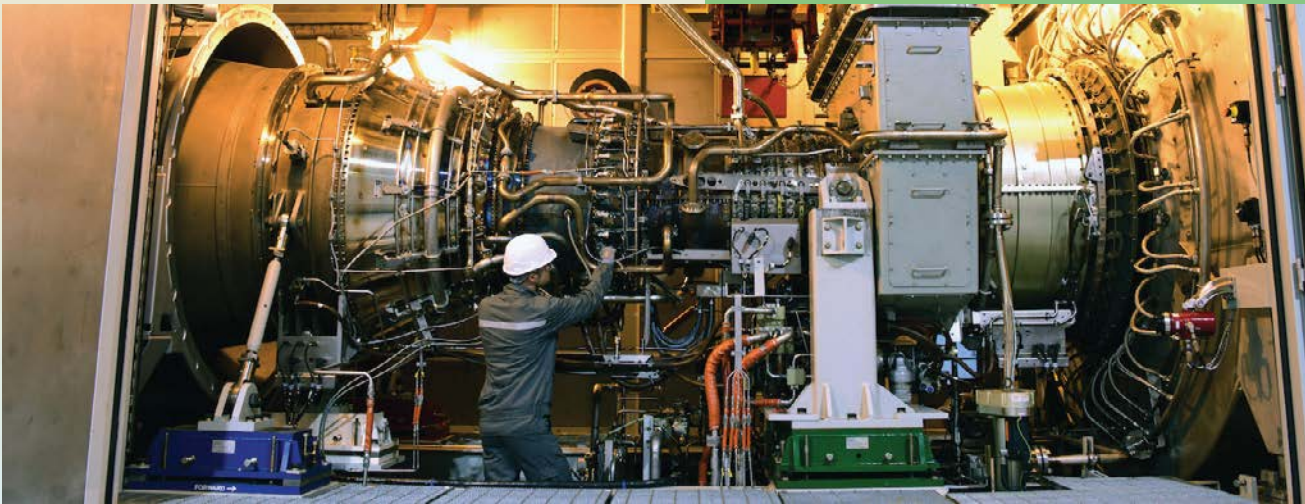
SAF production and reduce aviation-related emissions by 20 percent by 2030. RFA's members believe that with proper lifecycle accounting methods and the right policy incentives, ethanol can play a leading role in lowering the carbon intensity of the aviation sector.

At the same time, as the world focuses on expanding the power grid to accommodate more electric vehicles, ethanol could also serve as an excellent low-carbon, low-cost feedstock for power generation—especially as a fuel source for backup generators. Natural gas turbine power plants have traditionally used diesel as a backup fuel, but low-carbon ethanol can be used instead. In addition to lowering GHG emissions, the use of ethanol for stationary power generation would improve air quality and reduce water consumption. Going into 2022, RFA has recommended that the U.S. Department of Agriculture help develop “ethanol-to-electrons” technology via its Rural Energy Pilot Program.

Meanwhile, RFA member companies continue efforts to commercialize ethanol-powered engines for semi-trucks, farm equipment like tractors and combines, construction equipment, and other heavy-duty vehicles.

As we move into 2022, RFA expects the ethanol molecule to continue getting more and more attention as the transition to a low-carbon economy picks up speed.





The first power plant in the world using ethanol, the power plant at Saint-Pierre on Reunion Island in the Indian Ocean came into service in 2019 to produce energy for peak periods, securing the French island's power grid.



In December 2021, United Airlines became the first airline to fly a commercial jet full of passengers using 100 percent sustainable aviation fuel, on a flight from Chicago to Washington. Photo courtesy United.

White House Plan for Sustainable Aviation

Federal actions include:

- A new Sustainable Aviation Fuel Grand Challenge to help increase the production of sustainable aviation fuel to at least 3 billion gallons per year by 2030;
- New and ongoing funding opportunities of up to \$4.3 billion to support sustainable aviation fuel projects and producers;
- An increase in R&D activities to demonstrate new technologies that can achieve at least a 30 percent improvement aircraft fuel efficiency; and
- Efforts to improve air traffic and airport efficiency to reduce fuel use, eliminate lead exposure, and ensure cleaner air in and around airports.

How Ethanol Feeds the World

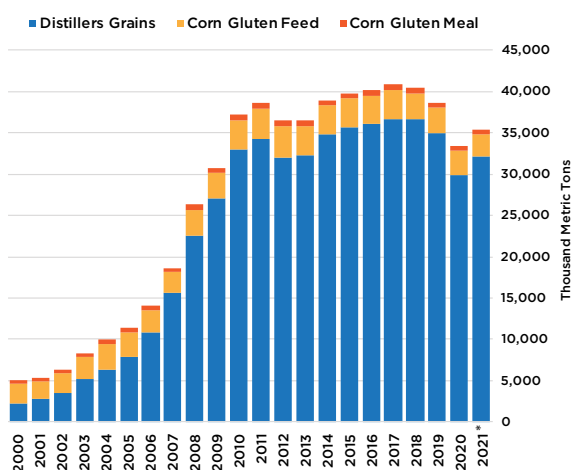
America's ethanol biorefineries continue to play an important—and often overlooked—role in feeding the world.

Specifically, the industry provides an enormous supply of high-protein animal feed for livestock, poultry, and aquaculture production across the globe.

In 2021, U.S. ethanol producers generated 35.4 million metric tons (mmt) of distillers grains, gluten feed, and gluten meal. In addition, biorefineries extracted over 3.8 billion pounds of corn distillers oil, a \$2.1 billion market underpinning the production of biodiesel, renewable diesel, and poultry feed.

As dietary trends continue to evolve around the world, U.S. ethanol producers continue to embrace new technologies that further enhance the nutritive qualities of animal feed co-products. New processes that concentrate the protein content of distillers grains, improve amino acid profiles, and reduce excess fat content are transforming the industry and opening new market opportunities.

U.S. ETHANOL INDUSTRY CO-PRODUCT ANIMAL FEED OUTPUT



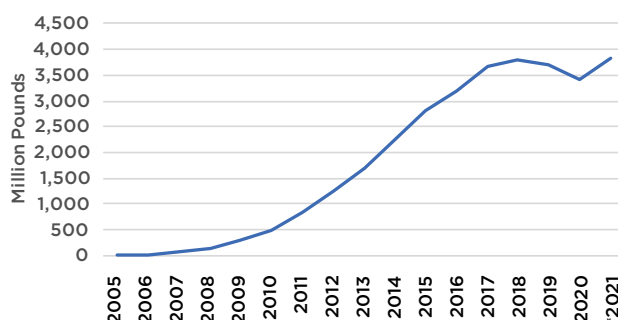
Source: RFA and U.S. Dept. of Agriculture.

Note: All co-products converted to 10 percent moisture basis
*Estimated

A Diversified Trade Portfolio

U.S. biorefineries satisfied growing domestic animal feed needs while also exporting about a third of distillers grains produced. In 2021, more than 50 countries purchased a cumulative 11.6 mmt of U.S. distillers grains. Half of these exports landed in Southeast and East Asia. Meanwhile about 20 percent of total U.S. distillers grains exports were shipped to Mexico, as the country extended its reign as our top customer for a fifth consecutive year.

