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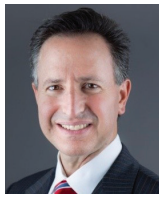
Renewable Diesel Projected to Turbo Charge Biofuel Growth



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Key Points:

- By producing fuel using sources with lower carbon intensity compared to traditional petroleum-based products, the U.S. biofuels sector is well-positioned to play a major role in reducing greenhouse gas emissions.
- The recently enacted Inflation Reduction Act is expected to boost biofuels by providing tax credits and funding to develop next-generation biofuels, including renewable diesel (RD) and sustainable aviation fuel (SAF).
- While electric vehicle (EV) adoption may eventually reduce demand for ethanol – which currently dominates U.S. biofuel production – prices of lithium batteries are surging due to supply shortages. Higher battery prices will likely slow demand for EVs and extend the time frame for mass EV adoption, cushioning the rate at which EVs disintermediate ethanol fuel.
- Driven in part by major oil companies' embrace of renewable diesel, numerous stakeholders have announced plans for new soybean crush and refinery projects over the past two years. If these projects come to fruition, RD capacity would grow more than six-fold to 6.5 billion gallons per year by 2030.
- The expected growth in soybean oil-based renewable diesel will require considerably more soybean bushels for domestic crush. To satisfy this demand, the U.S. would need to (theoretically) stop exporting whole soybeans while planting 17.9 million additional acres of soybeans (21% larger than the current crop) to satisfy the incremental biofuel demand.
- Besides importing soybeans, the alternatives to shifting massive farm acreage would include growing other types of oilseeds (such as canola and sunflower) at a larger scale, importing other vegetable oils, and/or using other feedstock such as beef tallow to produce renewable diesel fuel.

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Introduction

Global consumption of renewable energy has increased in recent years and will continue to do so as governments mandate and businesses and individuals voluntarily shift to less carbon-intensive energy sources. The recently enacted Inflation Reduction Act of 2022 will drive usage of renewable energy in general, and biofuels in particular.

The broader global energy sector is transitioning towards greater renewable fuel usage, and the U.S. biofuels complex will undergo a "micro-transition" featuring several distinct elements:

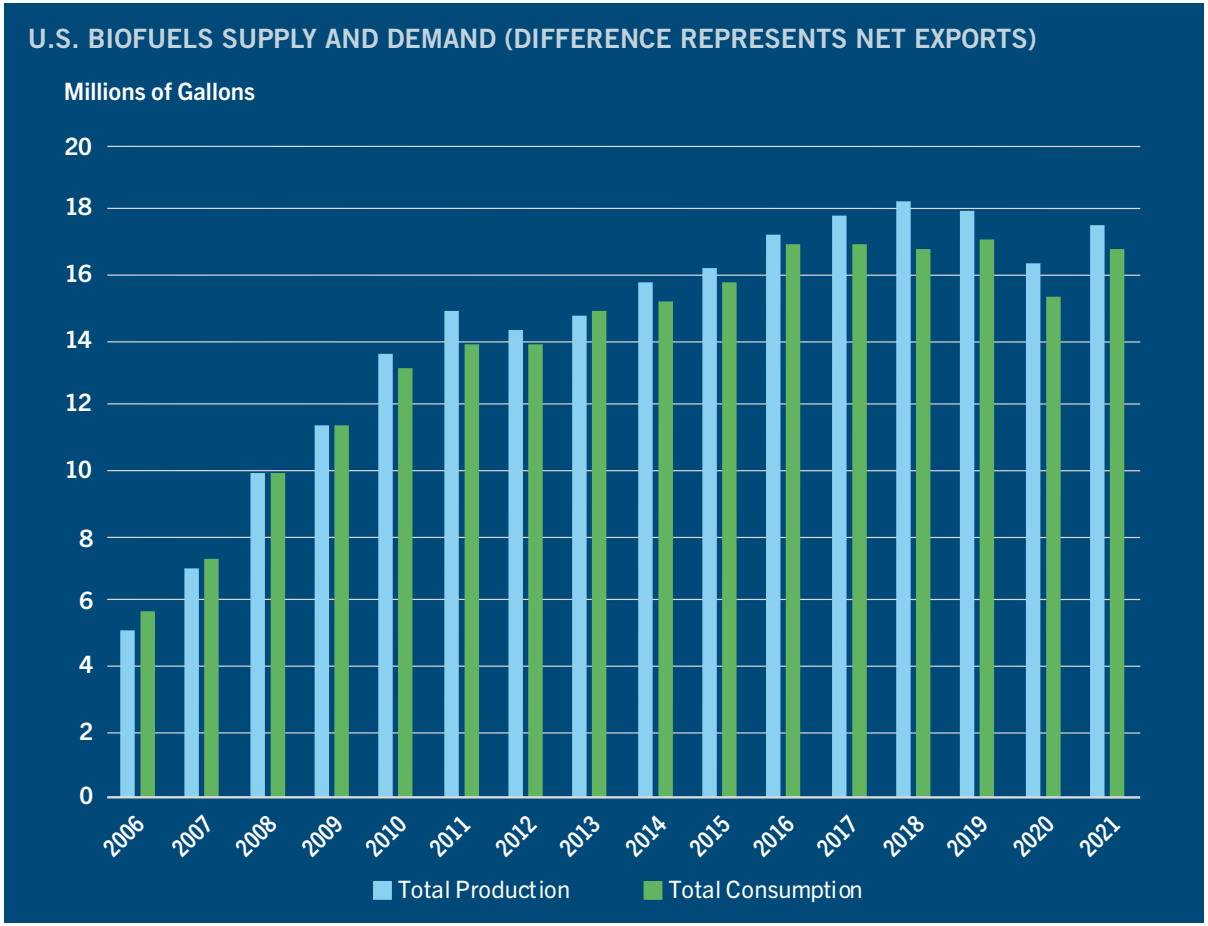
- Expanded use of fuel ethanol (towards 15% blending levels from 10% currently) serving as the bridge to lower GHG emissions along with increased adoption of electric vehicles;
- Increased renewable diesel (RD) production and usage as a drop-in fuel (no engine modifications or blending limits required) for trucks, heavy duty commercial equipment, ocean-going vessels, and locomotives; and
- Development of sustainable aviation fuel (SAF) using alcohol as a feedstock.

