



Profits without subsidies?

Many biodiesel producers have faced financial challenges in recent years due to delays in, or the absence of, subsidies.

With many companies struggling financially in recent years, a new approach towards biofuel manufacture is needed which involves low capital expenditure, the ability to retrofit technology and feedstock flexibility.

Current biofuels technologies

Until recently, there have been four families of biofuels technologies related to diesel substitutes:

Conventional biodiesel involves the trans-esterification of oil with sodium methylate and represents 80% of the installed capacity in the USA.

The production process features low capital expenditure (approximately US\$300-US\$450/tonne) but requires the use of high quality, low free fatty acids (FFAs) feedstocks such as refined vegetable oils (such as soyabean and canola oils). The feedstock requirements for this process make these producers heavily reliant on government subsidies to support production economics.

Acid/Base technology represents an evolution of the conventional trans-esterification biodiesel process and

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includes a re-esterification step to remove the FFAs from the feedstock. This approach can process waste feedstocks (such as distillers' corn oil or used cooking oil which contain a high level of FFAs) but requires an expensive pre-treatment step. Producers who invest in this pre-treatment step can process waste oils, producing a fuel with a lower carbon intensity.

Renewable diesel, produced by hydrotreating fats and oils, has attracted a wave of investment in Europe and the USA. Renewable diesel has the advantage of being able to utilise waste feedstocks and to produce drop-in diesel and jet fuel.

This fuel also has a lower carbon intensity than conventional biodiesel through the use of waste feedstocks. Despite its advantages, renewable diesel is typically only economical if implemented through a refinery retrofit or applied at large scale for greenfield projects, due to its high capital costs when compared to conventional biodiesel.

Lastly, there are technologies that use **solid state** or **enzymatic catalysts** to convert fats and oils into biodiesel. These technologies have a very small footprint with only a few small plants in operation. They can accept various feedstocks but the high cost of the enzyme and/or the difficulties in purifying the product downstream can present challenges in this route.

Unique pre-treatment approach

Air Liquide Engineering & Construction is active in each of these areas, with an extensive product portfolio in oleochemicals. The company has built more than 75 plants using its Lurgi biodiesel technology, including a recently completed 250,000 tonnes/year biodiesel plant in Wichita, Kansas, USA in 2019.

Air Liquide's involvement in renewable diesel projects stems from its core business in the production and sale of hydrogen, and in its unique oil-splitting pre-treatment technology. This patented

BIODIESEL

► technology combines ultra-degumming and bleaching with oil splitting to remove glycerine before the hydrogenation reactor, as shown in Figure 1 (right).

This oil splitting step translates into increased production capacity, no propane by-product, and lower hydrogen and utilities consumption which ultimately further reduces the carbon intensity of the fuel.

Understanding market needs

Air Liquide's experience in biodiesel technologies makes it well-positioned to understand the advantages and shortcomings of the different biodiesel approaches, whether that be the high capex requirements of renewable diesel or the high operational costs associated with conventional biodiesel production.

The most important concern is always how best to serve the hundreds of existing biodiesel facilities throughout the world. In the absence of government subsidies (which have proved unreliable), many of these facilities have struggled commercially in recent years.

The company has identified a market need for a new approach (see Figure 2, right) featuring:

- Low capital expenditure
- Technology that can be used in existing biodiesel plants, through retrofitting
- Feedstock flexibility, to allow the use of low-quality, low-cost feedstocks; and most importantly
- The ability to be profitable even without government subsidies.

Novel trans-esterification

Having identified this market need, Air Liquide's path crossed with Inventure Renewables – a technology company with a proven track record of innovation and recently-commercialised technologies.

One of these is a novel trans-esterification technology based on supercritical reaction without catalyst.

For Inventure, Air Liquide represented a strong partner with a global presence and the experience to commercialise, design and fabricate projects at scale.

The companies began collaborating in early 2019, resulting in a long-term partnership agreement in October 2019 in which Air Liquide became the exclusive licensor of the Inventure process.

Flexible feedstock technology

The Inventure technology can process the least expensive, low-cost waste oils and fats to produce distilled biodiesel and premium glycerine. The technology has been in commercial operation since 2017

