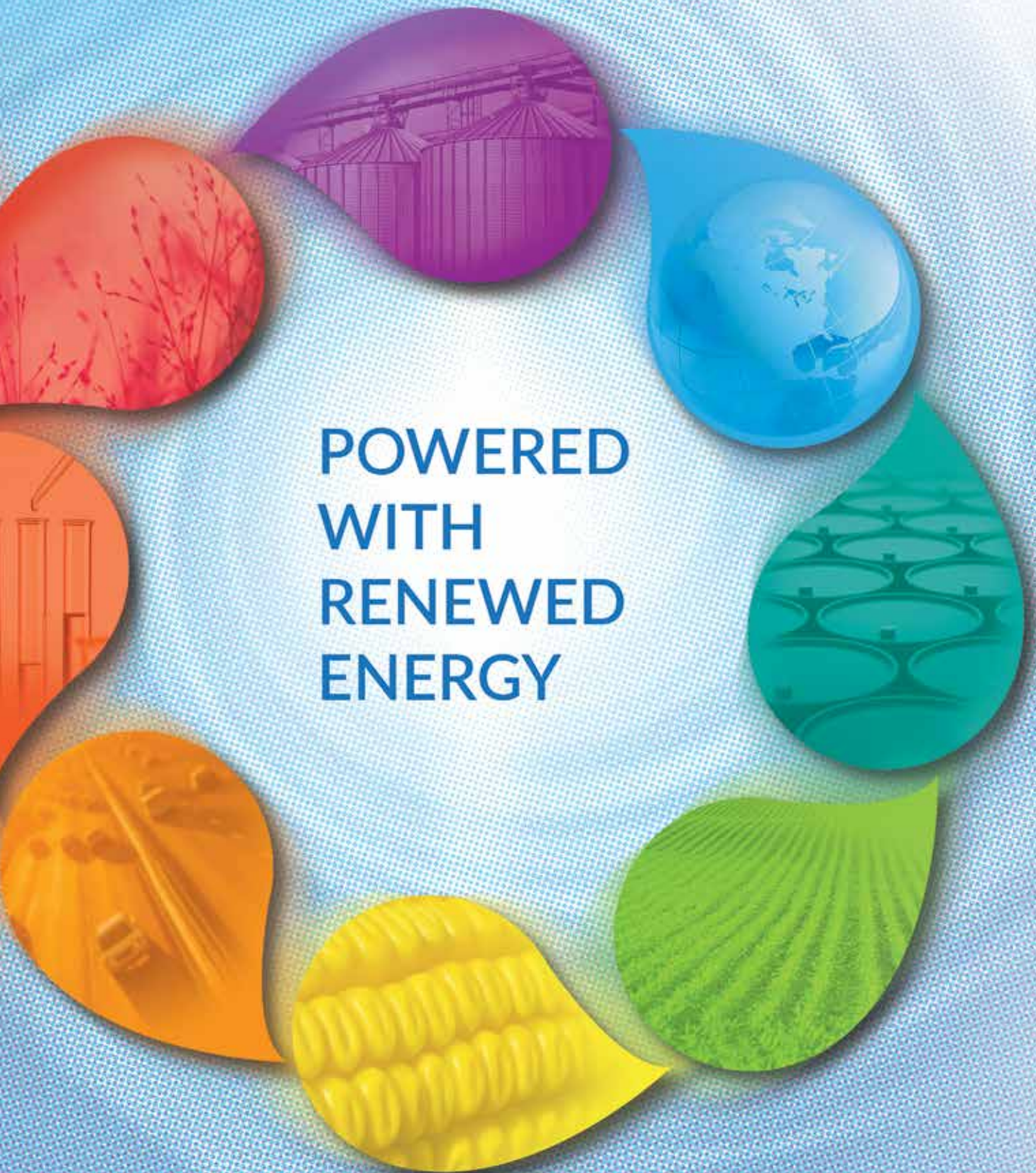
2019 ETHANOL INDUSTRY OUTLOOK

RFA RENEWABLE FUELS ASSOCIATION



POWERED WITH RENEWED ENERGY

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RFA RENEWABLE FUELS ASSOCIATION

At first glance, the theme of this year's Annual Industry Outlook, "Powered with Renewed Energy," might seem a safe and obvious choice. After all, biofuels like ethanol are, by nature, the epitome of renewed energy. As winter's cold and bleakness give way to the warmth and rejuvenation of spring, farmers enter their fields to sow a new crop. And after collecting and storing the sun's bountiful energy throughout the growing season, those crops are harvested and transformed into the clean fuels that power our nation and world. This natural rhythm renews and repeats itself each and every year.

However, this year's theme goes far beyond its literal underpinnings. Indeed, the Renewable Fuels Association (RFA)—and the ethanol industry itself—are experiencing renewal and remarkable change as well.

After 17 years at the helm of RFA, my friend and mentor Bob Dinneen has assumed a new role as Senior Strategic Advisor. Once described by the *Wall Street Journal* as "indefatigable" and the "ethanol lobby's old reliable," Bob has undoubtedly left an indelible mark on our industry. And he'll continue to provide guidance and counsel as we navigate an uncertain future.

But just as the best stories ever written have many chapters, the RFA is turning the page and entering an exciting new era. I was thrilled and humbled to assume the role as RFA's President and CEO in late 2018, and I am beyond excited to bring new energy, passion, and ideas to the association and the industry at large.

Make no mistake, our challenges are legion. Antiquated regulatory hurdles, attacks on the Renewable Fuel Standard, protectionist trade barriers, and a constant barrage of myths and misinformation are undermining domestic and global demand for our products. It is easy to become discouraged.

But our opportunities are boundless. Ethanol remains the highest-octane, lowest-cost motor fuel on the planet. And it is the only tool available at scale in the near term to significantly reduce carbon emissions from gasoline. Meanwhile, the industry's co-products—including distillers grains and distillers oil—provide indispensable protein and energy to a hungry world.

The world wants and needs your products! And when given a true choice, consumers will choose affordability, efficiency, security, and renewability every time.

It is our hope that the facts, figures, and data presented in this year's Outlook not only help you prepare for the challenges and opportunities ahead in 2019, but also that they renew your energy and passion for our extraordinary industry.

Sincerely,

Geoff Cooper

Geoff Cooper, President & CEO

Powering Forward

Despite strong headwinds, the U.S. ethanol industry powered forward in 2018, breaking records in production, total consumption, and exports.

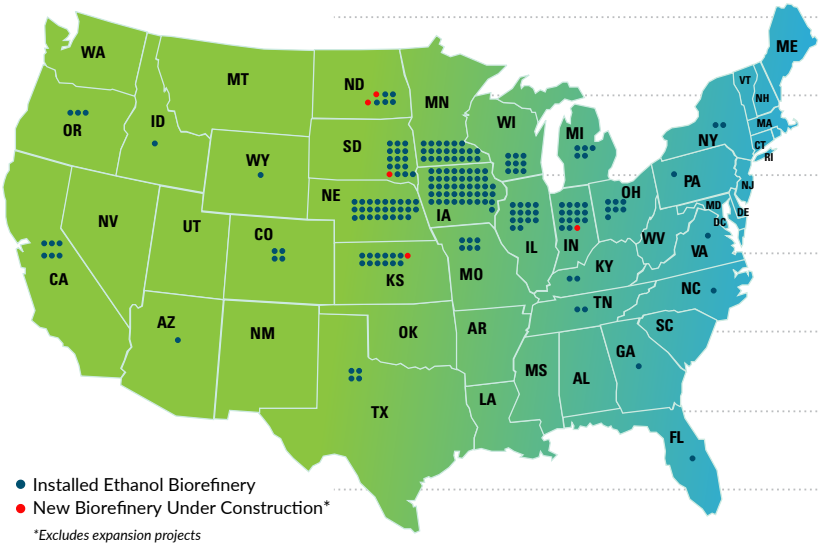
The nation's 210 ethanol plants located across 27 states produced an astounding 16.1 billion gallons of clean-burning renewable ethanol. Total consumption rose to a record 16.2 billion gallons, 300 million gallons more than a year ago, driven largely by record exports of over 1.6 billion gallons as global octane demand continues to grow.

Domestic demand also seemed destined for record levels as January blend rates topped a record 10.75%, shattering the so-called blend wall. But as word of EPA's indiscriminate use of small refinery exemptions from the federal Renewable Fuel Standard (RFS) spread, domestic usage fell precipitously, hitting a four-year low of just 9.54% in April.

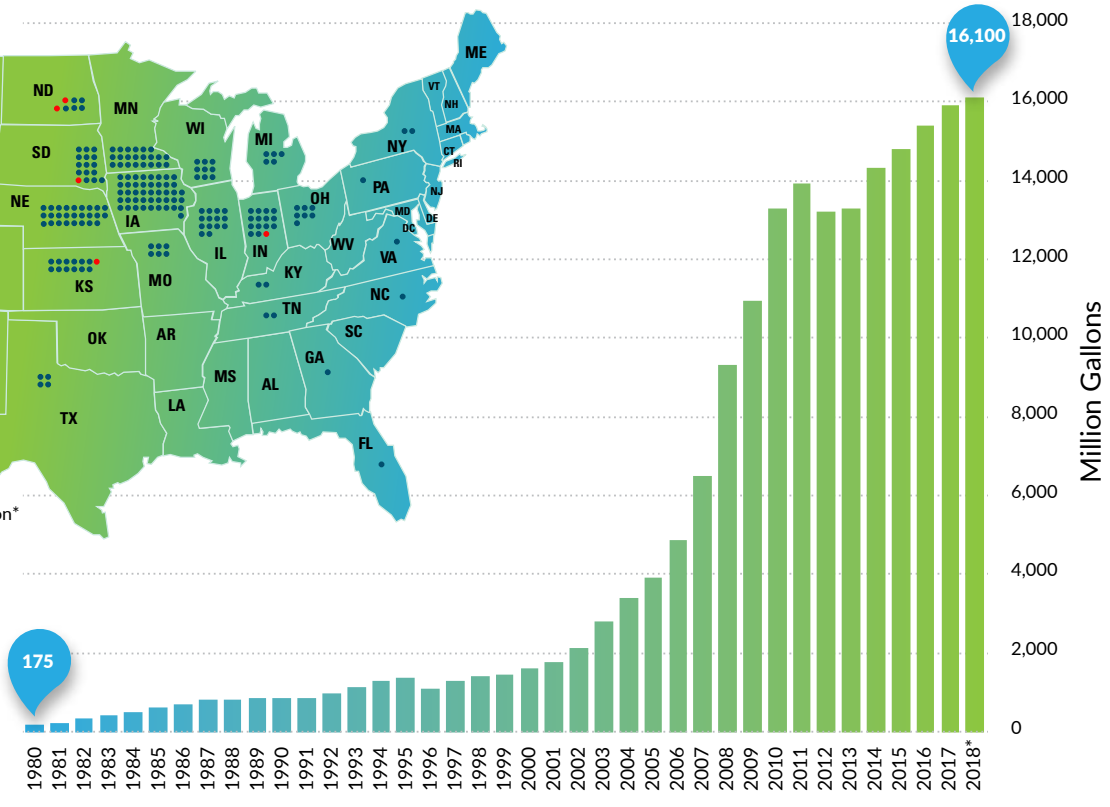
Not surprisingly, such a dramatic drop in demand caused an equally stark impact on ethanol prices and ethanol industry profitability. Ethanol prices fell to a 13-year low as the market responded to preserve some semblance of market share. Reduced demand also impacted farmers, who lost a large portion of their single most important value-added market for corn. Net farm income fell to its lowest level in a decade. Refiners benefitted. Average monthly U.S. refiner cash operating margins rose steadily throughout the year as ethanol stocks rose and RFS credit prices cratered.

Still, there are more optimistic signs on the horizon. President Trump has promised EPA will promulgate a rule allowing the year-round use of E15 before the summer of 2019, trade markets are expected to grow even more as uncertainty over various trade agreements dissipates and octane demand globally continues to soar, and a renewed interest in low carbon fuels portends increased demand for renewable fuels here and abroad. Production from newly constructed plants and completed expansions will be available to meet new demand and provide a beacon of hope for a brighter future.