This report focuses on the current situation and outlook for ethanol, biodiesel, and RD. SAF is still in its infancy and will be addressed in future KED reports. The expected growth in RD is extraordinary, with annual production capacity potentially rising from approximately 1.0 billion gallons today to 6.5 billion gallons by 2030. Should all projects in process and proposed be built, the U.S. will need to vastly increase feedstock. Sources could include materially increasing soybean production, reducing or stopping whole soybean exports, producing or importing massive quantities of other oilseeds and vegetable oil, and using other products (such as tallow) to provide enough feedstock to meet the demand of the proposed new RD capacity levels.

Biofuel Basics

Biofuel production has grown nearly 8% every year over the past 15 years, driven by tax credits and targeted government programs.

Biofuels are liquid fuels and blending components produced from biomass feed stocks, used mainly as transportation fuels and for some heating and electricity generation. The 8% compound annual growth rate (CAGR) in production and consumption since 2006 has been buoyed by government policies and programs intended to reduce the use of fossil transportation fuels by incentivizing and/or mandating biofuel usage. The government programs include the federal Renewable Fuel Standard Program and California's Low Carbon Fuel Standard. Oregon and Washington have also established their own clean fuel programs and other states may do so in the future. After falling by about 10% in 2020 amidst the pandemic outbreak, biofuel supply and demand began recovering in 2021. Production and consumption for 2022 is expected at 17 billion-18 billion gallons.



Source: U.S. Energy Information Administration

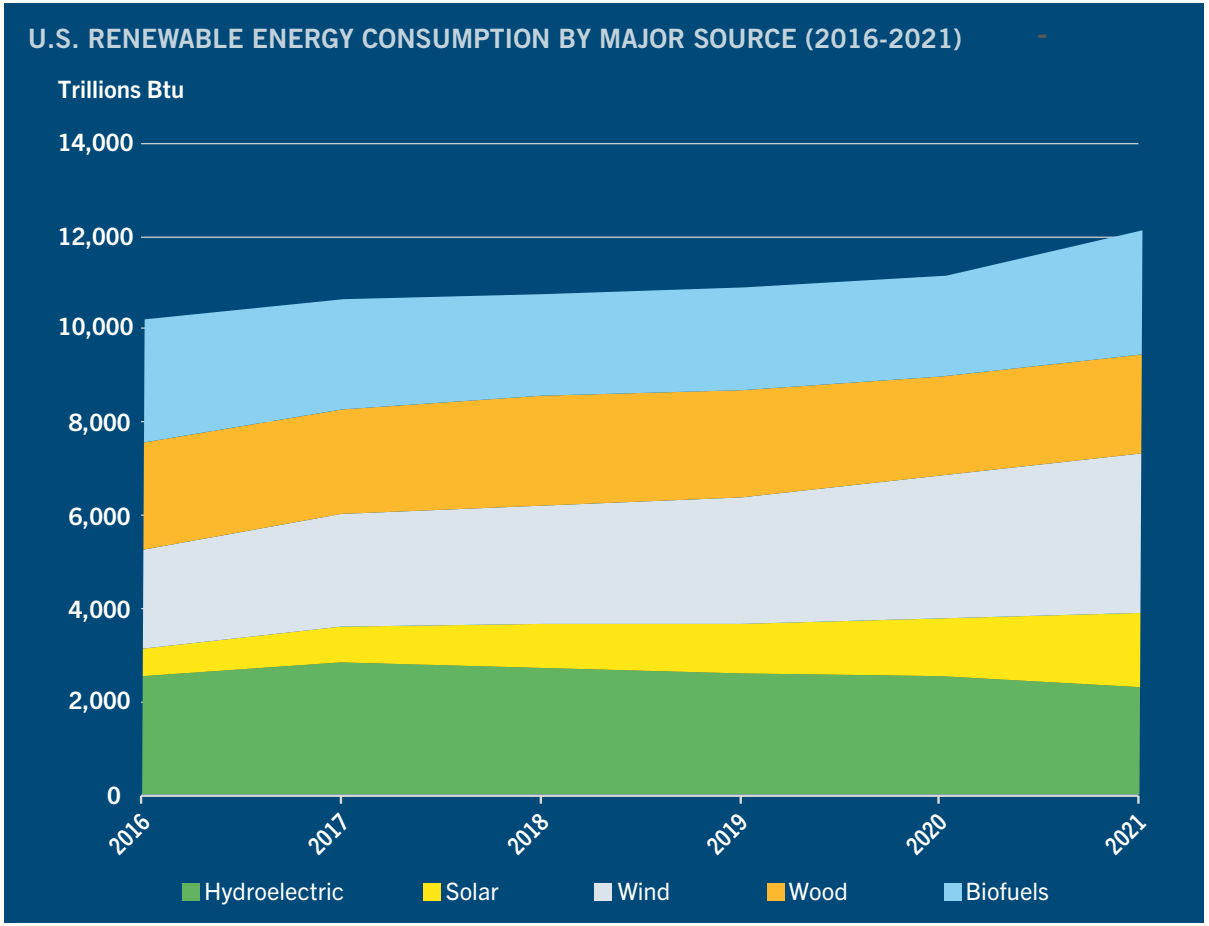
Biofuel Basics

Interestingly, the growth of U.S. biofuels has lagged that of two other renewable energy sources: wind and solar. However, the stage is set for that to change.

