A&M ENERGY

Integrated Supply Chain Strategy – Renewable Diesel/Sustainable Aviation Fuel (SAF)

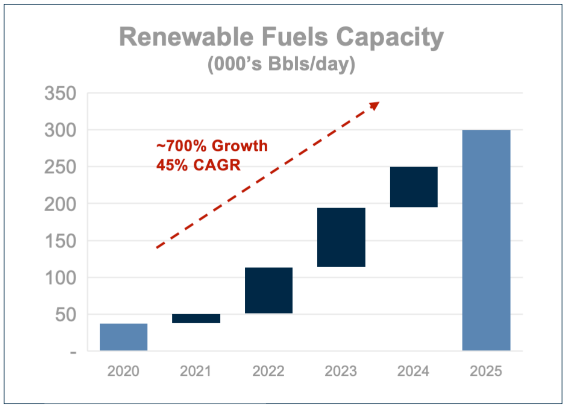
Executive Summary

Rapid growth in Renewable Diesel (RD) capacity and production has led to a significant increase in North American demand for soybean oil and other feedstocks. This demand has led to large price increases across the feedstock slate, resulting in intense margin pressure. As RD value shifts from the RD producers to the feedstock suppliers, RD producers reassess their supply chain strategies to recapture margins. We believe producer supply chain strategies should look holistically at the upstream value chain to identify both short-term value opportunities and long-term strategic positioning. Given the rapidly changing RD environment, we also believe these opportunities should be analyzed and tested under a variety of market and operating scenarios.

Designing Supply Chain Strategies in the Renewable Fuels Sector

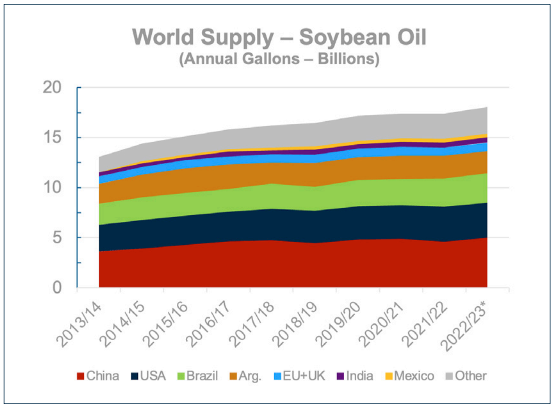
The renewable fuels sector is set to grow more than 700% from 2020 to 2025 with several major projects slated to come into production by 2025 as illustrated in **Exhibit 1**. This capacity increase could create an increase in soybean oil demand equivalent to between five and seven percent of current production. **Exhibit 2** shows historic soybean oil production and the expected increase in demand between now and 2025. The magnitude of the issue is better illustrated by converting the incremental hydrotreated vegetable oil (HVO) demand into acres of soybeans (the predominant feedstock in North America). Assuming historical yields and some regions able to produce two crops per year, these new projects would need to be supported by approximately 26 million crop-acres, or the equivalent to 100 percent of the active crop-acres in the state of Iowa.

Exhibit 1:



Source: EIA, Statista, A&M Analysis

Exhibit 2:



Source: EIA, Statista, A&M Analysis

1. Assumes yield of 66 gallons per acre and 30 percent of acres able to produce two crops per year (Source: USDA, A&M research)

Agricultural Feedstock Issues

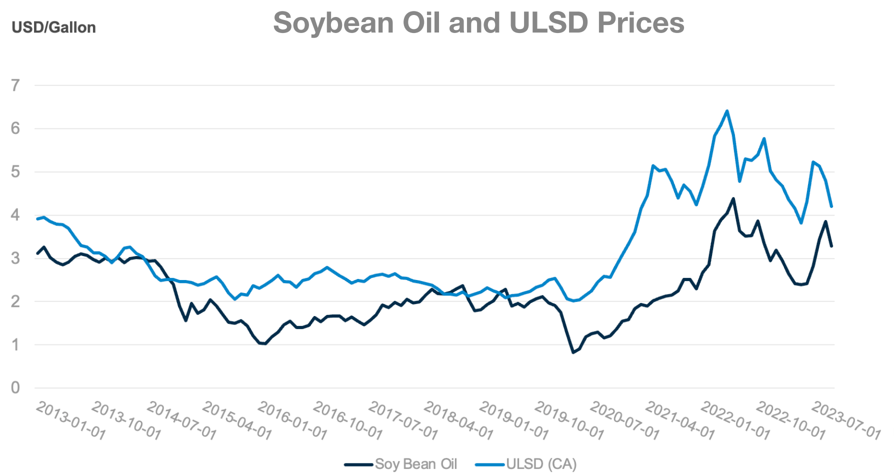
How Can Oil Companies Overcome Supply Chain Obstacles?

