

## **Accelerating the Transition to Renewable Fuels**

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The global push to neutralize carbon-based greenhouse gas (GHG) emissions by 2050 not only holds great promise for the future of the planet, but it also stands to create millions of jobs, spur rapid growth and drive technological innovation. Businesses in every industry around the world have rolled out environmental and social responsibility (ESR) initiatives, often with bold plans to decarbonize their operations in line with the 2050 net-zero goal, although they differ in scope and strategy. Since the transportation industry accounts for roughly 30% of all greenhouse gas emissions in the U.S.<sup>1</sup>, new kinds of [renewable fuels made from organic sources](#) – plant oils or animal waste – are expected to play a leading role in the transition to an environmentally sustainable economy.

### **How policy and technology changes are shaping biofuels' future**

Biofuels aren't new, of course. Ethanol, which is made from corn and mixed with gasoline, is the still the most-produced alternative transportation fuel in the U.S. at 17.5 billion gallons per year.<sup>2</sup> Having been developed in the 1970s and put into wide use by the 1980s<sup>3</sup>, its advantages and cost-related drawbacks are well understood. Today's new green fuels are sourced from agricultural waste and crops that are chemically identical to traditional fossil fuel-based products but provide better performance with a smaller carbon footprint.

Advances in automation technology make it more feasible to convert previously unusable raw materials, like switchgrass and used cooking grease, into feedstocks that can be processed into high-quality combustible fuels that compete with fossil-based products like jet fuel and automotive gasoline, and increasingly electric and natural gas. Meanwhile, leaders in the airline, railroad and trucking sectors have begun powering their fleets with renewable fuels, all of which have created opportunities for savvy downstream operators to stay ahead of the curve.

Carbon intensity (CI) is the amount of greenhouse gas emissions per unit of transportation energy delivered during a fuel's "well-to-wheel" lifecycle, measured in grams of CO<sub>2</sub> equivalent per megajoule of energy. Waste-based biofuel feedstocks, like used cooking oil, have lower CI scores than those that could be turned into an edible food source, like corn. Other factors affecting CI include distance from feedstock source to processing facility, and the energy and GHG emissions required to process the fuel into a finished product.

Research shows that depending on assumptions about future policies and societal norms, the decline in the share of hydrocarbons in the global energy system could be dramatic, especially with the corresponding rise in demand for renewable energy as the world increasingly electrifies. If the 2050 net-zero goal is met, the share of hydrocarbons in primary energy streams could drop from around 85% in 2018 to between 70-20%, with the share of renewable energy increasing to between 20-60%.<sup>4</sup>

Government programs such as the European Green New Deal and the EU's Renewable Energy Directive (RED) II, which sets the target for renewable consumption at 32% by 2030<sup>5</sup>, are a primary reason why more refiners are exploring these new fuels today. The U.S. government currently offers federal tax credits<sup>6</sup> to biofuel refiners, and Canada, California and Oregon have implemented their own low-carbon fuel standards (LCFS), which use a system of incentives and penalties to encourage industries to meet carbon intensity (CI) goals in both the manufacture and use of renewable transportation fuels.<sup>7</sup>

### **How the market landscape is shifting**

These policies have driven real changes in the market. Data from California shows that as consumption fossil-based ultra-low sulfur diesel (ULSD) fell between 2011 and 2020 and carbon intensity dropped along with it, renewable diesel and other biofuels more than made up the difference supporting demand without effecting CI.<sup>7</sup> Biodiesel consumption worldwide has more than doubled over the last 10 years to 682 thousand barrels of oil equivalent per day and is growing at over 11% per year.<sup>8</sup> The sentiment is already bearing out. Current market forecasts see global demand for renewable diesel on the rise through 2026 at beyond.<sup>9</sup>

The combination of government policies, corporate initiatives and recent breakthroughs in automation technology has turned more sustainable renewable fuels like green diesel and sustainable aviation fuel, (SAF) into the fastest-growing alternative energy streams in the market. SAF, which produces up to 70% less carbon than fossil fuels, could effectively bridge current renewable technologies with future hybrid, electric or hydrogen-powered engine designs.

In February 2022, Singapore's civil aviation authority announced it will support the city-state's flagship carrier Singapore Airlines in buying SAF from Exxon Mobil Corp. to fuel part of its passenger fleet.<sup>10</sup> Finnish oil refiner Neste Oyj will provide 1.25 million liters of SAF, which is mixed with refined jet fuel at Exxon Mobil's facilities in Singapore. The one-year pilot program is expected to reduce carbon dioxide emissions by about 2,500 metric tons

### **What leading refiners can do to seize the opportunity**

The most pressing challenges for most refiners in the global downstream oil and gas space are meeting KPIs while maintaining the flexibility to handle different production processes, ensuring

equipment reliability with demanding feedstocks, following complex regulatory requirements to secure government subsidies, and advancing refiners' own corporate social responsibility and sustainability initiatives.

### **Ensuring feedstock flexibility and measurement certainty**

Staying in the black while breaking ground on new renewable fuel plants and retrofitting others means that refiners must obtain the very best production yield possible while meeting quality specifications. This requires highly accurate process measurements to calculate CI data and advanced analytics software to evaluate overall plant performance under varying feedstock scenarios.

Traditional level and flow measurement technologies are impacted by changing fluid properties and ambient conditions, which are unavoidable when processing animal fats, corn oil, recycled cooking or vegetable oil. [Smart flow metering systems](#) and [level instrumentation](#) that can handle different fluid properties in a wider range of environments make it easier to dependably meter fluid transfers and report receipts, usage and shipments.