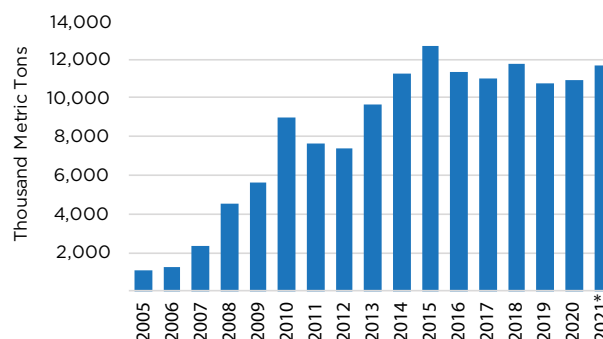
CORN DISTILLERS OIL PRODUCTION



Sources: U.S. Dept. of Agriculture and RFA

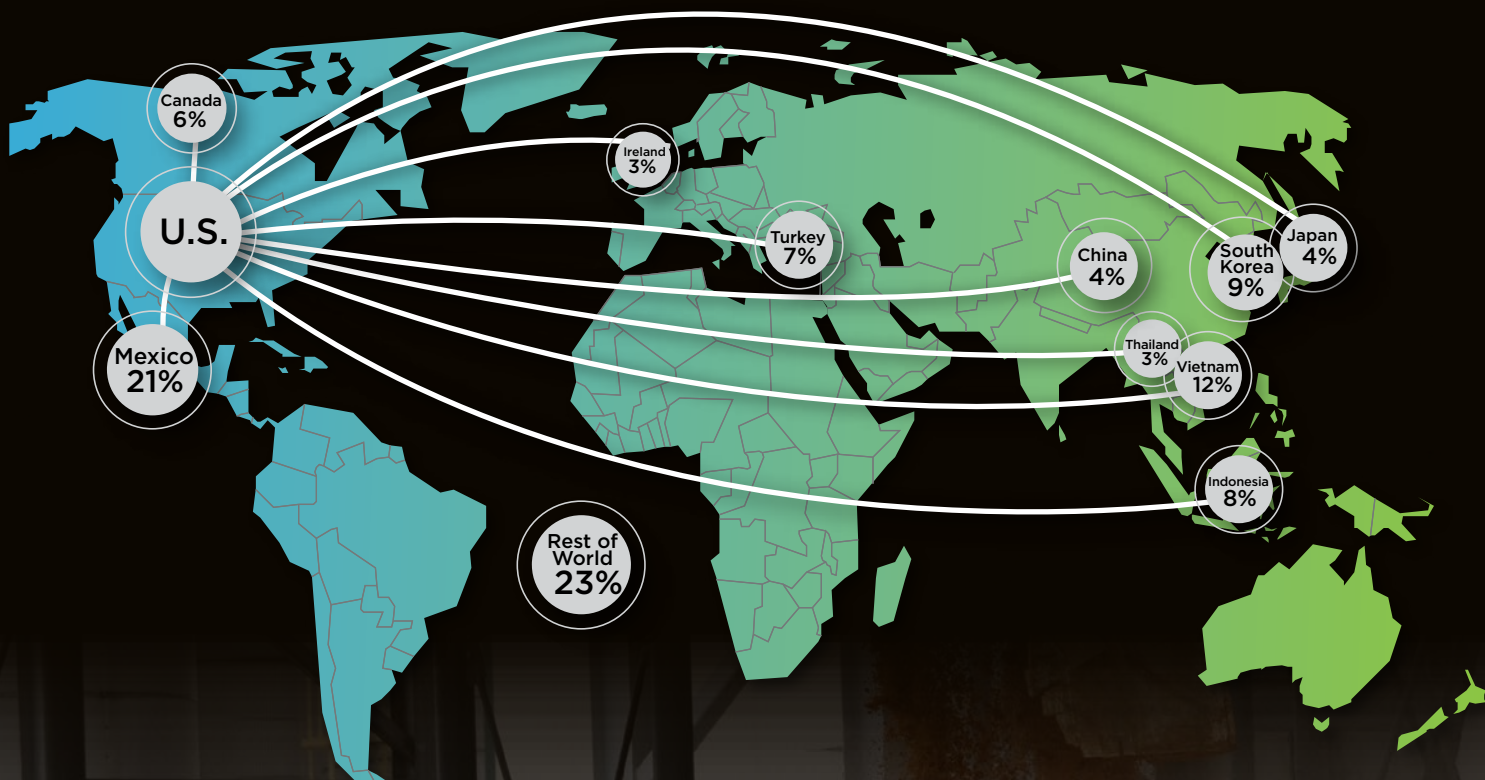
*Estimated

U.S. DISTILLERS GRAINS EXPORTS

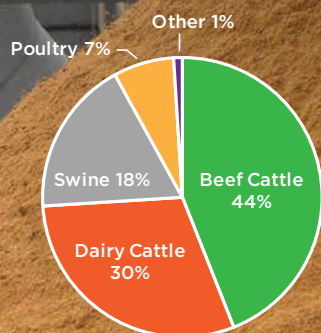


Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics *2021 estimated based on Jan.-Nov. 2021

TOP DESTINATIONS FOR U.S. DISTILLERS GRAINS EXPORTS IN 2021

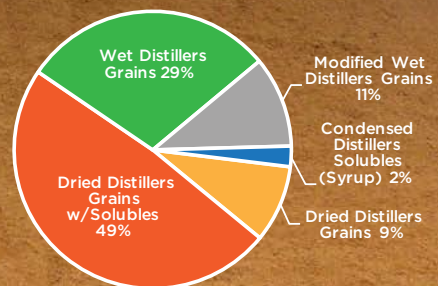


DISTILLERS GRAINS CONSUMPTION BY SPECIES



Source: U.S. Dept. of Agriculture

U.S. DISTILLERS GRAINS PRODUCTION BY TYPE: AS-IS BASIS



Source: U.S. Dept. of Agriculture

States Lead the Way

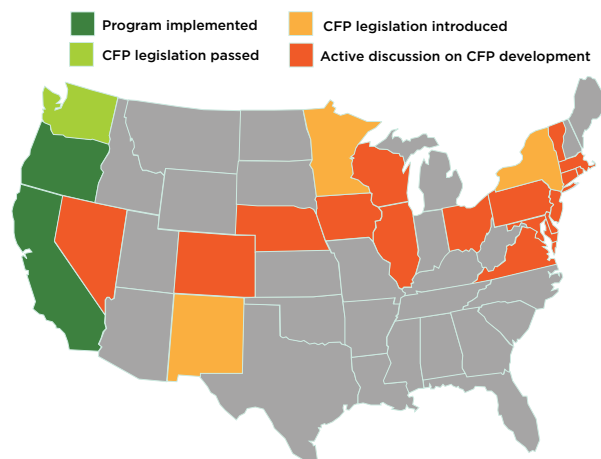
In a 1932 Supreme Court case, Justice Louis Brandeis popularized the notion of the states as laboratories of democracy, noting how “a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country.” This idea certainly holds true as we consider the many advances the ethanol industry has made as a result of state or regional initiatives.

A prime example of state leadership would be the various low-carbon or clean-fuel programs underway or being developed in several states and regions. To date, existing programs have relied heavily on the use of ethanol for reducing greenhouse gas emissions. In May 2021, RFA issued a ten-year retrospective on California’s LCFS, reporting that the use of ethanol under the LCFS has generated 26.9 million metric tons of GHG savings since implementation—35% of the total and more than any other low-carbon fuel used in the state..

After the EPA’s regulation allowing year-round E15 sales nationwide was overturned, the governors of seven Midwest states collaborated in a letter to EPA Administrator Michael Regan, seeking guidance from the agency on how best to pursue a specific provision of the Clean Air Act that allows states to establish a “level playing field” for E15. The governors signing the bipartisan letter were Kim Reynolds (R-Iowa), Pete Ricketts (R-Nebraska), Tim Walz (D-Minnesota), Tony Evers (D-Wisconsin), Doug Burgum (R-North Dakota), Kristi Noem (R-South Dakota), and Mike Parson (R-Missouri). Gov. Laura Kelly (D-Kansas) sent a complementary letter to EPA as well.

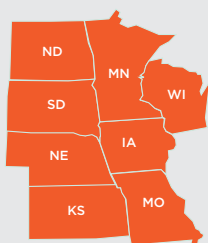
As we progress into 2022, we expect states will continue to pursue innovative policies and initiatives to expand the use of low-carbon renewable fuels.

STATE ACTIVITY ON LOW CARBON AND CLEAN FUEL STANDARDS



State and Regional Clean Fuel Programs

- **California:** Active Low Carbon Fuel Standard since 2010.
- **Oregon:** Active Clean Fuels Program since 2016.
- **Washington:** Clean fuel program signed into law in May 2021.
- **New York, New Mexico and Minnesota:** Legislatures considered clean fuel legislation in 2021.
- **Nevada:** State energy and environmental agencies are considering adoption of clean-fuel policy.
- **Colorado:** A 2018 executive order directed adoption of California’s low-emission vehicle standards; the Colorado Energy Office is evaluating a clean fuel standard.
- **Midwest states:** Ongoing stakeholder discussions underway regarding feasibility and design of a state or sub-regional program. Wisconsin and Illinois governors recommend adoption of a clean fuel standard. Ohio has formed the Clean Fuels Ohio coalition to push for CFS adoption.
- **Northeast/Mid-Atlantic:** Ten states and the District of Columbia are exploring a regional CFP.

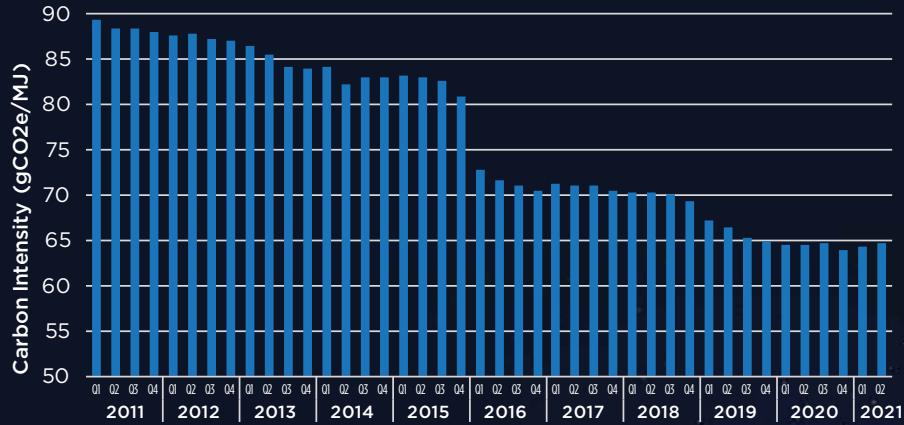


STATES SEEKING YEAR-ROUND E15 SOLUTION

These 8 Midwest states are home to:

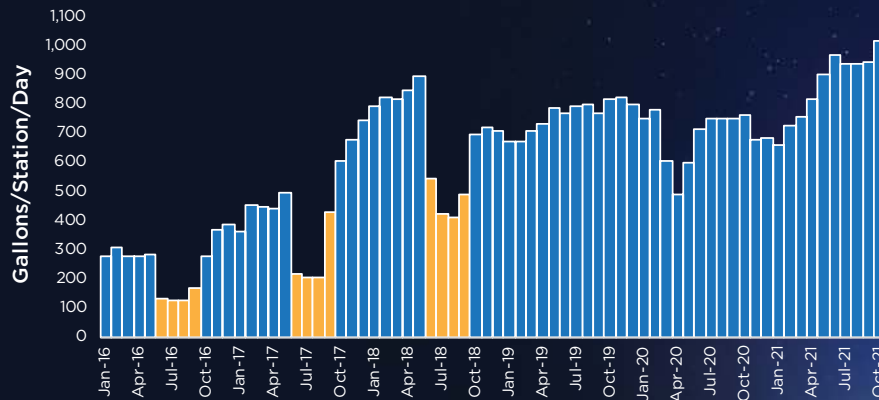
- Nearly 1,200 of the nation’s 2,300 gas stations offering E15
- \$31 million in USDA biofuels retail infrastructure investment
- 140 of the nation’s 208 ethanol biorefineries
- 208,000 jobs supported by the ethanol industry
- 158,000 farms that grow 60% of the nation’s corn

CARBON INTENSITY OF STARCH-BASED ETHANOL IN CALIFORNIA GASOLINE



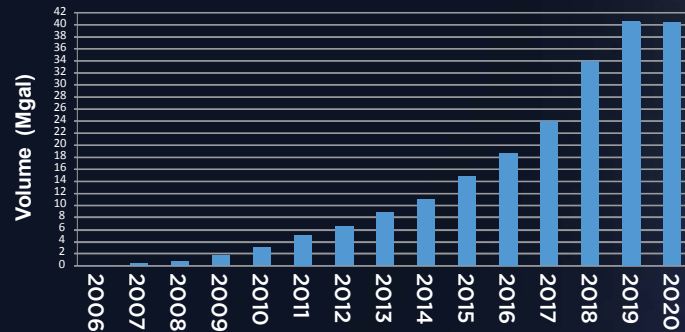
Source: RFA using California Air Resources Board data

MINNESOTA AVERAGE E15 SALES



Source: RFA based on Minnesota Dept. of Commerce data

ANNUAL E85 VOLUMES IN CALIFORNIA (Million Gallons)



This chart shows annual E85 volumes in California and is based on reported Test Program Exemption data.

