Renewable Diesel

With mounting economic, social, and regulatory pressure, the search for alternatives to petroleum-based fuels is intensifying. One promising path forward is the development of sustainable, renewable energy sources that have reduced carbon footprint and minimized GHG (greenhouse gas) emissions.

Within the heavy-duty transport sector, renewable diesel is rapidly gaining investment support and will play an integral role in decarbonization efforts. Not only is renewable diesel derived from non-petroleum sources, but it also burns cleaner, is a ready drop-on replacement for fossil diesel, and can pave the way to energy independence.

Renewable Diesel

Also known as hydrotreated vegetable oil or HVO, renewable diesel is produced by using a method called hydrotreating, which involves hydrogenating triglycerides (fats) to remove the oxygen. A wide range of feedstock can be used, including plant oils, animal fats, used cooking oils, greases, or other residue and waste streams; with other new non-food cover crops being researched and added to the pool. Renewable diesel can directly substitute for petroleum diesel in existing vehicles because it is chemically identical to petroleum diesel. This means that renewable diesel can be blended in any proportion into petroleum diesel and be readily operated by vehicles without any modifications in engines or distribution infrastructure.

Renewable Diesel vs. Biodiesel

It is noted that both renewable diesel and biodiesel are produced from vegetable oils, greases, animal fats, or other agricultural waste products. However, unlike renewable diesel, biodiesel, also known as fatty acid methyl ester or FAME, is created through transesterification and contains oxygenates. Biodiesel is not chemically identical to petroleum diesel, and can only be blended with petroleum diesel in relatively low concentrations (5% to 20%, known as B5 to B20 respectively). Higher blend ratios run risks of cold flow issues, or engines have to be specially adapted.

Advantages

Both renewable diesel and biodiesel have specific advantages including:

- Reduction of carbon intensity in production
- Reduction of greenhouse gas emissions
- Reduction of emissions of carbon monoxide, particulate matter, and sulfates

Renewable diesel has added benefits that biodiesel does not, including:

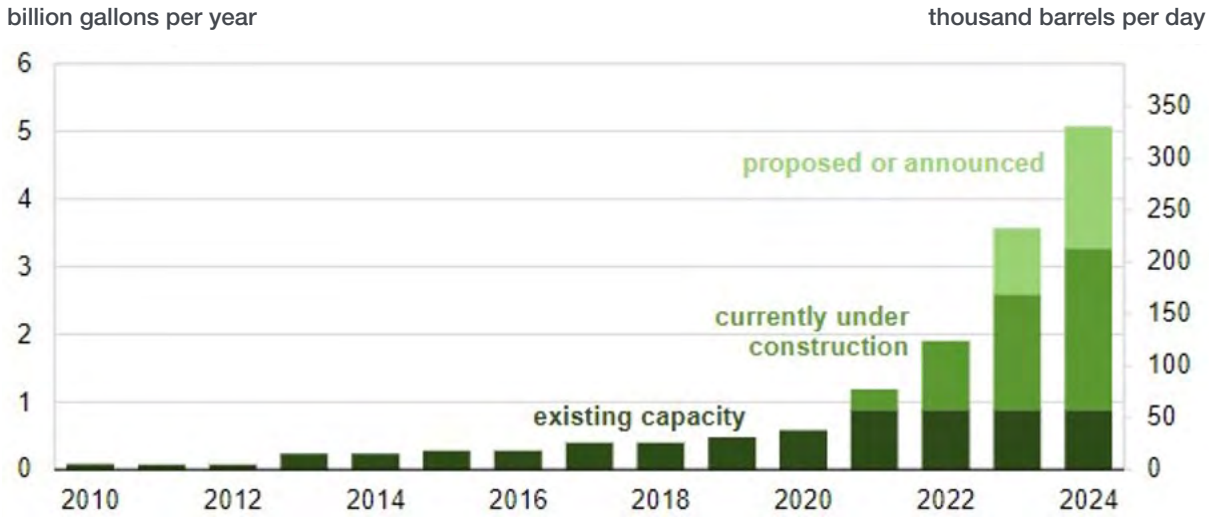
- Zero emissions of nitrogen oxide (NOx) – which can cause acid rain and smog
- Higher cetane number (>70) – meaning it burns cleaner than biodiesel
- Delivers more power to the engine than biodiesel
- Does not require equipment upgrades prior to use
- Can be fully substituted for petroleum diesel without any dilutions or blending
- Allows for improved fuel stability
- Improved cloud-point and cold-flow properties

