2024 ETHANOL INDUSTRY OUTLOOK

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RENEWABLE FUELS ASSOCIATION

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Delayne Johnson	Quad County Corn Processors	quad-county.com
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Walt Wendland	Ringneck Energy LLC	ringneckenergy.com
Mike Jerke	Southwest Iowa Renewable Energy LLC	sireethanol.com
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Dan Short	The Andersons Marathon Holdings LLC	andersonsinc.com
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**Prospective Producer Member*

POWERED BY PARTNERSHIPS

Over the past four decades, the Renewable Fuels Association and the U.S. ethanol industry have achieved numerous policy and regulatory victories, as well as major wins in expanding the world market for low-carbon renewable fuels. But none of those triumphs would have been possible without the ethanol industry's strong alliances and ability to collaborate with a broad and diverse group of stakeholders.

Throughout the history of the industry, RFA has forged alliances with agriculture, automakers, mechanics, petroleum companies, fuel retailers, government agencies, policymakers, environmental and health groups, academic researchers, consumer groups, military veterans, and many others to help advance the industry and promote the benefits of renewable fuels.

The Renewable Fuel Standard is a prime example of the power of partnerships. A landmark agreement between RFA and the American Petroleum Institute paved the way for passage of the original RFS in 2005. Two years later, we partnered with environmental groups, farmers, and energy security hawks to secure passage of the expanded RFS. Most recently, RFA has again partnered with API and fuel marketers to push for legislation that would permanently remove the summertime barrier to E15 sales.

Looking forward, our partnerships must continue to adapt and evolve. As you'll see throughout the pages of this year's Outlook, we'll need to continue expanding our coalitions and collaborations if we are to succeed in positioning ethanol as a solution to the world's most vexing problems.

Just a few years ago, it would have seemed unimaginable that the ethanol industry would be working closely with commercial airlines seeking sustainable aviation fuels; petrochemical manufacturers searching for low-carbon renewable feedstocks; professional fishing teams looking for a cleaner marine fuel; foreign governments pursuing low-cost clean energy for their citizens; the Girls Auto Clinic, which empowers women to make confident decisions regarding vehicle purchasing and maintenance; or a myriad of innovative companies seeking to sequester or utilize the pure CO_2 from ethanol fermentation. Today, we are working with all these groups—and many others—to chart the future path for ethanol.

It is a simple truth that when seemingly unrelated industries and entities face common challenges—like the need to decarbonize, the need to clean up the air in urban areas, or the need to enhance energy security—working together helps us all accomplish more. As we forge ahead in 2024, RFA will continue to collaborate and cooperate with a broad spectrum of partners who share our vision of improving livelihoods around the world through the expanded use of renewable fuels. As Helen Keller said, "Alone we can do so little, together we can do so much."

Geoff Cooper

Geoff Cooper, President and CEO

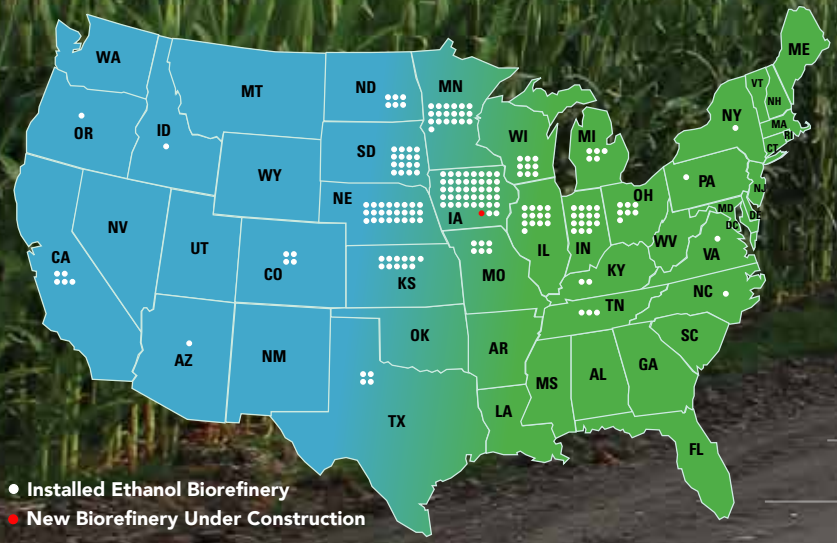
Powerful Progress

The U.S. ethanol industry had a tremendous year in 2023, with significant wins both in the marketplace and in the public policy arena. Ethanol production and consumption both approached pre-COVID levels, as export demand was robust and domestic use of E15 and flex fuels like E85 set new records. Gains in the marketplace were facilitated, in large part, by a series of important policy and regulatory victories. Emergency waivers issued by EPA allowed for year-round sales of lower-cost E15; finalization of strong Renewable Fuel Standard levels brought much-needed stability and certainty to the market through 2025; COVID relief funds continued to spur recovery from the worst fuel market disruption in decades; and innovation and new investment flowed into the industry as implementation of the Inflation Reduction Act began. It all added up to a banner year for America's ethanol producers.

As easy as it would be to sit back and celebrate the victories of 2023, the industry begins 2024 with much work left to do. Our nation still lacks a permanent, nationwide policy solution to allow the year-round sales of E15. State-level electric vehicle mandates and federal tailpipe emissions standards threaten to reduce long-term demand for low-carbon renewable fuels. Protectionist trade barriers continue to block U.S. ethanol from reaching international consumers who want a lower-cost, cleaner-burning option at the pump. And another heated election year promises to create plenty of distractions and drama in Washington, making it more difficult to achieve progress on industry priorities.

At the same time, numerous opportunities await the ethanol industry in 2024 and beyond. The drive to net-zero emissions continues, as RFA members embrace innovation and show progress in reducing carbon intensity. New uses and markets for ethanol—like sustainable aviation fuel—appear primed for takeoff. Higher blends and flex fuels continue to grow in popularity. And despite political division and partisan acrimony, ethanol remains a bipartisan solution attractive to both sides of the aisle. As 2024 begins, the future has never been brighter for ethanol, but the key to progress will be strengthening existing alliances, building new partnerships, and fostering creative collaborations—something RFA has been doing for more than 40 years.

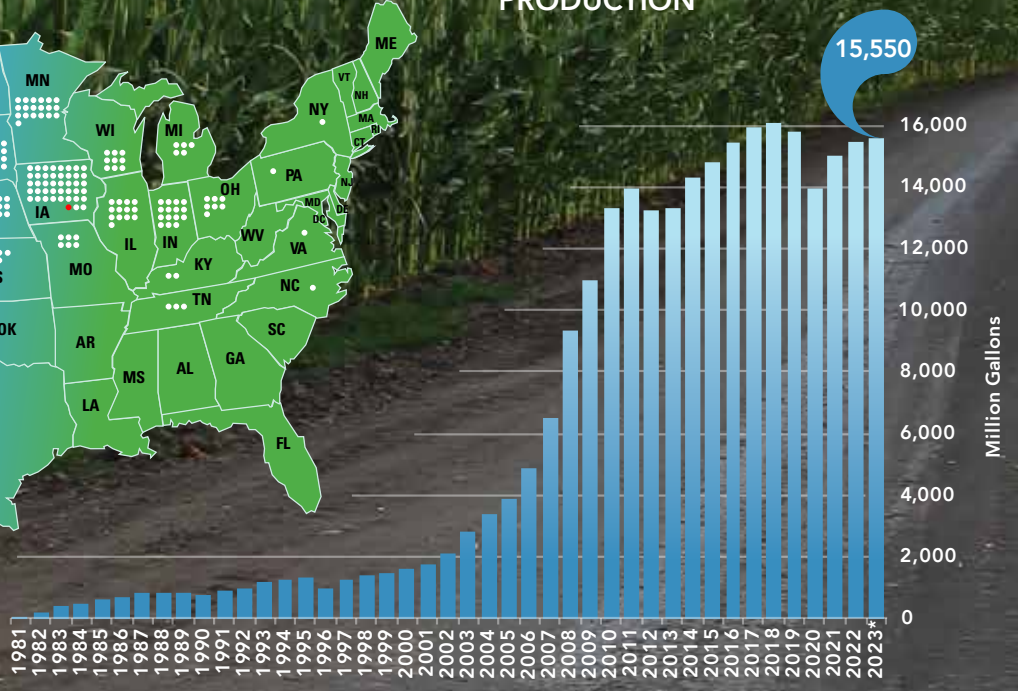
U.S. FUEL ETHANOL BIOREFINERIES BY STATE



● Installed Ethanol Biorefinery
● New Biorefinery Under Construction

Source: RFA, as of Dec. 2023

HISTORICAL U.S. ETHANOL PRODUCTION



Sources: RFA and U.S. Energy Information Administration **Forecast*

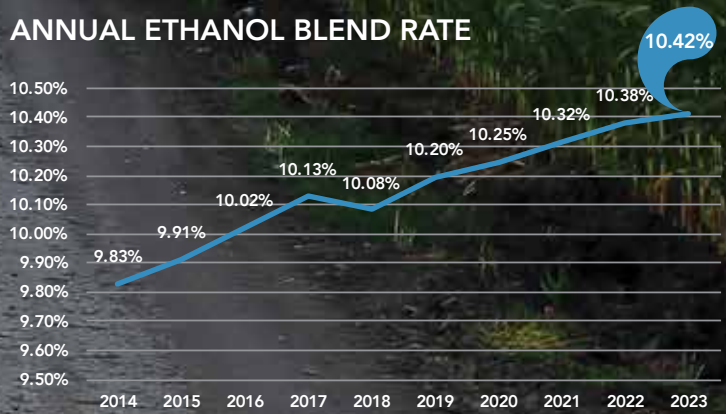
U.S. ETHANOL PRODUCTION CAPACITY BY STATE

(Million Gallons per Year)

	Existing Production Capacity	Capacity Under Constr./ Expansion	Installed Ethanol Biorefineries	Biorefineries Under Constr./ Expansion
Iowa	4,809	50	42	2
Nebraska	2,305	-	24	-
Illinois	1,886	-	13	-
South Dakota	1,442	-	16	-
Minnesota	1,427	-	19	-
Indiana	1,426	-	15	-
Ohio	732	-	7	-
Wisconsin	644	-	9	-
North Dakota	550	-	6	-
Kansas	540	-	11	-
Texas	420	-	4	-
Michigan	382	-	5	-
Missouri	335	-	6	-
Tennessee	235	-	3	-
California	227	-	5	-
Colorado	143	-	4	-
Pennsylvania	120	-	1	-
Idaho	60	-	1	-
New York	60	-	1	-
North Carolina	60	-	1	-
Arizona	55	-	1	-
Kentucky	50	-	2	-
Oregon	40	-	1	-
Virginia	2	-	1	-
TOTAL U.S.	17,950	50	198	2

Source: RFA, as of Dec. 2023

ANNUAL ETHANOL BLEND RATE



Source: U.S. Energy Information Administration

RFA Objectives

In July 2023, RFA's Board of Directors approved a new five-year strategic plan for the organization. The Board identified four strategic goals, which set the stage for our work going forward:

1. Increase global and domestic demand for renewable fuels and bioproducts.
2. Build a unifying coalition to communicate the economic, environmental, health, and energy security benefits of renewable fuels and bioproducts.
3. Facilitate innovation in policies, markets, and products.
4. Promote industry unity, best practices, safety, and continuous improvement through member services and support.

HISTORICAL ETHANOL BIOREFINERY COUNT & PRODUCTION CAPACITY

Year	Installed Ethanol Biorefineries	Total Installed Production Capacity (mgy)	Average Capacity per Biorefinery (mgy)
2003	72	3,699	51
2008	170	12,477	73
2013	210	14,881	71
2018	210	16,501	79
2023	198	17,950	91

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

The Ethanol Economy

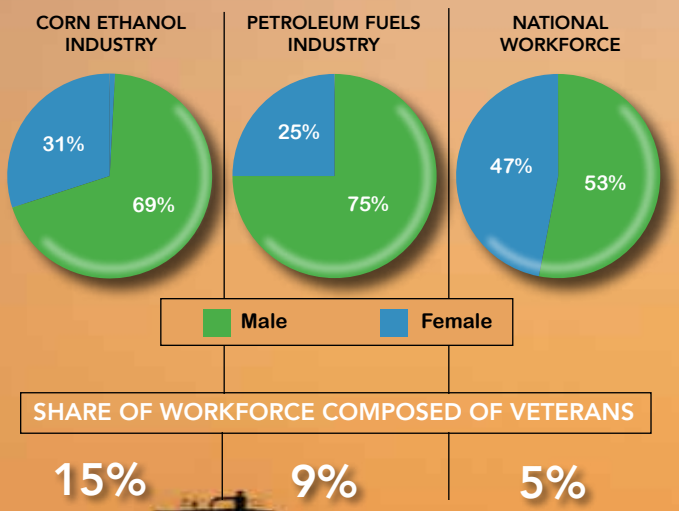
The U.S. ethanol industry fired on all cylinders in 2023. Operating margins hit their highest levels in nearly a decade as the cost of production fell, which also allowed ethanol to maintain its competitiveness against gasoline. In addition, continued expansion in the availability of E15 and flex fuels pushed the average ethanol content of gasoline (referred to as the ethanol "blend rate") farther above 10 percent.