Last Updated 11/30/2021

A Step Forward for the RFS

Originally passed in 2005 and significantly enhanced in 2007, the Renewable Fuel Standard (RFS) remains the seminal policy undergirding today's ethanol industry. In addition to annually escalating requirements for cellulosic and advanced biofuels, the law requires refiners to blend a minimum of 15 billion gallons of so-called "conventional biofuels" like corn ethanol into the fuel supply each year.

Unfortunately, inconsistent—and at times tepid—enforcement of the RFS has significantly undermined the program, hindering investments in advanced biofuels and delaying widespread commercialization of flex fuels like E85 and higher ethanol blends like E15. From the Obama administration's failure to promulgate annual Renewable Volume Obligation (RVO) rules for several years to the Trump EPA's indiscriminate and illegal use of small refinery exemptions (SREs), the RFS has never reached its full potential.

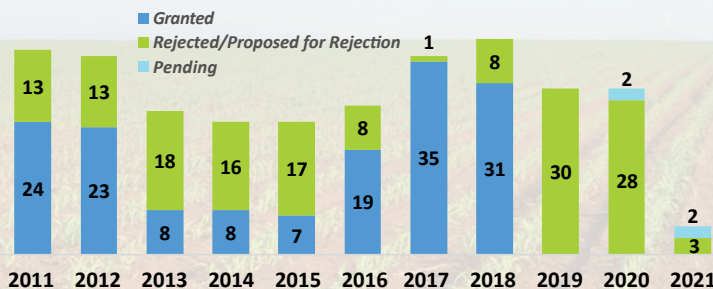
President Biden campaigned throughout the Midwest on the promise of getting the RFS back on track. And in December, the EPA proposed a regulation that takes a big step toward doing just that. First, the proposal set the 2022 RFS obligation at 15 billion gallons of conventional biofuel, returning demand to that required by the statute.

Second, the proposal augmented the RFS volumes in 2022 and 2023 with an additional 500 million gallons of blending requirements in accordance with a court order to restore illegally waived gallons in 2016. This is an important step toward recovering some of the demand destruction from the Obama years.

Third, EPA's proposal includes a denial of 65 pending RFS small refinery exemption petitions, representing 2.6 billion gallons of required renewable fuel blending the Trump EPA was prepared to exempt. Moreover, EPA proposed to bring transparency to the refinery exemption process, and to reallocate any potential volumes forgone by future exemptions.

However, in the same rule EPA somewhat inexplicably proposed to reach back in time and lower the 2020 RVO numbers that were finalized back in December 2019. The agency—which had previously and repeatedly said this sort of retroactive change was outside the law—blamed the pandemic's effect on fuel demand. However, the 2020 volume had already been automatically reduced to accommodate the impact of reduced demand and did not need a further cut.

THE END OF SMALL REFINERY EXEMPTIONS?



Source: EPA, as of 1/20/22

As 2022 began, RFA was working overtime to ensure the positive elements of EPA's proposals would be finalized, and the negative aspects would be improved or removed.

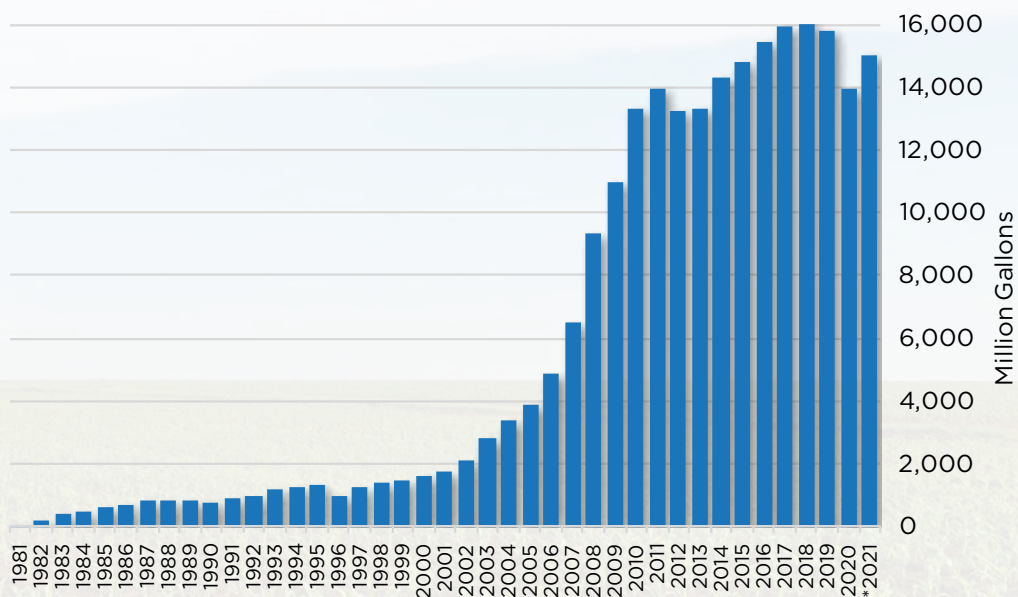
This will be an important year for the RFS, as 2022 is the last year for which Congress specified RFS volumes, and EPA must promulgate a "Set Rule" establishing renewable fuel volumes for 2023 and beyond. RFA and our allies will be working to assure the RFS continues to be a market driver for ethanol and advanced biofuels, lowering consumer gasoline costs, providing a critical value-added market for farmers, and dramatically lowering carbon emissions from the transportation sector.

HISTORICAL BIOREFINERY COUNT & PRODUCTION CAPACITY

Year	Installed Ethanol Biorefineries	Total Installed Production Capacity (mgy)	Average Capacity per Biorefinery (mgy)
2001	61	2,738	45
2006	110	5,493	50
2011	209	14,818	71
2016	213	15,998	75
2021	208	17,655	85

Source: RFA *As of December of each year specified

HISTORICAL U.S. FUEL ETHANOL PRODUCTION



Sources: RFA and U.S. Energy Information Administration

* Estimated

Higher Blends, Higher Benefits

If our nation is to fully reap the benefits of ethanol's low-carbon attributes, the renewable fuel will need a larger share of America's gas tank. That's why RFA continues its efforts to expand the availability of E15 and flex-fuels like E85 at the pump, while simultaneously advocating for more flex-fuel vehicles on the road.

One key piece of this strategy is the U.S. Department of Agriculture's Higher Blends Infrastructure Incentive Program (HBIIIP), which provides matching grants for higher blend infrastructure projects around the country. USDA in December 2021 unveiled a plan to make an additional \$100 million available for the program to continue increasing the sales and use of higher blends of ethanol. Additional biofuel infrastructure funding of nearly \$1 billion was included in the Build Back Better Act in 2021, and RFA remains hopeful those provisions become law in 2022. Our work to assist retailers and marketers participate in these funding opportunities will continue into 2022.

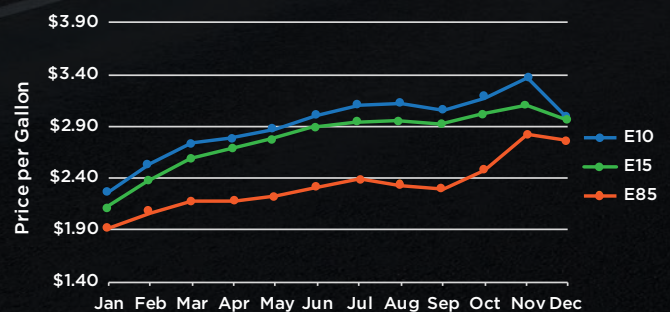
And while flex-fuels like E85 continue to gain in popularity, automakers continue to backtrack on their production of FFVs. For model year 2022, only Ford and GM offer FFVs; and of the 11 models available, five are for fleet purchases only. This is a marked difference from the more than 80 different models from eight manufacturers that were available to consumers as recently as the 2015 model year. RFA continues to strongly advocate for the production of more FFVs and fairness in how alternative fuel vehicles are incentivized under fuel economy and greenhouse gas regulations. One example of our advocacy was the introduction of the Clean Fuels Vehicle Act of 2021 by Sens. Amy Klobuchar (D-MN) and Joni Ernst (R-IA). The bill would establish an automaker tax credit for each FFV produced and restore certain compliance credits for FFVs under federal fuel economy regulations.



The following model year 2022 vehicles are available as flex-fuel vehicles (FFVs):

- | | |
|--|---|
| <ul style="list-style-type: none">• Ford Explorer 3.3L• Ford F-150 3.3L• Ford F-150 5.0L• Ford Super Duty (F-250, F-350) 6.2L• Ford Transit 3.5L• Ford Transit Connect 2.0L | <p>Fleet Purchase Only:</p> <ul style="list-style-type: none">• Ford Police Interceptor 3.3L• Chevrolet Silverado 5.3L• Chevrolet Silverado HD 6.6L• GMC Sierra 5.3L• GMC Sierra HD 6.6L |
|--|---|

2021 NATIONAL AVERAGE RETAIL PRICES FOR E10, E15 & E85



Source: RFA based on data from E85prices.com



E15 APPROVAL STATUS FOR U.S. LIGHT-DUTY VEHICLES

AUTOMAKERS / MODELS	MODEL YEAR												MARKET SHARE *
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022		
BMW Group **													
BMW													2.2%
Mini													0.2%
Daimler Group (Mercedes-Benz)													
Ford Motor Co. (Ford & Lincoln)													12.4%
GM (Buick, Cadillac, Chevrolet & GMC)													16.7%
Honda Motor Co. (Honda & Acura)													9.9%
Hyundai Motor Co. (Hyundai, Genesis & Kia)													9.5%
Mazda													2.2%
Mitsubishi Motors Corp.													0.6%
Nissan Motor Co. †													
Infiniti													0.4%
Nissan													6.1%
Stellantis (Alfa Romeo, Chrysler, Dodge, Fiat, Jeep, RAM & Wagoneer)													
Subaru ‡													4.2%
Tata Motors (Jaguar & Land Rover)													0.7%
Toyota Motor Corp.													
Lexus													2.3%
Toyota													13.4%
Volkswagen Group §													
Audi													1.4%
Porsche													0.4%
Volkswagen													2.4%
Volvo Car Group													
													0.8%

* Internal combustion engine (ICE) models only.

** Approves the use of up to 25% ethanol blends.

† Approves the use of E10 in QX80, Armada, NV & Sentra.

‡ Approves the use of E10 in 2.5L engines.

§ Approves the use of E10 in Golf.