Future Forecast

The renewable diesel market supply is expected to grow from approximately 5 million tons per year (MTon/yr) in 2018 to approximately 25 MTon/yr by 2025 and 30 MTon/yr by 2030.

U.S. production capacity for renewable diesel could increase significantly through 2024. As of the end of 2020, U.S. renewable diesel production capacity totaled 0.6 billion gallons annually. Several projects currently under construction could increase this capacity by 2.4 billion gallons and proposed and announced projects would add another 1.8 billion gallons annually by 2024.

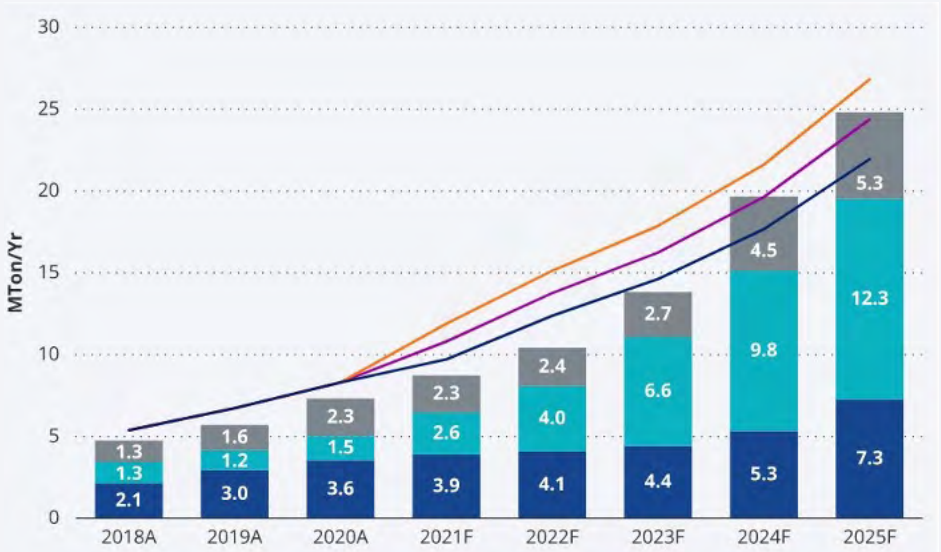
Existing and expected U.S. renewable diesel production capacity (2010-2024)



Source: U.S. Energy Information Administration (EIA), based on data from company announcements in trade press.

Europe is currently responsible for approximately 50% of total global renewable diesel supply, but is anticipated to transition from an exporter to an importer of renewable diesel over the next 5 years due to increasing demand.

Renewable Diesel Supply and Demand



Source: Seeking Alpha, Barclays (demand bottom-up base case model), VanEck (supply bottom-up model), BNEF and company and country data.