Bolstered by higher domestic consumption and exports, ethanol output increased to 15.6 billion gallons, closing to within 1 percent of the 2019 pre-pandemic volume. Approximately 5.3 billion bushels of corn worth nearly $32 billion were processed into ethanol, providing a vital market for growers.

After reaching a 10-year high in 2022, corn prices declined as a record crop was harvested in 2023, though prices were relatively robust for much of the year. After surging due to the Russian invasion of Ukraine in 2022, the cost of natural gas, another key input for ethanol production, fell sharply as U.S. production hit record levels and inventories were replenished.

Once again, the ethanol industry made enormous contributions to the U.S. economy in 2023, with $54.2 billion in gross domestic product, almost 400,000 jobs supported across all sectors, and nearly $33 billion in household income.

WORKFORCE DEMOGRAPHICS



Source: U.S. Dept. of Energy data

Ethanol and the 2023 Economy

Direct Jobs	72,463
Indirect/Induced Jobs	322,002
Household Income	$32.5 billion
GDP Contribution	$54.2 billion
Tax Revenues	$10.4 billion

Source: ABF Economics LLP

With a 15-billion-gallon conventional renewable fuel requirement under the RFS in 2024, the prospect of permanent year-round E15 sales, the implementation of Inflation Reduction Act programs, and emerging new uses such as sustainable aviation fuel, the future of the ethanol industry continues to look bright, along with its economic contribution in rural America and beyond.

Ethanol's Value-Added Proposition

Based on average prices and product yields in 2023, a typical dry mill ethanol plant was adding approximately $2.71 of additional value—a remarkable 45%—to every bushel of corn processed.

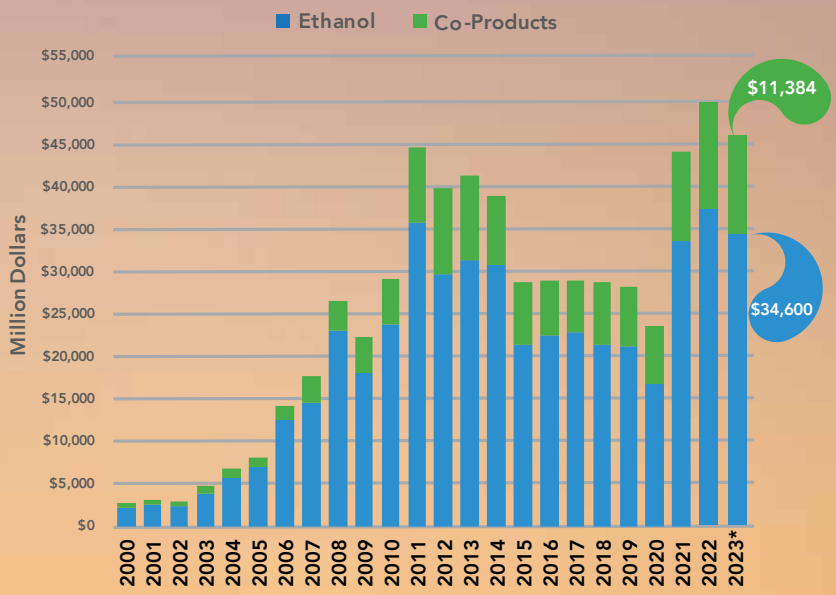
Corn Cost per Bushel

$ 5.99

Value of Outputs per Bushel	
Ethanol	$ 6.53
Distillers Grains	$ 1.64
Distillers Corn Oil	$ 0.53
TOTAL	**$ 8.70**

Estimate based on Jan.-Nov. 2023 data

GROSS VALUE OF U.S. ETHANOL INDUSTRY OUTPUT



Source: RFA based on U.S. Energy Information Admin. and U.S. Dept. of Agriculture data
**Forecast*

Ethanol Around the World

The United States has led the world in ethanol output for close to two decades. The production of 15.6 billion gallons in 2023 was nearly twice that of Brazil, notwithstanding that country's recent growth in sugarcane and corn ethanol production under its national biofuels policy.

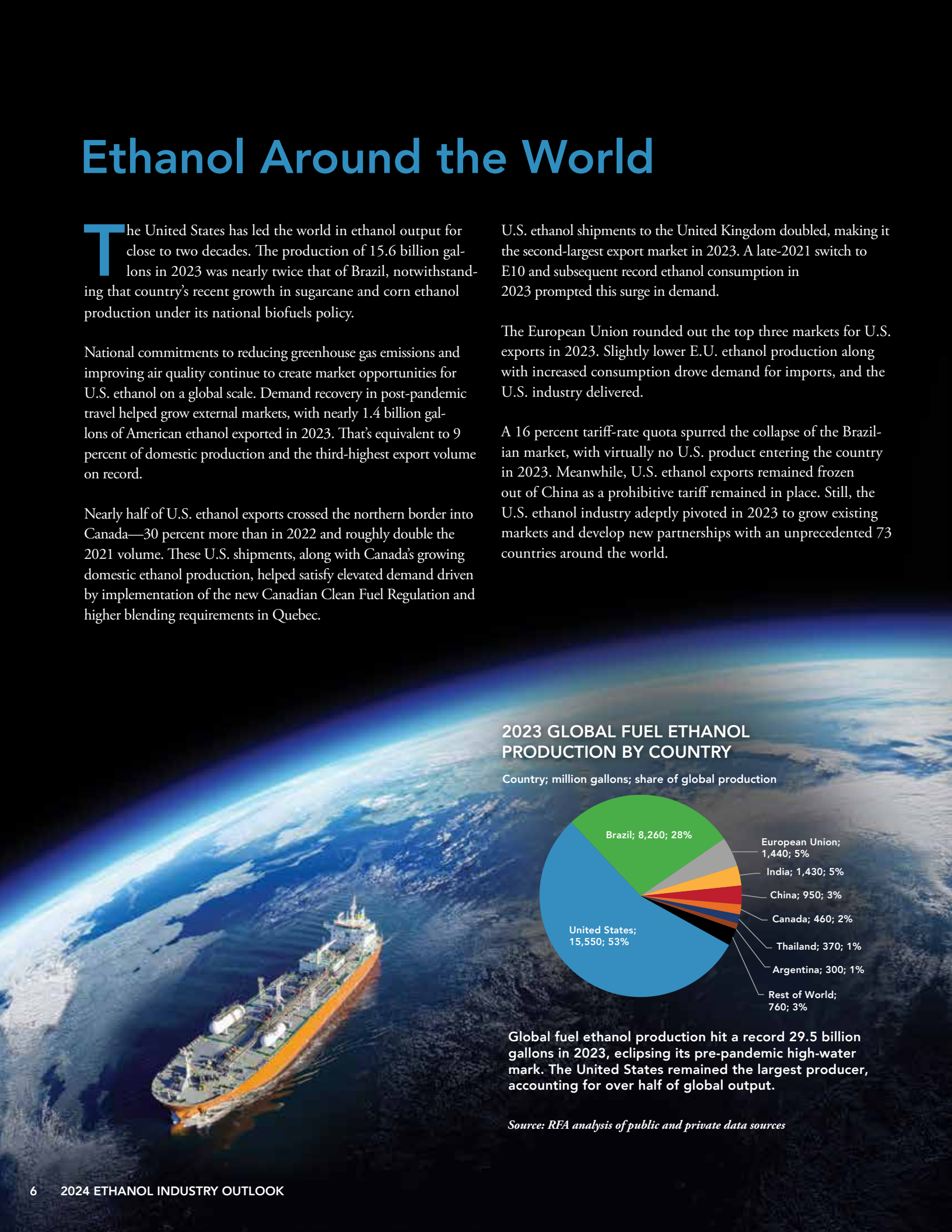
National commitments to reducing greenhouse gas emissions and improving air quality continue to create market opportunities for U.S. ethanol on a global scale. Demand recovery in post-pandemic travel helped grow external markets, with nearly 1.4 billion gallons of American ethanol exported in 2023. That's equivalent to 9 percent of domestic production and the third-highest export volume on record.

Nearly half of U.S. ethanol exports crossed the northern border into Canada—30 percent more than in 2022 and roughly double the 2021 volume. These U.S. shipments, along with Canada's growing domestic ethanol production, helped satisfy elevated demand driven by implementation of the new Canadian Clean Fuel Regulation and higher blending requirements in Quebec.

U.S. ethanol shipments to the United Kingdom doubled, making it the second-largest export market in 2023. A late-2021 switch to E10 and subsequent record ethanol consumption in 2023 prompted this surge in demand.

The European Union rounded out the top three markets for U.S. exports in 2023. Slightly lower E.U. ethanol production along with increased consumption drove demand for imports, and the U.S. industry delivered.

A 16 percent tariff-rate quota spurred the collapse of the Brazilian market, with virtually no U.S. product entering the country in 2023. Meanwhile, U.S. ethanol exports remained frozen out of China as a prohibitive tariff remained in place. Still, the U.S. ethanol industry adeptly pivoted in 2023 to grow existing markets and develop new partnerships with an unprecedented 73 countries around the world.



2023 GLOBAL FUEL ETHANOL PRODUCTION BY COUNTRY

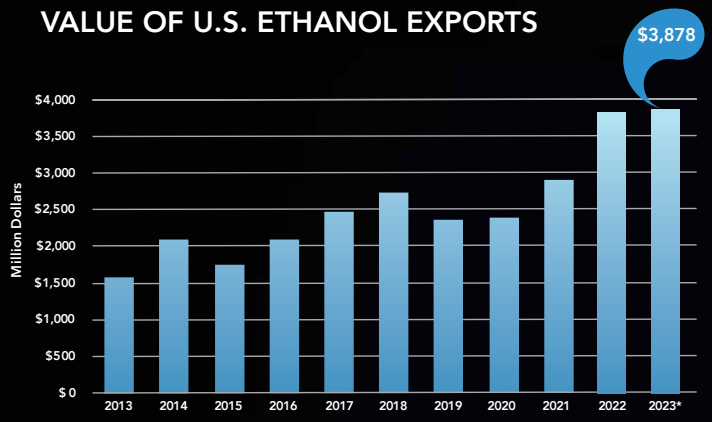
Country; million gallons; share of global production

Global fuel ethanol production hit a record 29.5 billion gallons in 2023, eclipsing its pre-pandemic high-water mark. The United States remained the largest producer, accounting for over half of global output.

Source: RFA analysis of public and private data sources

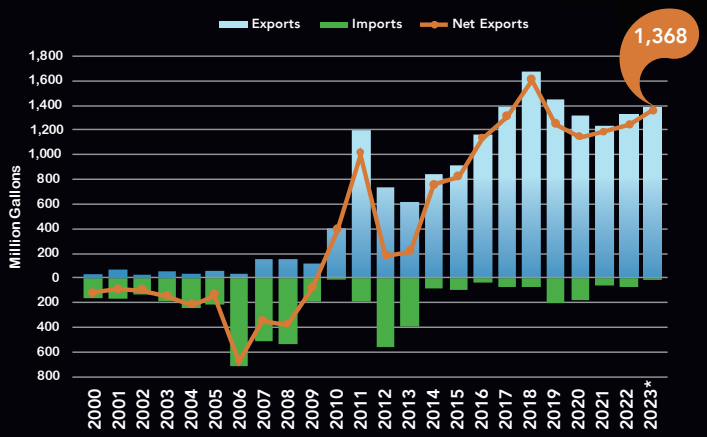
While exports continued to boom, U.S. ethanol imports were almost non-existent. Foreign ethanol entering the United States dropped to a 13-year low of 22 million gallons in 2023, equivalent to less than 1 percent of U.S. ethanol consumption. As in recent years, essentially all imports arrived duty-free from Brazil to take advantage of the RFS and California LCFS programs.

