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It has long been considered one of the most stubborn challenges in sustainability.

Decarbonizing heavy trucks and airplanes, which will continue to rely on liquid fuels for the foreseeable future, once seemed a distant dream. That is changing thanks to innovation and investment from America's fuel refiners, which are manufacturing renewable diesel and sustainable aviation fuels that cut carbon emissions by as much as 80 percent.

Renewable diesel is compatible with existing diesel engines and infrastructure, allowing trucks to immediately utilize fuel that achieves the win-win of reducing carbon emissions and, in some cases, repurposing and recycling everyday waste without requiring a costly infrastructure build-out.

Across the refining industry, early investments in renewable diesel are paying off — and new investments are ramping up. Valero — the second largest producer of renewable diesel globally — just completed a major expansion at its St. Charles refinery in Louisiana, bringing its current renewable diesel production capacity to 690 million gallons per year. Now Valero is investing another $725 million in Texas' first renewable diesel manufacturing facility at its refinery in Port Arthur, Texas, which will quadruple Valero's annual renewable diesel output to 1.2 billion gallons in the first half of 2023.



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Valero isn’t alone. American refiner HollyFrontier is investing more than $800 million for a renewable diesel unit and pre-treatment unit co-located at its Navajo Refinery in New Mexico and is converting its Cheyenne Refinery in Wyoming to renewable fuel production, with the target of eventually producing more than 200 million gallons of renewable fuel annually. Marathon Petroleum has similarly started renewable diesel production at its converted Dickinson, North Dakota, refinery this year, with a production capacity of approximately 184 million gallons per year. Marathon Petroleum is also transitioning its Martinez, California, facility over to renewable fuel production, with an anticipated capacity of 730 million gallons per year.



Marathon Petroleum's Dickinson renewable fuels facility reached full capacity in 2021, producing approximately 184 million gallons per year of renewable diesel.

Also in California, Phillips 66 plans to convert its San Francisco Refinery in Rodeo into one of the world's largest renewable fuel facilities. The project, known as Rodeo Renewed, stands to equip the facility with an initial production capacity of more than 800 million gallons per year of renewable diesel, renewable gasoline and sustainable aviation fuel (SAF).

U.S. oil majors Chevron and ExxonMobil are also making notable investments. Chevron is on track to triple renewable diesel volumes by 2025 and expects to have the capacity to produce 100,000 barrels per day of renewable diesel and SAF by 2030.

ExxonMobil is also investing in scaling renewable diesel. In the U.S., the company announced a five-year deal to purchase 5 million barrels of renewable diesel a year from Global Clean Energy's Bakersfield Biorefinery starting in 2022. In addition to purchasing renewable diesel, Exxon's majority-owned affiliate Imperial Oil Ltd. announced plans to produce renewable diesel at a new complex at its Strathcona Refinery in Canada. Production will utilize blue hydrogen, which is produced from natural gas with carbon capture and storage. Once complete, the project is expected to produce approximately 20,000 barrels of renewable diesel daily with the potential to reduce annual carbon emissions by about 3

million metric tons compared to conventional fuels. This reduction is comparable to taking more than 650,000 passenger vehicles off the road for one year, according to the U.S. Environmental Protection Agency.

“Our industry is demonstrating the power of American ingenuity to meet consumer demand and solve one of society’s most pressing challenges,” said Chet Thompson, president and CEO of the American Fuel & Petrochemical Manufacturers (AFPM). “It is difficult to overstate the timeliness of these investments, as diesel consumption looks to remain strong for decades.”

Steady diesel demand is expected, in part, because of the increased need for heavy trucking to accommodate e-commerce shipments. Recognizing this, Amazon and Walmart are integrating renewable diesel into their fleets. Demand from corporations of this size will encourage greater investment, higher rates of production and increased cost efficiency.

The build-out of renewable diesel production capacity supports the entire sustainable fuels industry. Investments in renewable diesel set the stage for the production of a range of renewable fuels because the infrastructure and technology used to manufacture renewable diesel is useful in the production of other fuels. If a facility is able to produce renewable diesel, it may have the option of producing renewable gasoline, naphtha and SAF, too.