Total U.S. renewable energy consumption grew at a 3.1% compound annual rate between 2016 and 2021. However, biofuels consumption was flat while solar and wind energy grew at 21.4% and 9.7% respectively. (Consumption of hydroelectric and wood energy each fell by roughly 1.5% during the same period.)

While biofuels consumption fell during the COVID pandemic, the reality is that ethanol, which accounts for the lion's share of U.S. biofuels production and consumption, had been flat over the past five years as traditional energy companies applied political pressure to hold the ethanol blend wall to 10%.

The landscape is changing, however, as the year-round use of E15 (15% ethanol blended gasoline) and soybean oil-based renewable diesel fuel are expected to grow.



Source: U.S. Energy Information Administration

Biofuel Basics

CoBank expects the Inflation Reduction Act of 2022 to be a catalyst for biofuels sector growth over the next 10 years.

The new Inflation Reduction Act of 2022 aims to curb spiraling inflation rates and takes square target at energy prices. A key element of the legislation is subsidizing and promoting private sector investment into domestic energy production while encouraging clean energy solutions. The Act provides several tangible benefits for renewable energy in general and biofuels in particular.

INFLATION REDUCTION ACT (IRA) OF 2022 BENEFITS

To Renewable Energy in General

- $9.7 billion in assistance to rural electric cooperatives for renewable energy and energy efficiency projects
- $1 billion in loans for renewable energy projects in rural areas
- $2 billion for USDA's Rural Energy for America Program, which funds renewable energy and energy efficiency projects

To Biofuels in Particular

- $500 million for blender pumps and other biofuel infrastructure
- Extension of the $1/gallon tax credit for biomass-based diesel through 2024 and afterward, tax credit based on carbon intensity score
- New Clear Fuel Production Tax Credit for new renewable projects and enhanced carbon capture and storage credits/payments
- Temporary tax credit for sustainable aviation fuel prior to implementation of a broader program

Source: Congress.gov https://www.congress.gov/bill/117th-congress/house-bill/5376

Biofuel Basics

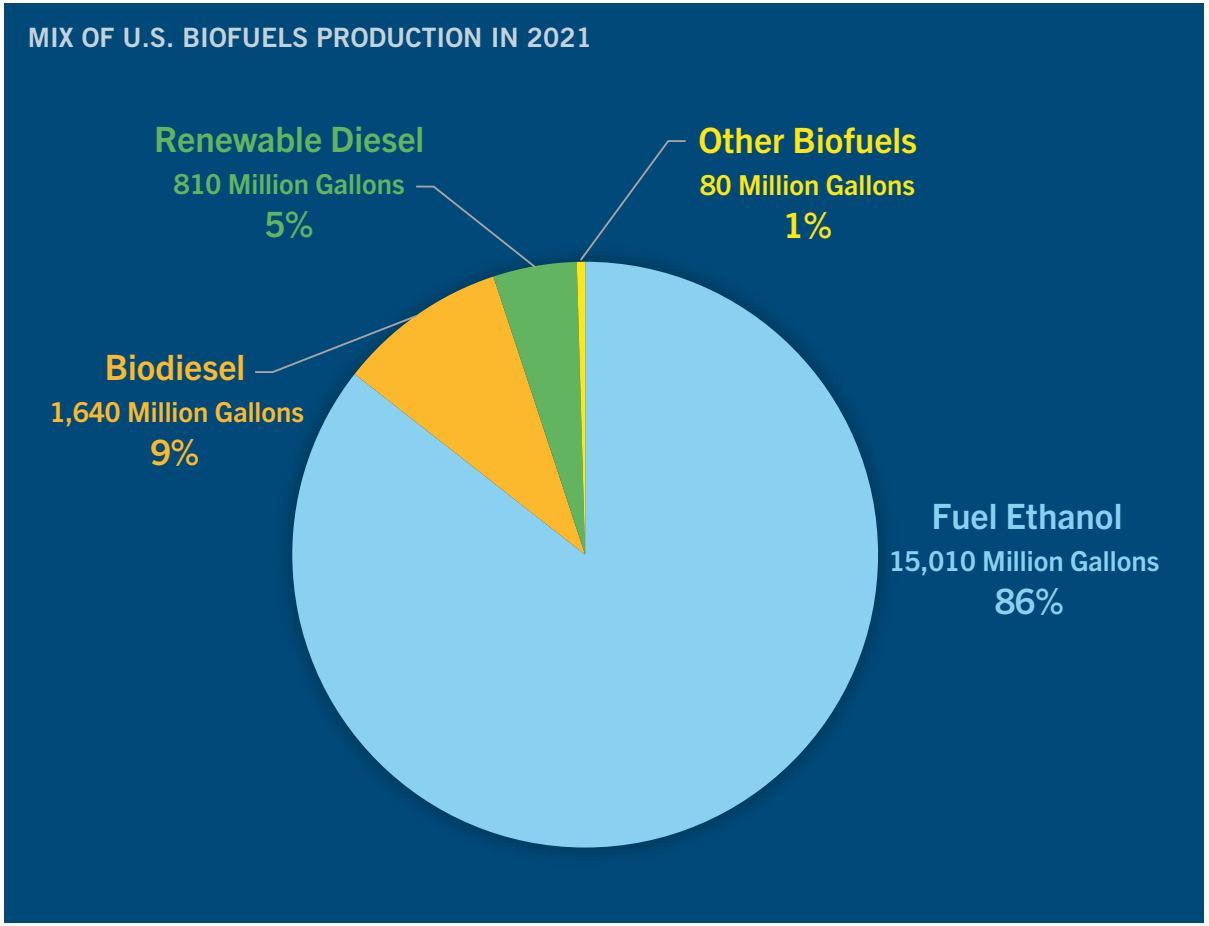
Ethanol is the largest of the various types of biofuels, accounting for 86% of total production.