VALUE OF U.S. ETHANOL EXPORTS



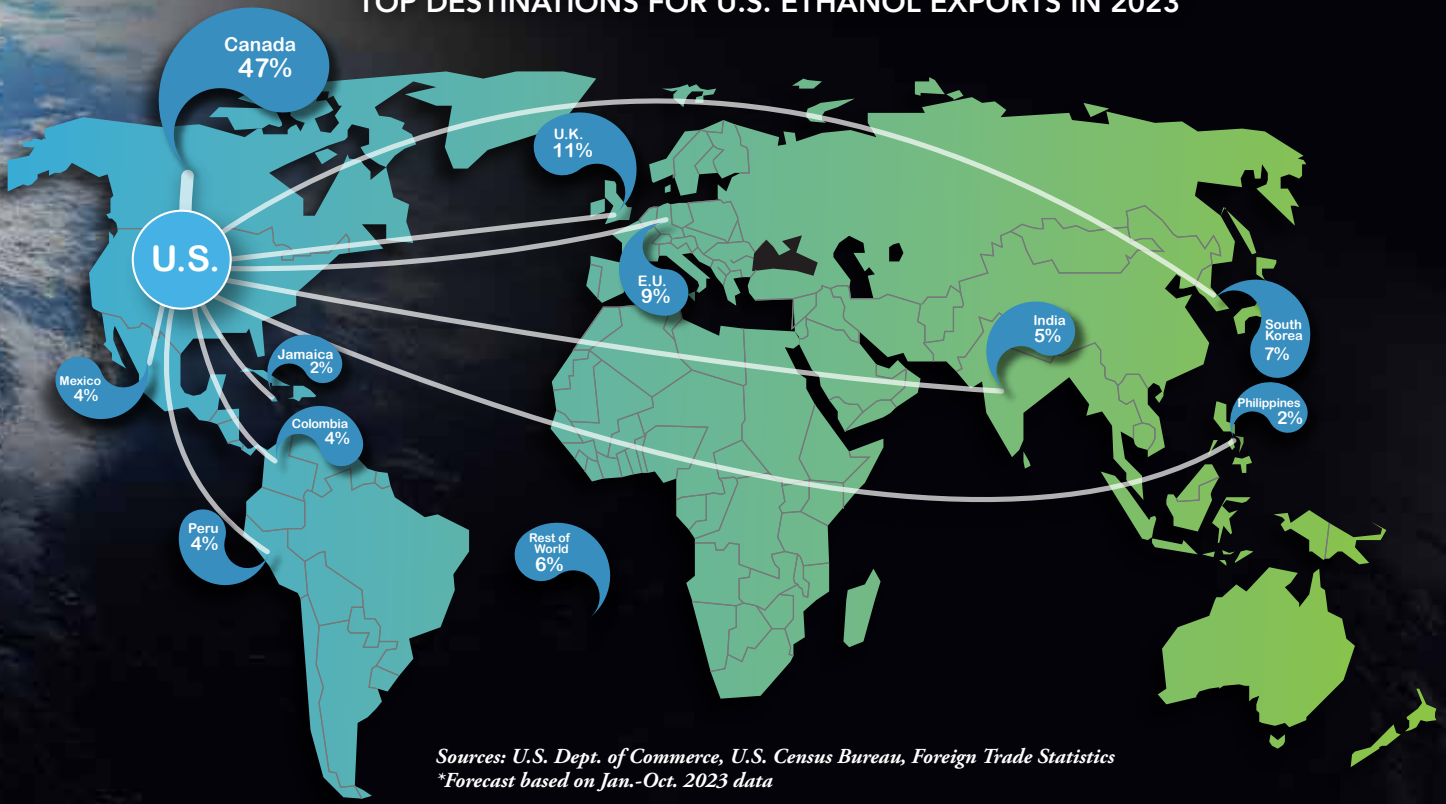
Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Oct. 2023 data*

U.S. ETHANOL EXPORTS AND IMPORTS



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Sep. 2023 data*

TOP DESTINATIONS FOR U.S. ETHANOL EXPORTS IN 2023



Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Oct. 2023 data*

Powerful Co-Products

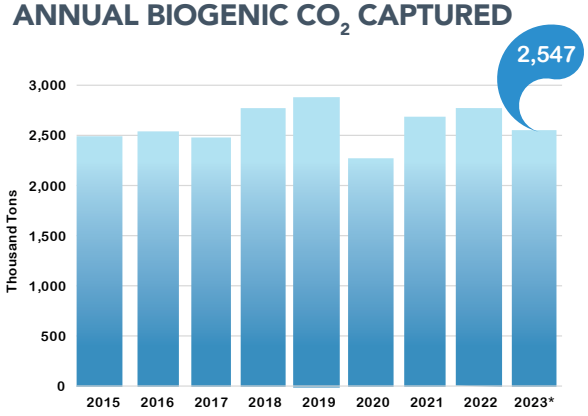
The U.S. ethanol industry is one of the world's largest suppliers of high-protein, low-cost animal feed. In 2023, biorefineries generated 35 million metric tons of distillers grains and corn gluten feed/meal. Attractive nutrient profiles render these ethanol co-products valuable ingredients in rations for livestock, poultry, and other animals.

In addition, biorefineries produced over 4.2 billion pounds of distillers corn oil (DCO). Ethanol producers continued to pursue optimized DCO production, as demand continued to surge. From its value as a poultry feed ingredient to its use as a major feedstock for renewable diesel, biodiesel, and—eventually—sustainable aviation fuel production, DCO demand has never been hotter.

U.S. biorefineries not only satisfy animal nutrition needs domestically, but they also export about one-third of the distillers grains they produce to customers around the world. In 2023, more than 50 countries purchased a cumulative 10.8 mmt of U.S. distillers grains. Half of these exports landed in Southeast and East Asia. Meanwhile, Mexico accounted for 21 percent of total U.S. distillers grains exports shipped, extending the country's title as the top DDGS importer for the seventh consecutive year.

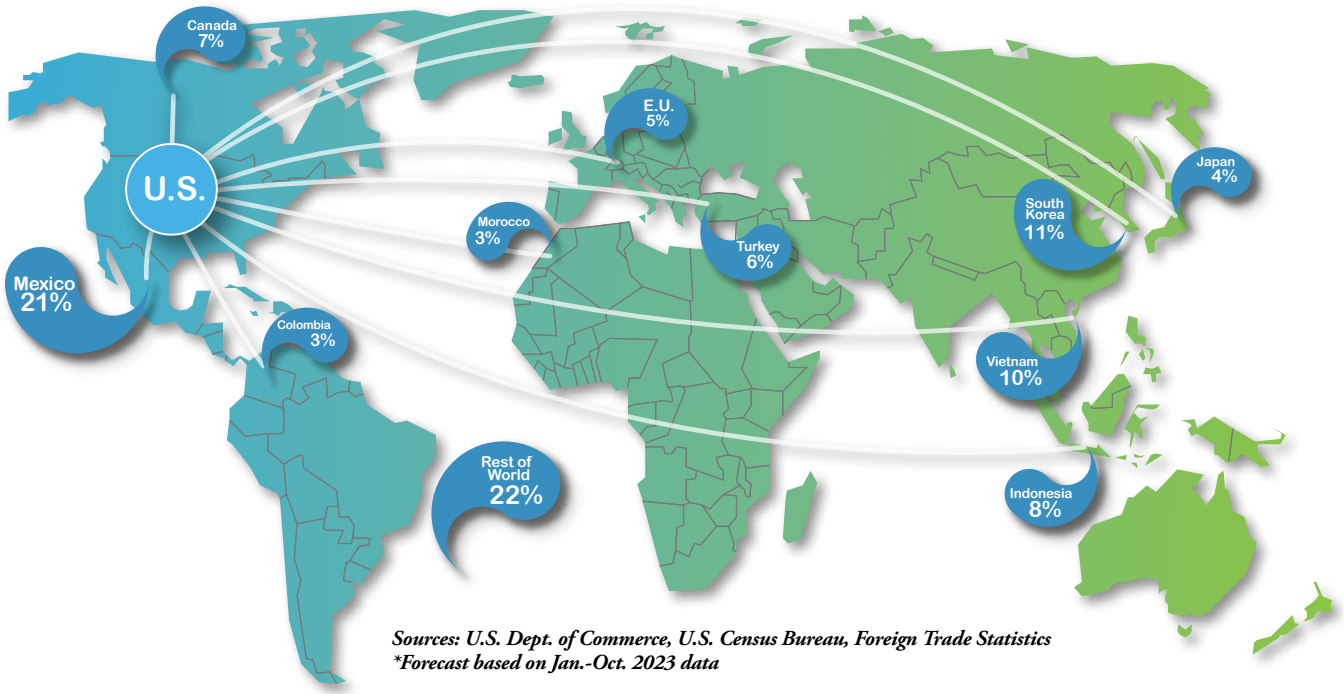
Additionally, biogenic CO_2 produced via fermentation continues to serve as an unheralded co-product from ethanol biorefineries. Used in everything from beverage carbonation, to dry ice, to wastewater treatment, to welding and many other commercial applications, CO_2's value continues to increase. In 2023, ethanol producers across the country turned their focus to emerging opportunities for captured CO_2, ranging from geological sequestration to utilization in new chemical, fuel, and industrial product applications. As a new year begins, producers will continue to pursue exciting new opportunities for their biogenic CO_2.

ANNUAL BIOGENIC CO_2 CAPTURED



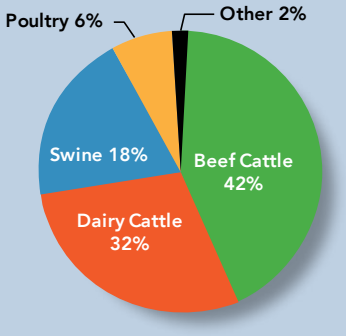
Source: RFA based on U.S. Dept. of Agriculture data
** Forecast based on Jan.-Oct. data*

TOP DESTINATIONS FOR U.S. DISTILLERS GRAINS



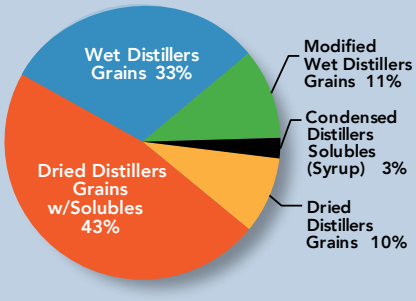
Sources: U.S. Dept. of Commerce, U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Oct. 2023 data*

2023 DISTILLERS GRAINS CONSUMPTION BY SPECIES



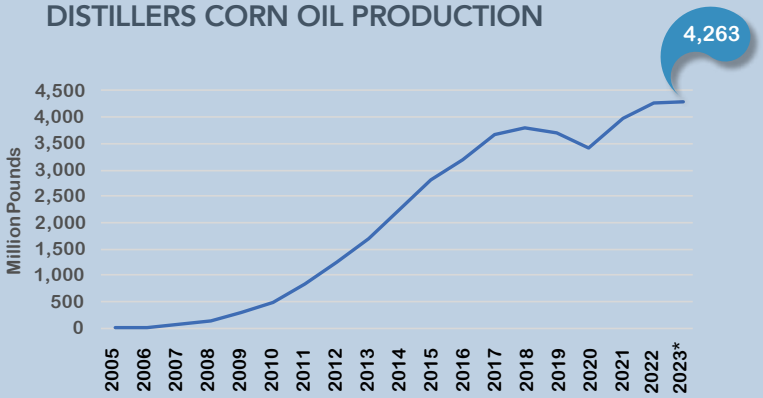
Source: Distillers grains marketing companies

2023 DISTILLERS GRAINS PRODUCTION BY TYPE, AS-IS BASIS



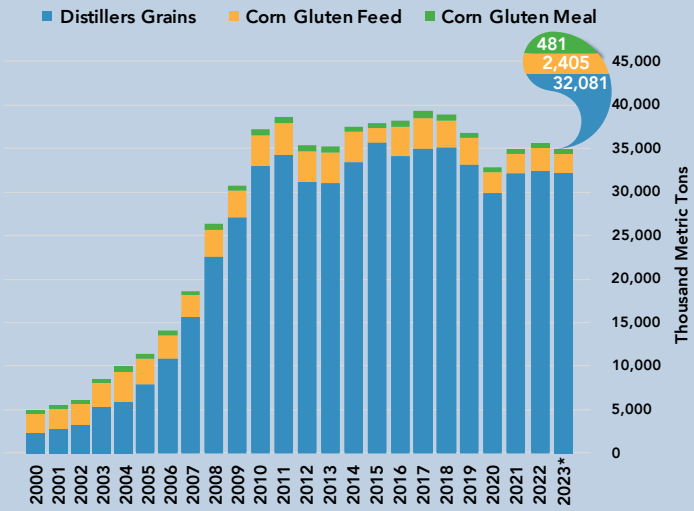
Sources: U.S. Dept. of Agriculture and RFA
**Forecast based on Jan.-Oct. 2023 data*

DISTILLERS CORN OIL PRODUCTION



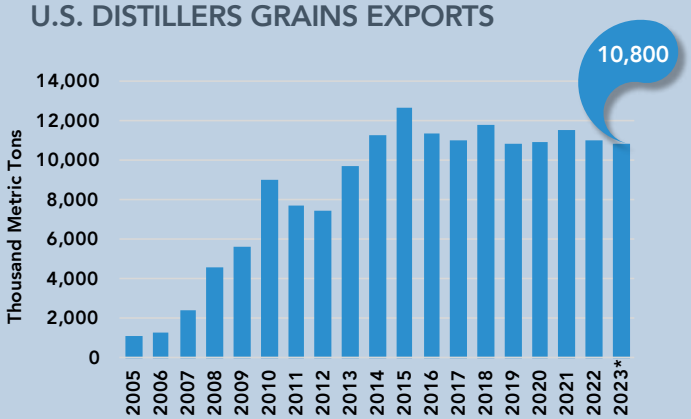
Sources: U.S. Dept. of Agriculture and RFA
**Forecast based on Jan.-Oct. 2023 data*

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.
**Forecast based on Jan.-Oct. 2023 data*

U.S. DISTILLERS GRAINS EXPORTS



Sources: U.S. Dept. of Commerce,
U.S. Census Bureau, Foreign Trade Statistics
**Forecast based on Jan.-Oct. 2023 data*

The RFS Table is Set

2023 marked the first year of a new chapter for the Renewable Fuel Standard (RFS). When the RFS was expanded in 2007, Congress included specific volume requirements through 2022, with 2023 being the first year where EPA had the discretion to "set" RFS volumes based on its analysis of several environmental, economic, and energy security factors.

After a multi-year advocacy effort by RFA and others, the RFS "set" rule was finalized by the EPA in June 2023, sending a strong signal to the marketplace and providing the longer-term certainty desired by affected parties. While the final RFS volumes may have been slightly lower than what biofuel producers had hoped for, the rule provided growth beyond 2022 levels in every category of renewable fuel, and—for the first time ever—provided three years' worth of requirements all at once.