U.S. Fuel Ethanol Biorefineries by State



Historic U.S. Fuel Ethanol Production



Source: RFA and U.S. Energy Information Administration

**Estimated*

U.S. Ethanol Production Capacity by State

(Million Gallons per Year)

	Existing Production Capacity	Operating Production	Under Construction/ Expansion	Total Capacity
Iowa*	4,328	4,278	30	4,358
Nebraska	2,239	2,186	-	2,239
Illinois	1,787	1,687	-	1,787
Minnesota	1,297	1,257	35	1,332
Indiana	1,198	1,198	80	1,278
South Dakota	1,080	1,080	80	1,160
Ohio	630	630	-	630
Wisconsin	585	585	4	589
Kansas	516	491	70	586
North Dakota	470	470	51	521
Texas	385	345	-	385
Michigan	355	355	-	355
Missouri	276	261	-	276
Tennessee	225	225	-	225
California	223	218	-	223
Oregon	162	42	-	162
New York	150	150	-	150
Colorado	125	125	-	125
Georgia	120	120	-	120
Pennsylvania	110	110	-	110
Idaho	60	60	-	60
North Carolina	60	-	-	60
Arizona	50	50	-	50
Kentucky	48	48	-	48
Wyoming	10	-	-	10
Florida	8	-	-	8
Virginia	4	4	-	4
TOTAL U.S.	**16,501**	**15,975**	**350**	**16,851**

Production Facilities

Installed Ethanol Biorefineries	Operating Ethanol Biorefineries	Biorefineries Under Constr./ Expansion
44	44	1
26	24	-
14	14	-
22	20	1
14	14	1
15	15	1
7	7	-
9	9	1
12	11	1
5	5	2
4	3	-
5	5	-
6	6	-
2	2	-
6	5	-
3	2	-
2	2	-
4	4	-
1	1	-
1	1	-
1	1	-
1	-	-
1	1	-
2	2	1
1	-	-
1	-	-
1	1	-
210	**199**	**9**

Source: RFA, as of January, 2019 **Data includes 2 operating plants with unknown or undisclosed production volumes.*

Historical Biorefinery Count and Production Capacity

	Installed Ethanol Biorefineries	Total Installed Production Capacity (mgy)	Average Capacity per Biorefinery (mgy)
1998	56	1,784	31.9
2003	72	3,101	43.1
2008	170	10,569	62.2
2013	210	14,880	70.9
2018	210	16,501	78.6

Source: RFA ** As of December for each year specified*

Renewing the Rural Economy

While the broader rural economy participated in national growth trends following passage of the Tax Cuts and Jobs Act in December 2017, the agriculture sector continued to struggle in 2018. The crop sector endured its sixth consecutive year of reduced cash receipts, as a trade dispute with China hit soybean producers particularly hard. Additionally, growers felt the effects of rising interest rates, as farm debt reached levels one-third higher than early in the decade.

According to Creighton University, farmland prices and farm equipment sales continued to be weak spots in the rural economy, and a survey for its Rural Mainstreet Index found, "Approximately one-fifth of bank CEOs expect low farm income and falling farmland prices to present the greatest challenge to banking operations over the next 5 years."

While the ethanol industry also was affected by the trade dispute with China, the export market overall remained a bright spot and production reached a record 16.1 billion gallons. The industry provided a critically important market for corn and sorghum producers and bolstered rural incomes.

In 2018, the ethanol industry directly employed 71,367 American workers, and it supported an additional 294,516 indirect and induced jobs across all sectors of the economy. The industry created $25 billion in household income and contributed $46 billion to the national Gross Domestic Product (GDP). Moreover, the ethanol industry generated nearly $10 billion in federal, state and local taxes, and spent over $26 billion on raw materials, inputs, and other goods and services.

Consistent with the ethanol industry's role of contributing to America's energy independence, almost one-quarter of the people employed by the industry are veterans of the U.S. military – nearly four times the rate of the U.S. workforce as a whole.

With new ethanol facilities starting up production and existing facilities expanding, the industry will continue to provide additional employment opportunities and add value to farm products.

Ethanol's Value-Added Proposition

Based on average prices and product yields in 2018, a typical dry mill ethanol plant was adding nearly $2 of additional value—or 55%—to every bushel of corn processed.

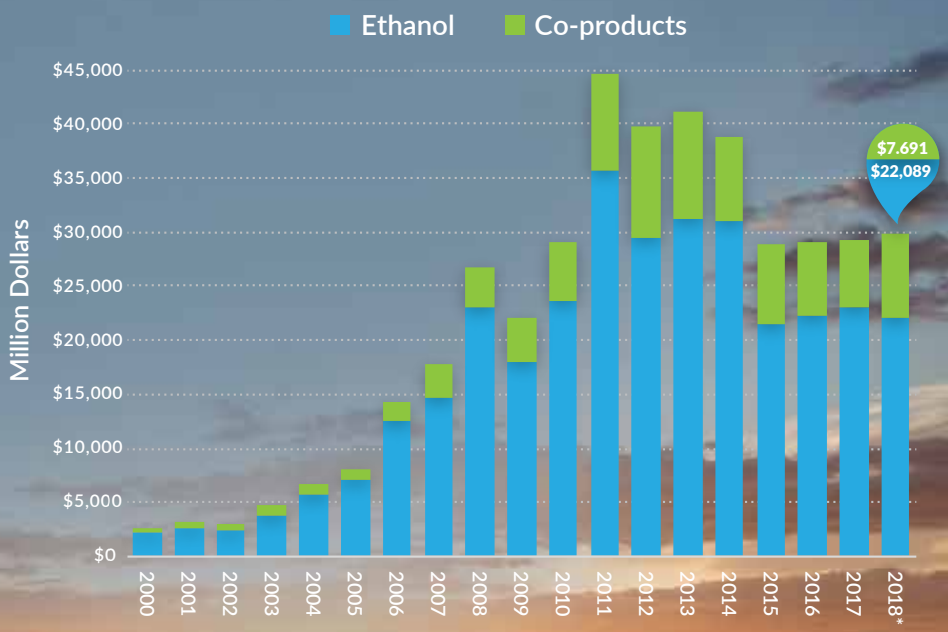
CORN COST PER BUSHEL	
	$3.35

VALUE OF OUTPUTS PER BUSHEL	
Ethanol	$3.84
Distillers Grains	$1.16
Corn Distillers Oil	$0.19
TOTAL	$5.19

In 2018, the production of 16.1 billion gallons of ethanol and 43 million metric tons of co-products and distillers oil had substantial economic impacts, including:

- **71,367 direct jobs**
- **294,516 indirect and induced jobs**
- **$46 billion contribution to GDP**
- **$25 billion in household income**
- **$10 billion in tax revenue**

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 (All Industries)
GENDER (Female / Male)	30% / 70%	26% / 74%	47% / 53%
55 AND OVER	29%	24%	23%
UNIONIZED	9%	2%	11%
MILITARY VETERANS	23%	11%	6%

Sources: National Association of State Energy Officials and Energy Futures Initiative

Energizing Global Markets

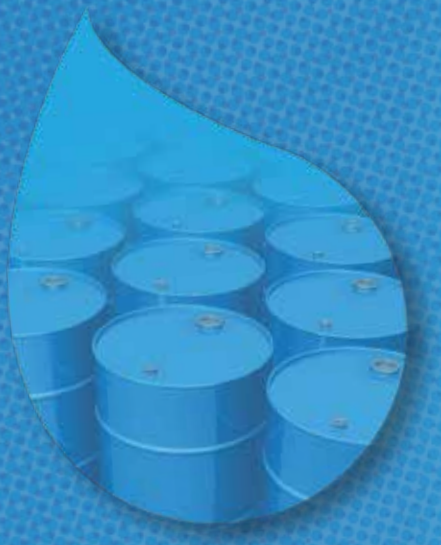
The United States ethanol industry is a global powerhouse, leading the world in supply and demand. With 16.1 billion gallons in 2018 output, the United States produced double the volume generated by Brazil—the world's second largest producer. Ethanol blending for transportation use continued to outpace the rest of the globe. Meanwhile exports swelled 20 percent to a new record high of over 1.6 billion gallons, finding a home for roughly 10% of American ethanol production in 2018.

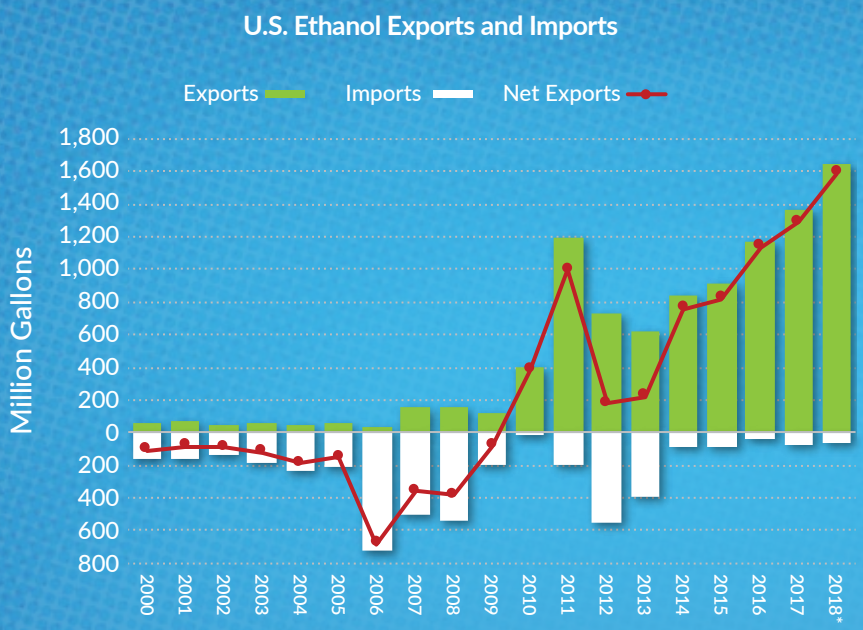
Brazil and Canada remained our top customers for the fourth straight year, accounting for half of all U.S. ethanol exports. However, Brazilian trade barriers caused U.S. ethanol shipments to vacillate significantly throughout the year following a peak draw in February. In addition, increased protectionist policies by China and a continuation of European Union barriers combined to shift the U.S. trading landscape further. As a result, U.S. shipments also were dispersed to several smaller and mid-sized markets like India, South Korea, and the Philippines. As a result, U.S. shipments also were dispersed to several smaller markets like India, South Korea, the Netherlands, and the Philippines.

Meanwhile, U.S. ethanol imports pressed below the 100-million-gallon mark for the fifth year in a row. Brazil shipped 60 million gallons of sugarcane ethanol—roughly 20 percent less than last year, taking advantage of the favorable treatment under the California Low Carbon Fuel Standard (LCFS) and RFS.

New opportunities within the global market are on the horizon in 2019. A new Japanese biofuel policy allows U.S. corn ethanol to meet up to 44 percent of the estimated ethanol required to make ETBE. This updates Japan's existing sustainability policy in which only sugarcane ethanol was eligible for import and production of the oxygenate.

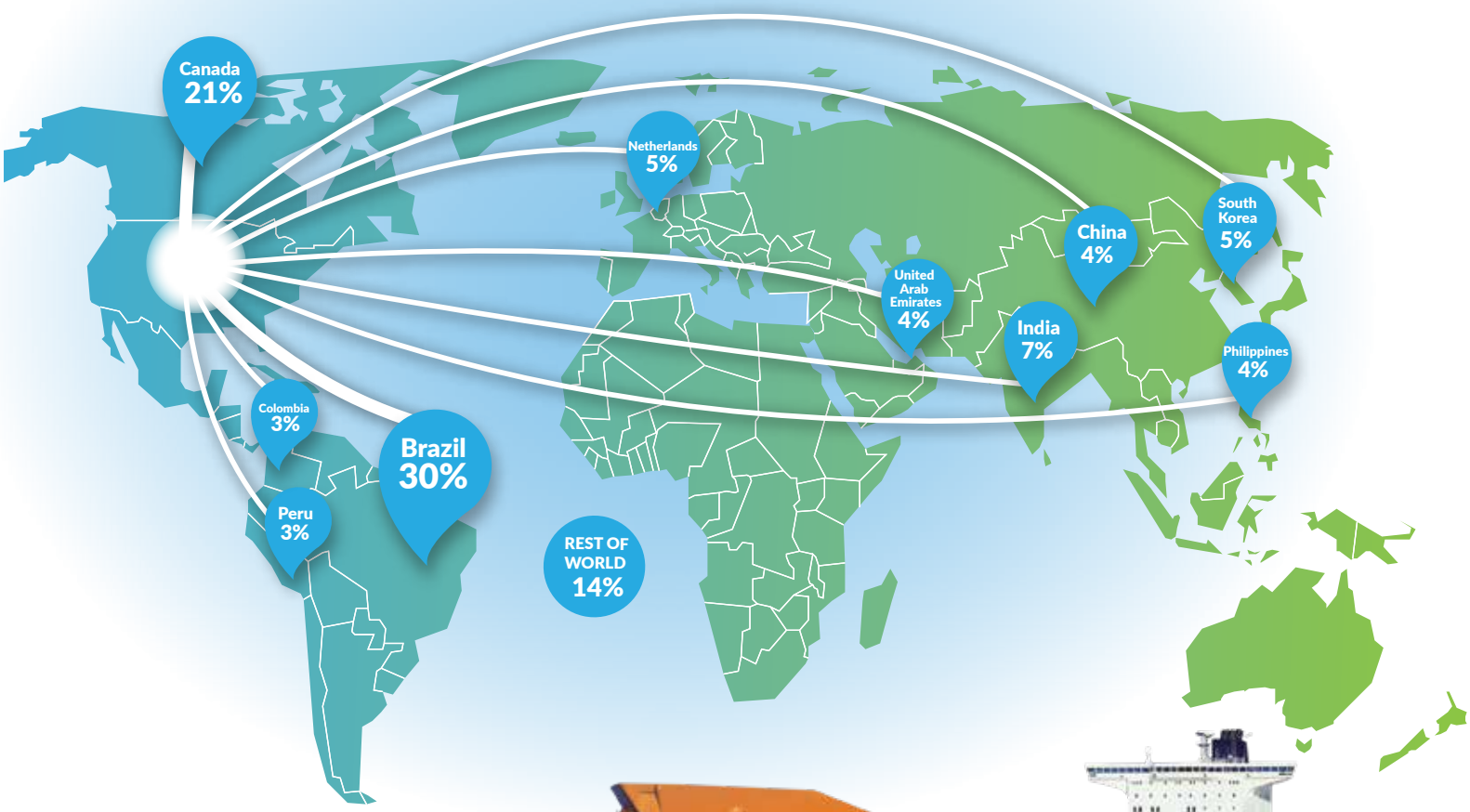
RFA continues to watch the unfolding of the implementation of Brazil's RenovaBio, a new national biofuels policy approved in December 2017. This policy will likely encourage significant growth in biofuels consumption in the country. In 2019, RFA will be collaborating closely with the Brazilian government to establish a fair trading platform. The primary focus will be to ensure the carbon intensity scoring of biofuel pathways under the program is transparent and science-based. If done correctly, RenovaBio could provide substantial U.S. ethanol export opportunities.





Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**2018 estimated based on Jan.-Sep. 2018*

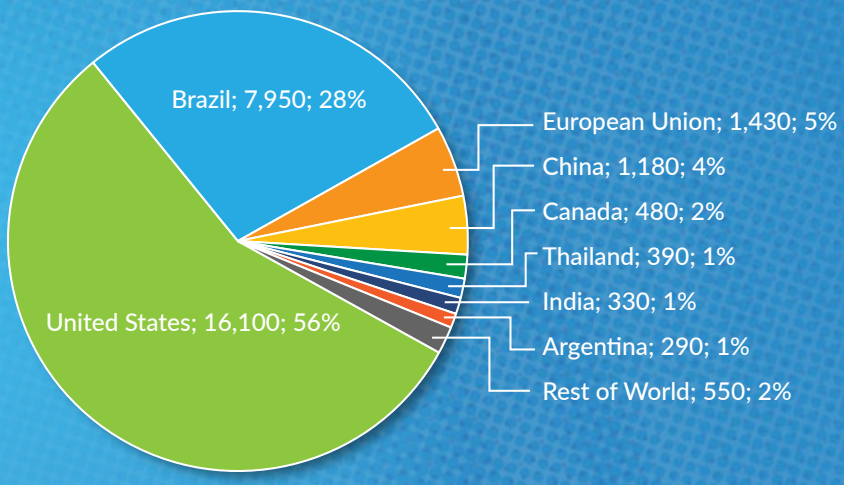
Top Destinations for U.S. Ethanol Exports in 2018



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Based on Jan.-Sep. 2018*

2018 Global Fuel Ethanol Production by Country

(Country, million gallons, share of global production)



Source: RFA analysis of public and private data sources

"The President promised to have the back of every American farmer and rancher, and he knows the importance of keeping our rural economy strong. Unfortunately, America's hard-working agricultural producers have been treated unfairly by China's illegal trading practices and have taken a disproportionate hit when it comes to illegal retaliatory tariffs. USDA will not stand by while our hard-working agricultural producers bear the brunt of unfriendly tariffs enacted by foreign nations."

USDA Sec. Sonny Perdue

Powerful Nutrition

Consistent with record ethanol production, the U.S. industry generated a record 41.3 million metric tons (mmt) of distillers grains (DDGS), gluten feed, and gluten meal. These ingredients are mixed into rations for beef and dairy cattle, swine, poultry, and even fish. The industry also produced 4 billion pounds of corn distillers oil, used as a feed ingredient or biodiesel feedstock.

Now fully under the regulatory oversight of the U.S. Food & Drug Administration, ethanol plants are required to comply with preventive controls requirements as mandated by the Food Safety Modernization Act (FSMA). This federal rule requires covered facilities to follow current good manufacturing practices for animal food production and have a written food safety plan that includes an analysis of hazards and risk-based controls. These preventive controls provide a formal assurance to buyers around the world that American ethanol co-products continue to be safe feed ingredients.

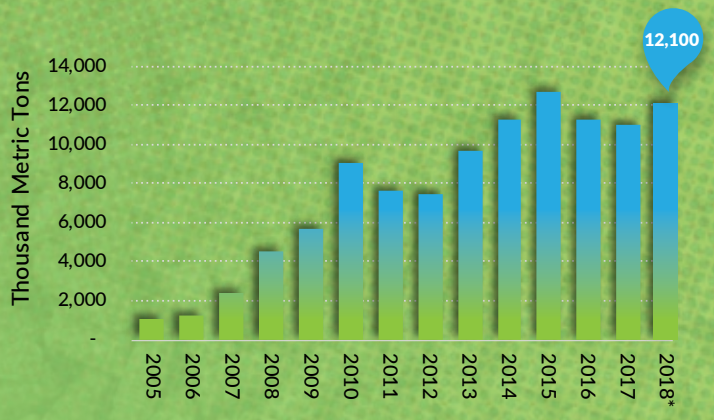
A GLOBAL DYNAMO

U.S. biorefineries satisfied growing domestic feed needs while also exporting nearly one out of every three tons of distillers grains. A geographically diverse set of markets on five continents jockeyed to purchase the 12.1 mmt of exported U.S. DDGS in 2018. For the second straight year, Mexico was the top market as close to a fifth of all shipments headed south of the border. South Korea, Turkey, Vietnam, and Thailand were other top markets in 2018.

Unfortunately, protectionist trade barriers also affected distillers grains exports. After serving as the top destination for U.S. DDGS five years in a row, the Chinese market collapsed to less than 2 percent of global shipments in 2018 due to the imposition of a punitive tariff in effect for five years starting January 2017. Vietnam, however, re-opened its doors to U.S. DDGS exports following its Dec. 2016 market suspension.

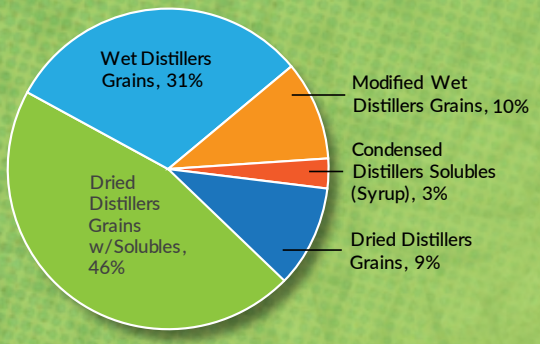
The Renewable Fuels Association will continue to look for ways to open and expand markets for American ethanol co-products in 2019.

U.S. Distillers Grains Exports



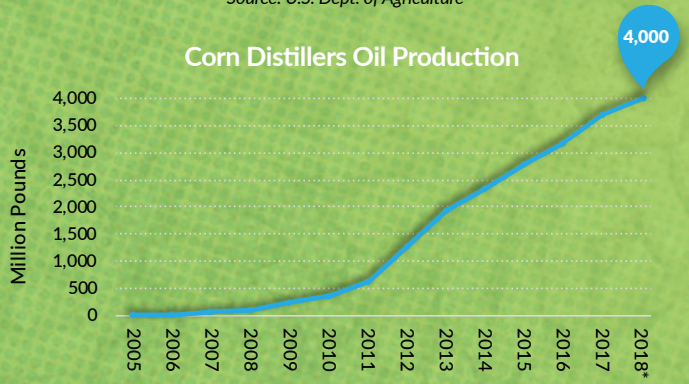
Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**2018 estimated based on Jan.-Sep. 2018*

Distillers Grains Production by Type, As-Is Basis



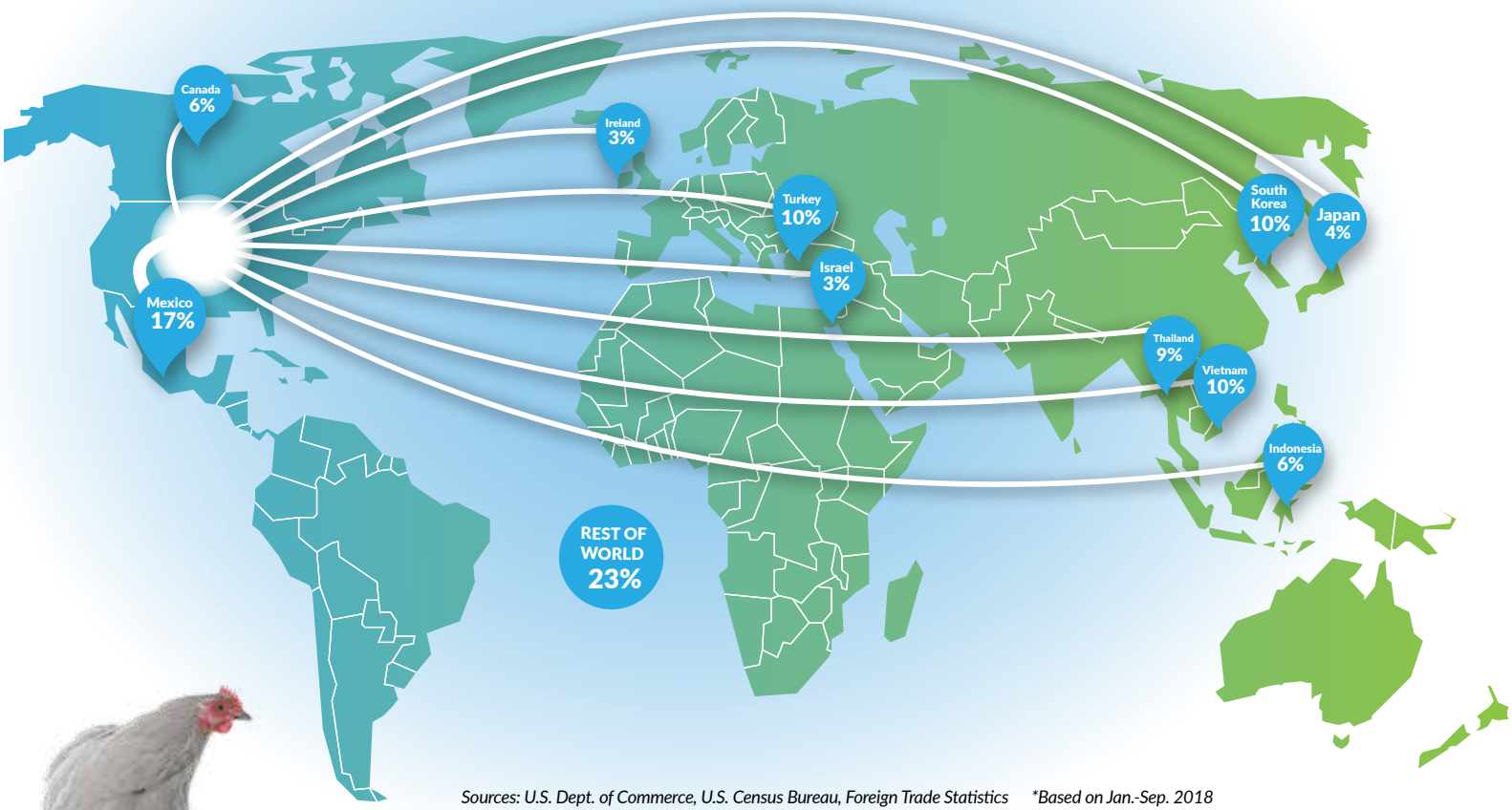
Source: U.S. Dept. of Agriculture

Corn Distillers Oil Production



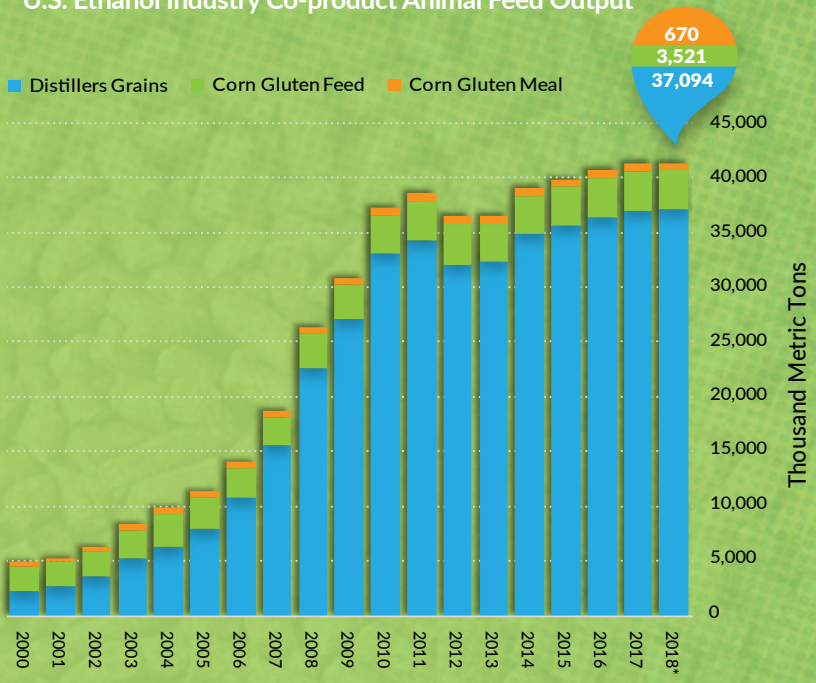
Source: RFA based on U.S. Dept. of Agriculture data **Estimated*

Top Destinations for U.S. Distillers Grains Exports in 2018



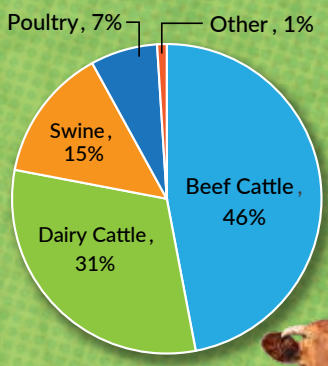
Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics **Based on Jan.-Sep. 2018*

U.S. Ethanol Industry Co-product Animal Feed Output



Source: RFA and U.S. Dept. of Agriculture. Note: All co-products converted to 10% moisture basis
**Estimated*

Distillers Grains Consumption by Specie



Source: Distillers grains marketing companies

Charged Up with Ethanol

Octane is in high demand. To meet corporate average fuel economy (CAFE) requirements and consumer preferences, automakers are increasingly utilizing turbocharged, higher-compression engines. To achieve performance and prevent engine knock, manufacturers are requiring or recommending the use of high-octane gasoline in these engines. As a result, premium gasoline sales over the last few years have been at their highest levels in a decade.