Ethanol is an alcohol fuel using corn as a feedstock and then blended with petroleum gasoline typically at rates of 10% ("E10") or 15% ("E15"). Approximately 35% of U.S. corn production has historically been used for ethanol production.

Biodiesel, also known as fatty acid methyl ester or FAME, is a biofuel made by processing vegetable oils and other fats for use in a diesel engines. For proper fuel flow and combustion, biodiesel must be blended with petroleum diesel at a rate of 5%-20%.

Renewable diesel, also known as hydro-treated vegetable oil or HVO, is chemically similar to petroleum diesel. Renewable diesel is a cousin of biodiesel but has a key benefit: It does not need to be blended with traditional diesel.

Other biofuels include renewable heating oil, sustainable aviation fuel (SAF) and other products. While there has been considerable recent press about the future growth of SAF, production at scale is unlikely to occur until 2025 at the earliest.



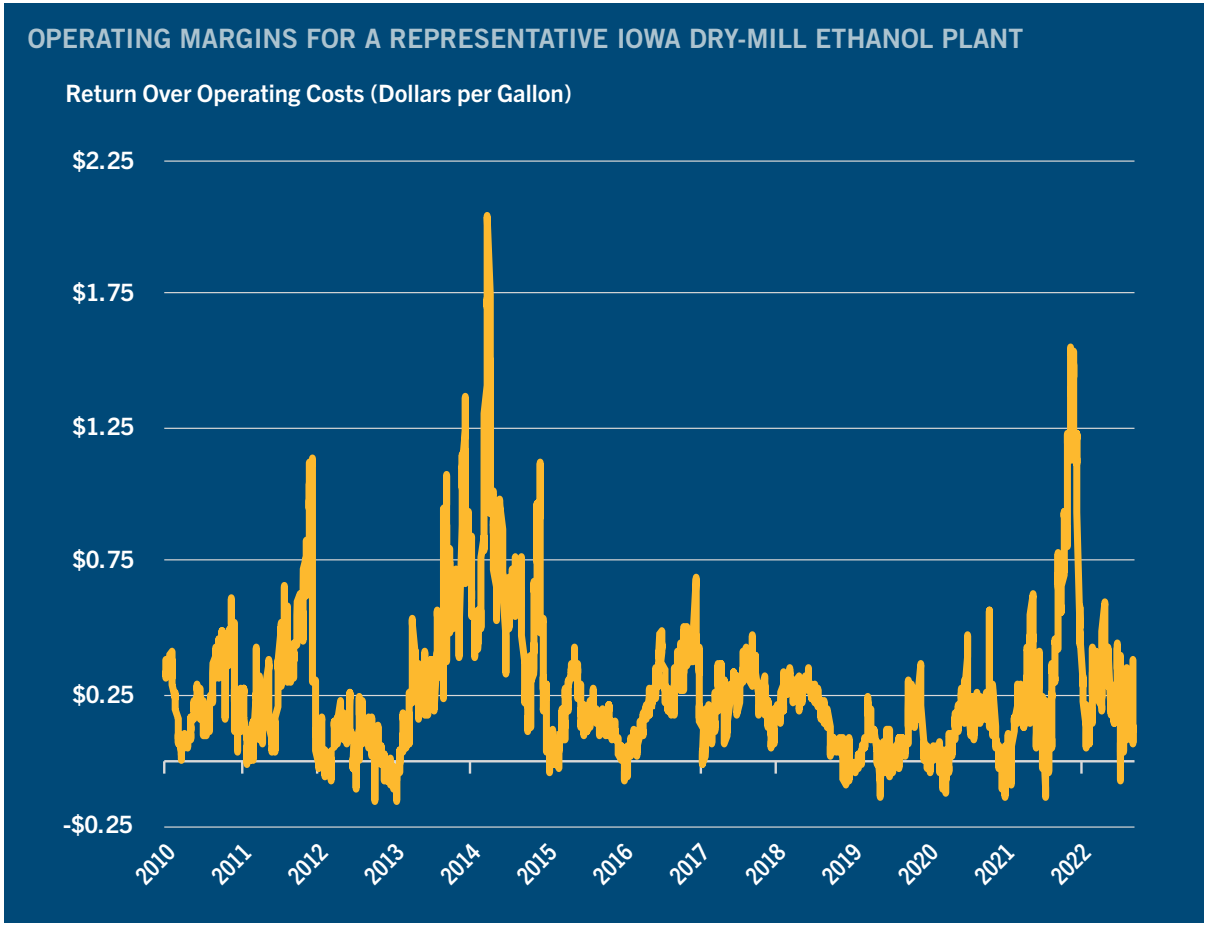
Source: U.S. Energy Information Administration

The Ethanol Situation

Ethanol production has recovered from COVID and current profitability is near parity with long-term averages.