In addition, EPA took the public's feedback to heart and decided against finalizing a flawed mechanism for allowing electric vehicle manufacturers to generate RFS credits ("eRINs") under the program. As RFA pointed out to EPA, its initial proposal for incorporating eRINs into the RFS was overly complex and inconsistent with the purpose of the RFS—which is to stimulate production and use of a wide range of clean fuels, not certain vehicle technologies.

Without a doubt, the RFS is the most successful federal clean fuels policy in history, and RFA's advocacy efforts will continue to support the program's role in lowering carbon emissions, providing more affordable fuels to consumers, and improving our nation's energy security.

2023-2025 Final Renewable Volume Obligations (Million RINs)	2023	2024	2025
Cellulosic Biofuel	840	1,090	1,380
Biomass-Based Diesel	4,230	4,560	5,025
Other Advanced	870	890	925
TOTAL ADVANCED	5,940	6,540	7,330
Implied Conventional Biofuel	15,000	15,000	15,000
TOTAL RENEWABLE FUEL	20,940	21,540	22,330
Supplemental Remand	250		

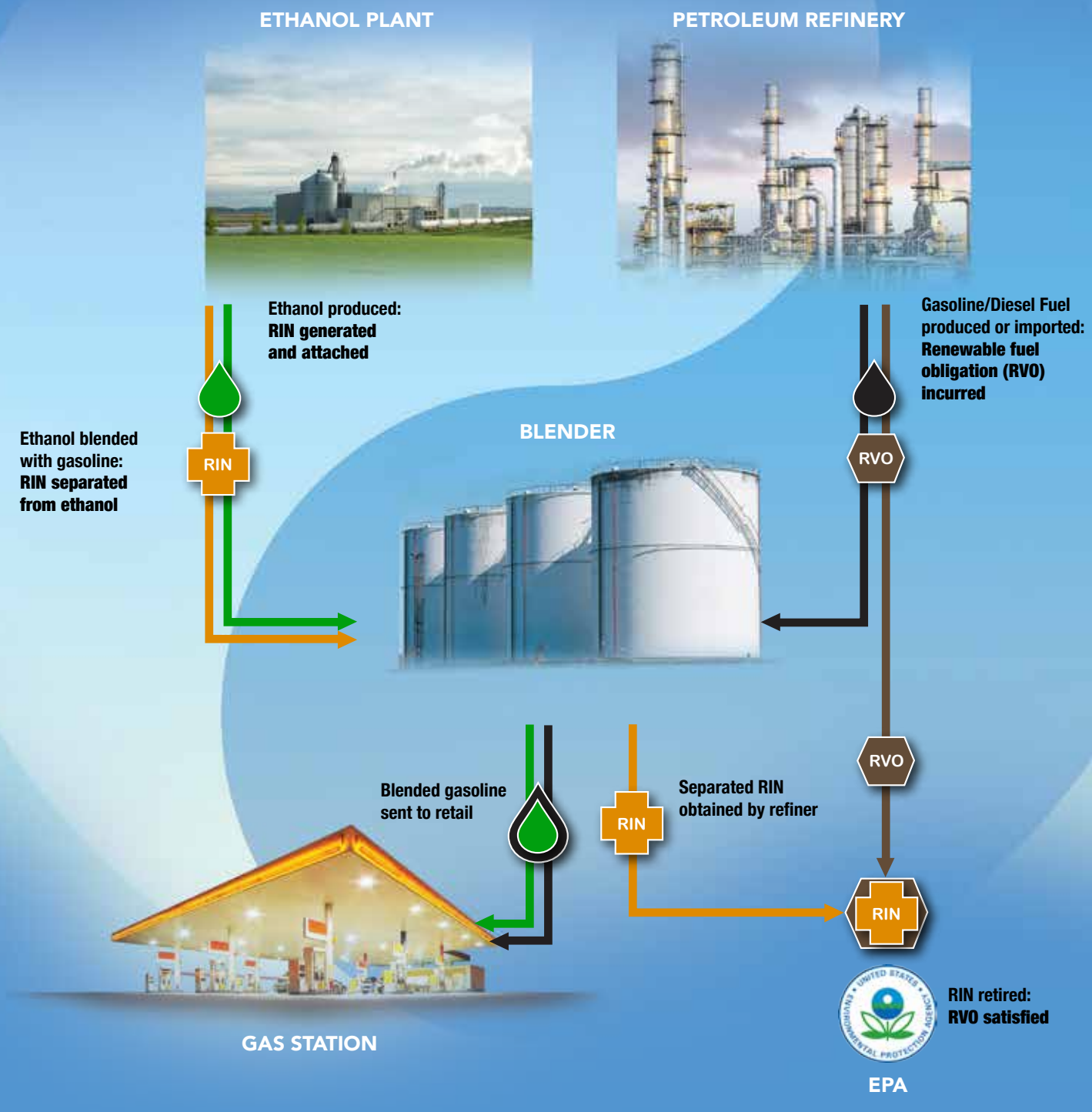
Source: EPA

"From day one, EPA has been committed to the growth of renewable fuels that play a critical role in diversifying our country's energy mix and combatting climate change, all while providing good paying jobs and economic benefits to communities across the country. Today's final rule reflects our efforts to ensure stability of the program for years to come, protect consumers from high fuel costs, strengthen the rural economy, support domestic production of cleaner fuels, and help reduce greenhouse gas emissions."

– EPA Administrator Michael S. Regan, June 2023

THE ETHANOL RIN LIFECYCLE

RINs, or Renewable Identification Numbers, are an important part of what makes the Renewable Fuel Standard a success. They represent gallons of renewable fuel that are produced and blended into U.S. gasoline and diesel fuel, and are numbered credits generated by the renewable fuel producer. Obligated parties under the RFS acquire RINs when they purchase and blend renewable fuel, and then turn in RINs to EPA to demonstrate compliance with their renewable volume obligation. RINs are tradeable in the marketplace; obligated parties who blend less than their required share of renewable fuels may purchase RINs from other parties who blended more.



Partnering for Policy

Throughout its 40-year history, the U.S. ethanol industry has developed powerful partnerships to promote government policies that support growth in the use of low-carbon renewable fuels. That tradition continued in 2023, as RFA strengthened existing partnerships and forged new ones to achieve mutual policy and regulatory objectives.

Whether it was working with airlines on implementation of sustainable aviation fuel (SAF) tax credits, partnering with oil companies and fuel retailers to promote legislation on year-round E15, collaborating with the executive branch on RFS implementation, or uniting with lawmakers on both sides of the aisle to advance key priorities, RFA's policy advocacy work was again powered by partnerships.

Successful implementation of 2022's Inflation Reduction Act (IRA) remains near the top of RFA's policy priority list as 2024 begins. We view the IRA as the most significant federal commitment to low-carbon renewable fuels since the RFS was expanded in 2007. Several measures in the bill grew out of stand-alone legislation that had been previously developed with substantial RFA input and advocacy. These include:

- $500 million in grants for higher-blend infrastructure
- Extensions of several current biofuel tax credits
- Creation of the "45Z" tax credit for clean fuel production
- Establishment of the "40B" sustainable aviation fuel tax credit
- Enhanced support for carbon capture, utilization, and storage.

RFA remains highly engaged as federal agencies implement these provisions. In particular, the lifecycle greenhouse gas modeling used to determine tax credit values, consideration of feedstock carbon intensity, and the law's documentation and verification practices will be of utmost importance.

Meanwhile, proposed federal vehicle emissions and fuel economy standards regulations were a cause for concern in 2023, and RFA continues to push for substantial revisions. These proposed standards set overly ambitious requirements that effectively result in mandating the production of electric vehicles while disregarding the emissions benefits of using renewable fuels like ethanol. RFA has testified and submitted comments outlining the industry's concerns, and we will remain engaged throughout the rulemaking process.

Another policy discussion that is gaining steam on Capitol Hill is around the potential of a national Clean Fuel Standard. RFA remains actively engaged in these conversations and we see great promise for ethanol in technology-neutral, performance-based policies focused on reducing GHG emissions from transportation.

Voters Like Ethanol Legislation

December 2023 polling of nearly 2,000 registered voters found strong support for some of RFA's key legislative priorities. **64 percent** support legislation establishing year-round E15 nationwide, and **67 percent** support the Flex Fuel Fairness Act. Recent polling also found that **61 percent** of voters support the Next Generation Fuels Act.

Implementing a national clean fuel program that incorporates a market-based, technology-neutral approach will be critical to decarbonizing the U.S. transportation sector, RFA President and CEO Geoff Cooper testified at a February 2023 hearing of the full U.S. Senate Committee on Environment and Public Works.

RFA's Ford Escape Flex Fuel PHEV project vehicle was the perfect backdrop when Sen. Pete Ricketts (R-NE) held a media event in July 2023 to announce his Flex Fuel Fairness Act.

Key Federal Legislation

RFA has expressed strong support for several ethanol-related bills introduced in the 118th Congress and will continue advocating for their adoption in 2024.

Nationwide Consumer and Fuel Retailer Choice Act.

Introduced by Senators Deb Fischer (R-NE), Shelley Moore Capito (R-WV), Tammy Duckworth (D-IL), and Tammy Baldwin (D-WI), as well as a diverse group of other senators, this bill would provide a permanent solution allowing the year-round, nationwide sale of E15, by allowing E15 and E10 to access the same 1-psi RVP waiver and use the same blendstock. For the first time, stakeholders from the petroleum industry, fuel marketing and retail sector, ethanol industry, agriculture, and consumers have all come together to support this mutually beneficial solution.

Next Generation Fuels Act. The Next Generation Fuels Act would create a national high-octane, low-carbon fuel standard and remove roadblocks that have prevented higher ethanol blends from entering the market. Originally introduced in the House in 2020 by Rep. Cheri Bustos (D-IL), it was introduced again in the 118th Congress in the Senate by Sens. Chuck Grassley (R-IA), Joni Ernst (R-IA), and Tammy Duckworth (D-IL); and in the House by Reps. Mariannette Miller-Meeks (R-IA), Angie Craig (D-MN), Darin LaHood (R-IL) and Nikki Budzinski (D-IL). RFA has been advocating for the creation of a national high-octane, low-carbon fuel standard since 2018.

Flex Fuel Fairness Act. This bill would revise EPA tailpipe standards to encourage automakers to produce more flex fuel vehicles (FFVs) capable of operating on low-carbon ethanol flex fuels like E85. The bill was introduced in the Senate by Sens. Amy Klobuchar (D-MN) and Pete Ricketts (R-NE), and in the House by Reps. Mariannette Miller-Meeks (R-IA) and Angie Craig (D-MN). The bill would help to level the playing field for FFVs by properly recognizing the emissions benefits associated with using flex fuels.

RFA also supports these other bills introduced in 2023 and is seeking their passage as the 118th Congress continues in 2024.

- The **Adopt GREET Act** would require the Environmental Protection Agency to update its greenhouse gas modeling for ethanol and biodiesel.
- The **SAF Accuracy Act** would clarify the definition of sustainable aviation fuel (SAF) and specify additional lifecycle greenhouse gas methodologies for the sake of federal SAF regulation.
- The **Farm to Fly Act** would likewise foster the development of SAF within existing U.S. Department of Agriculture programs and ensure USDA's SAF definitions reflect eligibility for American agricultural crops.
- The **Carbon Capture and Utilization Parity Act** would increase the tax credit for carbon capture and utilization to match the incentives for carbon capture and sequestration for both direct air capture and the power and industrial sectors.
- Legislation (Senate: **American Innovation and Jobs Act**; House: **American Innovation and R&D Competitiveness Act**) to re-establish research-and-development tax credits that expired in 2021.

Driving a Net-Zero Future

In an ethanol industry first, RFA's producer members pledged in 2021 that the renewable fuels they produce will be 70 percent less carbon intensive than gasoline by 2030 and achieve net-zero emissions by 2050 or sooner. The following year, RFA issued a landmark study that identified multiple technology pathways to achieving the net-zero goal. In fact, with the right policy and market conditions, the study found the industry could hit its net-zero aspiration around 2040—or 10 years ahead of schedule.

Today, ethanol producers are already well on the way there. A 2023 survey of RFA members found that nearly eight out of ten facilities are on track to achieve net zero by 2050 or sooner. Among other findings:

- All surveyed facilities reported adopting at least one carbon-reduction technology in recent years, and most have adopted more than one of these technologies and practices.
- Nearly two-thirds of the biorefineries have an approved Efficient Producer Pathway under the Renewable Fuel Standard.
- While just over one-third of the biorefineries surveyed currently capture high-purity biogenic CO_2 for food/beverage and industrial uses, more than three-quarters intend to adopt carbon capture and geological sequestration technology.