The additional demand has caused the value of octane to increase. While the price differential between premium and regular gasoline has risen at wholesale, the differential in what is charged to consumers at retail has jumped even more.

Even as this has occurred, the discount of ethanol to its octane value has widened dramatically. Ethanol has a blending octane rating of 114, which is higher than the ratings of the main petroleum-based components. In 2018, even as a rebound in petroleum prices resulted in a blending value for ethanol that was higher than that of other components, ethanol was actually priced lower than these competing octane sources. The position of ethanol as the most competitive source of octane on the planet became more apparent than ever.

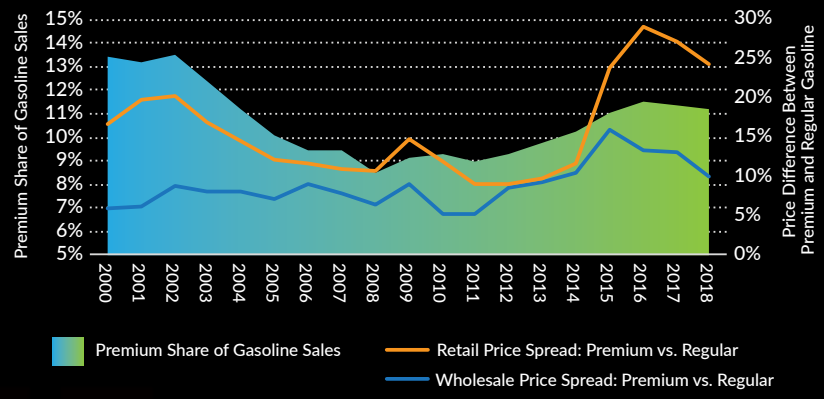
At the same time, supplies of petroleum-based components have become constrained, as a result of increasing availability of lighter shale oils, the configuration of refineries and restrictions on the sulfur content in fuel. An additional drawback of aromatic hydrocarbon octane sources, such as benzene, is that they are toxic and worsen air pollution.

As ethanol blends have been adopted nationwide, refiners have optimized operations to reduce hydrocarbon octane production and take advantage of the octane from ethanol. Today, most regular gasoline is produced using blendstock with an octane rating of 84, which is then upgraded to 87 (the minimum allowed in most states) by adding 10% ethanol.

The future is bright for ethanol as a source of octane. In 2018, President Trump directed the EPA to allow year-round sales of E15 (i.e., gasoline containing 15% ethanol) nationwide. Once a final rule is in place implementing this change, E15 sales volumes are expected to increase. E15 has an octane rating of 88, giving consumers an added boost at a lower cost.

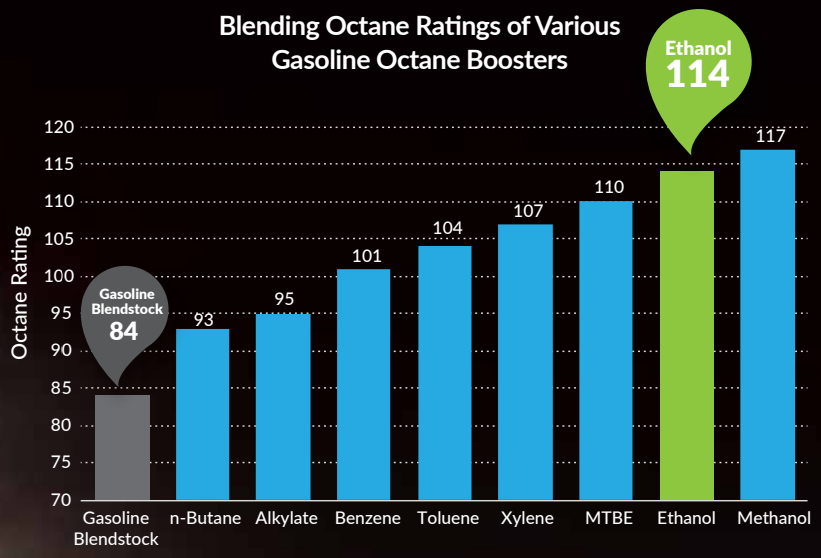
Additionally, turbocharged engines are expected to continue becoming more prevalent, resulting in growing demand for higher-octane gasoline.

Premium Gasoline: Share of Sales and Price Difference vs. Regular



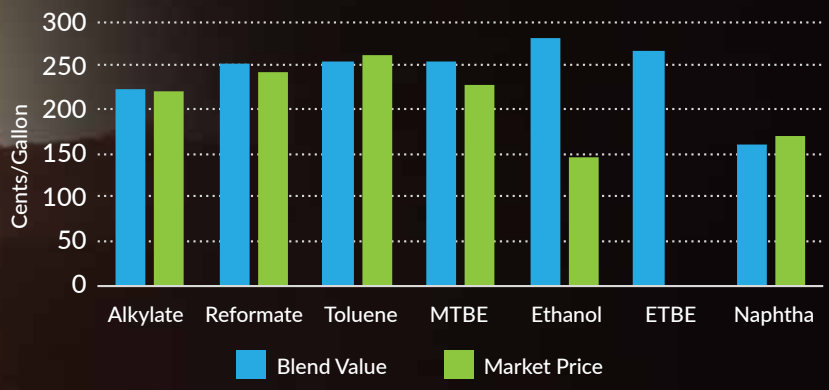
Source: RFA based on U.S. Energy Information Administration data

Blending Octane Ratings of Various Gasoline Octane Boosters



Source: Department of Energy

Octane Blending Value vs Market Price



Source: Argus Media

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 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."

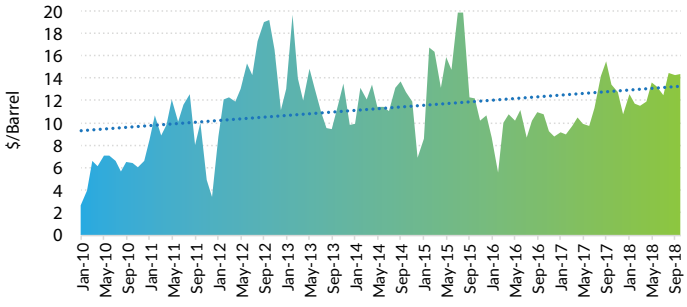
RFS Promise Waivering

Since it was passed in 2005 with overwhelming bipartisan support, the foundation of America's renewable energy policy has been the Renewable Fuels Standard (RFS). The RFS requires refiners to blend an annually increasing amount of renewable fuels like ethanol. By any measure, the RFS has been a huge success. It has stimulated investment in biofuels production and infrastructure, lowered gasoline prices, cut tailpipe pollution, created value-added markets for farmers, decreased petroleum imports, and reduced carbon emissions.

Recognizing the success of the program, President Trump promised to support the RFS and assured implementation in a manner consistent with the law. Indeed, the Administration has required the full 15-billion-gallon conventional biofuel volume, while also steadily increasing advanced and cellulosic biofuel requirements.

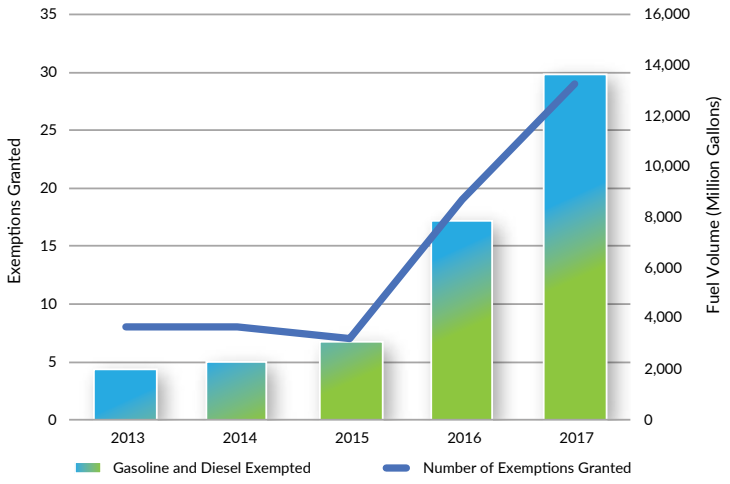
However, despite the success of the RFS, or perhaps because of it, former EPA Administrator Scott Pruitt in early 2018 initiated a demand destruction campaign against biofuels that devastated ethanol prices, expanded stocks of both ethanol and RIN credits, and left the industry reeling. Pruitt let 48 oil refineries out of their legal obligation to blend renewable fuels in 2016 and 2017, amounting to more than 2.25 billion gallons of renewable fuel, or 12% of the U.S. biofuels industry's production capacity.

Average U.S. Oil Refinery Cash Operating Margins



Source: Muse Stancil

Small Refiner Exemptions Granted and Associated Fuel Volumes



Source: U.S. Environmental Protection Agency

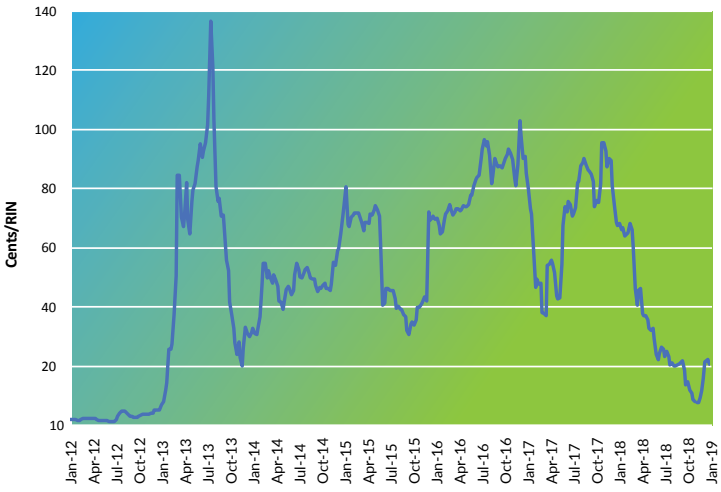
Pruitt's actions came just as ethanol was breaking through the so-called "blend wall," having hit a record 10.75% blend rate in January. As the marketplace realized the extent of the refinery exemptions, the blend rate fell to a five-year low of 9.5% in April and averaged well below 10% throughout the rest of the year. To maintain markets, ethanol prices were forced to adjust, falling to a 13-year low. Ethanol RIN credit prices fell from around $0.90 in November 2017 to less than $0.10 in November 2018. Those suggesting there has been no impact on ethanol from the small refiner waivers are ignoring reality.

Still, with RIN prices at near-record lows, refinery profits skyrocketing, a new Administrator at EPA, and a president remaining steadfast in his support of the RFS, there is reason to be optimistic that Pruitt's demand destruction policies will end, and the RFS will once again drive economic opportunities for rural America.

"We have a statutory volume of 15 billion gallons, and those waivers reduce that gallon for gallon. That's demand destruction."

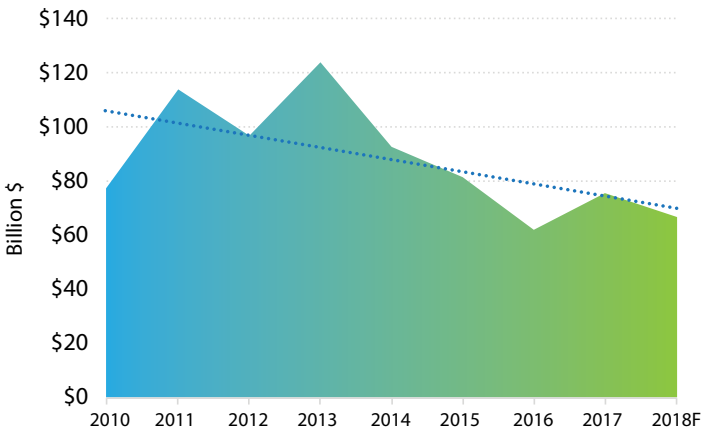
USDA Secretary Sonny Perdue

Average Weekly Ethanol (D6) RIN Price



Source: OPIS

U.S. Net Farm Income



Source: U.S. Dept. of Agriculture

Empowering E15

The inexorable march toward higher ethanol blends made great strides in 2018, as both marketplace and federal policy initiatives pushed E15 toward a tipping point, where consumers are empowered to choose the higher octane lower priced fuel in every state and at all times of the year.