Ethanol production has recovered from the initial demand destruction stemming from COVID, with average annualized production running near 16 billion gallons annualized, in line with five-year average levels. The recent steep pullback in gasoline prices at the pump – from peak national average levels of $5.02 on June 14, 2022 to near $3.65 at present – lessens the risk that ethanol will experience a demand shock in the near-term.

Industry profitability is currently running in line with long-term average levels, i.e., pretax operating margins of $0.25 to $0.30/gallon. For the balance of 2022, we see profitability remaining steady for the industry-leading ethanol producers, barring any unhedged spikes in corn feedstock or natural gas costs. We are keeping a close eye on the latter; domestic natural gas prices have been rising as the U.S. exports liquid natural gas to Europe to help offset shortages as Russia withholds supplies.



Source: Iowa State University - Center for Agricultural and Rural Development (CARD)

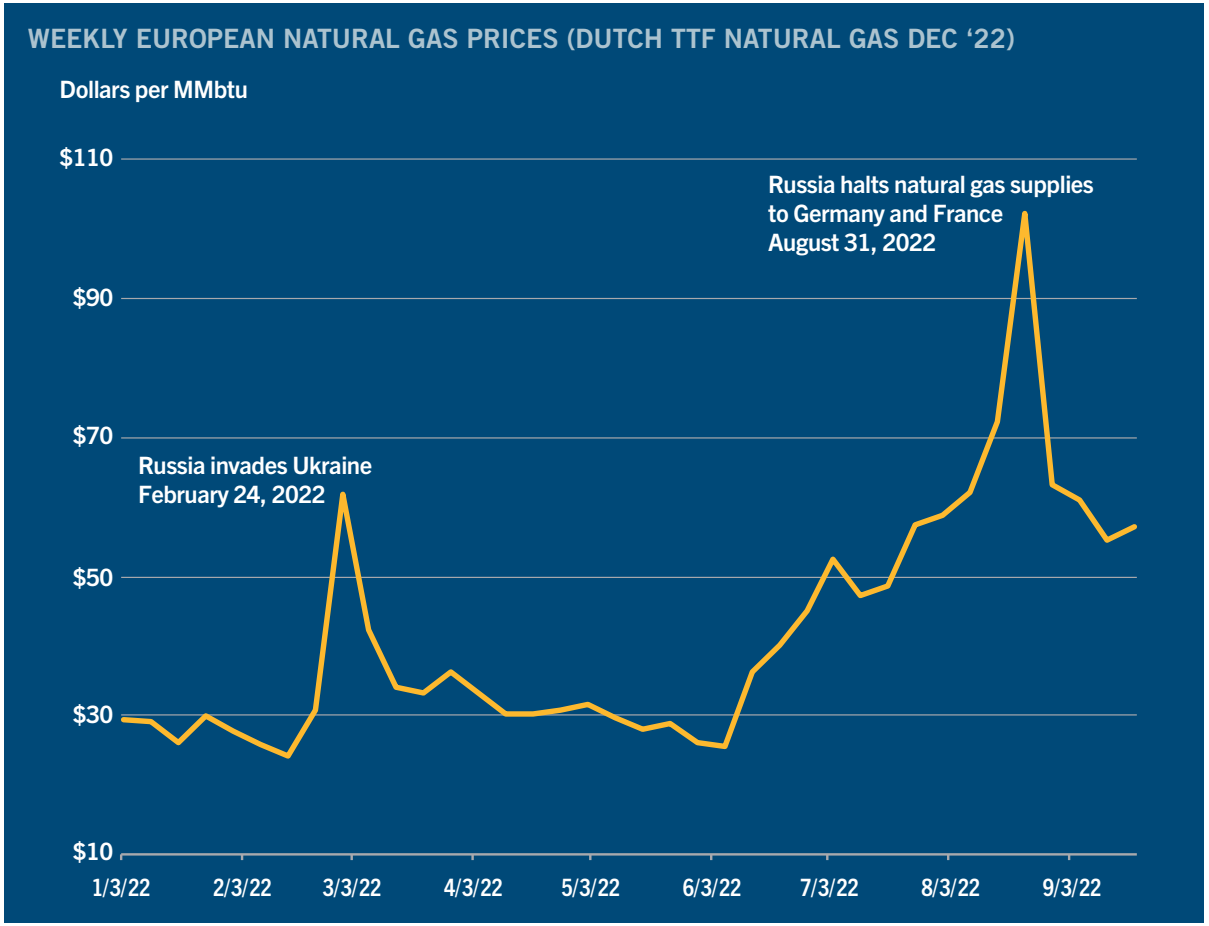
The Ethanol Situation

Three recent developments are brightening the short-term outlook for ethanol, though falling energy prices could crimp margins.

First, EPA's emergency fuel waiver to allow E15 sales has helped lower the retail price of gasoline and boosted overall ethanol demand. Consumer acceptance of E15 is growing, which could lead to all-year-round sales of E15.

Second, Russia's withholding of critical natural gas supplies from Europe (in response to EU support of Ukraine) is resulting in upward, volatile moves in gas prices, especially in Europe. Russia's actions underscore the need for the U.S. to maintain diverse sources of energy, including ethanol.

Third, although electric vehicle (EV) sales are increasing – projected to account for about 20% of total new car sales by 2026 – EV battery production will be hampered by skyrocketing elemental lithium prices and ongoing supply chain challenges. This should cushion the rate at which EVs disintermediate ethanol fuel.