Sources: Auto manufacturers' owner's manuals, GoodCarBadCar.net

■ E15 approved by automaker in ALL models
■ E15 approved by automaker in SOME models
■ E15 approved by EPA only; NOT approved by automaker

EXPANSION OF U.S. RETAIL STATIONS OFFERING E15 AND E85



Source: RFA

*Estimated



Opportunities for Octane

The data are clear: automakers and consumers alike want more octane. The share of gasoline sales represented by premium grade hit a nearly 20-year high in 2021, as automakers continued to favor turbocharged, higher-compression engines in which the use of high-octane gasoline is recommended or required. While the wholesale price spread between premium and regular grades of gasoline fell to a more historically consistent level, the retail price spread remained elevated after spiking higher during the pandemic.

These continuing dynamics in the automobile and fuel markets highlight the need for ethanol as a clean, affordable source of octane—a need that will only intensify as automakers contend with more stringent fuel economy requirements moving forward.

WHAT IS OCTANE AND WHY IS IT IMPORTANT?

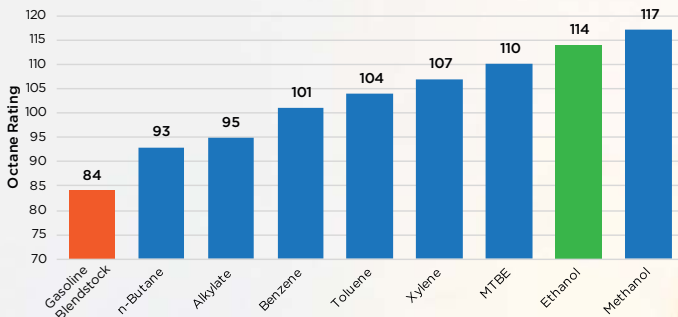
A fuel's OCTANE RATING is the measure of its ability to resist "knocking" in the engine, which is caused when the air/fuel mixture detonates prematurely during combustion. According to the U.S. Department of Energy, "Using a lower octane fuel than required can cause the engine to run poorly and can damage the engine and emissions control system over time. It may also void your warranty."

Ethanol's blending octane rating of 114 is significantly higher than the ratings of the main petroleum-based components. Moreover, aromatic hydrocarbons such as benzene worsen air pollution and are toxic.

Refiners have largely optimized their processes to take advantage of ethanol's properties. Today, most regular gasoline in the U.S. is produced using blendstock with an octane rating of 84, which is then upgraded to a rating of 87 by adding 10 percent ethanol. This allows refiners to increase throughput of hydrocarbon blendstock at a lower cost.

Demand for sources of octane is expected to continue to grow, driven by the utilization of advanced vehicle engines, tighter gasoline specifications, and the expansion of E15. It could be propelled further by the need for midlevel ethanol blends (e.g., E25-E30) to meet future fuel economy and emissions standards. While the Biden administration's new greenhouse gas emissions standards for model year 2023-2026 vehicles did not leverage the potential of high-octane, low-carbon fuels, RFA remains highly engaged with policymakers on the issue. We're optimistic that there will be an expanded future role for high-octane, low-carbon ethanol once the benefits of such fuels are fully recognized—especially as ethanol moves toward net-zero emissions.

BLENDING OCTANE RATINGS OF VARIOUS GASOLINE OCTANE BOOSTERS



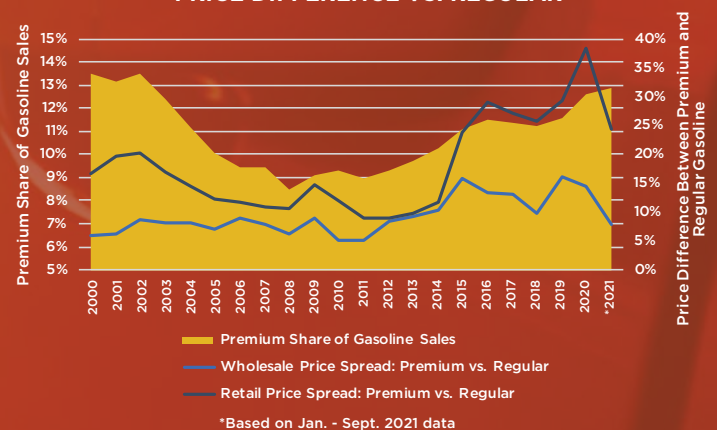
Source: U.S. Dept. of Energy

NEXT GENERATION FUELS ACT

In August 2021, Rep. Cheri Bustos (D-IL) and a bipartisan group of cosponsors introduced the Next Generation Fuels Act of 2021. Specifically, the bill would:

- Establish high-octane (95 and 98 RON) certification test fuels containing 20-30 percent ethanol, while requiring automobile manufacturers to design and warrant their vehicles for the use of these fuels beginning with model year 2026.
- Specify that the source of the octane boost must reduce lifecycle greenhouse gas emissions by an average of at least 40 percent compared to a 2021 gasoline baseline, as measured by the Department of Energy's GREET model.
- Restrict the aromatics content of gasoline, ensure parity in the regulation of gasoline volatility (Reid vapor pressure), correct key variables used in fuel economy testing and compliance, require an update to the EPA's MOVES model, ensure infrastructure compatibility, and address other regulations impeding the deployment of higher octane blends at the retail level.

PREMIUM GASOLINE: SHARE OF SALES AND PRICE DIFFERENCE VS. REGULAR



Source: U.S. Dept. of Energy

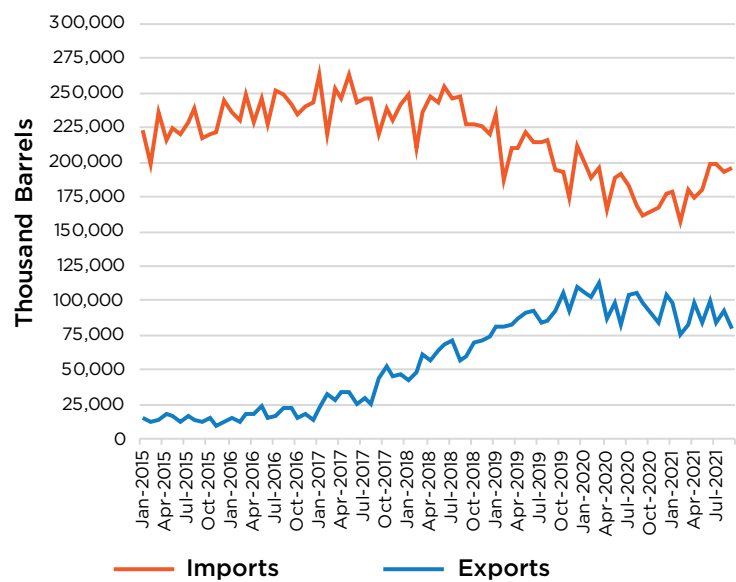
Energy Security Back in Focus

Americans received a stark reminder in 2021 that the country is not, and never has been, “energy independent,” despite the rhetoric. Gasoline prices increased 50 percent, the second-largest increase since the 1979 Oil Crisis.

This was largely a reflection of the fact that the U.S. crude oil market remains tightly tethered to the global market, even though U.S. production has increased in recent years. Oil prices increased sharply as the Organization of the Petroleum Exporting Countries and other producers like Russia (collectively called OPEC+) limited oil supplies following the pandemic downturn. This led the Biden administration to urge OPEC+ to increase output, even as it was rolling out policies to wean the U.S. off fossil fuels. Late in the year, tensions between Russia and Ukraine flared, adding another dimension to the balance of power in the global energy market.

The U.S. remained a sizable importer of crude oil in 2021, with imports rebounding while exports stagnated. Over one-third of U.S. crude supplies came from foreign sources, and imports equated to 40 percent of the oil processed by refineries.

U.S. CRUDE OIL TRADE



While U.S. crude oil production and exports have increased, our nation still imports nearly 200 million barrels per month.

Source: U.S. Dept. of Energy



VALUE OF U.S. OIL PURCHASES FROM OPEC

Saudi Arabia	\$8.2
Iraq.....	\$3.3
Nigeria.....	\$2.9
Libya	\$2.3
Angola	\$1.0
Kuwait	\$0.6
Other OPEC	\$0.9
TOTAL.....	\$19.2

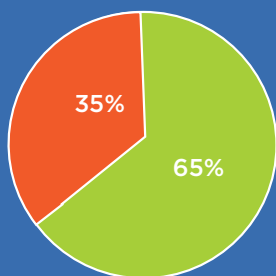
Our nation still transfers billions of dollars every year to the OPEC cartel.

In 2021 alone, the U.S. sent some \$19 billion—or \$150 per American household—to OPEC nations to pay for crude oil imports.

Source: RFA based on U.S. Dept. of Energy and U.S. Census Bureau data
Estimated based on Jan.-Sep. 2021 data

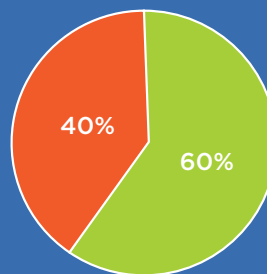
SOURCES OF U.S. CRUDE OIL SUPPLY

Domestic Production Imports



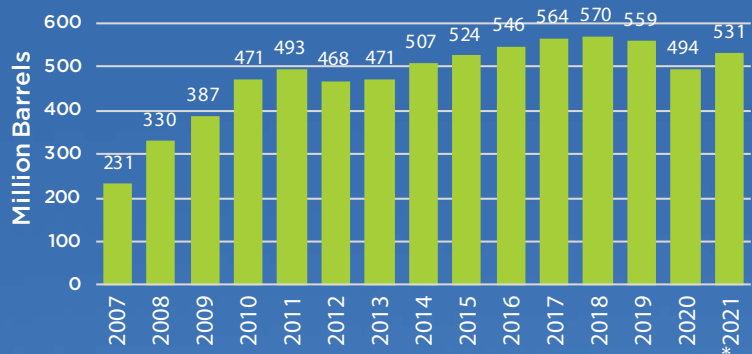
INPUTS TO U.S. REFINERIES

Domestic Production Imports



Source: RFA based on U.S. Dept. of Energy data and forecasts

HISTORIC OIL IMPORT DISPLACEMENT BY ETHANOL



Source: RFA based on U.S. Dept. of Energy data and forecasts * Estimated

“OPEC is, unfortunately, controlling the agenda with respect to oil prices. OPEC is a cartel and it controls over 50 percent of the supply of gasoline.”