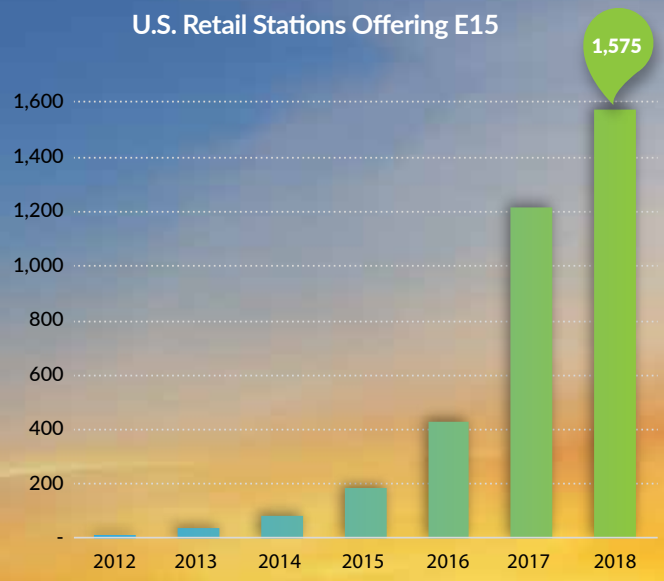
A combination of federal and state infrastructure programs and funding from the industry-sponsored Prime the Pump initiative helped increase the number of stations offering E15 at the pump by a third last year, to approximately 1,575 stations across some 30 states. E15 sales are forecast to be 280 million gallons in 2018, the ethanol content of which would be 42 million gallons. E15 is also increasingly being made available at the terminal, with companies like Growmark Energy now offering blended E15 at their terminals across the Midwest.

EPA allows the use of E15 in all passenger vehicles 2001 and newer. But the number of vehicles with expressed warranty coverage for E15 continues to grow as well. Last year, Subaru joined most other auto companies in extending warranty coverage to E15 in its most popular vehicles. Indeed, more than 93 percent of 2019 model year (MY) vehicles are explicitly approved by the manufacturer to use E15, according to the results of an annual RFA analysis of warranty statements and owner's manuals.

In the six years since E15 was formally approved for use by EPA, American drivers have logged over 5 billion miles on the fuel without a single reported case of "engine damage," misfueling, or inferior performance.

But the biggest E15 news came on October 9, when President Donald Trump announced he would direct EPA to initiate a rulemaking allowing the year-round use of E15. To this point, E15 has been severely restricted by EPA's disparate application of fuel volatility regulations impacting ethanol fuels. With the president's directive, EPA will extend the same volatility waiver currently available only to E10 blends in the summer months to E15 as well. That will allow E15 to be sold year-round and greatly expand market opportunities for the higher ethanol blend.

If implemented as the president directed, E15 sales could grow significantly next year, perhaps approaching 800 million gallons, utilizing 120 million gallons of ethanol. This represents an increase of 40 million gallons over the amount of ethanol that would be contained in an equivalent volume of E10. Of course, over time, as consumers seek out a higher octane, lower priced fuel for the vehicles, the growth potential for ethanol will grow exponentially.

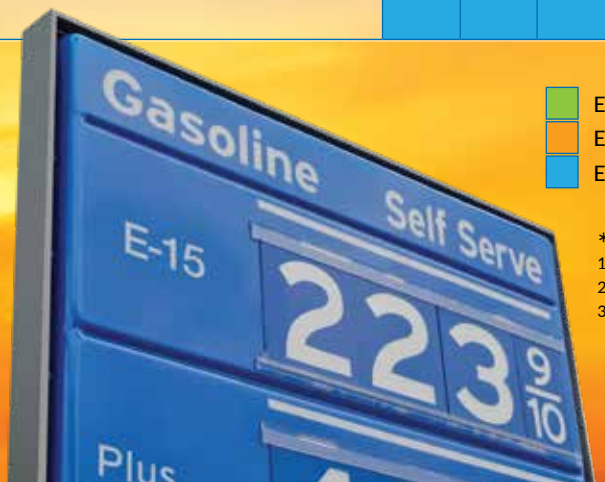


Source: RFA

"We're going to go to 12 months, which makes a lot of farmers very happy — because we go from 8 months to 12 months, that's a big difference. That was always unnecessary and ridiculous."

President Donald Trump

	MODEL YEAR								U.S. Market Share*
	2012	2013	2014	2015	2016	2017	2018	2019	
BMW Group									
BMW									**1.8%**
Mini[1]									**0.3%**
Daimler Group (Mercedes-Benz)									**2.1%**
FCA (Chrysler, Dodge, Fiat, Jeep, Ram)									**12.4%**
Ford Motor Co. (Ford, Lincoln)									**14.5%**
General Motor Co. (Buick, Cadillac, Chevrolet, GMC)									**17.4%**
Honda Motor Co. (Honda, Acura)									**8.8%**
Hyundai Motor Co. (Hyundai, Kia)									**6.7%**
Mazda Motor Corp.									**2.0%**
Mitsubishi Motors Corp.									**0.9%**
Nissan Motor Co. (Nissan[2], Infiniti[3])									**10.1%**
Subaru									**3.6%**
Tata Motors (Jaguar, Land Rover)									**0.7%**
Toyota Motor Company									
Lexus									**13.2%**
Toyota									
Volkswagen Group									
Audi									**1.2%**
Porsche									**0.3%**
Volkswagen									**2.0%**
Volvo Car Group									**0.5%**
All Others									**0.5%**



E15 Approved by Automaker in ALL Models
E15 Approved by Automaker in SOME Models
E15 Approved by EPA ONLY; Not Approved by Automaker

* *Motor Intelligence* (Jan.-Apr. 2018)
1 Approved the use of up to 25% ethanol blends
2 Approved the use of E15 for all models except Infiniti Frontier
3 Approved the use of E15 for all models except Nissan Armada

Flexing Muscle

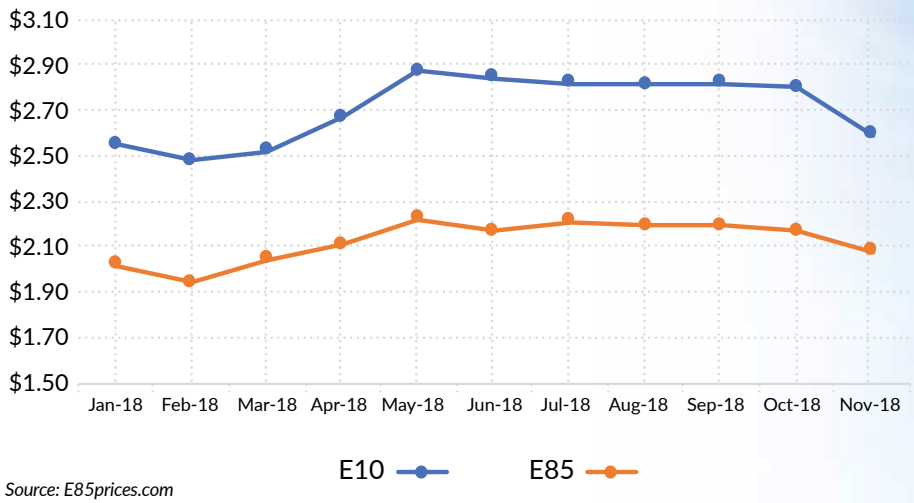
Flex fuels like E85 enjoyed another strong year of growth in number of stations and gallons sold. This success was thanks to incentive programs, low carbon fuel standards and champions in the fuel retailer world. Hundreds of millions of gallons of E85 were sold across 2,478 cities in the country. Unfortunately, not all of the news was positive. The number of flex fuel vehicles (FFVs) remained unchanged from last year given the overall reduction in flex fuel vehicle production from automakers. This is already catching the attention of some fuel retailers. Still, others see great promise for many years to come in a growing fuel market. Moreover, other flex fuel blends like E30 are growing rapidly as consumers realize what appears to be the optimal blend level for ethanol, maximizing performance and emissions reduction.

This growing market for flex fuels is also beginning to be seen in unconventional markets like the tuner and off-road sectors. They have found E85 for the power, and the overall savings at the pump by utilizing simple conversion technologies available in the marketplace today.

What are FLEX FUELS?

Flex fuels are gasoline-ethanol blends containing between 51-83 percent ethanol (excluding denaturant). Flex fuels are intended for use in flex fuel vehicles (FFVs) only. Historically, flex fuels had been commonly referred to as "E85" because prior to 2012, the fuels were limited to 70-85 percent denatured ethanol and E85 was the most popular blend. Today, the actual amount of ethanol in the flex fuel depends on economics, time of year and fuel specifications.

National Average Retail Prices for E10 and E85

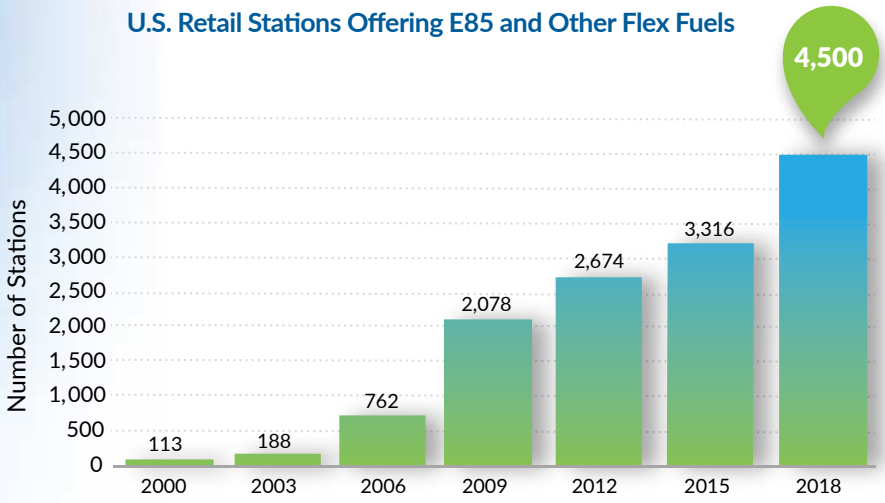


Source: E85prices.com

Can you Flex Fuel?

The following model year 2019 vehicles are available as Flex Fuel Vehicles (FFVs):

Chrysler 300 (3.6L)
Chevrolet Express (6.0L)
Chevrolet Express (6.0L)
Chevrolet Impala (3.6L)
Chevrolet Silverado (5.3L)
Chevrolet Silverado HD (6.0L)
Chevrolet Suburban (5.3L)
Chevrolet Tahoe (5.3L)
Dodge Charger (3.6L)
Dodge Grand Caravan (3.6L)
Dodge Journey (3.6L)
Dodge Ram 1500 (3.6L)
Ford E-Series (6.2L)
Ford Escape (2.5L)
Ford Explorer (3.5L)
Ford F-150 (3.5L, 5.0L)
Ford F-Series Super Duty (6.2L)
Ford Police Interceptor (3.5L, 3.7L)
Ford Taurus (3.5L)
Ford Transit Connect (2.0L)
Ford Transit T150 (3.7L)
GMC Savana (6.0L)
GMC Sierra (5.3L)
GMC Sierra HD (6.0L)
GMC Yukon (5.3L)
GMC Yukon XL (5.3L)
Jeep Cherokee (2.4L)
Jeep Renegade (2.4L)
Mercedes-Benz CLA250 (2.0L)
Mercedes-Benz GLA250 (2.0L)
Mercedes-Benz GLE350 (3.5L)
Nissan Frontier (4.0L)
Toyota Tundra (5.7L)



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

Re-Fueling Knowledge

RFA launched a "Fuel Your Knowledge" campaign in 2018 to correct misinformation and provide up to date, informed material about the effects of ethanol on motor cycles, boats, and small engines.

The Fuel Your Knowledge campaign included RFA's sponsorship of the Crappie Masters National Tournament Trail, putting ethanol in the spotlight for anglers across the country. Crappie Masters hosts 18 tournaments across 9 states, from Florida, to Texas, to Illinois. The events are televised and covered by countless angler and boating publications. The message of this effort was unambiguous – E10 is safe for your boat and the environment; and provides increased performance at lower cost.

RFA also took the E10 compatibility story to the motorcycle community. RFA worked with the Discovery Channel's *American Chopper* and Paul Teutel, Jr. to build a custom E85 chopper. The show highlighted ethanol's impact to the economy and the environment and Paul Jr. even toured an ethanol plant, expressing support for the benefits of ethanol for both cyclists and farmers. The show was broadcasted to over 200 countries in over 90 languages and is still being played globally today.

The use of the new motorcycle did not stop there. For the tenth straight year, RFA returned to the Black Hills of South Dakota for the Sturgis Motorcycle Rally and promoted ethanol to over 500,000 bikers. The custom E85 motorcycle built by Paul Jr. participated in the Legends Ride and was on display all week during other RFA promotions. The RFA motorcycle has since participated in countless events and promotions across the country.

Value-added Processing

The production of ethanol is among man's earliest ventures into value-added processing. Henry Ford and Alexander Graham Bell were among the first to recognize that the plentiful sugars found in plants could be easily and inexpensively converted into clean-burning, renewable fuel.

While the production concept remains the same, today's ethanol industry uses state-of-the-art technologies to produce high-octane ethanol and valuable co-products from the starches and sugars found in grains, beverage and food waste, and cellulosic biomass.

More than 90% of the U.S. fuel ethanol is produced using the dry mill process, with the remaining 9% coming from wet mills. The main difference between the two processes is in the initial treatment of the grain.