Oil companies are accustomed to feedstocks that are produced ratably throughout the year and have designed and built their supply strategies and assets accordingly. Agricultural feedstocks come in batches as harvest times occur only once or twice a year, usually over two months in any given region. A refinery planning to source predominantly local crops would need to plan for several months' worth of feedstock storage to accommodate the locally sourced supply strategy. This requirement is quite different than the typical refinery configuration which usually has only weeks of storage. HVO is storable; however, HVO storage requires greater environmental controls (moisture and temperature) to prevent degradation. Agricultural and food companies have been dealing with these issues for years and have developed supply chain and production strategies and capabilities that use a mix of storage, international sourcing and batch processing to accommodate the growing/harvest cycles. Developing and managing these additional supply chain requirements would require a host of new skills for oil companies.

Additional key differences between petroleum and agricultural feedstocks are quality and content. While both petroleum and agricultural feedstocks have variations in quality and content, agricultural feedstocks can be engineered to optimize yield, quality and cost of processing. Most of the new renewable diesel projects being contemplated have, or are adding, pre-processing units to enable a wider range of feedstocks and offer greater consistency in processing requirements and yields. However, renewable diesel and SAF companies could take a page from the agricultural and food industries and explore crop hybridization and genetic engineering to create proprietary seed/crops that offer higher oil yields, lower water requirements and lower cost of processing. This could create a competitive advantage in the future when the renewable diesel and SAF market margins face compression as new entrants and capacity come online. This approach has been successfully used by companies such as McDonald's and Frito-Lay who have developed unique strains of potatoes, corn and other grains to improve consistency of their products, increase crop yields and lower manufacturing costs. Unfortunately, this is another skill set that is entirely new to oil companies.

The third major set of differences between agriculture and petroleum feedstocks is volatility and supply risk. First, crops are subject to production variability related to weather and the farmers' ability to switch between crops from year to year. This can create price and availability issues in both the short and long term. Secondly, weather impacts also drive significant changes in productivity and thus production that can quickly translate into shortages and price volatility. Thirdly, soybeans and other grain/seed crops have food and feed uses that are both a competing factor as well as a source of the growers' total income and will influence pricing and availability as other substitute crops or international production issues affect the local/regional market. Lastly, as **Exhibit 3** illustrates, soybean oil markets and renewable diesel and SAF markets are not highly correlated making hedging and margin management difficult. The combination of all these factors must be considered by renewable diesel and SAF producers as they develop their supply chain and hedging strategies.

Exhibit 3:



Supply Chain Strategies

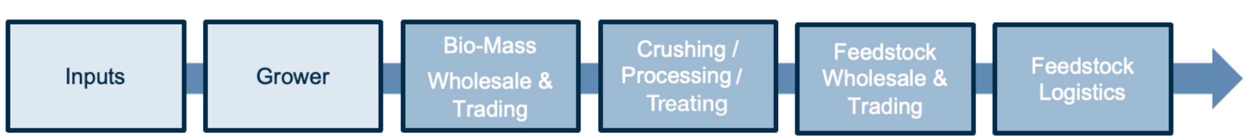
Many of the early movers have already developed their feedstock supply chain strategies. Feedstock concerns have led several large refiners (e.g., Valero, British Petroleum (BP) and Marathon) to partner with Agri-business firms (Darling, Bunge, Archer Daniels Midland Company (ADM), respectively) to manage the feedstock issues of existing and planned capacity. Chevron's strategy utilizes acquisitions of an existing renewable fuels company, Renewable Energy Group Inc. (REGI). This strategy gives Chevron expertise in all aspects of renewable fuels including significant research and development capabilities. On the agricultural side, major firms like Cargill and ADM, seeing a new opportunity, have recently announced transactions to increase their position in the renewable diesel feedstock chain. While partnering is not a requirement, renewable diesel and SAF players need to carefully design their feedstock strategies and supply chain capabilities to manage what could be a significant squeeze on available HVO as new capacities come online.