- Energy Secretary Jennifer Granholm, November 2021



Farm to Fuel

Ethanol's potential to change the world for the better was recognized long ago. In fact, Henry Ford and Alexander Graham Bell were among the first to realize that the sugars found in plants could easily and inexpensively be converted into clean-burning renewable fuel. Bell himself referred to ethanol as a "clean, beautiful, and efficient fuel" more than a century ago.

Today, more than 200 ethanol biorefineries are living up to the potential first identified by some of our nation's foremost inventors. Modern-day facilities use state-of-the-art technologies to produce ethanol and valuable coproducts from the starches and sugars found in grains, beverage and food waste, and cellulosic biomass, and American farmers themselves are often actively involved in many of these ethanol biorefineries through ownership or leadership roles. While corn is by far the predominant feedstock for ethanol, sorghum also is used, and biorefineries typically use about one-third of the nation's sorghum crop for ethanol production.

More than 91 percent of U.S. fuel ethanol is produced using the dry mill process, with the remaining amount coming from wet mills. The main difference between the two processes is in the initial treatment of the grain.

On average, 1 bushel of corn (56 pounds) processed by a dry mill ethanol biorefinery produces:

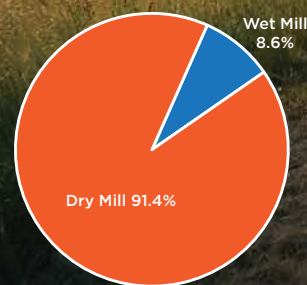
- 2.9 gallons of denatured fuel ethanol
- 15.1 pounds of distillers grains animal feed (10 percent moisture)
- 0.8 pounds of corn distillers oil
- 17 pounds of captured biogenic carbon dioxide*

In 2021, ethanol biorefineries captured roughly 2.7 million tons of CO₂, which was used for dry ice production, bottling, food processing, and other uses.

In **DRY MILLING**, the entire grain kernel is first ground into meal, then slurried with water to form a mash. Enzymes are added to the mash to convert starch to sugar. The mash is first cooked, then cooled and transferred to fermenters. Yeast is added and the conversion of sugar to alcohol begins. After fermentation, the resulting "beer" (not the kind you might drink) is separated from the remaining stillage. The ethanol is distilled and dehydrated, then blended with about 2 percent denaturant (such as gasoline) to render it undrinkable. It is then ready for shipment. The stillage is sent through a centrifuge that separates the solids from the solubles. These co-products eventually become distillers grains and corn distillers oil.

In **WET MILLING**, the grain is first separated into its basic components through soaking. After steeping, the slurry is processed through grinders to separate the corn germ. The remaining fiber, gluten and starch components are further segregated. The gluten component (protein) is filtered and dried to produce animal feed. The remaining starch can then be fermented into ethanol, using a process like the dry mill process.

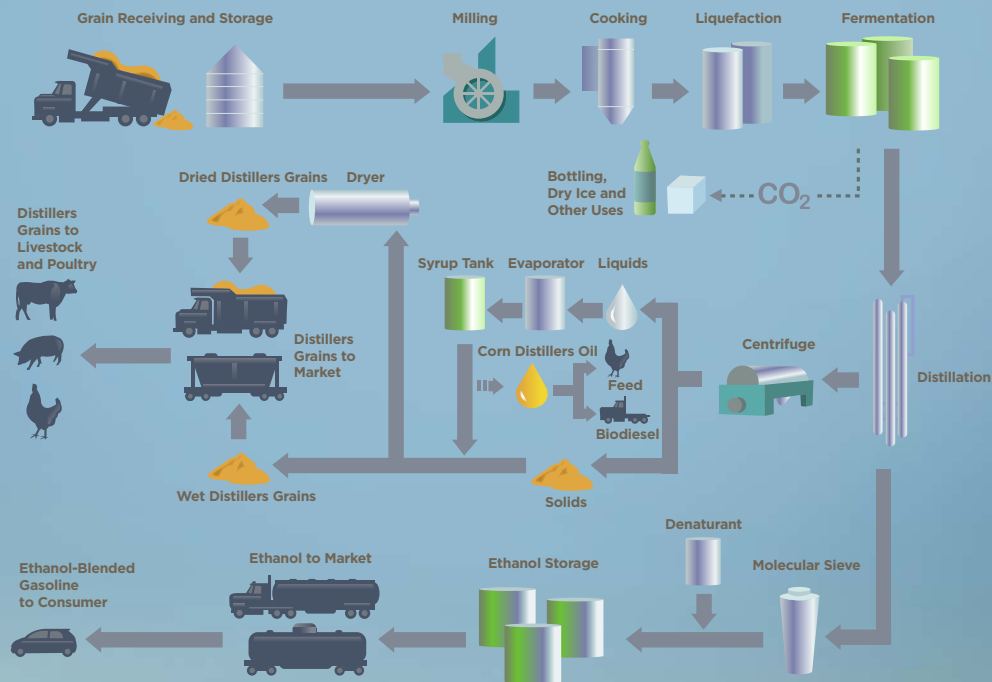
U.S. ETHANOL PRODUCTION BY TECHNOLOGY TYPE



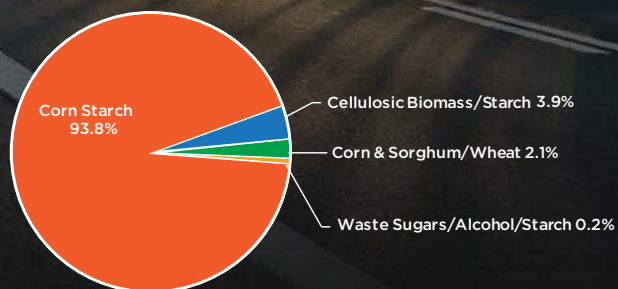
Source: RFA based on U.S. Dept. of Agriculture data

Source: RFA. *As of December for each year specified.
Source: RFA based on U.S. Dept. of Agriculture data
*Approximately 25 percent of U.S. dry mills capture CO₂ from fermentation.

DRY MILL ETHANOL PROCESS



U. S. ETHANOL PRODUCTION BY FEEDSTOCK TYPE



Source: RFA

Busting Ethanol Myths

From the “food versus fuel” canard to the “indirect land use change” myth, renewable fuels have been under attack for years. Even though these falsehoods have been disproven time and time again, opponents continue their attempts to halt the ethanol industry’s progress by fabricating new myths and recycling the same old misinformation.

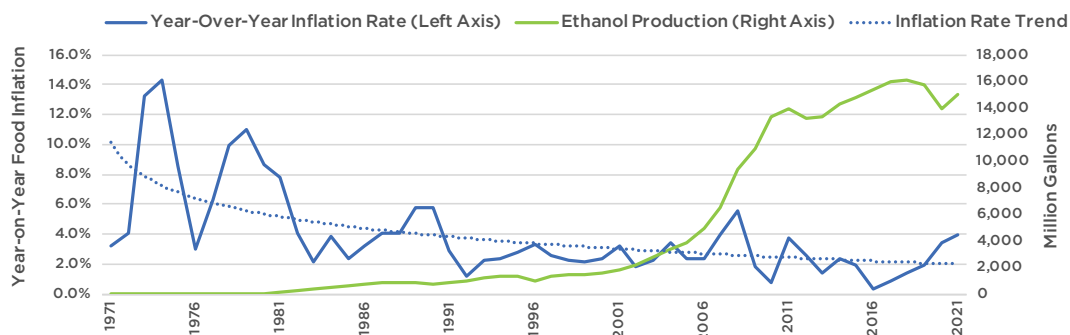


Ethanol Does **NOT** Raise Food Prices

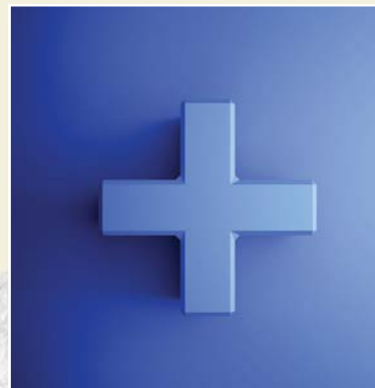
The facts responding to many common attacks are covered elsewhere in the pages of this Outlook, such as ethanol’s environmental benefits (pages 2-3) and impact on energy security (pages 22-23). Here’s a review of some other key points that prove the accusations coming from ill-informed biofuel critics are wrong.

One of the longest running attacks on ethanol is also one of the most incorrect, as America’s family farmers grow more than enough corn for all uses and corn remains inexpensive as a food ingredient—even at nearly \$6 per bushel. And the total percentage, or “farm share,” of every dollar spent on food has remained below 15 cents, meaning the value of raw agricultural ingredients in our grocery items account for just 15 percent of the retail price on average. In addition, as the ethanol industry has grown over the years, overall food inflation decreased until the pandemic. Other factors, like energy prices and, more recently, supply-chain issues, play a far more significant role in food prices. Other factors, like energy prices, play a far more significant role in food prices. And let’s not forget that ethanol biorefineries make both fuel and feed—returning one-third of every bushel processed to the animal feed market in the form of highly nutritious distillers grains.