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 cooked, then cooled and transferred to fermenters. Yeast is added and the conversion of sugar to alcohol begins. After fermentation, the resulting "beer" is separated from the remaining "stillage." The ethanol is then distilled and dehydrated, then blended with about 2% 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, as well as 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.

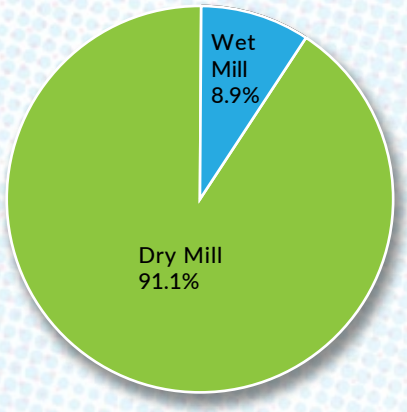
On average, **1 bushel of corn** (56 pounds) processed by a dry mill ethanol biorefinery produces:

- 2.86 gallons of denatured fuel ethanol
- 15.9 pounds of distillers grains animal feed (10% moisture)
- 0.75 pounds of corn distillers oil
- 16.5 pounds of biogenic carbon dioxide

In 2018, ethanol biorefineries captured more than 2.8 million tons of CO2, which was used for bottling, food processing, dry ice production and other uses.

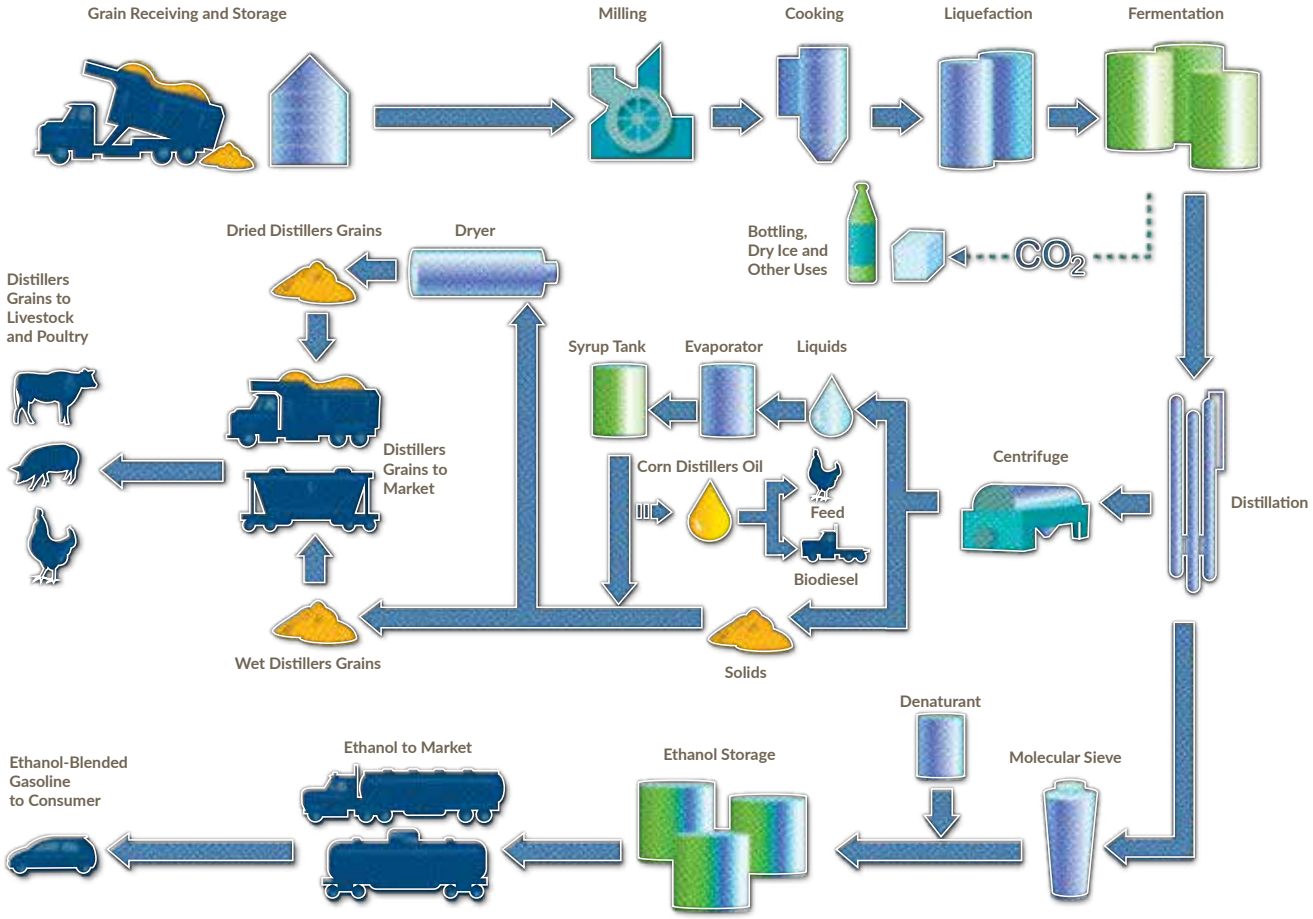
Source: RFA based on data from U.S. Dept. of Agriculture

U.S. Fuel Ethanol Production by Technology Type



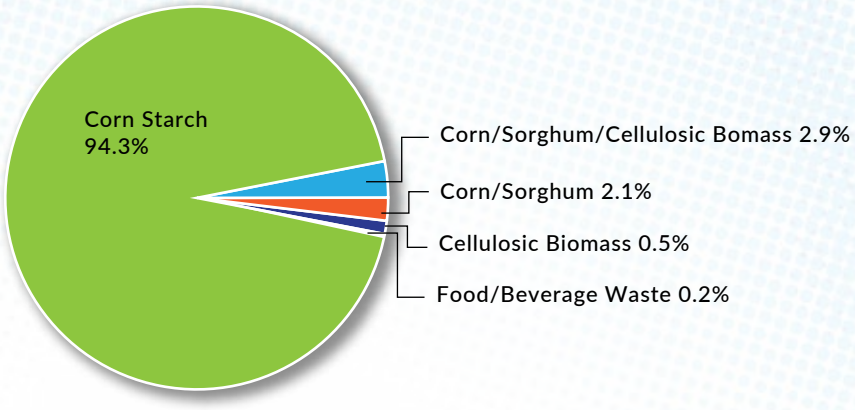
Source: RFA based on data from U.S. Dept. of Agriculture

Dry Mill Ethanol Process



Source: RFA

U.S. Ethanol Production Capacity by Feedstock Type



Source: RFA

Technology Powers Innovation

Because of improvements in production efficiencies and the use of "new" feedstocks, today's ethanol biorefinery operates much like a chemical refinery, able to produce multiple renewable fuels and products. Some biorefineries are producing biodiesel and renewable diesel from corn distillers oil, but the largest impact has been in corn kernel fiber production.

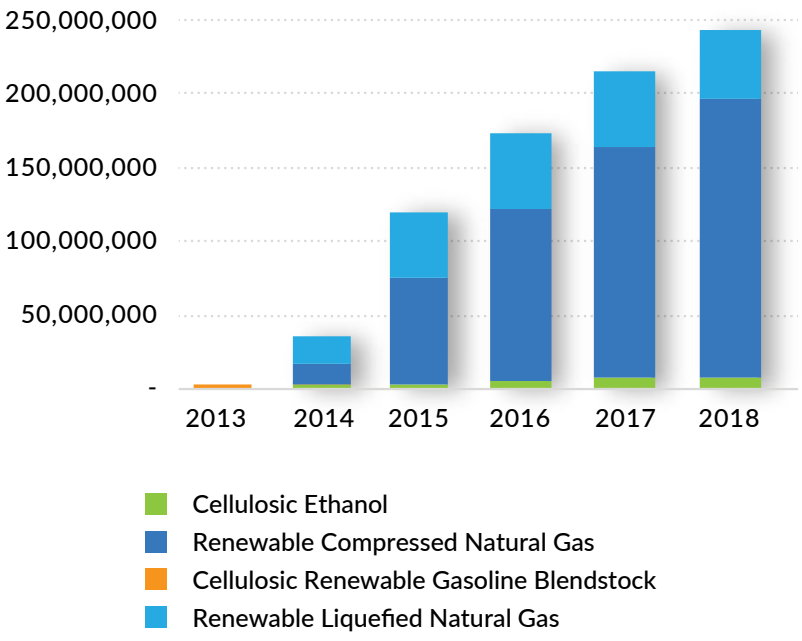
The addition of "bolt-on" technologies has allowed producers to expand yields by processing ethanol from corn fiber, a cellulosic portion of the grain. New corn fiber technology allows a greater portion of the corn kernel – the fiber - to be converted to ethanol, allowing biorefineries to increase yields while producing both cellulosic ethanol and starch ethanol from the same feedstock. Unleashing corn kernel fiber ethanol production could result in existing ethanol plants producing hundreds of millions of gallons of cellulosic ethanol from this single stream of agricultural residue in the near term.

Cellulosic ethanol presents an exciting and tangible economic opportunity for ethanol producers, as the fuel's greater greenhouse gas (GHG) reductions result in a price premium under the California Low Carbon Fuel Standard (LCFS) and the federal Renewable Fuel Standard (RFS). However, the U.S. Environmental Protection Agency (EPA) must act to address questions pertaining to corn kernel fiber D3 eligibility under the RFS. Producers are ready and able to produce corn fiber ethanol and are growing increasingly frustrated by the slow progress to approve pathways and registrations at EPA.

Importantly, reforms to the 45Q carbon capture credit as part of the 2017 tax reform bill have made the economics for carbon capture storage more favorable, as well as for the delivery of carbon dioxide for enhanced oil recovery efforts, which could drive the development of carbon dioxide pipelines. The credit will also help producers meet requirements for low carbon fuels, such as California's LCFS market.

Quad County Corn Processors, Galva, Iowa. QCCP was the first plant in the country to commercially produce ethanol from cellulose.

Total D3 RINs Generated

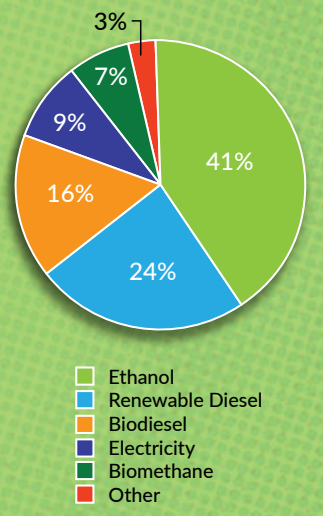


Source: U.S. Environmental Protection Agency and RFA

BIOFUELS REDUCING CARBON

To date, ethanol is responsible for 45% of the total greenhouse gas reduction occurring under the LCFS program. Between 2011-2017, 10.6 billion gallons of ethanol were consumed in California, resulting in 15.5 million metric tons of CO2 reduction. 96% of the ethanol used was produced from corn and sorghum. Amendments to the LCFS scheduled to go into effect January 1, 2019, will result in further reductions in carbon intensity for corn ethanol pathways. The amendments recognize further carbon reductions from lower corn farming and fertilizer emissions, lower electricity emissions, and an increased soybean meal displacement credit for dried distillers grains with solubles.

California LCFS Credit Percentage by Fuel Q1 2011 - Q2 2018



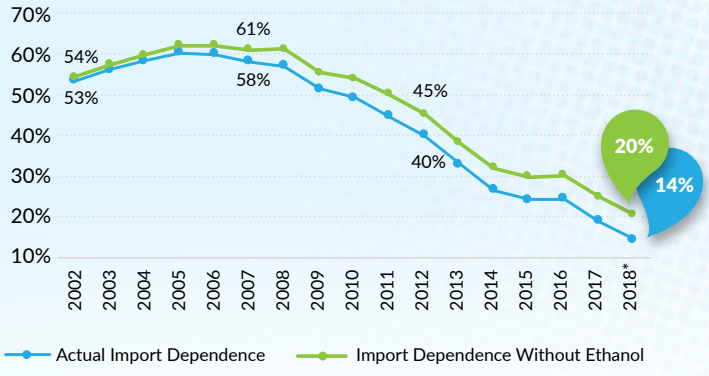
Source: California Air Resources Board (CARB) and RFA

Powering Energy Dominance

Energy security remains a significant concern for the U.S., but thanks in part to homegrown ethanol, Americans are importing less petroleum, helping the nation rein in oil imports for the transportation sector. On a net basis, U.S. dependence on imported crude oil and petroleum products fell to just 14 percent in 2018, due in part to booming domestic production. However, without the addition of 16.1 billion gallons of ethanol to the domestic fuel supply, U.S. import dependence would have been 20 percent. In other words, without ethanol's contribution, it would have taken an additional 594 million barrels of imported crude oil to meet America's petroleum needs!

While progress has been made to boost U.S. energy security, more needs to be done. The nation still transfers a significant amount of money to the OPEC cartel. In 2018, the U.S. sent a collective $54 billion, or $425 per household, to countries like Saudi Arabia, Iraq, Venezuela and Nigeria to OPEC to pay for crude oil imports. Energy security is one of the main drivers behind the Renewable Fuel Standard and why it remains critical the program stays in place and grows over time, providing consumers with more choices at the pump and shoring up domestic energy usage.