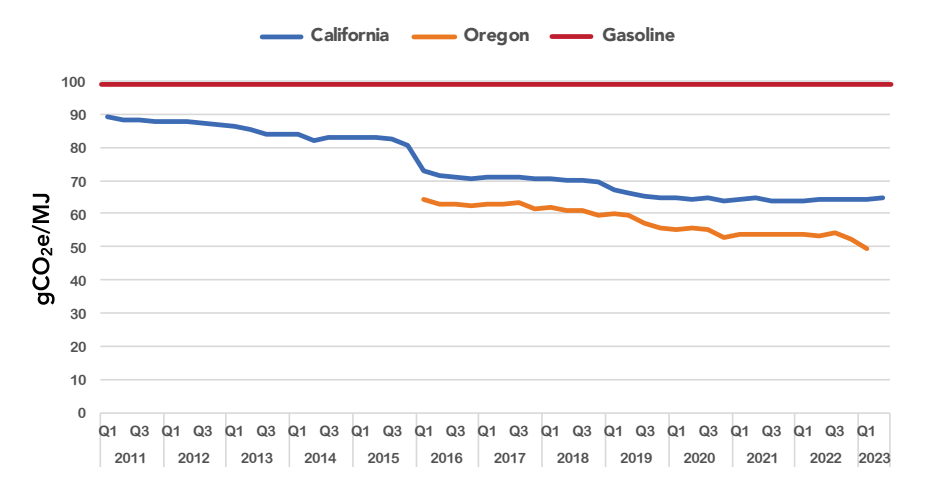
Nevertheless, there are some barriers to overcome, such as securing capital with favorable terms, permitting challenges, policy and regulatory uncertainty, and a lack of clear return on investment.

While capturing CO_2 from fermentation is the easy part, employing relatively new and unproven utilization or sequestration technologies is proving to be the hard part. Still, CCUS is a critical element of RFA's net-zero pathway, and new policies and regulations are helping to break down barriers to adoption. In 2024, RFA will continue efforts to find new and expanded markets for biogenic CO_2, while at the same time supporting efforts to geologically sequester onsite, nearby or in centralized sites via pipeline or other modes of transportation.

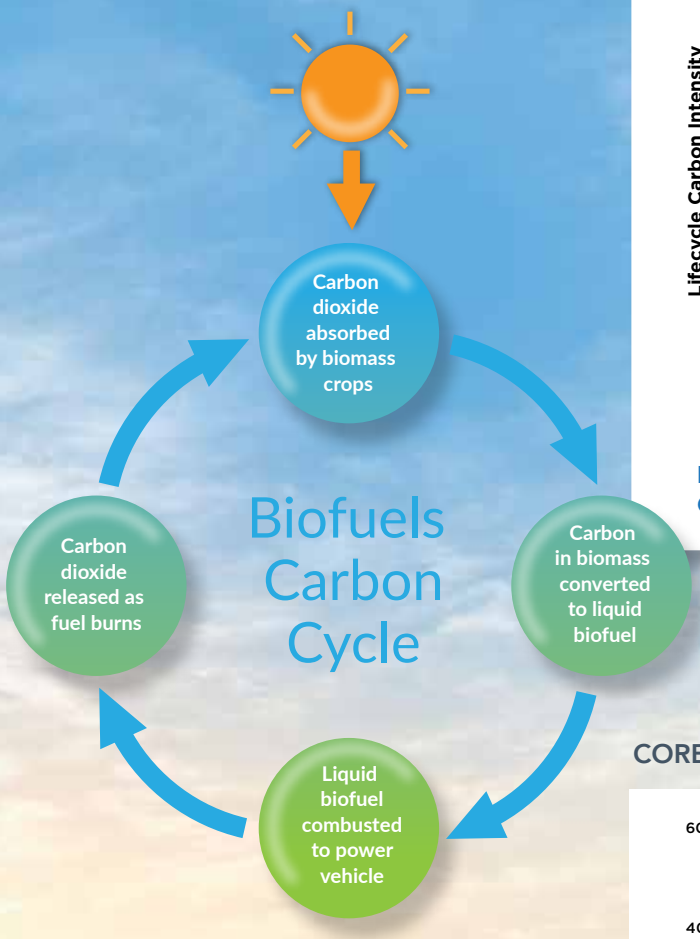
The use of ethanol in gasoline in 2023 reduced CO_2-equivalent greenhouse gas emissions from the transportation sector by 56.5 million metric tons. That's equivalent to:

- **Removing 12 million cars from the road for an entire year**
- **Eliminating the annual emissions from 15 coal-fired power plants**
- **Eliminating the emissions from 325,000 roundtrip flights from Los Angeles to New York City.**

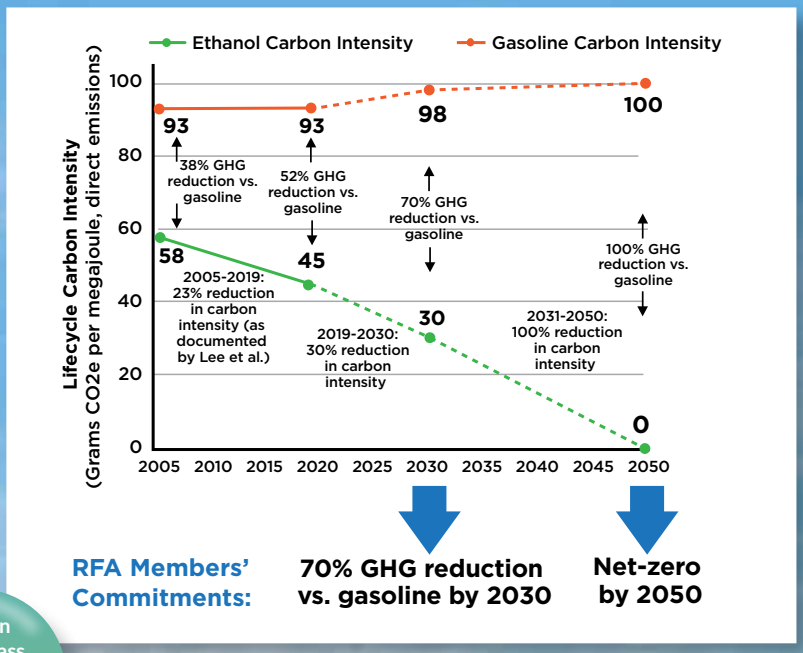
CARBON INTENSITY OF ETHANOL FUELS IN CALIFORNIA AND OREGON



Sources: California Air Resources Board, Oregon Department of Environmental Quality

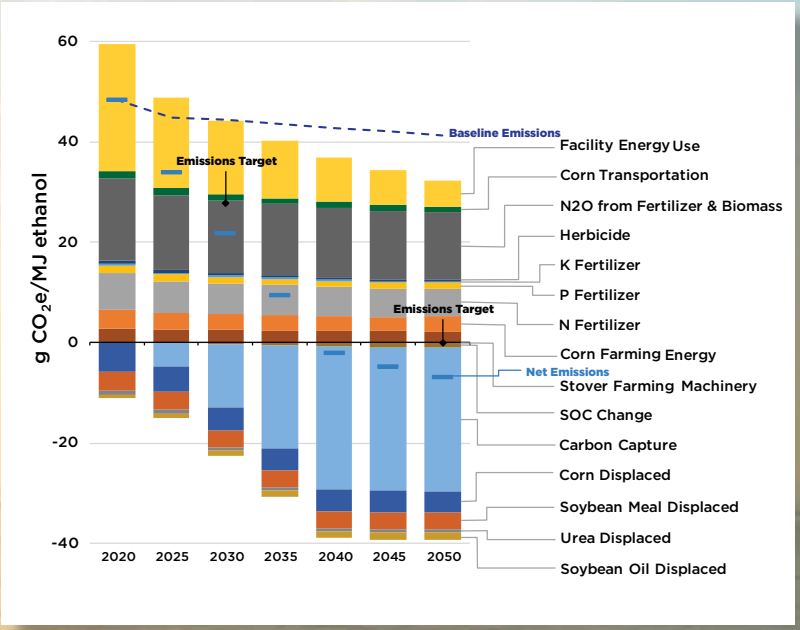


ACTUAL 2005 AND 2019 ETHANOL CARBON INTENSITY (DOE-ARGONNE) AND RFA GOALS FOR 2030 AND 2050



Source: RFA based on data provided in 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.

CORE PATHWAY TO NET-ZERO EMISSIONS



Source: "Pathways to Net-Zero Ethanol: Scenarios for Ethanol Producers to Achieve Carbon Neutrality by 2050," Isaac Emery, Ph.D., of Informed Sustainability Consulting LLC, February 14, 2022.

Ethanol Takes Flight

In 2023, the U.S. aviation sector consumed more than 24 billion gallons of petroleum-based jet fuel and emitted a staggering 190 million metric tons of heat-trapping greenhouse gases—or nearly 10 percent of all transportation-related emissions.

Recognizing the substantial environmental impacts of air travel, the aviation sector is actively seeking solutions to affordably reduce its carbon footprint. As the airline industry has evaluated different decarbonization options, sustainable aviation fuels (SAF) have emerged as the most promising opportunity.

And that's where ethanol comes in.

With nearly 18 billion gallons of existing annual production capacity and established infrastructure systems, ethanol is a readily available low-carbon, low-cost feedstock for the production of SAF. According to the Department of Energy, SAF made from today's average corn starch ethanol is 20-25 percent less carbon intensive than petroleum-based jet fuel—a good head start. But with the addition of carbon capture, utilization, and sequestration (CCUS), ethanol-based SAF can reduce GHG emissions by more than 50 percent compared to conventional jet fuel. Ethanol-to-jet fuel can even approach—or exceed—net zero carbon emissions if biorefineries replace fossil electricity and natural gas use with renewable energy, or if lower-carbon farming practices are broadly adopted.

In addition, SAF made from distillers corn oil—one of our industry's valuable co-products—is already capable of offering a 70 percent GHG reduction.

But reducing carbon intensity requires investment in new technology, and investment in new technology requires assurance that a robust market opportunity for SAF will exist. The tax credits included in the Inflation Reduction Act (IRA) are an important first step toward providing that assurance, but more work is needed to build confidence in the future of the SAF marketplace. As 2023 came to an end and 2024 began, RFA and its partners were laser-focused on ensuring IRA tax credits for SAF are implemented in a way that allows America's ethanol producers, farmers, and airlines to fully participate.

SAF represents an unprecedented decarbonization opportunity for the aviation sector and unprecedented economic opportunity for rural America and the renewable fuels sector. With the right mix of policy, investment, and science, the sky is the limit for ethanol-based SAF.

"Mark my words: By the next 20 years, farmers are going to be providing 95 percent of all the sustainable airline fuel."

– President Joe Biden, at a July 2023 event in Maine

"There is great potential to produce SAFs with potentially zero or negative GHG emissions, through a combination of cleaner production technologies and sustainable farming practices."

– U.S. Department of Energy

What is SAF?

Sustainable Aviation Fuel, or SAF, is aviation fuel made from renewable, non-petroleum sources or waste streams. Numerous feedstocks, technologies, and processes can be used to make SAF, which is chemically identical to conventional petroleum-based aviation fuel and must meet the same specifications for performance. Certain statutory definitions require that SAF must reduce lifecycle greenhouse gas emissions by 50 percent or more compared to conventional aviation fuel. SAF is often blended at a 50 percent level with conventional jet fuel; however, some airlines have demonstrated the efficacy of 100 percent SAF.

SAF Grand Challenge

Announced in September 2021, the Grand Challenge is a federal approach to support the U.S. industry build out and annual production of 3 billion gallons of SAF having a minimum reduction in lifecycle greenhouse gas emissions of 50 percent compared to conventional fuel by 2030, and 100 percent of projected annual aviation jet fuel use—35 million gallons—by 2050.

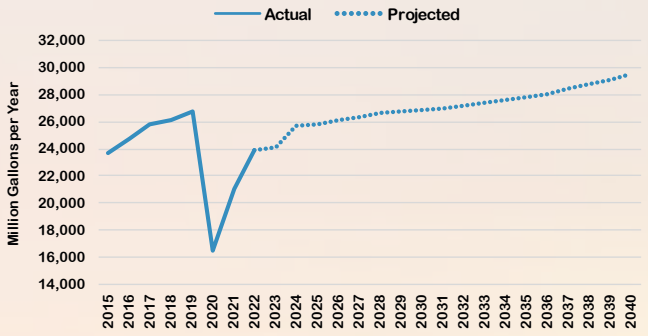
Aviation Group Sees SAF Tripling in 2024

In December 2023, the International Air Transport Association announced estimates for global SAF production. In 2023, SAF volumes reached over 150 million gallons, double 2022 production. For 2024, IATA expects SAF production to triple to nearly 500 million gallons. This still amounts to just half of one percent of global aviation fuel consumption.

How the Industry Can Decarbonize Global Aviation by 2050

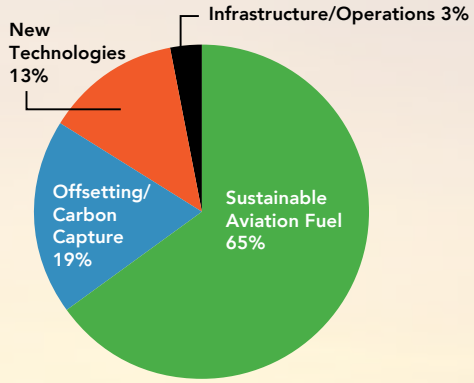
The International Air Transport Association has determined SAF represents the single largest opportunity for decarbonizing the global aviation sector.