**U.S. FOOD PRICE INFLATION
AND ETHANOL PRODUCTION**

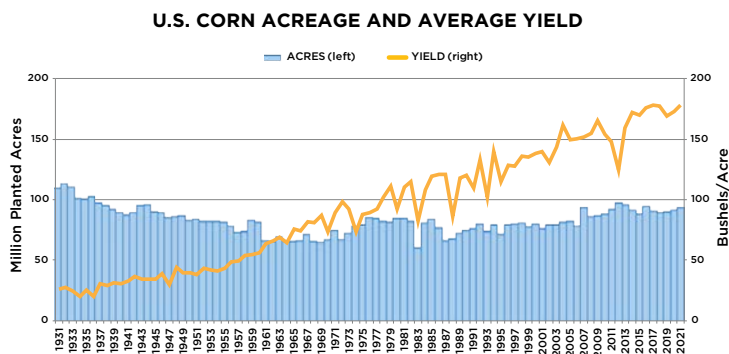


Source: Bureau of Labor Statistics and RFA



Ethanol Has **NOT** Caused Cropland Expansion

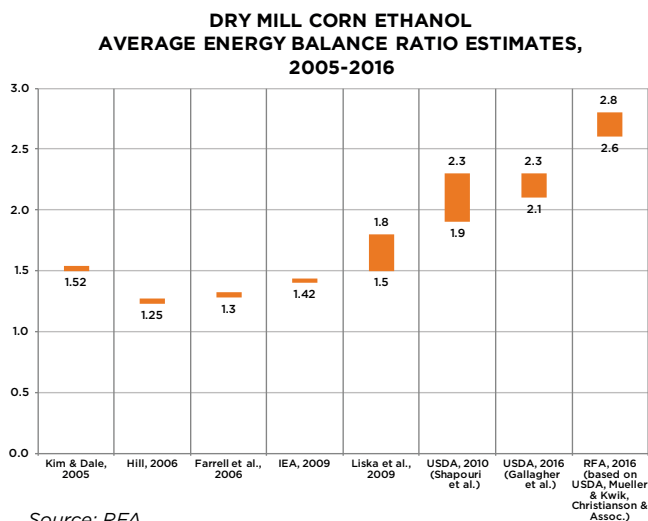
Misinformed ethanol critics often assume that increased ethanol production can only be accomplished with a big increase in cropland, and that forestland and other natural habitat will be converted to corn acres. In reality, there has been very little increase in corn acres planted during the “ethanol era,” because farmers are growing so much more corn per acre. And additional corn acres haven’t come from forest or grassland, they have come from “crop switching” (e.g., replacing wheat or cotton) or expiring CRP. What’s more, since the Renewable Fuel Standard was expanded in 2007, total U.S. cropland has actually trended lower.



Source: RFA using U.S. Dept. of Agriculture data

Ethanol’s Energy Balance is Unequivocally **POSITIVE**

For every unit of energy invested into the production of ethanol, the fuel itself provides 2.6 to 2.8 units of energy to the user, on average. The top quartile of dry mill biorefineries are averaging an energy balance of 3.2 to 3.4, with some plants very likely achieving 4.0. As far back as 2007, experts from Michigan State University and the Department of Energy pointed out that ethanol’s net energy balance is more favorable than that of gasoline or coal, an energy source for electric vehicles.



Source: RFA

Advocacy and Industry Support

As the COVID pandemic continued to disrupt normal routines in 2021, the Renewable Fuels Association began the year with an emphasis on digital tools for many of its activities, from Capitol Hill meetings to the National Ethanol Conference.

In February, the NEC was held “virtually” for the first and, we hope, last time. As vaccination rates increased and venues opened up, we were able to gather RFA’s board of directors together in St. Louis in July for the first in-person meeting since October 2019. It was at that meeting that our ethanol producer members unanimously committed to achieving a net-zero carbon footprint for ethanol by 2050 or sooner. They also pledged to achieve an average carbon intensity for ethanol that is 70 percent below gasoline’s carbon intensity by 2030 or sooner. Several months after RFA’s board adopted this trailblazing net-zero pledge, other major producers in the ethanol industry made the same commitment.

In late September, our annual membership meeting took place in Des Moines, and a new addition to the agenda—a New Uses Forum focused on emerging uses for ethanol outside of the gasoline pool—was a huge hit, drawing a standing-room audience.

Even with closed offices and telecommuting by many of our colleagues and other stakeholders, RFA continued to be a leading resource for information and advocacy on national policy and regulation. In September, for example, RFA President and CEO Geoff Cooper was invited to speak at a White House event on sustainable aviation fuel, a meeting that included several Cabinet members and other industry leaders.

RFA’s advocacy directly resulted in renewable fuel producers being specifically included as eligible to receive COVID-19 emergency relief aid. USDA announced \$700 million in pandemic relief specifically for biofuel producers, to be disbursed in early 2022. Meanwhile, our legal efforts paved the way for EPA’s proposed denial of all pending small refinery exemptions late in 2021.



Above: : In a “Virtual Day on the Hill” in April, the RFA Board met with many members of Congress, including (clockwise from upper right) Rep. Randy Feenstra (R-IA), Rep. Jim Hagedorn (R-MN), Sen. Amy Klobuchar (D-MN) and Rep. Michelle Fischbach (R-MN).

Right: New Uses Forum



Through RFA's committees, our members continued to direct the association's technical, safety, marketing, and research priorities. With regular interaction at RFA meetings, regular virtual events and conference calls, and the National Ethanol Conference, RFA members stay abreast of the policy, marketing, and technology developments that affect their bottom line.

Below: RFA Chairperson Jeanne McCaherty and President and CEO Geoff Cooper (center) were joined by NCGA President John Linder (left) and CEO Jon Doggett (right) at June's board meeting in St. Louis. The entire NCGA board leadership took part in the meeting.



RFA COMMITTEES

TECHNICAL COMMITTEE

Accurate and reliable information regarding the production, blending, distribution, and performance of renewable fuels is essential for the success of our industry. The RFA Technical Committee focuses heavily on fuel specifications and standards such as ASTM International, National Conference of Weights and Measures, ISO, Canadian General Standards Board, and other international fuel requirements. RFA members and staff continue to be recognized for their meaningful contributions within these standards development organizations.

Chair: Mark Gouthro, E Energy Adams LLC

CO-PRODUCTS COMMITTEE

The renewable fuels industry produces more than just ethanol. Renewable fuel facilities across the country also produce distillers grains, corn distillers oil, corn gluten, CO₂, and other products. The RFA Co-Products Committee focuses on issues relevant to all ethanol co-products, from research and educational programs to regulatory issues and trade. Members are involved daily in the production and marketing of co-products, making this committee an excellent forum for exchanging ideas and information.

Chair: Matt Fitzthum, CHS

NEW USES COMMITTEE

The RFA New Uses Committee focuses on expanded uses for our ethanol, carbon dioxide, co-products, and processes. Research and development projects like utilizing ethanol in heavy-duty engines or ethanol and carbon dioxide to greener chemicals are explored. The committee works to support R&D, technical and regulatory issues that arise from new uses.

ENVIRONMENTAL, HEALTH & SAFETY COMMITTEE

Part of the industry's environmental record is helping to ensure ethanol production facilities are meeting or exceeding the environmental regulations they face. The EH & S Committee is focused on making sure our member company facilities are protecting the environment while providing a forum for navigating the complex regulations imposed on this industry. This committee's highly technical discussions help familiarize renewable fuel producers with relevant environmental regulations and ensure their facilities remain compliant. For more information, please click [here](#).

Chair: Steve Schleicher, Pinnacle Engineering Inc.

RFA POLITICAL ACTION COMMITTEE

The Renewable Fuels PAC builds a stronger voice for American-made renewable fuels on Capitol Hill. Organized and operated by RFA members and staff, this Political Action Committee promotes consistent and forward-looking public policy essential to the growth and evolution of the industry by focusing on federal election activity.

Chair: Randy Doyal, AI-Corn Clean Fuel LLC

Opportunities for Outreach

Going into 2022, the Renewable Fuels Association will continue exploring innovative ways to reach important audiences—especially consumers who want or need to learn more about the fuels they use.

For the first time, RFA exhibited at the nation's largest farm show, the Farm Progress Show, in Decatur, Ill., in September, an event attended by more than 200,000 people. RFA's large exhibit area displayed the association's flex-fuel Jeep Wrangler and Polaris Ranger. Hundreds of attendees came through the outdoor exhibit to ask questions about ethanol, and to express their gratitude for RFA being there and for what we do for agriculture. We will continue our presence when the Farm Progress Show pivots to Boone, Iowa, in summer 2022.

RFA conducted its 13th—and final—sponsorship of the Sturgis Motorcycle Rally in 2021, as more than 500,000 motorcycle enthusiasts made last year's event one of the largest in the rally's storied history. RFA again partnered with the Buffalo Chip Campground to host Free Fuel Happy Hours for four days, and also participated in Women's Day, an event dedicated to female riders. To top off a long and successful run at Sturgis, the RFA team appeared on stage ahead of Kid Rock's concert, which sold more than 100,000 tickets, to share the facts about ethanol's use in motorcycles.

- Also ending after 2021 is a long-running effort with Crappie Masters to promote ethanol as a fuel for recreational boating. Ethanol had a prominent presence in 109 tournaments conducted in 12 states last year, with all winning teams running on E10.
- RFA's "Ethanol Days of Summer" sweepstakes rewarded drivers who reported E15 and E85 prices on RFA's E85prices.com web site and mobile app between Memorial Day and Labor Day, a program expected to continue into the foreseeable future.
- After a successful project building its flex-fuel Jeep Wrangler, RFA is partnering again with Kenny Hawk (and Red Bull) to build a flex-fuel UTV. TV episodes around this project will start rolling out in early 2022.



Rep. Cheri Bustos (D-IL) attended the Farm Progress Show and spent some time at the RFA exhibit. She was very interested in hearing the needs of the ethanol industry and, as an avid Jeep fan, wanted to learn more about RFA's Jeep project.

LEADING IN SAFETY TRAINING

RFA fosters industry stewardship through our award-winning ethanol safety initiatives. Supported by federal grants and managed under a cooperative partnership with TRANSCAER, we provided in-depth online and in-person education, hands-on training, and resources related to ethanol emergency response to nearly 1,600 first responders and other stakeholders in 2021 alone. Armed with record financial awards and an overhauled online course, the RFA is equipped to extend our expertise to communities across the globe in 2022.







MISSION: Drive expanded demand for American-made renewable fuels and bioproducts worldwide.

VISION: Help the world breathe easier with the power of renewable fuels.

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EthanolRFA.org/about/staff



MISSION: Meet the research and education needs of the U.S. fuel ethanol industry.

FOCUS: Collaboration with academia, industry, and public policymakers on new uses, feedstocks, and technologies to promote a growing and sustainable renewable fuels industry.