U.S. Petroleum Net Import Dependence with and without Ethanol



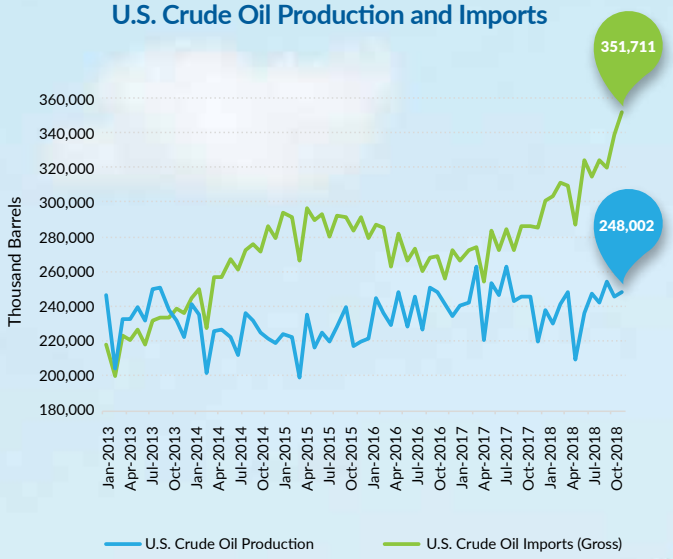
On a net basis (i.e., after accounting for U.S. exports), the United States relied on imports to meet 14% of its petroleum demand in 2018. Without the contribution of 16.1 billion gallons of ethanol, U.S. import dependence would have been equivalent to 20% of petroleum demand.

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

"The American energy renaissance is pressing forward with stunning speed.... American energy dominance means the end of our crippling dependence on foreign energy, and that our industries have access to reliable, affordable, and diverse energy supplies that enable them to compete in the global marketplace. Increasing energy security is also ushering in a new era of American leadership around the world as we export more of our energy bounty to friends and allies abroad, freeing them from hostile dependence."

President Trump in his Presidential Proclamation on National Energy Awareness Month, Sept. 28, 2018

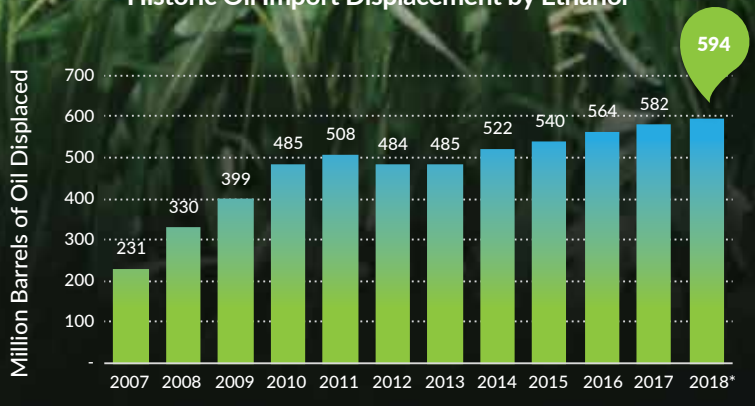
U.S. Crude Oil Production and Imports



While U.S. crude oil production has increased to over 350 million barrels per month, our nation still imports about 240 million barrels per month on a gross basis.

Source: U.S. Dept. of Energy

Historic Oil Import Displacement by Ethanol



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

Transferring American Wealth to **OPEC**

Even though U.S. oil production has increased in recent years, our nation's economy still transfers tens of billions of dollars every year to the OPEC cartel. In 2018 alone, the U.S. sent some $54 billion--roughly $425 per American household--to OPEC nations to pay for crude oil imports.

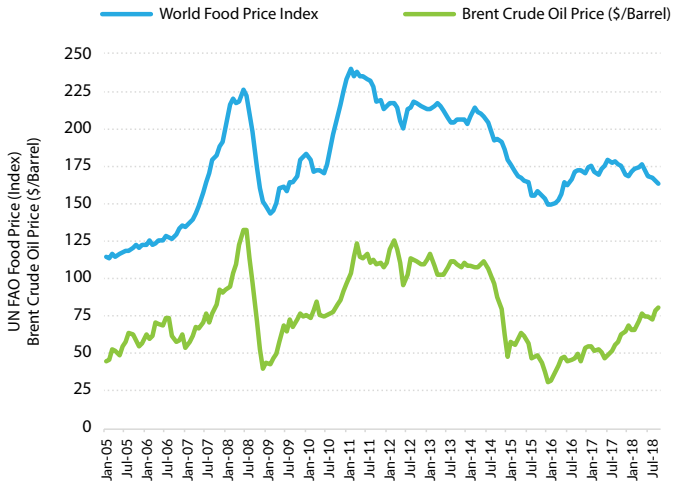
OPEC Nation	U.S. Spending on Crude Oil Imports (Billion $)
Saudi Arabia	$15.4
Iraq	$12.9
Venezuela	$9.6
Nigeria	$4.3
Ecuador	$3.9
Angola	$2.4
Kuwait	$1.9
Algeria	$1.3
Libya	$1.6
Other OPEC	$0.6
TOTAL	**$53.9**

RFA based on U.S. Dept. of Energy data

Empowering Consumers

The debunked "food vs. fuel" myth drifted another year farther into the rearview mirror in 2018. In the U.S., farmers harvested the second-largest corn crop ever and shattered the previous record for soybean production.

World Oil Prices Drive Global Food Prices



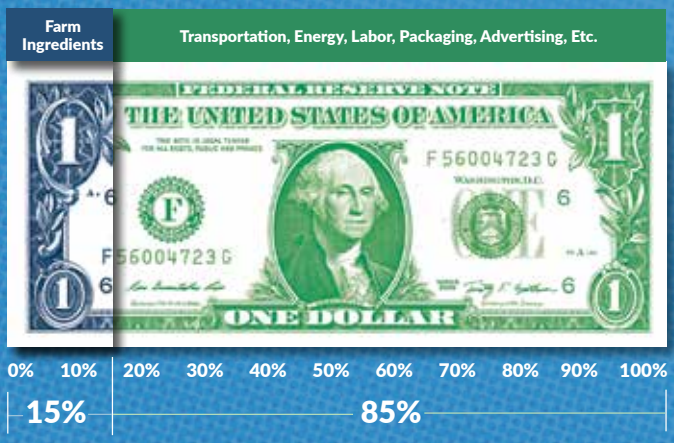
Source: United Nations Food & Agriculture Org. and U.S. Dept. of Energy

Yet, financial conditions remained tenuous for crop producers. Trade tensions affected crop exports, with soybeans particularly affected. Demand for ethanol was affected by trade actions as well, along with large-scale grants to refineries of exemptions from the RFS, which contributed to weak production levels in the fourth quarter and thereby affected corn demand. Globally, crop inventories remained ample.

As crop prices languished, the share of each dollar U.S. consumers spend on food that goes to pay for farm products receded further to 15% in 2018.

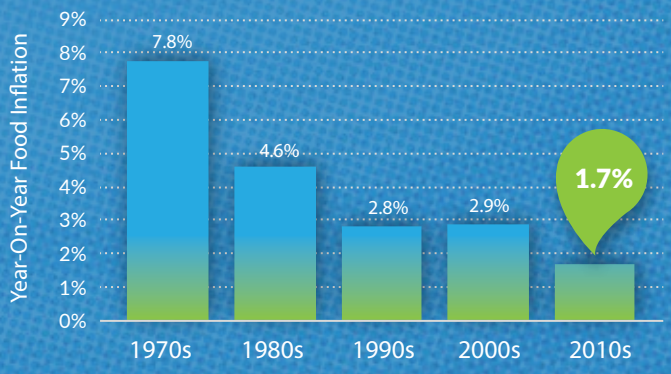
Meanwhile, the U.S. animal protein sector continued the strong expansion it has experienced over the last few years. Production of meat and poultry, other than beef, has expanded relatively steadily over the long term, other than a correction during the 2009 financial crisis (following a surge in 2008). After stagnating for a number of years, beef production also began expanding in 2016 Such growth is facilitated not only by ample supplies of grains and oilseed meals, but also by the availability of high-quality feed co-products from the ethanol industry.

What Does $1 Spent on Food Really Pay for?



Source: U.S. Dept. of Agriculture

Average Annual Food Inflation Rates by Decade

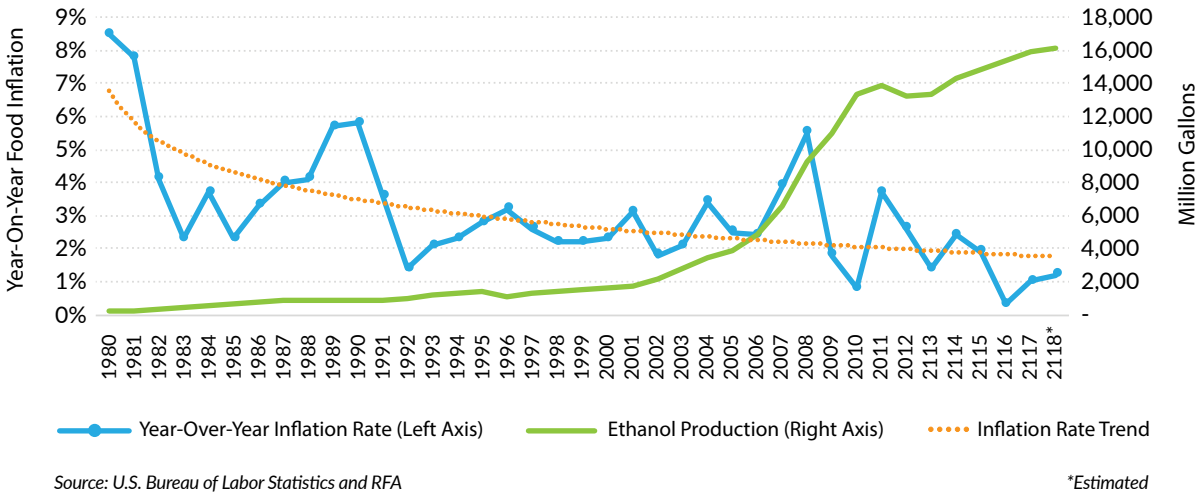


Source: U.S. Bureau of Labor Statistics

Meanwhile, retail food price inflation rates continued to be subdued. U.S. food prices were just 1 percent higher in 2018 than in 2017, lower than the "headline" inflation rate for the overall economy. Annual average food price inflation has averaged just 2.2 percent since 2005 when the RFS was enacted, a significant deceleration from prior decades.

Globally, the world food price index maintained by the Food and Agriculture Organization of the United Nations was on track to finish 2018 as the second lowest level since 2009. Due to the remarkable productivity of farmers in the U.S. and globally, consumers are able to purchase both food and fuel at reasonable prices, while reducing greenhouse gas emissions.

U.S. Food Price Inflation and Ethanol Production



Source: U.S. Bureau of Labor Statistics and RFA

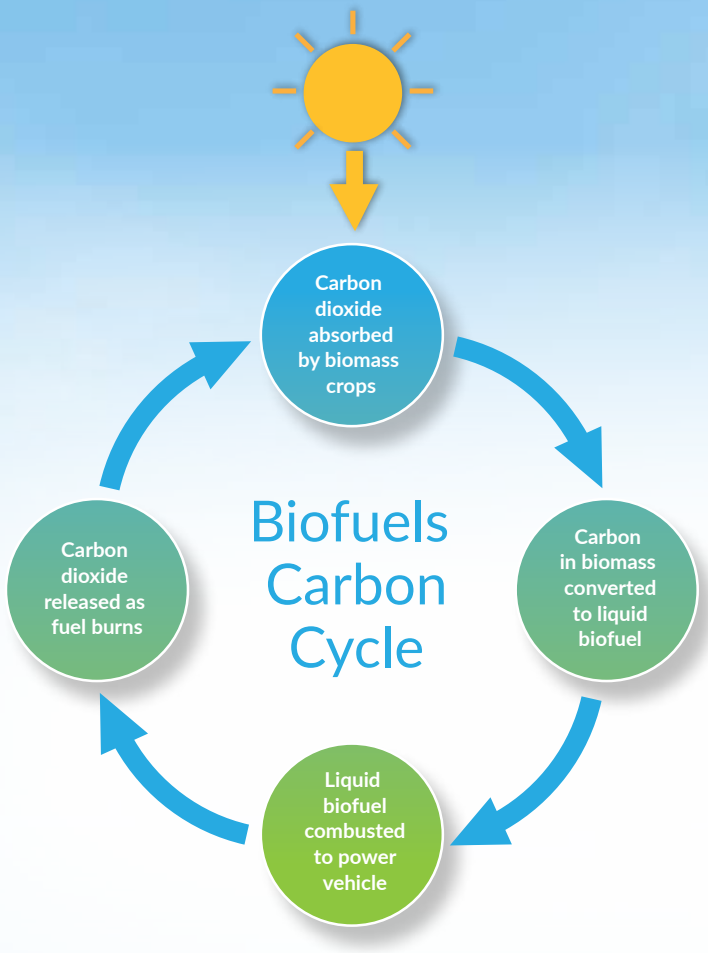
**Estimated*

Clearing the Air

Since the signature of the Clean Air Act Amendments by President George H.W. Bush in 1990, ethanol has been used to reduce carbon monoxide emissions from vehicles, with considerable success. The use of ethanol also has contributed to the reduction of other criteria pollutants, such as nitrogen oxides and fine particulate matter.