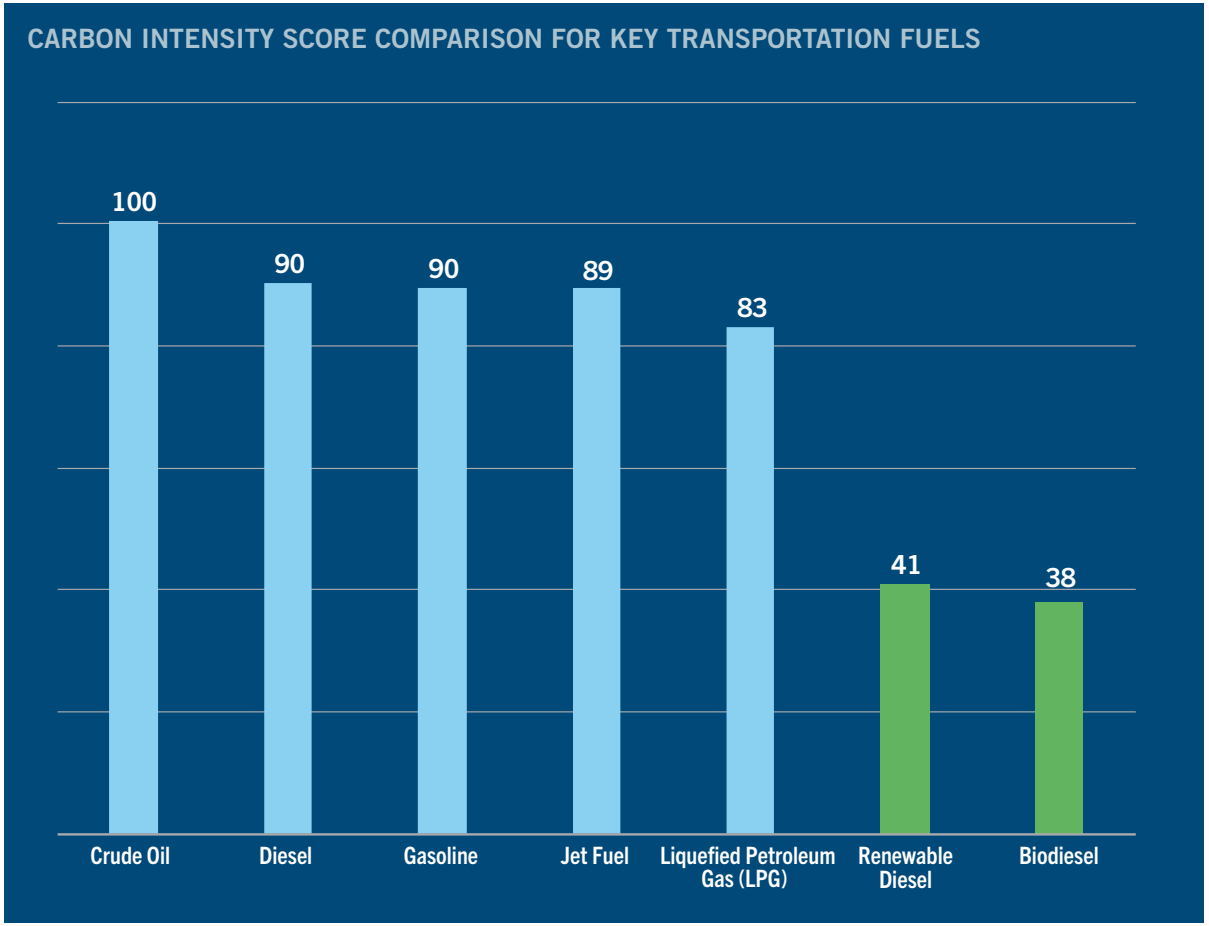
Source: Barchart.com

Biodiesel vs. Renewable Diesel

Biodiesel and renewable diesel are 50%-55% less carbon-intensive than traditional petroleum diesel. RD also offers some additional benefits.

Crude oil and traditional diesel fuel have the highest carbon intensity scores of 100 and 90, respectively, while renewable diesel and biodiesel are much greener with respective scores of 41 and 38. Although renewable diesel and biodiesel have similarly low carbon scores, RD offers several superior benefits compared to biodiesel.

Because RD is chemically identical to petroleum diesel it can be used as a "drop-in" fuel which means older engines do not require any modifications to tolerate the fuel. Biodiesel, on the other hand, requires additional blending with petroleum diesel before it can be used by commercial engines. Not having to upgrade existing commercial equipment is a key selling point for increased adoption of renewable diesel.