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clearflameengines.com

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compeer.com

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micorn.org

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cozairo.com

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cte-global.com

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d3maxllc.com

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datagumbo.com

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EcoEngineers
ecoengineers.us

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fageninc.com

Farm Credit Services of America
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fbn.com

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fluidquiptechnologies.com

GROWMARK Inc.
growmark.com

**Hawkeye Gold LLC, a subsidiary of
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heiskell.com

Honeywell
uop.honeywell.com

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xcelis.com

Illinois Corn Marketing Board
ilcorn.org

Indiana Corn Marketing Council
incorn.org/icmc

Iowa Corn Growers Association
iowacorn.org

Iowa Renewable Fuels Association
iowarfa.org

Kansas Corn Commission
kscorn.com/kcc

Kansas Corn Growers Association
kscorn.com/kcga

KATZEN International Inc.
katzen.com

K•Coe Isom LLP
kcoel.com

**Kentucky Corn Growers
Association**
kycorn.org

Kentucky Corn Promotion Council
kycorn.org/ky-corn-promotion-council

Kurita America Inc.
kuritaamerica.com

**Lallemand Biofuels & Distilled
Spirits**
lallemandbds.com

**Leaf, by Lesaffre Advanced
Fermentations**
lesaffreadvancedfermentations.com

Merjent Inc.
merjent.com

Michael Best & Friedrich LLC
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Minnesota Bio-Fuels Association
mnbiofuels.org

**Minnesota Corn Growers
Association**
mncorn.org

**Minnesota Corn Research &
Promotion Council**
mncorn.org

Missouri Corn Growers Association
mocorn.org

**Missouri Corn Merchandising
Council**
mocorn.org

Mole•Master Services Corp.
molemaster.com

Murex LLC
murexltd.com

National Corn Growers Association
ncga.com

**National Corn-to-Ethanol Research
Center**
ethanolresearch.com

Navigator CO₂
navigatorco2.com

Nebraska Corn Board
nebraskacorn.gov

Nebraska Corn Growers Association
necga.org

Nebraska Ethanol Board
ethanol.nebraska.gov

Next Wave Energy Partners
nextwavenergy.com

Novozymes
novozymes.com/en/advance-your-business/bioenergy

Ohio Corn Marketing Program
ohiocornandwheat.org

Orion Oil LLC
orionoil.com

Phibro Ethanol Performance Group
ethanolperformancegroup.com

Pinnacle Engineering Inc.
pineng.com

The ProExporter Network
proexporter.com

Protec Fuel Management LLC
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eflexfuel.com

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**SUEZ Water Technologies
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tncorn.org

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terracon.com

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trinityrail.com

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wibiofuels.org

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iowafuellab.com

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marylandgrain.org

Michigan Corn Growers Association
micorn.org

National Sorghum Producers
sorghumgrowers.com

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nycornsoy.org

North Dakota Corn Council
ndcorn.org/corncouncil

**South Dakota Corn Growers
Association**
sdcorn.org

2022 U.S. ETHANOL PRODUCTION CAPACITY BY PLANT

Company	City	State	Feedstock	Production Capacity (mgj)	Operating Capacity (mgj)	Capacity Under Construction/Expansion (mgj)
Absolute Energy LLC	St. Ansgar	IA	Corn	127	127	-
Ace Ethanol LLC	Stanley	WI	Corn/Cellulosic Biomass	54	43	-
Adkins Energy LLC	Lena	IL	Corn	60	30	-
Aemetis Inc.	Keyes	CA	Corn/Sorghum	65	65	-
AI-Corn Clean Fuel LLC	Claremont	MN	Corn	130	130	-
AltEn LLC	Mead	NE	Corn	25	-	-
Alto Ingredients Columbia Inc.	Boardman	OR	Corn	40	40	-
Alto Ingredients Magic Valley Inc.	Burley	ID	Corn	60	60	-
Alto Ingredients Pekin Inc. (Dry Mill)	Pekin	IL	Corn	60	60	-
Alto Ingredients Pekin Inc. (Wet Mill)	Pekin	IL	Corn	140	140	-
Alto Ingredients Pekin ICP Inc.	Pekin	IL	Corn	90	90	-
Archer Daniels Midland Co. (Dry Mill)	Cedar Rapids	IA	Corn	300	300	-
Archer Daniels Midland Co. (Wet Mill)	Cedar Rapids	IA	Corn	240	240	-
Archer Daniels Midland Co.	Clinton	IA	Corn	237	237	-
Archer Daniels Midland Co. (Dry Mill)	Columbus	NE	Corn	313	313	-
Archer Daniels Midland Co. (Wet Mill)	Columbus	NE	Corn	100	100	-
Archer Daniels Midland Co.	Decatur	IL	Corn	375	375	-
Archer Daniels Midland Co.	Marshall	MN	Corn	48	48	-
Arkalon Energy LLC	Liberal	KS	Corn	115	115	-
Attis Biofuels LLC	Fulton	NY	Corn	100	100	-
Aurora Cooperative Ethanol LLC - East	Aurora	NE	Corn	45	45	-
Aurora Cooperative Ethanol LLC - West	Aurora	NE	Corn	108	108	-
Badger State Ethanol LLC	Monroe	WI	Corn	90	90	-
Benchmark Renewable Energy LLC	Raeford	NC	Corn	60	-	-
Big River Resources Boyceville LLC	Boyceville	WI	Corn	55	55	-
Big River Resources Galva LLC	Galva	IL	Corn	125	125	-
Big River Resources West Burlington LLC	West Burlington	IA	Corn	112	112	-
Big River United Energy LLC	Dyersville	IA	Corn	130	130	-
BioUrja Renewables LLC	Peoria	IL	Corn	135	135	-
Blue Flint Ethanol LLC	Underwood	ND	Corn	70	70	-
Bonanza BioEnergy LLC	Garden City	KS	Corn/Sorghum	62	62	-
Bridgeport Ethanol LLC	Bridgeport	NE	Corn	54	54	-
Bushmills Ethanol Inc.	Atwater	MN	Corn	90	90	-
Butamax Advanced Biofuels LLC	Scandia	KS	Corn	12	12	-
Calgren Renewable Fuels LLC	Pixley	CA	Corn	55	55	-
Carbon Green BioEnergy LLC	Lake Odessa	MI	Corn	50	50	-
Cardinal Ethanol LLC	Union City	IN	Corn	140	140	-
Cargill Inc.	Blair	NE	Corn	210	210	-
Cargill Inc.	Eddyville	IA	Corn	37	37	-
Cargill Inc.	Fort Dodge	IA	Corn	115	115	-
Chief Ethanol Fuels Inc.	Hastings	NE	Corn	70	70	-
Chief Ethanol Fuels Inc.	Lexington	NE	Corn	55	55	-
Chippewa Valley Ethanol Co.	Benson	MN	Corn	44	22	-
CHS Inc.	Annawan	IL	Corn	130	91	-
CHS Inc.	Rochelle	IL	Corn	130	91	-
CIE	Marion	IN	Corn	55	55	-
Commonwealth Agri-Energy LLC	Hopkinsville	KY	Corn	45	45	-
Corn LP	Goldfield	IA	Corn	75	75	-
Dakota Ethanol LLC	Wentworth	SD	Corn	50	25	-
Dakota Spirit AgEnergy LLC	Spiritwood	ND	Corn	70	70	-
DENCO II LLC	Morris	MN	Corn	36	36	-
Diamond Ethanol LLC	Levelland	TX	Corn	40	40	-
Didion Ethanol LLC	Cambria	WI	Corn	50	50	-

Company	City	State	Feedstock	Production Capacity (mgy)	Oprating Capacity (mgy)	Capacity Under Construction/Expansion (mgy)
Dynamic Recycling LLC	Bristol	TN	Waste Sugars/Alcohol	2	2	-
E Energy Adams LLC	Adams	NE	Corn	100	100	-
East Kansas Agri-Energy LLC	Garnett	KS	Corn	45	36	-
ELEMENT LLC	Colwich	KS	Corn/Sorghum/Cellulosic Biomass	70	56	-
Elite Octane LLC	Atlantic	IA	Corn	150	150	-
ESE Alcohol Inc.	Leoti	KS	Waste Seed Corn	2	2	-
Fox River Valley Ethanol LLC	Oshkosh	WI	Corn	65	65	-
Front Range Energy LLC	Windsor	CO	Corn	40	40	-
Gevo Inc.	Luverne	MN	Corn	22	-	-
Glacial Lakes Energy LLC	Aberdeen	SD	Corn	50	50	-
Glacial Lakes Energy LLC	Huron	SD	Corn	40	40	-
Glacial Lakes Energy LLC	Mina	SD	Corn	140	140	-
Glacial Lakes Energy LLC	Watertown	SD	Corn	130	130	-
Golden Grain Energy LLC	Mason City	IA	Corn	120	120	-
Golden Triangle Energy LLC	Craig	MO	Corn	20	20	-
Grain Processing Corp.	Muscatine	IA	Corn	78	70	-
Grain Processing Corp.	Washington	IN	Corn	35	35	-
Granite Falls Energy LLC	Granite Falls	MN	Corn	62	56	-
GreenAmerica Biofuels Ord LLC	Ord	NE	Corn	57	57	-
Green Plains Atkinson LLC	Atkinson	NE	Corn	55	55	-
Green Plains Central City LLC	Central City	NE	Corn	116	116	-
Green Plains Fairmont LLC	Fairmont	MN	Corn	119	119	-
Green Plains Madison LLC	Madison	IL	Corn	90	90	-
Green Plains Mount Vernon LLC	Mount Vernon	IN	Corn	90	90	-
Green Plains Obion LLC	Rives	TN	Corn	120	120	-
Green Plains Otter Tail LLC	Fergus Falls	MN	Corn	55	55	-
Green Plains Shenandoah LLC	Shenandoah	IA	Corn	82	82	-
Green Plains Superior LLC	Superior	IA	Corn	60	60	-
Green Plains Wood River LLC	Wood River	NE	Corn	121	121	-
Green Plains York LLC	York	NE	Corn	50	50	-
Greenfield Global Inc.	Winnebago	MN	Corn	48	48	-
Guardian Energy LLC	Janesville	MN	Corn	150	150	-
Guardian Hankinson LLC	Hankinson	ND	Corn	150	150	-
Guardian Lima LLC	Lima	OH	Corn	70	60	-
Heartland Corn Products	Winthrop	MN	Corn	120	114	-
Hereford Ethanol Partners LP	Hereford	TX	Corn	105	105	-
Heron Lake BioEnergy LLC	Heron Lake	MN	Corn	59	53	-
Highwater Ethanol LLC	Lamberton	MN	Corn	66	66	-
Homeland Energy Solutions LLC	Lawler	IA	Corn	190	190	-
Husker Ag LLC	Plainview	NE	Corn	80	56	-
ICM Biofuels LLC	St. Joseph	MO	Corn	50	50	-
Iroquois Bio-Energy Co. LLC	Rensselaer	IN	Corn	55	55	-
KAAPA Ethanol LLC	Minden	NE	Corn	80	80	-
KAAPA Ethanol Ravenna LLC	Ravenna	NE	Corn	125	125	-
Kansas Ethanol LLC	Lyons	KS	Corn	80	80	-
LanzaTech Freedom Pines Fuels LLC	Soperton	GA	Industrial Off-Gases/Biomass/Biogas	-	-	10
Lincolnland Agri-Energy LLC	Palestine	IL	Corn	62	62	-
Lincolnway Energy LLC	Nevada	IA	Corn	80	72	-
Little Sioux Corn Processors LLC	Marcus	IA	Corn	160	160	-
Louis Dreyfus Grand Junction LLC	Grand Junction	IA	Corn/Cellulosic Biomass	125	125	-
Louis Dreyfus Norfolk LLC	Norfolk	NE	Corn	50	50	-
Marquis Energy LLC	Hennepin	IL	Corn	365	365	-
Marquis Energy-Wisconsin LLC	Necedah	WI	Corn	50	50	-

