

FOCUS ON | PARAFFINIC FUELS

On hearing the term paraffin, one could be forgiven for imagining old lamps or the aroma that hits passengers walking onto the asphalt at Heathrow.

Kerosene, as it is commonly known when used as a fuel, is a fractional distillation of petroleum derived during the catalytic cracking (refining) of crude oil. It's what jet engines burn. The term paraffinic diesel has crept into the commercial vehicle vocabulary relatively recently. It refers to three types of road fuel that can be burnt in a compression ignition engine: gas to liquid (GTL), biomass to liquid (BTL) and hydrotreated vegetable oil (HVO).

GTL and BTL fuels are produced using the Fischer-Tropsch process. Developed in Germany in 1925 by two scientists of the same names, in simple terms it chemically converts carbon monoxide and hydrogen produced from liquefied coal, natural gas or biomass into a synthetic diesel fuel or lubricating oil. Companies involved in GTL production include Shell, Petro SA, Sasol, Petronas, Chevron,

Mitsubishi, Qatar Petroleum, NNPC, Calumet, and Oxford Catalysts (Velocys). In the UK, Certas Energy distributes Shell GTL, and has refuelling sites in south-east England (Ashford, Kent; Grays, Essex; and Horsham, West Sussex) as well as Merseyside (Eastham and Peel Ports).

In contrast, BTL producers seem to be relatively thin on the ground. BTG Bioliquids (Holland) produces limited quantities; it is still developing commercial production. Production at IFPEN (France) is not set to reach industrial quantities until 2020. Neste is also a producer, but seems to sell it mainly to crude oil refiners as an additive to mineral diesel.

Shell's head of speciality fuels, Katrina McDonnell, explains that the name of the fuel derives from its characteristic molecular constituent, paraffins, now more commonly known as alkanes. The Fischer-Tropsch process breaks down molecules and reassembles them into larger, uniform molecules in a carefully controlled three-stage process: gasification, synthesis and hydrocracking. She says: "First, the natural

gas is partially oxidised to create a mixture of hydrogen and carbon monoxide, which is known as synthesis gas. During the second part of the process, the synthesis gas is converted into liquid

hydrocarbons using the Fischer-Tropsch process. In the third stage the hydrocarbons are further processed and fractionated."

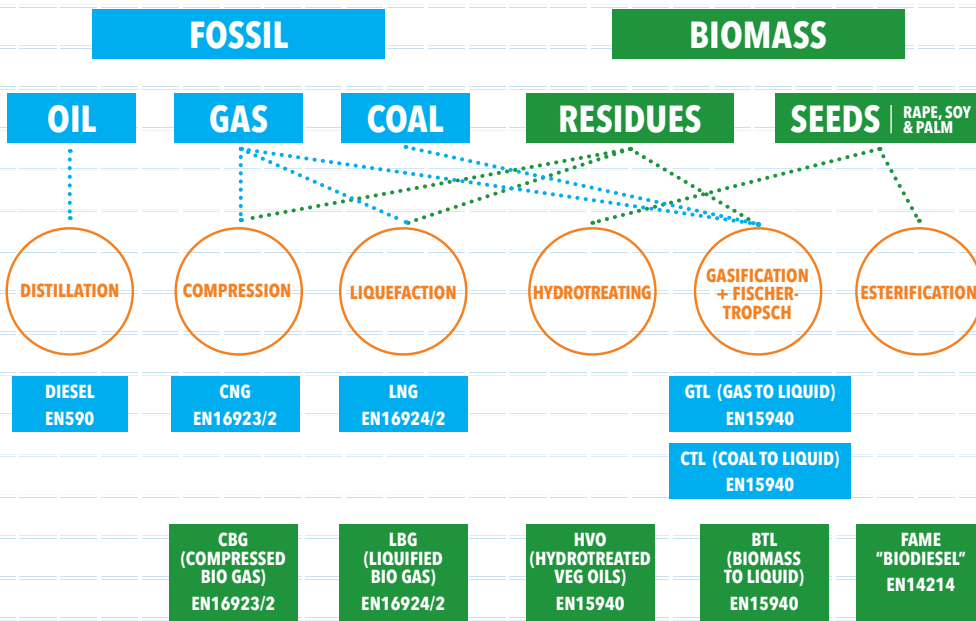
GTL differs from diesel in that it is almost purely 'paraffinic' - that is, containing only alkane hydrocarbon molecules. That results in a higher calorific value that delivers more energy per unit mass of fuel. Also, the compounds that make up paraffins tend to be saturated, which means their atoms link together only in one-to-one single bonds. Saturated compounds tend to be chemically more stable than unsaturated ones. Paraffinic fuels have only very low concentrations of unsaturated hydrocarbons, such as aromatics, poly-aromatics and olefins that are common in conventional fuels. They also have much lower concentrations than diesel of polar compounds: sulphur- and nitrogen-containing species that cause pollution.