Challenges

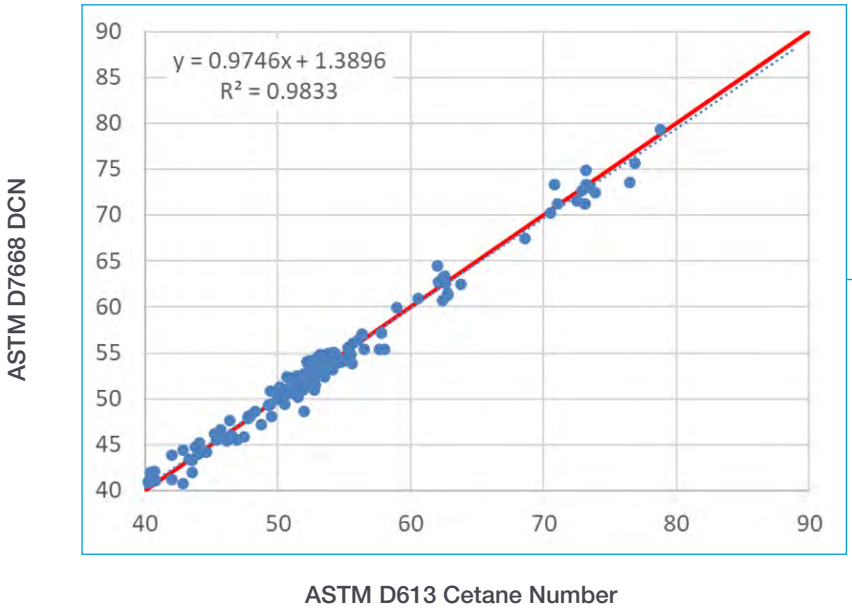
The primary challenge to higher utility of renewable diesel is the cost of production. It's not currently cost-competitive with petroleum diesel. Nevertheless, as more nations strive for sustainability ambitions and shift to green fuels, renewable diesel offers a higher quality end product and provides greater power and efficiency than biodiesel. Also because renewable diesel doesn't require equipment modifications, many projections suggest that renewable diesel will become the preferred option when considering biomass-based diesel.

PAC Solutions for Renewable Diesels

Parameter	Conventional Diesel D975, EN 590	Paraffinic HVO EN 15940	PAC Solution
Cetane	≥ 40 (D975) / ≥ 51 (EN 590)	≥ 70	D7668: CID 510
Cloud point / Pour point			D5771, D5950: OptiCPP, D5773, D5949: DFA-70Xi D7689: D7346: OptiMPP
Viscosity			D445: HVM D7945: DFA-70Xi, OptiMVD
Flash point	≥ 52°C (D975) / ≥ 55°C (EN 590)	≥ 55°C	D93: OptiFlash
Sulfur	≤ 15 ppm	≤ 15 ppm	D5453: ElemeNtS
Distillation			D86: OptiDist D7345: OptiPMD
Thermal Oxidative Stability		Non-mandatory	DTOT: special research tool for Diesels based on D3241

CID 510:

Since HVO possesses superior cetane value, It is often used as a blendstock for petroleum diesel to improve and bring the product to specification. The CID 510 measures DCN (Derived Cetane Number), which is a fast and accurate correlation of the cetane number for both the neat HVO and the blended final product.



The CID 510 has been extended to correlate to cetane number (ASTM D613) from 39 to 80, covering the range for conventional diesel, biodiesel, renewable diesel and HVO.

OptiCPP, OptiMPP, DFA-70Xi:

Likewise, HVO can be processed with Improved cold properties over FAME, and therefore are used as blendstock to optimize the cold flow specification. All of OptiCPP, OptiMPP, and DFA-70Xi provide fast measurements for both cloud and pour points. The DFA-70Xi also combines cloud/pour, viscosity, and density measurement in a single analyzer.

ElemeNtS:

Detects Total Sulfur and/or Total Nitrogen efficiently using ultraviolet fluorescence (UVF) and chemiluminescence (CLD) in solid, liquid, gaseous materials and LPG samples, including HVO and renewable diesel blends.

OptiDist, OptiPMD:

Measure the distillation characteristics of renewable diesel using either automated D86 methodology or with reduced sample volume and fast speed with D7345.

See PAC's complete portfolio of solutions for diesel: https://www.paclp.com/lab-instruments/application/diesel

Summary

Renewable diesel has become a leading solution to replace petroleum-based diesel as the world transition from first-generation biodiesel for the heavy-duty transport sector.

PAC has decades of experience in helping the diesel fuel industry to comply with many standards. We have instruments for a wide range of parameters, including cetane, cloud and pour points, viscosity, flash point, sulfur, distillation, and more. Beyond our product capabilities lies our depth of application knowledge and a deep understanding of specifications as ASTM D975, EN 590, EN 15940, and many other national specifications.