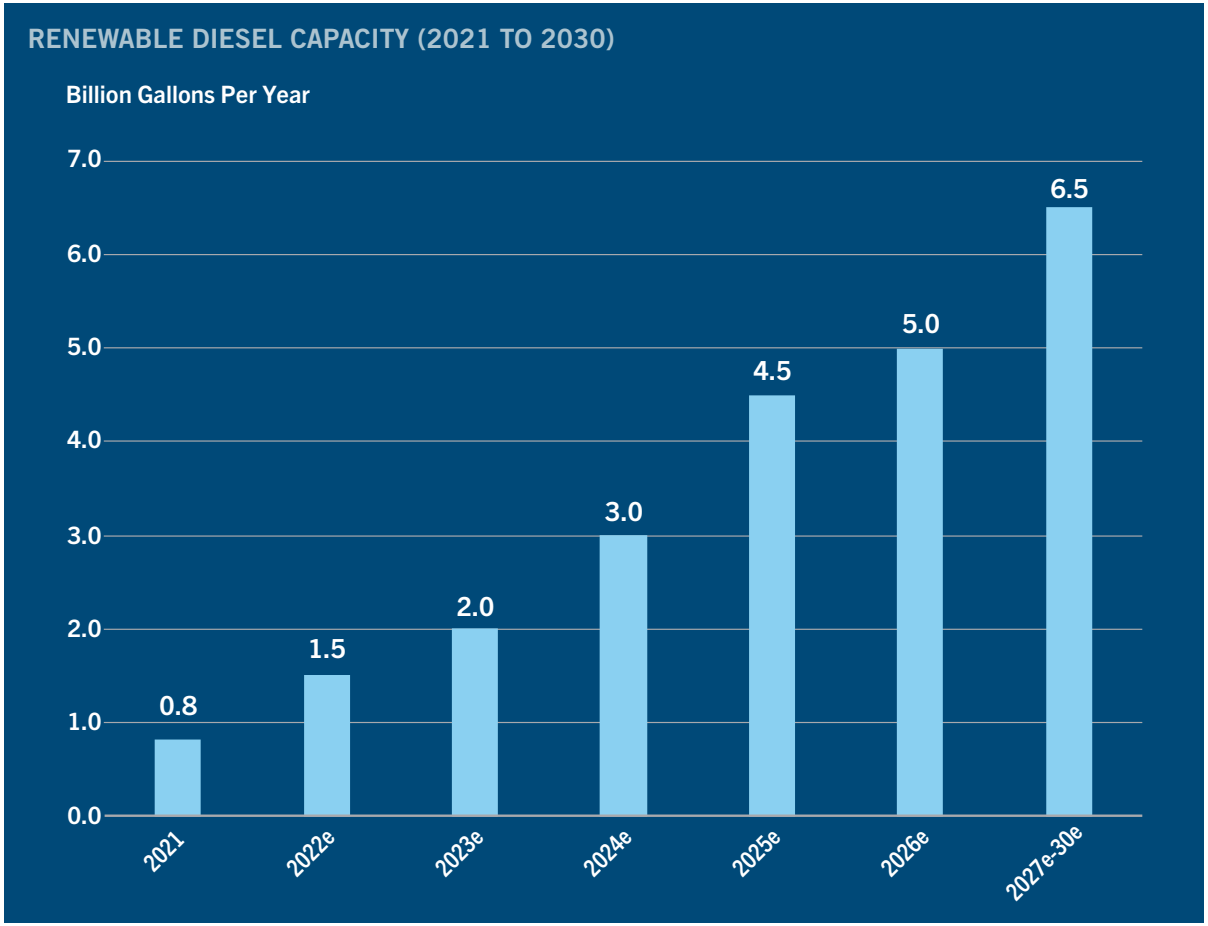


Source: The ProExporter Network and California Air Resource Board

The Renewable Diesel Situation

RD production is on track to rapidly grow, with numerous greenfield projects and expansions announced since 2020.

RD is undergoing a rapid phase of expansion, largely the result of California's Low Carbon Fuel Standard incentives and mandates placed on petroleum refineries under the federal Renewable Fuel Standard. While renewable diesel can be produced using numerous types of vegetable oil, i.e., oil derived from multiple crops such as soybeans, canola and sunflower, soybeans are the primary oilseed available to crush into oil for U.S. production. The reason stems from the availability of soybean acres (87 million were harvested in 2020-21) and existing industry infrastructure. (Canola and sunflower harvested acres totaled just 2.5 million in 2020-21.) Based on announcements over the past two years, U.S. renewable diesel capacity will grow to approximately 6.5 billion gallons of annual production by 2030 if all announced and proposed projects are finished and operate at capacity.



Source: Energy Information Administration and CoBank

The Renewable Diesel Situation

Will the U.S. produce enough soybeans for the 6.5 billion gallons of proposed renewable diesel capacity?

To answer this, consider the following:

- With about 1.0 billion gallons of RD capacity existing today, we need to produce 5.5 billion additional gallons of RD by 2030.
- 3.4 billion new bushels of soybeans are needed to crush for feedstock to produce those 5.5 billion gallons.
- Even if we retained all soybean exports, projected at 2.5 billion bushels in 2030, we would still be short 927 million bushels.
- Using a future projected yield estimate of 51.9 bushels per acre, meeting the needed production would require 17.9 million more soybean acres.