How Can Companies Develop a Resilient Feedstock Supply Chain Strategy?

The options and components of a robust feedstock supply chain strategy are many. To develop a holistic strategy, companies should start with an evaluation of the entire renewable diesel and SAF supply chain upstream of the refinery as illustrated in **Exhibit 4**. This starts with seeds, then crops/production, crop by-products, waste products (e.g., used cooking oil (UCO), tallow and other fats), logistics, storage, pre-processing and processing and environmental and tax credits (renewable identification numbers (RINS), low carbon fuel standard (LCFS), Inflation Reduction Act (IRA), etc.). The evaluation should be detailed and tested using a range of scenarios as value capture can accrue differentially to each part of the supply chain over time. Each company's analysis should be through the lens of its own unique position (both assets and capabilities).

Exhibit 4:

Renewable Fuels Upstream Supply Chain



How companies choose to participate, manage and contract across the value chain can determine the realized value and risk the company can expect from its renewable diesel business. A robust feedstock strategy development process like the one shown in Exhibit 5 can be used to create a strategy that addresses the company's feedstock needs, positions the company favorably versus peers/competitors and enables near and long-term growth. Following this process, companies will be able to clearly articulate the strategy, its benefits and trade-offs, and execute to address the concerns of investors and regulators.

Exhibit 5:

Strategic Framework

Companies with renewable fuel projects or aspirations should take a deeper look at their feedstock strategy early to ensure the viability and profitability of their projects as well as to preserve their optionality as others in the renewable fuels sector are placing their bets and establishing strategic positions.

Challenge: Much of the new capacity is associated with existing refineries (either as expansions or replacements) owned and operated by traditional petroleum companies. These companies are well-equipped to manage petroleum feedstocks and refining margins. However, bio-feedstocks create a new set of challenges and opportunities that are unique to agricultural products. These include:

1. Seasonality – growing and harvest seasons vs. ratable oil and gas production
2. Storage – storage constraints to minimize diminution of feedstock quality (spoilage) requiring time limits and condition monitoring and management
3. Competition with non-energy demand (food and feed markets)
4. Competition across crops (corn vs. soy or wheat, etc.)
5. Sustainable certification – inventory tracking to ensure only sustainably grown product is in the feedstock
6. Ability to engineer crops to optimize yields for energy production
7. Contracting production with farmers for fixed fees, rather than purchasing output
8. Greater feedstock flexibility (soy vs. palm vs. rapeseed vs. UCO vs. Tallow, etc.)
9. Expanded use of rail, truck and marine transport (lack of pipeline infrastructure or scale to enable it)
10. Entirely new set of suppliers (big and small) to access, manage and trade with

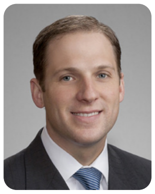
Resolution: To solve this problem, we recommend taking a holistic and integrated view of the feedstock value chain to ensure availability, quality and cost of the required and future feedstock. Developing an integrated supply chain strategy should follow a natural sequence:

- Where and how to play on the value chain? (Contract, invest, partner, etc.)
- What will our portfolio strategy entail? (Geographies, crop types, local vs. import, etc.)
- How will we manage price and operational risk?
- What assets will we need for transportation and storage?
- How will we optimize the portfolio yearly, monthly or daily?
- How should we contract for feedstocks, components and services?
- What processes, technologies, capabilities and analytics will we need?
- What new governance structures do we need to manage performance?

The answers to these questions should be developed and tested against a range of market and operating scenarios to ensure the resulting supply chain strategy is resilient as the industry develops and matures. The scenarios and related impacts enable documentation of associated risks and contingencies that will enable management to anticipate and/or respond to market developments and disruptions.

Key Contacts

John Corrigan | Managing Director
+1 214 438 1231
jcorrigan@alvarezandmarsal.com



Mark Clevenger | Managing Director
+1 713 547 3638
mclevenger@alvarezandmarsal.com

Lee Maginniss | Managing Director
+1 214 438 1010
lmaginniss@alvarezandmarsal.com

This article contains significant contributions from Alvarez & Marsal's Emma Kackley and Edreece Mangal.

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