### **Optimizing yield and asset health in new processes**

Average yields from the second-generation renewable diesel process depend on many operating factors. Having precise control over the complex processes inside a plant's reactors is key to avoid over-cracking products and meeting quality and emissions standards. Control also directly affects reactor catalyst life, which is a major cost concern. Analytics software can identify optimum operating conditions for each feedstock type, calculate ideal production targets, and alert operators to potential issues early so they can maximize diesel yield while reducing waste disposal and streamlining maintenance.

Always a priority, equipment reliability is even more critical when processing highly corrosive biomass feedstocks. [Asset health monitoring solutions](#) such as [corrosion sensors](#) installed on critical vessels, are now more common, but corrosion data can be difficult to interpret and act upon. [Wireless ultrasonic sensors](#) with data historian software extend vital equipment life by enabling proactive maintenance well before workers' safety and production throughput suffer from safety incidents and unplanned downtime.

### **Reporting to regulations, minus the headache**

While the renewable fuels market owes its continuing growth largely to government subsidy programs, the policies impose complex reporting rules that require licensors to store data in an agile, secure place that can serve a variety of functions. Renewable diesel plants must meet extensive federal and state reporting requirements. In North America, the Environmental

Protection Agency (EPA) and the Internal Revenue Service work with state agencies to administer tax incentive programs, which require refiners to gather extensive data from many sources: reconciled pathways, contracts, invoices, transportation, custody chain documentation, and more. Penalties and fines are enforced for reporting errors.

Aggregating the data in a central repository is common, but companies often find themselves drowning in swamps of data they can't use. They need a data management strategy that allows them to connect to all sources and also make the data useful in the right context, whether it's operational decisions, regulatory reporting, trend analysis, or whatever's needed.

[Emerson's Plantweb digital ecosystem platform](#) features data lake tools that help aggregate, historicize and organize information required for reports and analytics, as well as integrated visualization tools and KPI dashboards, all with real-time secure remote access. This technology makes it possible to effectively automate the entire regulatory data gathering, analysis, visualization and reporting workflow with the flexibility to accommodate future fuel standards and inevitably changing requirements, which is crucial in such a fast-evolving market.

### **Advancing refiners' sustainability initiatives**

With the growing impact of decarbonization on socioeconomic priorities worldwide, tasks such as accurately tracking CI data, continuously monitoring and predicting emissions, maximizing energy efficiency, identifying waste, and measuring the impact of operational decisions have never been more imperative for downstream manufacturers.

Renewable diesel plants are large consumers of electric power and hydrogen, which involves complicated energy-intensive process interactions. Lower CI numbers mean more LCFS credits but gathering and calculating the information accurately is complicated by varying feedstocks and plantwide energy consumption data, which is often only available after the fact in monthly reports. Fortunately, it's now possible for renewable diesel plants to maximize their CI credits using [AI-powered energy management information systems \(EMIS\)](#) that provides real-time energy performance data and can reduce total site energy usage by up to 15%.

Two other areas where automation can help are [pressure relief valve \(PRV\) monitoring and flare gas analysis](#). Locating the source, time, and duration of releases from PRVs requires extensive hands-on work and data interpretation, but wireless pressure gauges, acoustic transmitters and analytical software can record and interpret PRV events, making it easier to find and seal leaks. Of course, fugitive emissions are a concern for many valve types in a refinery, which is why Emerson's low-emissions valve seal packing systems are rigorously designed and tested to ensure that ambient conditions meet the EPA's 100 parts-per-million concentration requirement.

Finally, all refineries flare vented gases into the atmosphere as a byproduct of normal operations. Precise measurement and analysis of the flare itself is critical to monitor emissions

and ensure efficient combustion. Sophisticated [instrumentation and control systems](#) can detect precise changes in gas composition and respond in real-time to optimize combustion efficiency and hold emissions within targeted levels.

## Key takeaways

Leading refiners have been preparing for the world to eventually phase out fossil fuels for years, not only because it's the socially responsible thing to do, but also because it makes good business sense. [Reducing emissions](#) and optimizing energy consumption means lower cost of operations and extracting greater value from resources. In some countries, producers are carving out 40% to 60% of their refining capacity to produce green fuels. Implementation of new technology, software and analytics only increases reliability, optimizes energy, lowers emissions and reduces the overall environmental impact.

Downstream operators are in a unique position to invest now and get in on the ground floor as the transportation industry's transition to renewable fuels picks up momentum. Emerson can help refiners capitalize on this opportunity by giving them better insight into their processes, aggregating and analyzing a broad range of data and making that data more useful on an enterprise level. Those who fully recognize the potential competitive advantage that automation can deliver could be the leaders in the renewable fuel market in the next decade and beyond.

## References

1. U.S. Environmental Protection Agency, [Sources of Greenhouse Gas Emissions](#), 2019.
2. U.S. Energy Information Agency, [U.S. Ethanol Plant Production Capacity](#), 2021.
3. North Dakota State University, [History of Ethanol Production and Policy](#).
4. BP, [Energy Outlook](#), 2020.
5. European Commission, [Renewable Energy Directive II](#), Dec. 2018.
6. Cohen Research, [A Primer on Renewable Diesel](#), Jun. 2020.
7. California Air Resources Board, [Low-Carbon Fuel Standards](#), 2022.
8. BP, [Statistical Review of World Energy](#), 2021.
9. Baker & O'Brien, Inc., [The Push for Alternative Fuels](#), Oct. 2021.
10. Reuters, "[Singapore Airlines to buy ExxonMobil's sustainable fuel in push to cut emissions](#)", Feb. 11, 2022.