NEW SOYBEAN ACRES REQUIRED FOR NEW RENEWABLE DIESEL CAPACITY

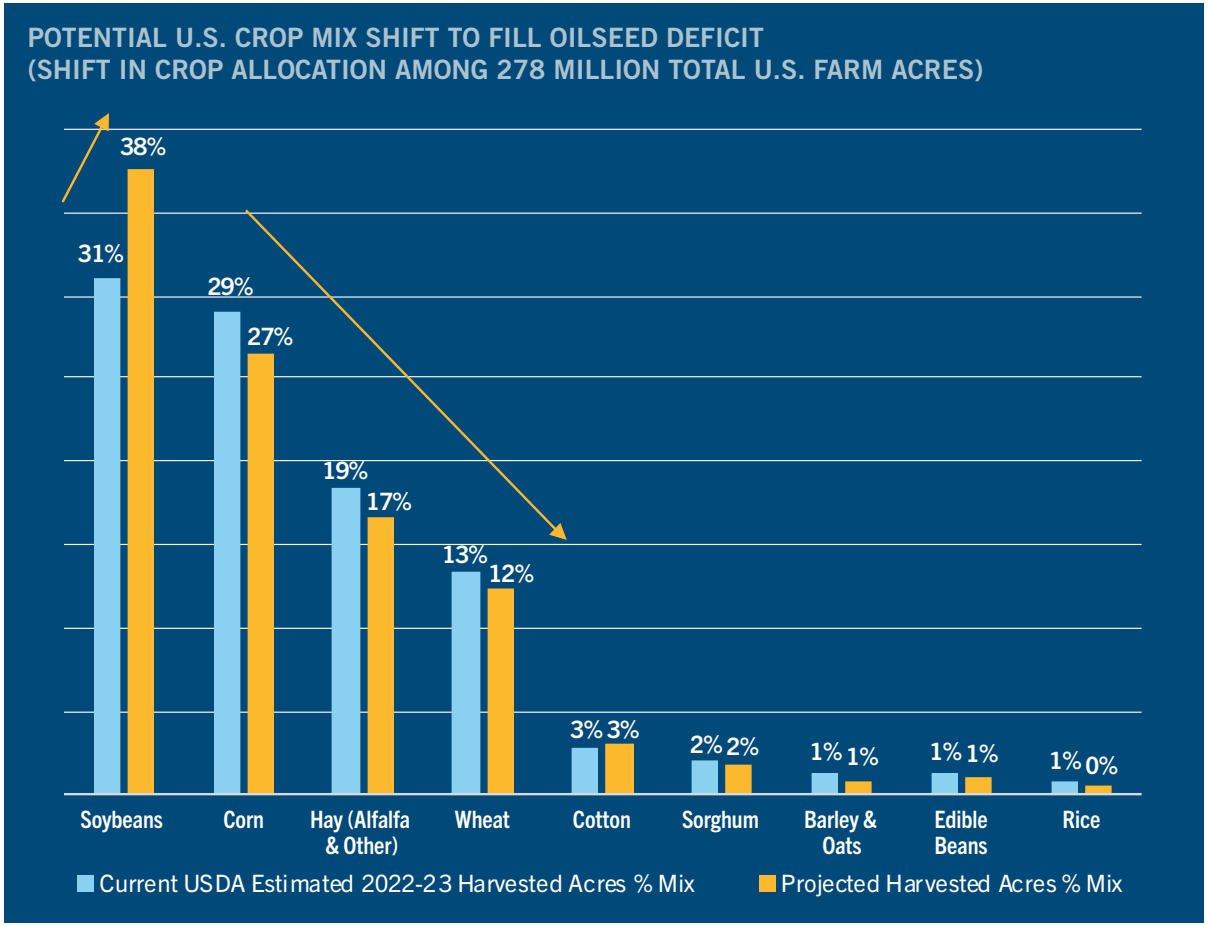
Estimated New Renewable Diesel Capacity	Billion gallons	5.5
Conversation Factor (i.e., How Many Bushels of Soybeans Need to be Crushed for Each Gallon of RD)		1.6x
New Soybean Production Required for Soybean Crush in 2030	Billion bushels	3.438
Baseline Estimates of Soybean Exports in 2030	Billion bushels	2.511
Difference = Net New Soybean Production Needed	Billion bushels	0.927
New Soybean Acres Needed	Million acres	17.9

Source: CoBank Estimates

The Renewable Diesel Situation

Where will 17.9 million new soybean acres come from?

The analysis shows that 17.9 million new soybean acres would be needed to produce the 927 million bushels of additional soybeans to satisfy the deficit in needed supply and incremental renewable diesel demand (assuming that the U.S. would not import any soybeans). Ignoring agronomic considerations (i.e., the yield effect on continuous soybean plantings), 192 million acres are theoretically available for soybean production from other major crops (corn, wheat, and alfalfa hay) and minor crops (cotton, sorghum, barley, and rice). Looking out to 2030, corn acres will have to be the primary source of new soybean acres, especially if electric vehicle adoption eventually reduces the need for corn-based ethanol. The below chart shows the potential new acreage mix after the planned RD capacity is fully built out. This would provide an elegant solution to the expected shifts in ethanol and renewable diesel consumption.



Source: USDA and CoBank

Conclusion

The outlook for biofuels is favorable as the United States and other leading developed countries embrace renewable liquid transportation fuels as a green solution to reduce greenhouse gas emissions. The momentum is supported by renewed government support, as evidenced by passage of the Inflation Reduction Act of 2022, deep commitments by the major oil companies and others in private industry to decarbonize, and a growing recognition that biofuels provide energy diversity and security.

Ethanol will continue to dominate biofuel for private automobiles, with incremental demand stemming from higher blending rates. While electric vehicle adoption will result in lower ethanol usage over time – all else being equal – escalating lithium battery prices due to component shortages may slow EV production, short-term.

Renewable diesel offers the most exciting growth opportunity in the biofuels space with proposed total capacity rising from ~ 1.0 billion gallons of annual production in 2021 to 6.5 billion gallons by 2030 (equating to about 15% of the petroleum diesel market today). As illustrated in this report, our analysis indicates that getting there will require producing 927 million more bushels of soybeans on 17.9 million additional soybean acres.

The alternative to such a massive acreage shift (beyond importing soybeans) would include growing other types of oilseeds (such as canola and sunflower) at a larger scale, importing other vegetable oils, and/or using other feedstocks such as tallow (an animal protein feedstock with low carbon intensity) to produce renewable diesel fuel.

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