U.S. JET FUEL CONSUMPTION



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

SOURCES OF AVIATION SECTOR DECARBONIZATION



Source: International Air Transport Association

Partnering for Higher Blends

Expanding the availability of E15 and flex fuels like E85 remains critically important to the future of the ethanol industry. The continued push for year-round E15, in particular, shows how our partnerships lead to progress. This past year, RFA worked with fuel retailers, the American Petroleum Institute, and others to advance legislation that would make E15 permanently available year-round and nationwide.

For the second time in two years, RFA's efforts helped secure emergency waivers from the Biden administration for year-round E15 in summer 2023. The result was record sales volumes of lower-cost E15 and rapid growth in the number of customers seeking out the fuel.

At the same time, automakers continue to endorse the use of E15 in their vehicles. For model year 2024, Subaru has approved the use of E15 in its popular Forester model, completing the manufacturer's multi-year shift to E15 across the board. And while BMW and Mini go even further, approving the use of gasoline containing up to 25 percent ethanol in their vehicles, Mercedes-Benz, Mazda, and Volvo still do not specifically list E15 as an approved fuel.

While flex fuels like E85 continue to gain in popularity—its use in California rose to record heights in 2023—automakers continue to backtrack on their production of FFVs. For model year 2024, the only FFV available to consumers is a select Ford F-150 model, with a few other models available for fleet purchases only. This is a marked difference from the more than 80 different models offered by eight manufacturers 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, such as with the Flex Fuel Fairness Act of 2023, introduced in Congress last year.

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

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

AUTOMAKERS / MODELS	MODEL YEAR													MARKET SHARE *
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
BMW Group **														
BMW														2.4%
Mini														0.2%
Daimler Group (Mercedes-Benz)														2.4%
Ford Motor Co. (Ford & Lincoln)														13.6%
GM (Buick, Cadillac, Chevrolet & GMC)														17.8%
Honda Motor Co. (Honda & Acura)														8.4%
Hyundai Motor Co. (Hyundai, Genesis & Kia)														11.2%
Mazda														2.4%
Mitsubishi Motors Corp. †														0.6%
Nissan Motor Co. ‡														
Infiniti														0.4%
Nissan														5.7%
Stellantis (Alfa Romeo, Chrysler, Dodge, Fiat, Jeep, Maserati & RAM)														10.5%
Subaru														4.3%
Tata Motors (Jaguar & Land Rover)														0.5%
Toyota Motor Corp.														
Lexus														2.0%
Toyota §														12.7%
Volkswagen Group ¶														
Audi														1.5%
Porsche														0.5%
Volkswagen														1.8%
Volvo Car Group														0.8%

* Internal combustion engine models only.
** Approves the use of up to 25% ethanol blends.
† Approves the use of E15 in Outlander.
‡ Approves the use of E15 except in 1.6L, 2.0L, 3.8L TT & 5.6L engines.
§ Approves the use of up to 25% ethanol blends in Supra.
¶ Approves the use of E15 except in Golf.

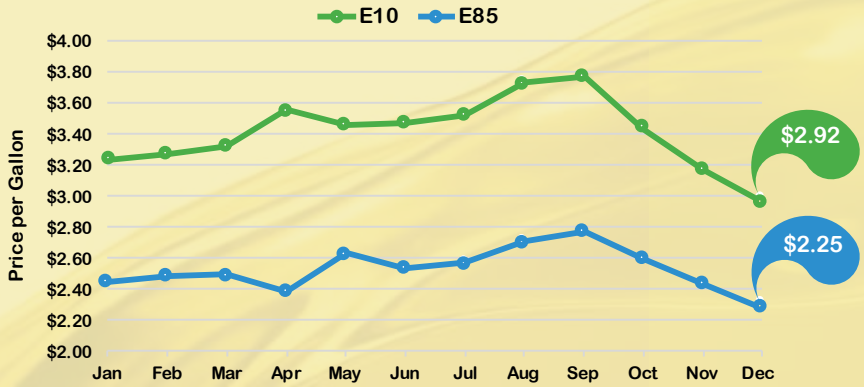
Source: RFA based on data from manufacturers and GoodCarBadCar.net

RFA's latest project vehicle, a 2022 Ford Escape, is the first-ever plug-in electric vehicle that runs on low-carbon E85 fuel. This project demonstrates how ethanol and electricity can jointly power our vehicles today. Running this vehicle on lower-cost E85 flex fuel has resulted in outstanding emissions reductions — without sacrificing fuel economy. ***See Page 30 for details.***

Polling Shows Strong Support for Higher Blends

December 2023 polling by Morning Consult showed that registered voters strongly support higher blends. 70 percent of respondents support the United States increasing the availability of E15 to help lower fuel prices and support energy independence. 68 percent believe it is important for the U.S. government to promote the production and sale of flex fuel vehicles in the United States.

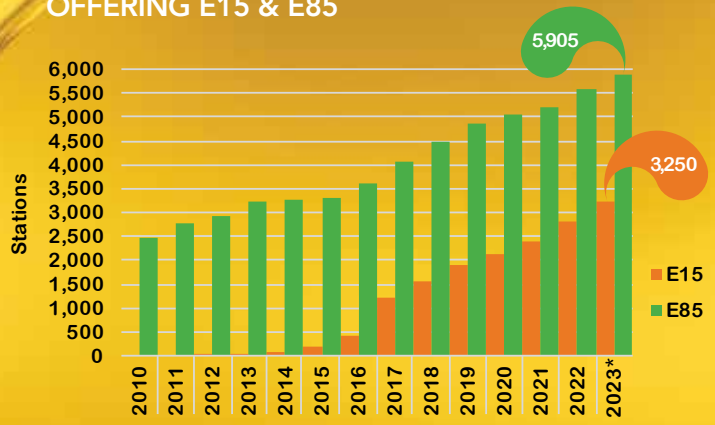
2023 NATIONAL AVERAGE RETAIL PRICES FOR E10 & E85



Source: RFA based on data from E85prices.com

E85's national average discount to E10 in 2023 was an attention-grabbing $0.88/gal.—a 26% savings!

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



Source: RFA **Estimated*

Partnering for Infrastructure Expansion

RFA continues its work on the U.S. Department of Agriculture's Higher Blends Infrastructure Incentive Program (HBIIP), which provides grant funding for higher blends infrastructure projects around the country. Since the program kicked off in 2020, RFA has had a 100 percent success rate in assisting retailers and other stakeholders apply for HBIIP grants. Through 2023, we have helped over 150 companies submit applications for over $105 million that would affect more than 600 locations across 30 states and upgrade nearly 3,500 dispensers. Combined with matching retailer funds, these grants would total more than $350 million.

Driving Energy Security

For the second straight year, geopolitical developments brought energy security concerns to the forefront, once again highlighting the benefits of American-made ethanol. On the 50th anniversary of the Yom Kippur War—and the related OPEC embargo of crude oil exports to the United States—Hamas attacked Israel, precipitating a war between the two. The war, along with other confrontations across the Middle East and strikes on ships in the Red Sea, heightened concerns about oil supplies and prices. In addition, ongoing constraints on Russian oil sales following the 2022 invasion of Ukraine continued to create volatility in global energy markets.

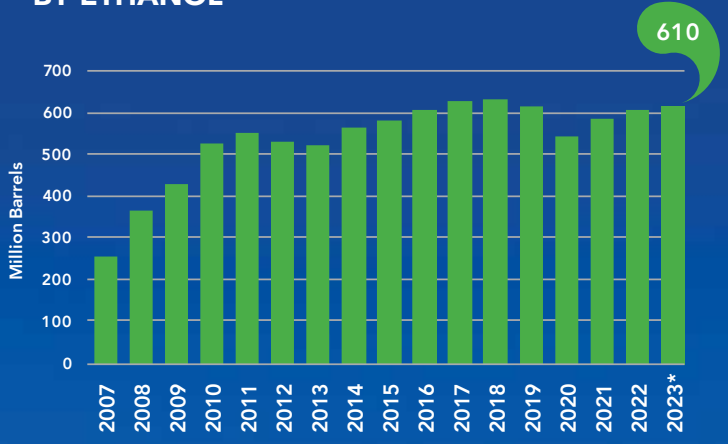
U.S. exports of crude oil and petroleum products increased after the Russian invasion and remained elevated in 2023. Yet, the United States continued to import nearly 200 million barrels of crude oil per month, and one-third of U.S. crude supplies came from foreign sources. Moreover, over 40 percent of the oil processed by U.S. refineries was imported.

Crude oil prices surged higher in the fall, first as a result of the extension of OPEC+ production restrictions and then as an initial response to the events in Israel and Gaza. Overall, Americans paid OPEC member countries approximately $29 billion for oil—the equivalent of $221 per household.

The presence of ethanol in our fuel supply reduced U.S. gas prices by 77 cents per gallon between 2019 and 2022.

- From a February 2023 study by energy economists from the University of California, Berkeley and leading universities in Brazil and the Czech Republic

HISTORICAL OIL IMPORT DISPLACEMENT BY ETHANOL



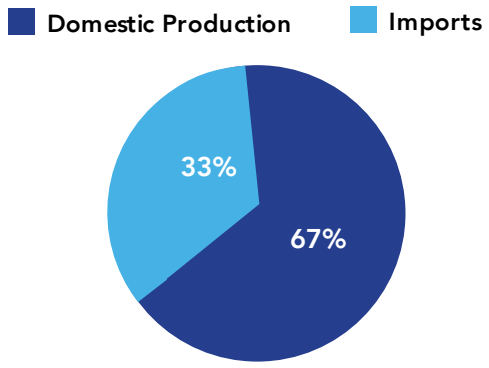
Source: RFA based on U.S. Dept. of Energy data **Estimated*

It is apparent from the events of the last two years that the United States remains tethered to an interconnected global petroleum market. Within this context, ethanol continues to make a substantial contribution to U.S. energy security. In fact, the 15.6 billion gallons of U.S. ethanol produced in 2023 displaced an amount of gasoline refined from more than 600 million barrels of crude oil.

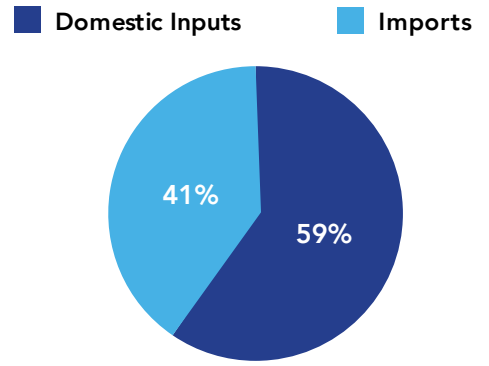
Additionally, ethanol was priced at an average discount to gasoline blendstock of $0.50 per gallon in the wholesale market, and the differential approached $1 per gallon during the summer.

These benefits were confirmed in a February 2023 study led by a University of California, Berkeley economist, which concluded that "adding ethanol to gasoline decreases the price paid by U.S. drivers at the pump. We estimate the average discount per gallon to be $0.77 between 2019 to 2022 and averaged across our models." The researchers also noted, "The accessibility of renewable fuels limits the bargaining power of the largest oil producers and brings about a higher degree of fuel security to the U.S."

SOURCES OF U.S. CRUDE OIL SUPPLY



INPUTS TO U.S. REFINERIES



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

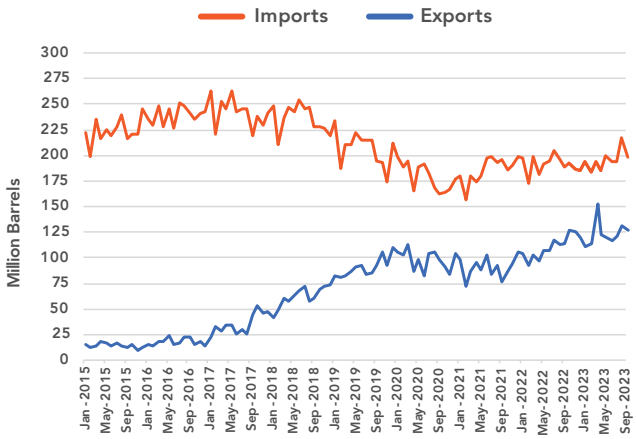
Transferring American Wealth to OPEC

Our nation still transfers billions of dollars every year to the OPEC cartel. In 2023 alone, the U.S. sent some $29 billion or $220 per American household to OPEC nations to pay for crude oil imports.

OPEC Nation	U.S. Spending on Crude Oil Imports (Billion $)*
Saudi Arabia	$10.9
Iraq	$6.1
Nigeria	$4.7
Venezuela	$3.0
Libya	$1.3
Angola	$1.0
Other OPEC	$1.9
TOTAL	$29.0

**Estimated based on Jan.-Oct. 2023 data*

U.S. CRUDE OIL TRADE



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

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

The Power of Octane

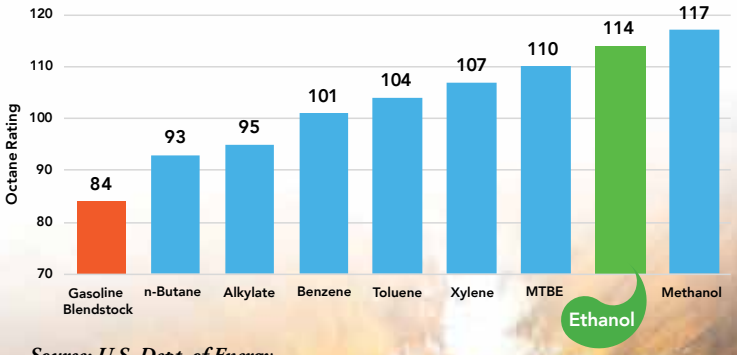
Automakers and consumers alike continue to demand higher octane fuels. Each year, auto manufacturers produce more turbocharged, higher-compression engines that need higher-octane gasoline to operate efficiently. This is the sort of marketplace dynamic that demands ethanol as a clean, affordable source of octane—a need that will only intensify as automakers contend with more stringent fuel economy requirements moving forward.