Company	City	State	Feedstock	Production Capacity (mg)	Operating Capacity (mg)	Capacity Under Construction/Expansion (mg)
Marysville Ethanol LLC	Marysville	MI	Corn	50	50	-
MGPI Processing Inc.	Atchison	KS	Corn	3	3	-
Mid America Agri Products/Wheatland LLC	Madrid	NE	Corn	49	49	-
Mid-Missouri Energy Inc.	Malta Bend	MO	Corn	60	36	-
Midwest Renewable Energy LLC	Sutherland	NE	Corn	26	26	-
MMI/Etoh Inc.	Aurora	CO	Waste Alcohol	3	3	-
MXI Environmental Services LLC	Abingdon	VA	Waste Alcohol	2	2	-
Nebraska Corn Processing LLC	Cambridge	NE	Corn	50	50	-
New Energy Blue LLC	Mason City	IA	Cellulosic Biomass	-	-	20
NuGen Energy LLC	Marion	SD	Corn	150	150	-
One Earth Energy LLC	Gibson City	IL	Corn	150	150	-
Parallel Products	Louisville	KY	Waste Sugars/Alcohol	5	5	-
Parallel Products	Ontario	CA	Waste Sugars/Alcohol	2	2	-
Pelican Acquisition LLC	Stockton	CA	Corn/Sorghum/Cellulosic Biomass	60	60	-
Pennsylvania Grain Processing LLC	Clearfield	PA	Corn	120	120	-
Pinal Energy LLC	Maricopa	AZ	Corn	55	55	-
Pine Lake Corn Processors LLC	Steamboat Rock	IA	Corn	80	80	-
Plymouth Energy LLC	Merrill	IA	Corn	55	55	-
POET Biorefining - Alexandria LLC	Alexandria	IN	Corn	103	103	-
POET Biorefining - Arthur LLC	Arthur	IA	Corn	140	140	-
POET Biorefining - Ashton LLC	Ashton	IA	Corn	56	56	-
POET Biorefining - Big Stone LLC	Big Stone City	SD	Corn	79	79	-
POET Biorefining - Bingham Lake LLC	Bingham Lake	MN	Corn	34	34	-
POET Biorefining - Camilla LLC	Camilla	GA	Corn	120	120	-
POET Biorefining - Caro LLC	Caro	MI	Corn	53	53	-
POET Biorefining - Chancellor LLC	Chancellor	SD	Corn	110	110	-
POET Biorefining - Cloverdale LLC	Cloverdale	IN	Corn	92	92	-
POET Biorefining - Coon Rapids LLC	Coon Rapids	IA	Corn	54	54	-
POET Biorefining - Corning LLC	Corning	IA	Corn	65	65	-
POET Biorefining - Emmetsburg LLC	Emmetsburg	IA	Corn	55	55	-
POET Biorefining - Fairbank LLC	Fairbank	IA	Corn	135	135	-
POET Biorefining - Fairmont LLC	Fairmont	NE	Corn	137	137	-
POET Biorefining - Fostoria LLC	Fostoria	OH	Corn	68	68	-
POET Biorefining - Glenville LLC	Albert Lea	MN	Corn	42	42	-
POET Biorefining - Gowrie LLC	Gowrie	IA	Corn	69	69	-
POET Biorefining - Groton LLC	Groton	SD	Corn	53	53	-
POET Biorefining - Hanlontown LLC	Hanlontown	IA	Corn	56	56	-
POET Biorefining - Hudson LLC	Hudson	SD	Corn	56	56	-
POET Biorefining - Iowa Falls LLC	Iowa Falls	IA	Corn/Cellulosic Biomass	115	115	-
POET Biorefining - Jewell LLC	Jewell	IA	Corn	90	90	-
POET Biorefining - Laddonia LLC	Laddonia	MO	Corn	50	50	-
POET Biorefining - Lake Crystal LLC	Lake Crystal	MN	Corn	60	60	-
POET Biorefining - Leipsic LLC	Leipsic	OH	Corn	103	103	-
POET Biorefining - Macon LLC	Macon	MO	Corn	46	46	-
POET Biorefining - Marion LLC	Marion	OH	Corn	150	150	-
POET Biorefining - Menlo LLC	Menlo	IA	Corn	150	150	-
POET Biorefining - Mitchell LLC	Mitchell	SD	Corn	68	68	-
POET Biorefining - North Manchester LLC	North Manchester	IN	Corn	68	68	-
POET Biorefining - Portland LLC	Portland	IN	Corn	68	68	-
POET Biorefining - Preston LLC	Preston	MN	Corn	46	46	-
POET Biorefining - Shelbyville LLC	Shelbyville	IN	Corn	80	80	-
POET Biorefining - Shell Rock LLC	Shell Rock	IA	Corn/Cellulosic Biomass	140	140	-
POET Research Center Inc.	Scotland	SD	Corn	12	12	-

Company	City	State	Feedstock	Production Capacity (mgy)	Operating Capacity (mgy)	Capacity Under Construction/Expansion (mgy)
Pratt Energy LLC	Pratt	KS	Corn	55	55	-
Project LIBERTY	Emmetsburg	IA	Cellulosic Biomass	25	-	-
PureField Ingredients LLC	Russell	KS	Corn/Sorghum/Cellulosic Biomass	55	55	-
Quad County Corn Processors	Galva	IA	Corn/Cellulosic Biomass	38	34	-
Red River BioRefinery LLC	Grand Forks	ND	Waste Sugars/Starch	17	17	-
Red River Energy LLC	Rosholt	SD	Corn	35	35	-
Red Trail Energy LLC	Richardton	ND	Corn	65	65	-
Redfield Energy LLC	Redfield	SD	Corn	60	54	-
Reeve Agri-Energy Inc.	Garden City	KS	Corn/Sorghum	13	13	-
Ringneck Energy LLC	Onida	SD	Corn	80	80	-
Seaboard Energy California LLC	Madera	CA	Corn/Sorghum	40	40	-
Show Me Ethanol LLC	Carrollton	MO	Corn	51	46	-
Siouxland Energy Cooperative	Sioux Center	IA	Corn	70	70	-
Siouxland Ethanol LLC	Jackson	NE	Corn	90	90	-
South Bend Ethanol LLC	South Bend	IN	Corn	102	102	-
Southwest Iowa Renewable Energy LLC	Council Bluffs	IA	Corn	130	98	-
Sterling Ethanol LLC	Sterling	CO	Corn	50	50	-
Summit Agricultural Group	Phillipsburg	KS	Corn/Sorghum/Wheat	40	-	-
Tate & Lyle PLC	Loudon	TN	Corn	110	110	-
Tharaldson Ethanol LLC	Casselton	ND	Corn	175	175	-
The Andersons Albion Ethanol LLC	Albion	MI	Corn	140	140	-
The Andersons Clymers Ethanol LLC	Clymers	IN	Corn	135	135	-
The Andersons Denison Ethanol LLC	Denison	IA	Corn	65	65	-
The Andersons Marathon Ethanol LLC	Greenville	OH	Corn	135	135	-
Three Rivers Energy LLC	Coshocton	OH	Corn	55	55	25
Trenton Agri Products LLC	Trenton	NE	Corn	50	40	-
United Ethanol LLC	Milton	WI	Corn	62	62	-
United Wisconsin Grain Producers LLC	Friesland	WI	Corn	60	60	-
Valero Renewable Fuels Co. LLC	Albert City	IA	Corn	135	135	-
Valero Renewable Fuels Co. LLC	Albion	NE	Corn	135	135	-
Valero Renewable Fuels Co. LLC	Aurora	SD	Corn	140	140	-
Valero Renewable Fuels Co. LLC	Bloomington	OH	Corn	135	135	-
Valero Renewable Fuels Co. LLC	Bluffton	IN	Corn	130	130	-
Valero Renewable Fuels Co. LLC	Charles City	IA	Corn	140	140	-
Valero Renewable Fuels Co. LLC	Fort Dodge	IA	Corn	140	140	-
Valero Renewable Fuels Co. LLC	Hartley	IA	Corn	140	140	-
Valero Renewable Fuels Co. LLC	Jefferson	WI	Corn	110	110	-
Valero Renewable Fuels Co. LLC	Lakota	IA	Corn	110	110	-
Valero Renewable Fuels Co. LLC	Linden	IN	Corn	135	135	-
Valero Renewable Fuels Co. LLC	Mount Vernon	IN	Corn	100	100	-
Valero Renewable Fuels Co. LLC	Riga	MI	Corn	57	57	-
Valero Renewable Fuels Co. LLC	Welcome	MN	Corn	140	140	-
VERBIO North America Corp.	Nevada	IA	Corn/Cellulosic Biomass	7	-	60
West Coast Waste	Madera	CA	Waste Sugars	-	-	45
Western New York Energy LLC	Medina	NY	Corn	65	65	-
Western Plains Energy LLC	Campus	KS	Corn/Sorghum	50	40	-
White Energy Inc.	Hereford	TX	Corn/Sorghum	100	100	-
White Energy Inc.	Plainview	TX	Corn	100	100	-
Yuma Ethanol LLC	Yuma	CO	Corn	50	50	-
U.S. TOTAL				17,655	17,127	160

ZEROING IN ON THE RENEWABLE FUELS ASSOCIATION



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Suite 101
Ellisville, MO 63011
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WASHINGTON, DC

425 3rd Street, SW
Suite 1150
Washington, DC 20024
202-289-3835