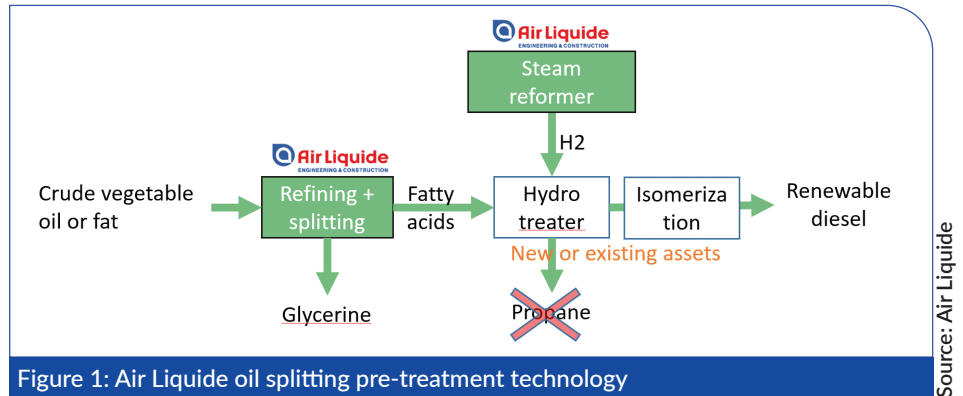


Figure 1: Air Liquide oil splitting pre-treatment technology

Source: Air Liquide

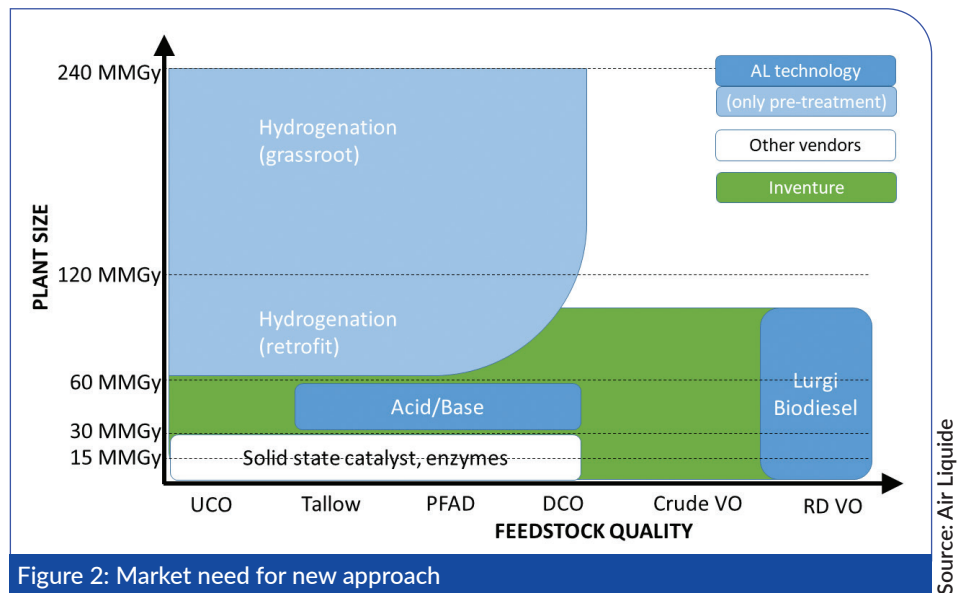


Figure 2: Market need for new approach

Source: Air Liquide

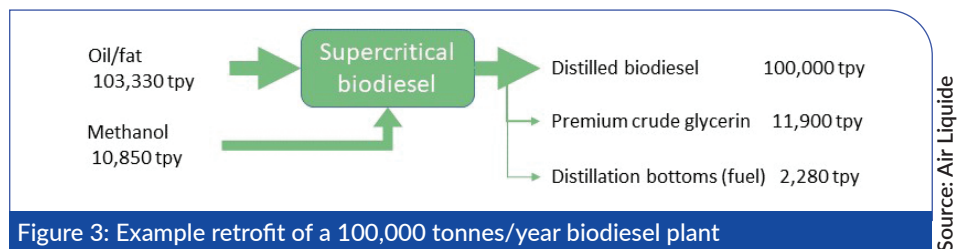


Figure 3: Example retrofit of a 100,000 tonnes/year biodiesel plant

Source: Air Liquide

and is a simple retrofit for existing trans-esterification facilities.

It represents a truly game-changing process for the market, combining the advantages of existing technologies but without any of the disadvantages:

It can process any feedstock including crude or refined vegetable oil, distillers corn oil, used cooking oil, acid oil, tallow and yellow grease with minimal cleaning.

The capex is similar to conventional biodiesel (around US\$300-US\$450/tonne) and considerably lower than the capex for renewable diesel. The conversion costs are lower than any biofuel technology.

Adding up all the advantages, the technology offers a payback period of less than one year. The technology improves the economics of existing plants significantly:

Feedstock advantage +US\$170/tonne
Carbon credit* advantage +US\$230/tonne
TOTAL +US\$300/tonne

* considering US\$200/tonne and following California Air Resources Board methodology

Finally, the novel trans-esterification technology can be retrofitted to existing biodiesel facilities as some of the front and back-end equipment can be re-used.

Not only can this process fill a previously vacant niche in the biodiesel market, but it is probably the only way for existing producers to survive long-term without federal tax credits. It therefore has tremendous potential in the US market. ●

This article has been supplied by Air Liquide Engineering & Construction, which supplies technologies and solutions for green chemicals and fuels worldwide