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

Refiners have largely optimized their processes to take advantage of ethanol's properties. Today, most regular gasoline in the United States is produced using blendstock with an octane rating of 84, which is then upgraded to a rating of 87 by adding 10 percent ethanol. Refiners may continue to reduce the octane rating of the gasoline blendstock to 82 or 83 as E15 becomes more ubiquitous. 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 policies that compel the use of mid-level ethanol blends such as E25 or E30 to meet future fuel economy and emissions standards. RFA continues to push for an expanded future role for high-octane, low-carbon ethanol and we continue our work with policymakers to highlight the benefits of such fuels—especially as ethanol moves toward net-zero emissions.

BLENDING OCTANE RATINGS OF VARIOUS OCTANE BOOSTERS



Source: U.S. Dept. of Energy

What is Octane?

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 Clears the Air

With the world focused on the threat of climate change and the need to achieve net-zero carbon by mid-century, a lot of attention is paid to ethanol's ability to reduce greenhouse gas emissions. And while ethanol does indeed have impressive low-carbon credentials, ethanol also still has an incredibly important role to play in reducing harmful tailpipe pollution.

Adding ethanol to gasoline reduces tailpipe emissions of the following pollutants, among others:

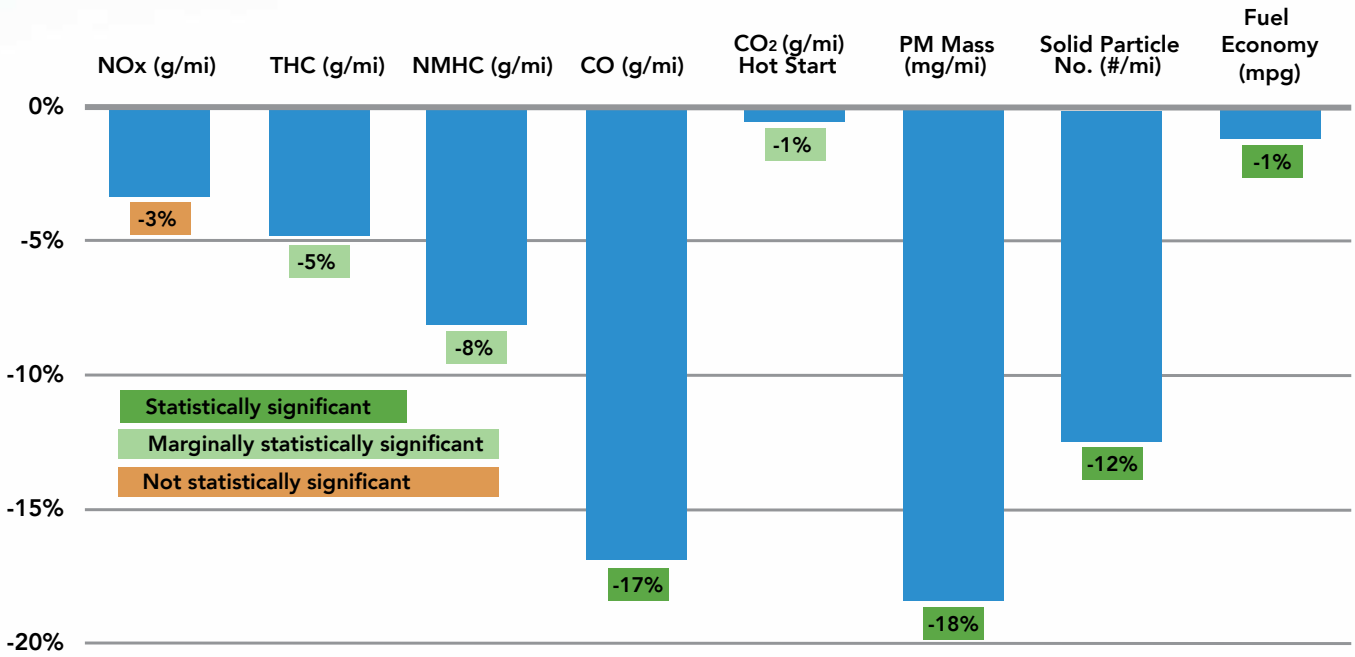
- Carbon monoxide, which can cause harmful health effects by reducing oxygen delivery to the body's organs.
- Exhaust hydrocarbons, which contribute to ozone, irritate the eyes, damage the lungs, and aggravate respiratory problems.
- Air toxics like benzene, which can cause cancer and reproductive effects or birth defects.
- Fine particulate matter, which can pass through the throat and nose and enter the lungs, causing serious health effects.

And not surprisingly, more ethanol means even less pollution. Testing of 20 vehicles by the University of California at Riverside in 2022 found that replacing E10 with E15 provides the following emissions benefits:

- Particulate matter reductions of 18 percent;
- Hydrocarbon gas emissions reductions of 5 to 8 percent;
- Carbon monoxide reductions of 17 percent; and
- Nitrogen oxide reductions of 3 percent.

These emissions benefits—along with ethanol's ability to replace toxic aromatic compounds in gasoline—mean ethanol blended fuels present a lower risk to human health than regular gasoline. Indeed, a study by the Hormel Institute, the University of Minnesota, and the Energy Resources Center at the University of Illinois Chicago, demonstrates that gasoline containing ethanol produces significantly lower emissions of toxic chemicals known to cause cancer.

E15 vs. E10: CHANGES IN EMISSIONS AND FUEL ECONOMY



Source: University of California, Riverside CE-CERT
Notes: Statistical significance based on least square means; NOx, THC, NMHC, CO, CO_2 and PM Mass results are weighted based on cold-start, hot-start, and hot-running emissions.

Fuel from the Farm

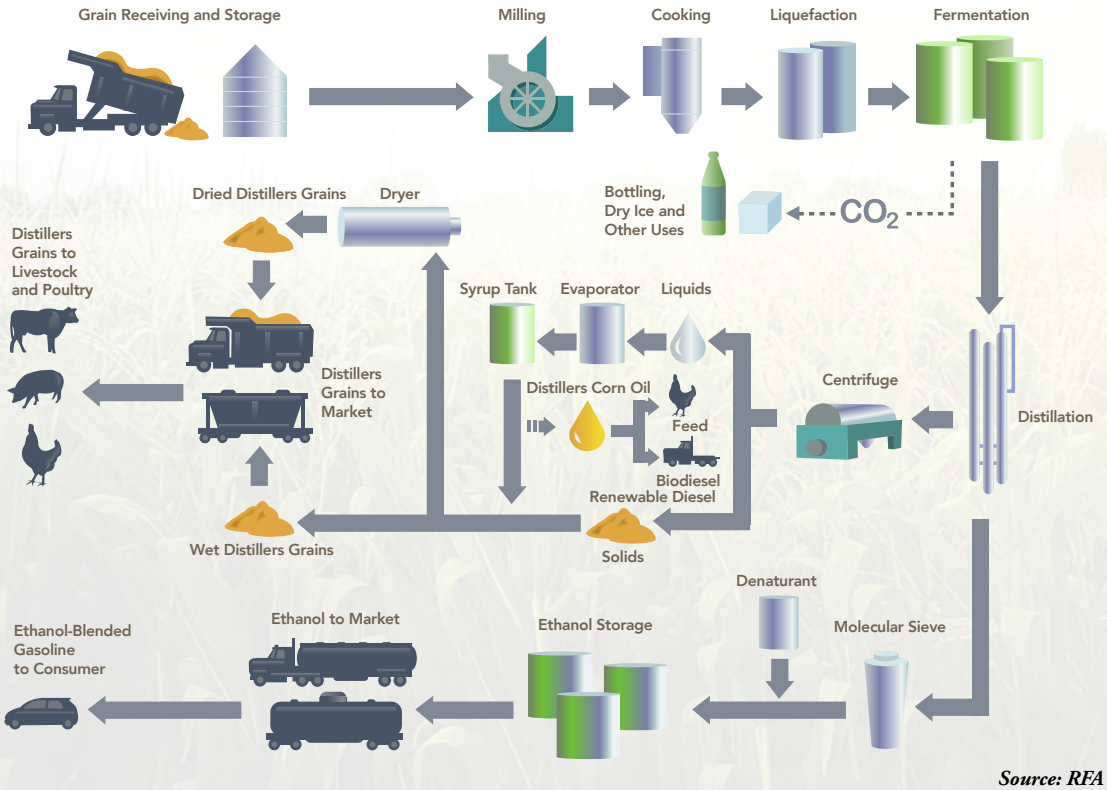
Ethanol's potential to change the world for the better was recognized long ago, and the past four decades have shown great growth in an industry that started on the American farm. Today, roughly 200 ethanol biorefineries across the United States are living up to the potential first identified by some of our nation's foremost inventors, such as Alexander Graham Bell, Henry Ford and Thomas Edison.

Modern-day facilities use state-of-the-art technologies to produce ethanol and valuable co-products from the starches and sugars found in grains, beverage and food waste, and other feedstocks, and American farmers themselves are actively involved in many of the ethanol biorefining businesses through ownership, investment, or leadership roles. While corn is by far the predominant U.S. feedstock for ethanol, grain sorghum also is used, and biorefineries typically use about one-third of the nation's sorghum crop for ethanol production.

Well over 90 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.

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 distillers corn oil.

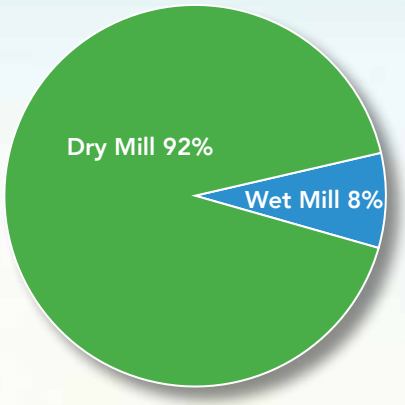
DRY MILL ETHANOL PROCESS



Source: RFA

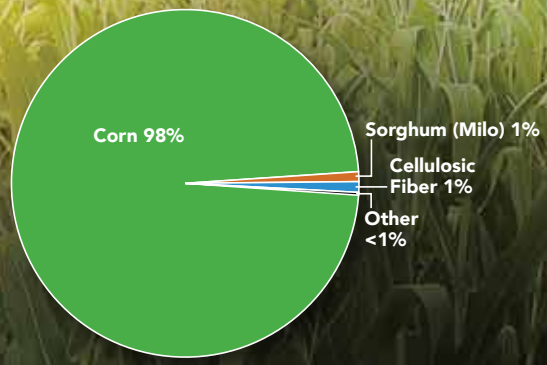
In **WET MILLING**, the grain is first separated into its basic components through soaking. After steeping, the slurry is processed through grinders to separate the corn germ. The remaining fiber, gluten and starch components are further segregated. The gluten component (protein) is filtered and dried 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

U.S. ETHANOL PRODUCTION BY FEEDSTOCK TYPE



Sources: RFA using U.S. Dept. of Agriculture, U.S. Energy Information Admin., and California Air Resources Board data

What Comes from Corn

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

2.9 gallons	Denatured fuel ethanol
14.8 pounds	Distillers grains animal feed (10% moisture)
0.9 pounds	Distillers corn oil
16 pounds	Captured biogenic carbon dioxide*

In 2023, ethanol biorefineries captured roughly 2.6 million tons of CO_2, which was utilized for dry ice production, bottling, food processing, and other uses.

Source: RFA based on U.S. Dept. of Agriculture data
**Approximately 30 percent of U.S. dry mills capture CO_2 from fermentation.*

The Power of TRUTH

When Congress expanded the Renewable Fuel Standard in 2007, some ill-informed environmental advocates and ideological academics argued farmers couldn't possibly produce enough grain to grow renewable fuel production while meeting traditional demands for animal feed. They also claimed using more crops for renewable fuels would strain water resources and cause expansion of cropland at the expense of native grasslands and forests. Simply put, they argued that Congress's renewable fuels expansion couldn't happen sustainably.

They were wrong.

In the 15 years since the RFS was expanded, the amount of U.S. cropland has continued to shrink, grasslands and forests have increased, and the volume of grain available for animal feed and exports has risen—all while renewable fuel production has tripled.