The end result is that the GTL manufacturing processes produce more consistent and uniform molecules compared to conventional crude oil refining. Claimed benefits include improved and more efficient combustion inside standard diesel engines, leading to lower NOx and PM pollutant emissions, reductions in engine noise of up to 3-5dB. For example, a GTL sample set on fire produces less smoke than a diesel sample (pictured, right). Also, in cold conditions, its starting performance is better, thanks to a high cetane number (at least



FUELS AND HOW THEY ARE MADE

Chart courtesy DAF



70, compared to 53 for diesel) and good cold flow properties, according to Shell.

HVO, too, is made in a refinery-based process. It uses hydrogen as the catalyst in the process, which converts virgin and waste vegetable (and animal) oils into paraffins, removing oxygen from the product. HVO's properties are very similar to GTL and BTL.

Finnish HVO producer Neste pioneered production and now has four refineries around the world. Quarterly reports claim a production capacity of around 2.5 million tonnes a year. Currently, its market share exceeds 50%. Eni of Italy has started HVO production at plants in Sicily and Venice, and the company plans to boost output to 1.2 million tonnes annually. Total's plant in La Mede, France will add production capacity of 500,000 tonnes/year to the European HVO market when it starts up this year. In the UK, leading distributors of HVO

include Crown Oils and Green Biofuels.

OEMs have approved paraffinic fuels for use in their vehicles, under the EN15940 standard. According to Certas Energy, Shell GTL has had approvals from MAN and Scania. DAF Trucks marketing manager Phil Moon adds DAF Euro VI engines to that list.

Part of Euro VI emissions legislation requires fuel-specific emissions testing.

Says Moon: "We did this with paraffinic diesels on the latest engines, so we have the approval. On earlier models - 2013 through to 2017 - we didn't, so we can't fully approve the fuel. But what I can say is we have no technical concerns about operators using these fuels in our trucks. It's an issue around the small print of the legislation. And we can approve it for previous



engine generations, Euro V and below. They [paraffinic fuels] are benign fuels and don't have any of the issues around oxidation and other characteristics that could hinder oil life."

Says Moon: "We have several customers running trials of HVO and GTL in urban environments. These operations are the ones that suffer from the need to regularly regenerate DPFs. We know intuitively that low speed, low temperature operations require more fuel to simply heat up the exhaust system to burn off the particulates. The hypothesis is you can improve fuel economy and uptime for an urban vehicle by using paraffinic diesel.

"Brakes, for instance, is using GTL in its London operation and it tells us it is seeing a 0.4 mpg saving on the 18-tonne fleet. Hackney Borough Council is running on HVO and it is seeing less instances of drivers having to stop for a static regeneration. Evidence suggests there are considerable benefits."

DAF has been running its demo fleet on Green Biofuels' D+ HVO for several months, for which it has installed a 2,000-litre bulk tank at its base. Concludes Moon: "The beauty of paraffinic diesels compared with other alternative fuels, such as LNG or CNG, is if you run low while out on the road you can switch back to mineral diesel without any concerns. You don't have to buy new vehicles. And, while GTL is produced from fossil fuels (natural gas), HVO is renewable and around 90% carbon neutral, as well as being a clean fuel, so gives you the best of both worlds."