Like renewable diesel, SAF is derived from feedstocks such as grease, animal fat and used cooking oil, along with soy, woody biomass, forest residue, sugar and starch. These feedstocks are transformed into a fuel that is chemically identical to its petroleum counterpart, meaning SAF can be blended with existing petroleum-based jet fuel seamlessly with no need to modify aircraft engines or existing fuel distribution infrastructure.

SAF is experiencing a breakout moment in the marketplace.

In April, Phillips 66 and Southwest Airlines signed a memorandum of understanding (MOU) to advance the commercialization of SAF, focusing on public awareness and research and development. The MOU sets the framework for the companies to explore a future supply agreement involving Phillips 66’s Rodeo Renewed project.



Phillips 66 aims to convert its San Francisco Refinery in Rodeo, Calif. into one of the world's largets renewable fuels facilities, a project known as Rodeo Renewed. Once operational, the facility will be in prime position to supply renewable diesel and sustainable aviation fuel to customers in California and beyond.

In early September, Chevron announced an MOU with Delta Air Lines and Google to track SAF test-batch emissions data using cloud-based technology. Chevron manufactured a test batch of SAF at its El Segundo Refinery, located just across the highway from Los Angeles International Airport (LAX), with Delta, which has a hub at LAX, purchasing the fuel. Google will analyze the test-batch emissions data through cloud-based technology to provide greater transparency and improved reporting of SAF emissions.

Andy Walz, president of Americas Fuels & Lubricants for Chevron, highlighted how the partnership will advance Chevron's longer-term lower carbon strategy. "The data-sharing and transparency component of the partnership with Delta Air Lines and Google will help us better understand the emissions from SAF production and delivery, supporting our goal to advance lower carbon fuels," he said.1

In the same week that this partnership was announced, United Airlines and Honeywell unveiled a joint investment in a new technology from Alder Fuels, which, coupled with Honeywell's refining process, could produce a first-ever carbon-negative jet fuel.

Amid this news, Airlines for America (A4A), the industry trade organization representing the leading U.S. airlines, announced in September that its members pledged to work with government leaders and other stakeholders to make 3 billion gallons of cost-competitive SAF available to use in 2030.

"We are increasing our SAF 'challenge goal' by an additional 50 percent to 3 billion gallons," said A4A President and CEO Nicholas Calio at a White House roundtable on Sept. 9. "To get there, we must work together — industry and government." 2

Renewable fuel production is a central part of many American refiners' sustainability ambitions. It also provides an avenue to comply with federal and state environmental policies. This is especially true for renewable diesel, which generates credits under both California's Low Carbon Fuel Standard and the federal Renewable Fuel Standard.



A test-batch of sustainable aviation fuel (SAF) produced at Chevron's El Segundo Refinery in California (pictured) was sold to Delta Air Lines at Los Angeles International Airport (LAX). Parallel to this project, Google Cloud plans to build a framework to analyze emissions data from Delta Air Lines and Chevron related to the SAF test-batch, supporting the long-term goal of achieving greater transparency and

improved reporting around SAF emissions.

It could become the case for SAF as well. Until recently, Washington has largely been silent on SAF, so fuel refiners, the airline industry and the greater marketplace led the production charge and built this burgeoning U.S. industry without a robust federal policy roadmap. Now, a new executive order from the Biden administration is leveraging this and establishing national goals for SAF production and adoption to reduce aviation emissions 20 percent by 2030.3

While these targets are laudable, the economics of SAF and renewable diesel production must be factored into future policy. Both products are expensive to produce and must be priced accordingly, representing real costs to refiners and consumers alike. Renewable fuel production and blending requirements should not be explored without a clear accounting of consumer impacts and a long-term understanding of whether sufficient feedstocks will be available.

As public policy and consumer interest work together to make sustainable fuels more popular and affordable, the U.S. refining industry is well-positioned to meet growing demand — not just in our own country, but around the world. Our leading-edge facilities and ongoing investments in renewable fuels are part of the groundwork that will enable the transportation sector to be less carbon intensive every year.

“Heavy trucking and airline travel have represented the biggest challenges for those seeking to decarbonize the transportation sector. American refiners have put our manufacturing muscle and sharpest scientific minds behind this effort, and we are at a point now where a much lower carbon future for heavy transit is within reach,” said AFPM’s Chet Thompson. “It is encouraging to see the White House acknowledge the potential of SAF, and we hope even more elected officials embrace the opportunity of renewable diesel and sustainable aviation fuels going forward.”

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