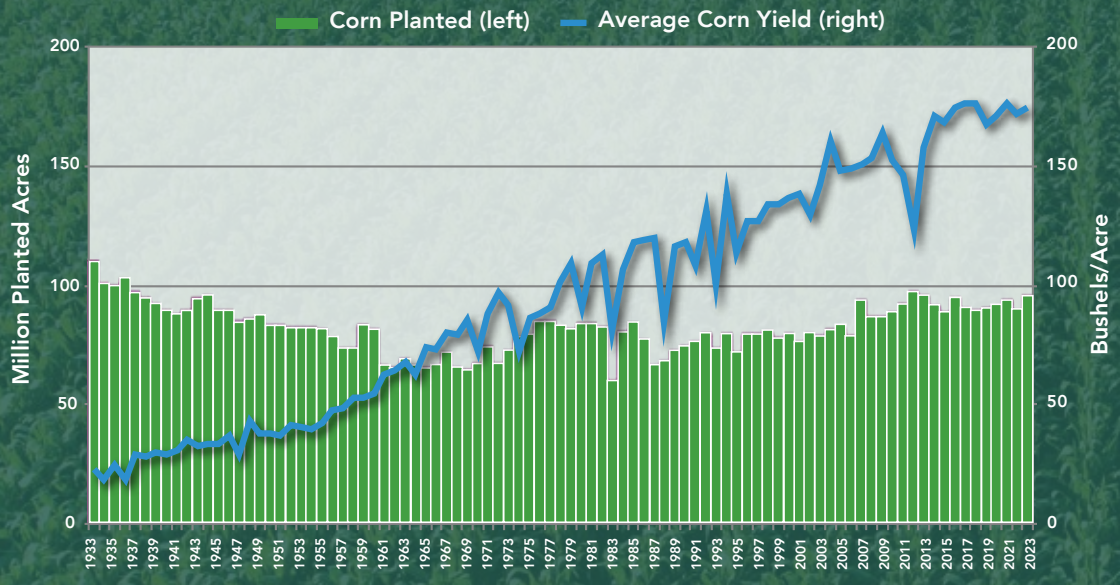
How is that possible? Through innovation, greater productivity, and an unwavering commitment from American farmers and ethanol producers to use sustainable practices.

But even with years of real-world data and experience, the old myths and misinformation about "land use change," water use, and "food vs. fuel," are coming back around again. This time the debate is being driven by the enormous potential to use crop-based biofuels to meet future demand for sustainable aviation fuel (SAF).

Never mind the naysayers. The facts and data are on our side. Ethanol producers and corn growers have already proven once that renewable fuel expansion can occur sustainably and responsibly—and we are ready to prove it again.

The TRUTH about Ethanol and Land Use

U.S. CORN ACREAGE AND AVERAGE YIELD

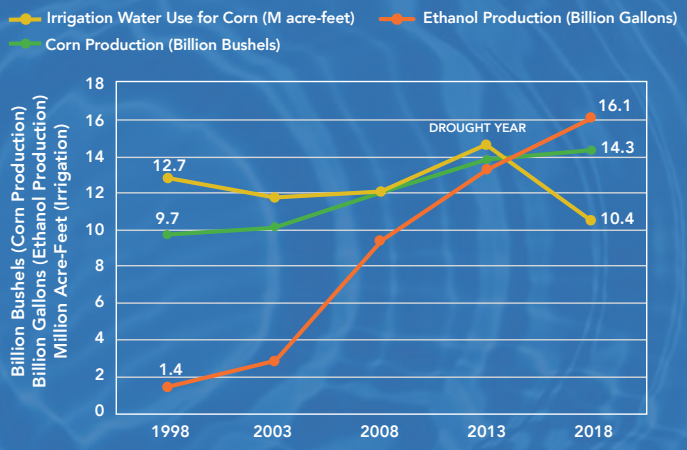


Source: RFA based on U.S. Dept. of Agriculture data

The TRUTH about Corn and Water Use

- The vast majority of U.S. corn acres are not irrigated, relying only on natural rainfall. This did not change with the growth of the ethanol industry. Only **13 PERCENT** of the corn crop is irrigated—the same share as in 1998.
- The total amount of irrigation water applied to corn is **DOWN 18 PERCENT** since 1998. In fact, irrigation water use in corn has dropped by 749 billion gallons over the past 25 years, enough to cover the entire state of New Jersey with six inches of water.
- Due to yield increases and irrigation technology efficiency gains, the amount of irrigation water needed to produce a ton of irrigated corn is **DOWN 42 PERCENT** since 1998.

U.S. CORN PRODUCTION, IRRIGATION WATER USE FOR CORN, AND ETHANOL PRODUCTION

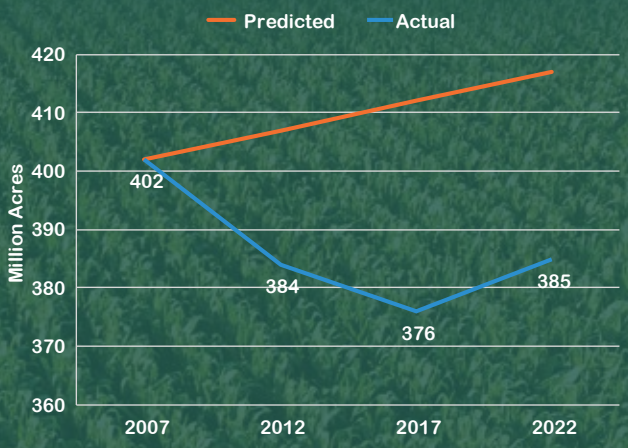


Source: U.S. Dept. of Agriculture

Between 1998 and 2018:

- Water use to irrigate corn dropped 18 percent
- Corn production increased 47 percent
- Ethanol production increased 1,045 percent

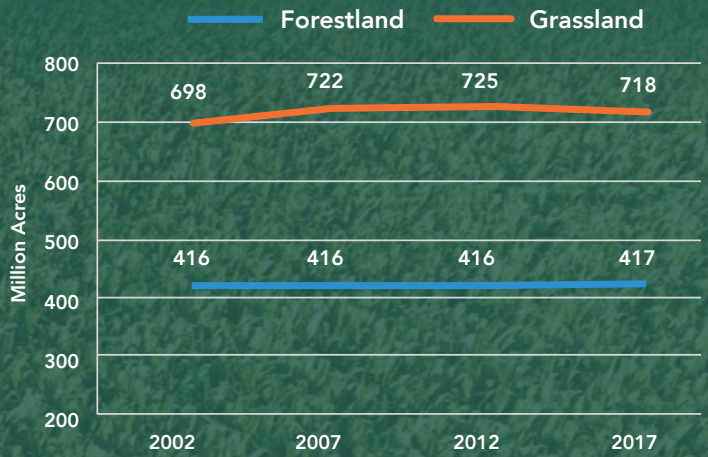
U.S. CROPLAND AREA: 2007 PREDICTIONS VS. REALITY



Source: RFA based on U.S. Environmental Protection Agency

- Since the RFS was expanded in 2007, total U.S. cropland has continued trending lower.
- Additional corn acres haven't come from conversion of forest or grassland; they have come primarily from "crop switching."

U.S. FORESTLAND AND GRASSLAND HAVE REMAINED STABLE



Source: RFA, based on UN Food & Agriculture Organization and USDA National Resources Inventory

Partners for Success

Through our various committees, forums, and networks, the Renewable Fuels Association gives its members the power to connect, lead and contribute to the growth of renewable fuels beyond their own particular operations.

RFA 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 Environment, Health & Safety Committee

RFA's members strive to ensure their facilities meet or exceed environmental, health, and safety standards and comply with all pertinent regulations. 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. And because nothing is more important than the well-being of the people who work in the renewable fuels industry and the consumers we serve, the safety of ethanol production, transportation, distribution, and emergency response is a top priority for this Committee.

RFA Strategy and Innovation Forum

The renewable fuels industry is experiencing an accelerated pace of technological change. It is RFA's goal to keep its members up to date on the most recent advances in technology, incentives, grant opportunities, production efficiencies, and new co-products, keeping them informed and ready to position their organizations for success. In a new seminar series that kicked off in late 2023, we discuss issues relevant to the renewable fuels space by focusing on short, medium, and long-term technologies, R&D, economics, and trade information.

Young Professionals Network

RFA's Young Professionals Network (YPN) was formed in 2020 and is dedicated to bringing together innovative and dedicated young professionals from across the U.S. ethanol industry. The YPN is a community of young leaders with a common goal to advance their respective businesses forward, build new relationships, and work with one another to identify new opportunities that grow and strengthen the renewable fuels industry.

Veterans for Renewable Fuels

Veterans for Renewable Fuels was formed in 2023 as an RFA special project to recognize the tremendous contribution of military veterans in the U.S. ethanol industry and provide these American heroes opportunities to come together and support each other in their careers and personal lives. We welcome active military members, veterans, and their immediate family members who are employed by a company in the U.S. ethanol industry or stakeholder industries.

An Award-Winning Safety Program

RFA's nationally recognized safety programs were honored in 2023 with their 11th consecutive National Achievement Award from TRANSCAER, a national hazardous materials safety coalition with whom RFA has partnered for several years. Missy Ruff, RFA's Director of Safety and Technical Programs, also received an Individual Recognition Award for her efforts.

Since its inception in 2010, RFA's safety program has been responsible for training over 17,000 individuals and conducting over 420 training sessions and events. RFA has trained individuals from all 50 U.S. states and 41 other countries. In 2023, RFA held numerous training sessions around the country, as well as a series of train-the-trainer webinars. In April, RFA updated its award-winning Emergency Response website, which is a go-to resource for the first responder community. RFA also revised its "Ethanol Response Considerations" and "Responding to Ethanol Incidents" videos, producing English and Spanish versions. For 2024, we will continue emergency response seminars and train-the-trainer webinars, along with refilming the "Tank Car Walk Around" video with the DOT 117 railcar.

Plugging in with Flex Fuels

What if you could slash carbon emissions from light-duty vehicles without sacrificing the convenience and low-cost benefits of liquid-fuel engines? That's the question RFA asked—and is now answering—with its latest concept vehicle, a 2022 Ford Escape plug-in hybrid electric flex-fuel vehicle.

We acquired this vehicle new and converted its engine to run on E85 flex fuel, in partnership with Husker Motorsports at the University of Nebraska-Lincoln and using technology from RFA associate member eFlexFuel. Several corn grower associations and other groups have partnered with RFA to support this project. With this conversion in place, RFA tested tailpipe emissions on E10, E85, and splash-blended E30 at the University of California, Riverside Center for Environmental Research & Technology. A full well-to-wheels lifecycle greenhouse gas analysis was conducted by researchers from the University of Illinois-Chicago and Life Cycle Associates LLC.

RFA's goals in this project are to:

- Prove that low-carbon liquid fuels, in combination with hybrid technology, can deliver superior environmental performance at a low cost to the consumer
- Show that consumers don't need to sacrifice optionality, convenience, or affordability for superior environmental performance
- Demonstrate synergies between low-carbon ethanol and electricity—that ethanol and electricity can be complementary decarbonization solutions
- Show that combining two low-carbon technologies provides greater flexibility, reliability, and security for American consumers

What we've learned so far has surpassed our expectations.

- All ethanol-blended fuels provide significant greenhouse gas savings relative to a battery electric vehicle charged on a selective coal-only grid.
- E85 ethanol blends in an optimized engine provide approximately the same greenhouse gas savings as a battery electric vehicle charged on the Midwest electricity grid.
- E85 in an optimized engine where the ethanol is produced with carbon capture and climate-smart agriculture provides significantly lower emissions than a similar battery EV vehicle charged on the U.S. average electricity grid.
- The low-carbon E85 used in this vehicle can achieve greenhouse emissions savings of 77 percent relative to ethanol-free gasoline. This carbon reduction is in the same ballpark as a battery EV operating on California grid electricity.

On the Road with RFA

RFA's Ford Escape has been on the road from Florida to Minnesota, from California to Washington, D.C., logging more than 25,000 miles through November 2023. Nearly three-quarters of those miles were powered by E85, with the remainder powered by the vehicle's electric motor.

Over the past 12 months, our Ford Escape appeared at the National Ethanol Conference, Commodity Classic, Government Fleet Expo, Fuel Ethanol Workshop, Minnesota Farmfest, Iowa State Fair, the Farm Progress Show, and other events. In late January 2024, it was on display in the EV Pavilion at the Washington, D.C. Auto Show.

While the vehicle's fuel economy was rated at 40.0 mpg on E10 (combined city/highway) by EPA and NHTSA, our actual fuel economy average has been 39.9 mpg—meaning we've enjoyed a substantial cost and emissions savings with E85 without sacrificing fuel economy!

RENEWABLE FUELS ASSOCIATION

MISSION: Drive growth in sustainable renewable fuels and bioproducts for a better future.

VISION: Help the world by unlocking the power of renewable fuels and bioproducts.

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RENEWABLE FUELS FOUNDATION

MISSION: Meet the future education, research, and strategic planning needs of the U.S. ethanol industry.

FOCUS: Collaboration with academia, industry, and public policymakers on new uses, feedstocks, and technologies that will impact the future of ethanol.

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IFF
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Illinois Corn Marketing Board
ilcorn.org

IMA Financial Group Inc.
imacorp.com

Indiana Corn Marketing Council
incornandsoy.org

Innospec Fuel Specialties
innospec.com/fuel-additives/renewable-fuel-specialties

Iowa Corn Growers Association
iowacorn.org

Iowa Renewable Fuels Association
iowarfa.org

Kansas Corn Commission
kscorn.com

Kansas Corn Growers Association
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KATZEN International Inc.
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National Corn Growers Association
ncga.com

National Corn-to-Ethanol Research Center
siue.edu/ncerc

Nebraska Corn Board
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ethanol.nebraska.gov

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Iowa Central Fuel Testing Laboratory
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North Dakota Corn Council
ndcorn.org

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sdcorn.org

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