The expansion of ethanol usage following the establishment of the Renewable Fuel Standard (RFS) in the mid-2000s resulted in further declines in emissions of these pollutants.

At the same time, ethanol production efficiency has continued to improve, and greenhouse gas (GHG) emissions reductions associated with ethanol compared to gasoline have continued to grow.



Recently, this has allowed the ethanol industry to contribute extensively to meeting California's Low Carbon Fuel Standard (LCFS). The estimated carbon intensity of starch-based ethanol used toward the LCFS has declined by 21% since implementation in 2011.

Moreover, according to the U.S. Departments of Energy and Agriculture, corn ethanol from a typical dry mill has 40-45 percent lower GHG emissions than gasoline. This includes theoretical emissions from land-use change, even though the EPA estimates that agricultural land use in the United States has declined since legislation establishing the current version of the RFS was enacted in 2007.

Plants that are ultimately made into biofuels absorb carbon dioxide from the atmosphere as they grow, and that same amount of carbon dioxide is re-released when the biofuel is produced and combusted in an engine. In this way, ethanol and other biofuels simply recycle atmospheric carbon.

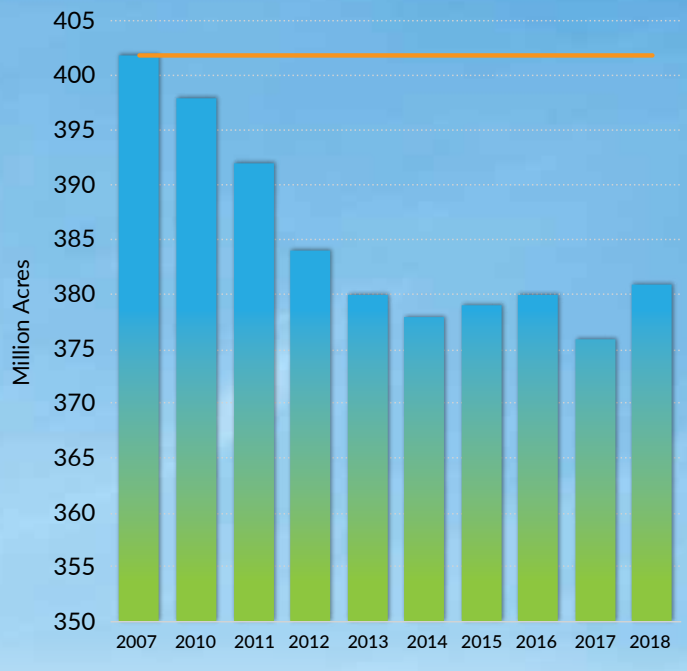
By displacing hydrocarbon substances like aromatics in gasoline, ethanol helps reduce emissions of air toxics, along with particulate matter, carbon monoxide, nitrogen oxides and exhaust hydrocarbons. These pollutants cause smog and ground-level ozone and adversely affect human health.

Cutting these emissions results in lower incidence of respiratory illness and asthma, heart disease, lung disease and cancer – and ultimately fewer premature deaths.

The use of ethanol in gasoline in 2018 reduced CO_2-equivalent greenhouse gas emissions from the transportation sector by 55.1 million metric tons. That's equivalent to removing 11.7 million cars from the road for an entire year, or eliminating the annual emissions from 13 coal-fired power plants.

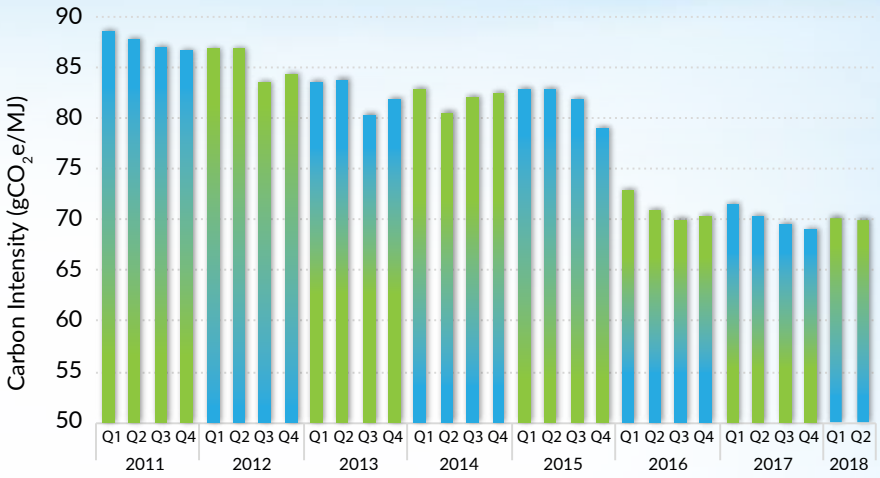
Source: RFA analysis using U.S. Dept. of Energy GREET model

U.S. EPA Determination of Agricultural Land Use vs. 2007 Baseline



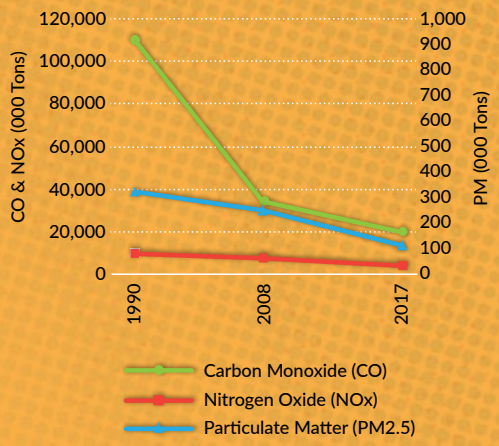
Source: RFA using U.S. Environmental Protection Agency data

Carbon Intensity of Starch-based Ethanol in California Gasoline

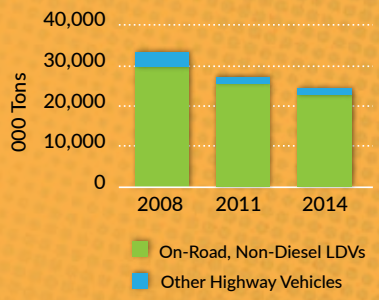


Source: RFA using CARB data

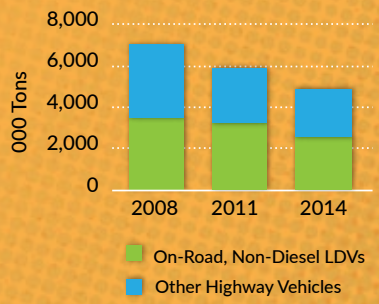
Emissions from All Highway Vehicles



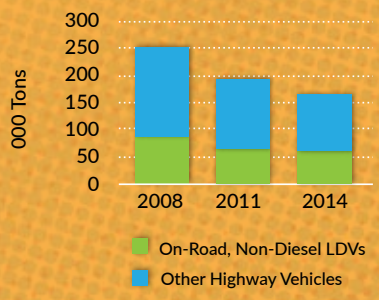
Carbon Monoxide



Nitrogen Oxides



Particulate Matter 2.5, Primary



Note: LDVs=light duty vehicles

Source: RFA using CARB and EPA data

Energetic Advocacy

With more than 37 years of effective advocacy in Washington, the RFA is recognized on Capitol Hill and throughout the regulatory agencies as the go-to source for credible, timely, and valuable information about the U.S. ethanol industry. The RFA regularly participates in congressional hearings, administrative hearings, judicial proceedings and public forums where ethanol issues are being discussed. Whether in testimony before the Environmental Protection Agency on the proposed rules implementing the RFS, before Congress giving the industry's perspective on draft legislation, or before the courts arguing to restore lost demand due to EPA's indiscriminate use of its RFS waiver authority, the RFA proudly and passionately advocates for expanded market opportunities for ethanol.

RFA's advocacy extends beyond Washington, D.C., to promote ethanol export markets, inform consumers about the benefits of higher octane lower carbon fuel, and with the media.

The RFA is a producer-led organization. Every producer member has a seat and an equal vote on the Board of Directors and helps to set the mission and agenda of the association. The RFA is known for its technical acumen and focus on the issues affecting plant profitability. That can be best seen in the work of its various Committees, each of which is led by a member expert.

The RFA Technical Committee focuses on fuel specifications and standards development by ASTM International, National Conference of Weights and Measures, regulatory bodies, and other organizations. Committee members monitor technical issues impacting day-to-day plant operations, such as storage and handling, transportation, and fuel quality, as well as state and regional regulations and international blending practices.

Committee Chair: Cathy Woodliff, The Andersons Albion Ethanol LLC

The RFA Co-Products Committee focuses on issues relevant to co-products from ethanol production, including distillers grains, corn distillers oil, corn gluten, carbon dioxide and other products. Committee members address operational and regulatory issues concerning production, storage and handling, transportation, international trade, animal nutrition, and animal feed safety.

Committee Chair: Sean Broderick, CHS, Inc.

The RFA Plant & Employee Safety Committee leads the industry in advocating safe practices in ethanol production, storage and handling, transportation, and use. Committee members monitor and share information on hazardous materials, safety standards, and federal and state safety regulations. The Committee also supports continuing education for every link of the ethanol supply chain.

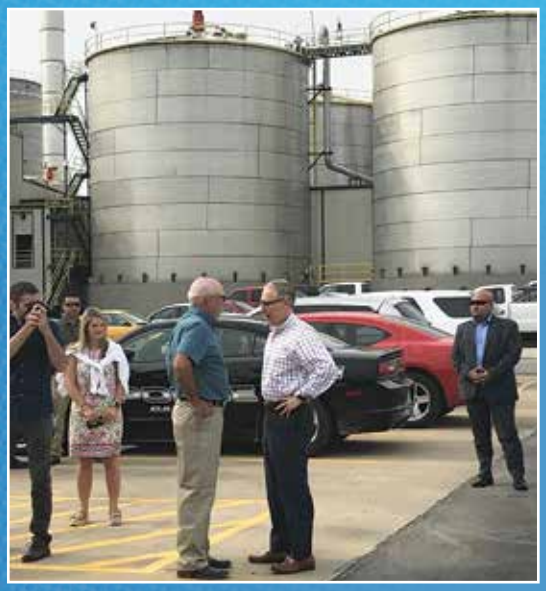
Committee Chair: Joe Oswalt, E Energy Adams, LLC

The RFA Environmental Compliance Committee examines and educates industry stakeholders on the implementation of environmental regulations for production, storage and handling, and transportation of ethanol. The committee tackles complex regulatory issues and provides guidance to members.

Committee Chair: Steve Schleicher, Pinnacle Engineering, Inc.

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.

Committee Chair: Randall Doyal, Al-Corn Clean Fuel, LLC




Grain Handling
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Mr. Cooper

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Drive expanded production and use of American-made renewable fuels and bio-products worldwide.

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- Public Policy & Regulation
- Fuel Ethanol Technical Issues
- Ethanol Market Development
- Research & Economic Analysis
- Trade Policy & Export Promotion
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*Go to **EthanolRFA.org/staff** for full bios and contact info.*

RFF RENEWABLE FUELS FOUNDATION

RFF MISSION

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

RFF 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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Murex LLC
murexltd.com

NALCO Water
ecolab.com/nalco-water

National Corn Growers Association
ncga.com

Nebraska Corn Board
nebraskacorn.gov

Nebraska Ethanol Board
ethanol.nebraska.gov

Novozymes
novozymes.com/en/solutions/bioenergy

Ohio Corn Marketing Program
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bemidjistate.edu

Bismarck State College
https://bismarckstate.edu/

Colorado Farm Bureau
coloradofarmbureau.com

Corn Marketing Program of Michigan
micorn.org/cmpm

Distillers Grains Technology Council
distillersgrains.org

EPAC (Ethanol Producers and Consumers)
ethanolmt.org

Great Falls Development Authority Inc.
gfdevelopment.org

Illinois Corn Marketing Board
ilcorn.org

Indiana Corn Marketing Council
incorn.org/icmc

Iowa Central Fuel Testing Laboratory
iowafuellab.com

Iowa Corn Growers Association
iowacorn.org

Jamestown/Stutsman Development Corp.
growingjamestown.com/jsdc

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

Kentucky Energy and Environment Cabinet—Office of Energy Policy
energy.ky.gov

Maryland Grain Producers Utilization Board
marylandgrain.org

Michigan State University Dept. of Agricultural, Food and Resource Economics
canr.msu.edu/afre

Minnesota Corn Research & Promotion Council
mncorn.org

Minnesota Department of Agriculture
mda.state.mn.us

Mississippi State University Dept. of Forestry
cfr.msstate.edu/forestry

Missouri Corn Growers Association
mocorn.org

Morton College
morton.edu

National Corn-to-Ethanol Research Center
ethanolresearch.com

National Sorghum Producers
sorghumgrowers.com

North Dakota Corn Council
ndcorn.org/corncouncil

South Dakota Corn Growers Association
sdcorn.org

South Dakota Corn Utilization Council
sdcorn.org

Steele-Waseca Cooperative Electric
swce.coop

Texas Renewable Energy Industries Alliance
treia.org

United Association
ua.org

United Sorghum Checkoff Program
sorghumcheckoff.com

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