Towards HVO

Photo: Adobe Stock

EU biodiesel consumption fell in 2020 due to COVID-19 movement restrictions, with hydrotreated vegetable oil (HVO) production growing at the expense of fatty acid methyl ester (FAME)

The EU is the world's largest producer of biodiesel, which accounts for about 85% of the region's total transport biofuels market, according to a report by the US Department of Agriculture (USDA) Global Agricultural Information Network (GAIN) published in June last year.

Biodiesel includes fatty acid methyl ester (FAME) and hydrogenation derived renewable diesel or hydrotreated or hydrogenated vegetable oil (HVO).

"In 2020, EU biodiesel consumption was expected to decrease by 6% from the previous year as a result of COVID-19 movement restrictions, economic recession and resulting reductions in diesel use," the report said. The 6% fall in biodiesel and HVO equated to around 1.1bn litres.

In contrast, biodiesel and HVO production was forecast to decline by only 0.8% (145M litres).

Demand/consumption

EU FAME and HVO consumption is driven almost exclusively by EU and member state mandates, according to the USDA GAIN report.

With the outbreak of COVID-19 last year, most EU member states began to enforce lockdown measures, resulting in reduced demand for biofuels.

However, "diesel-biodiesel demand was less impacted by the lockdown measures than gasoline-ethanol demand. This was because declines in heavy-duty commercial vehicle use were less severe than declines in light-duty passenger use of diesel, whereas demand for ethanol-gasoline light-duty vehicle use was impacted by lockdown measures alone."

Biodiesel feedstock availability, especially the used cooking oil (UCO) waste stream supply, was sharply curtailed with restaurant and food service industry activity falling off from March to early summer in most EU member states and external third country suppliers.

For 2020, the highest biodiesel consumption reductions by volume were forecast for France, Spain, Germany, the UK and Belgium; while the highest reductions in percentage terms were forecast for Belgium, Spain, Portugal Ireland, and France.

Blending rates

Looking at blending rates, the percentage of biofuels in total transport fuel use was forecast to continue its steady upward trend which began in 2017.

In 2020, total biofuel blending with fossil fuels in the EU was forecast to reach 8.1%, compared with 7.6% in 2019, on an energy basis and taking into account double-counting of advanced biofuels.

Exclusive of double-counting, the total blend rate in 2020 was forecast at 7.1% for biodiesel and HVO.

Blending of food-based biofuels was estimated at 4.9%, well below the 7% cap set by the Indirect Land Use Change (ILUC) Directive. Blending of advanced, non-food based biofuels was estimated at 1.5% in 2020, 80% of which was produced from waste fats and oils.

Production and capacity

With production continuing to shift from FAME to HVO, biodiesel production was expected to decrease by 4% in 2020, while HVO production has been forecast to increase by 14%.

The production of HVO has taken off in the EU since 2012. HVO can be produced from waste oils and fats and can be fully substituted for diesel.

In 2019, HVO production was estimated at 2.9bn litres and, with new plants in France and Italy, is expected to increase to 3.4bn litres in 2020.

HVO consumption is forecast not to be significantly hit by the COVID-19 crisis

because of the waste-based double-counting content of HVO fuels. Recent HVO developments include:

Finland and the Netherlands: Neste Oil sells it HVO as a drop-in fuel for road and marine transport. The renewable fuels are available for customers in Finland, Sweden, Estonia, Latvia, Lithuania, the Netherlands and the USA (California and Oregon). In addition to drop-in biofuels, the Neste plants produce renewable naphtha, propane, and alkanes. In Finland, Neste operates one plant with two lines of roughly 215M litres each. In 2010, Neste Oil opened up a renewable diesel plant in Singapore with an annual capacity of 910M litres and a similar scale plant in Rotterdam in 2011. Current annual production capacity at the plant in Rotterdam is a maximum of 1.280bn litres. Neste is reportedly planning to build another plant in Europe with a capacity of roughly 2bn litres. In 2018 and 2019, about 80% of the feedstock used by the three Neste plants consisted of waste fats and oils. The waste and residues consist of UCO, palm fatty acid distillate (PFAD), bleaching earth oil, technical corn oil and animal fats. Neste's goal is to reach a 100% waste and residues share by 2025.

In 2015, forest product company UPM opened a HVO plant in Lappeenranta, Finland. The plant's capacity is some 115M litres of advanced biofuels per year, and the plant is using tall oil, a residue of pulp production, as a feedstock. The company is studying the opening of another plant in Kotka with a capacity of about 550M litres of advanced biofuels and biomaterials. The targeted feedstocks are forest by-products, such as saw dust and branches, and oil from the Brassica carinata crop grown in South America. The plant will be able to supply biofuels to the road, marine, and aviation transport sectors.

Additionally, Green Fuel Nordic Oy partnered with Dutch company BTG to produce 25M litres of pyrolysis oil in 2020 at its plant in Lieksa. Other companies which are planning to build advanced biofuel plants in Finland are Nordfuel, BioEnergo and Fintoil.

France: The Total HVO plant located in La Mède, southern France started producing HVO in July 2019. This plant has a maximum capacity of 640M liters/year. Feedstocks were expected to be 60-75% vegetable oils, and 25-40% waste oil such as UCO and animal fats. Under pressure from NGOs, Total announced, in July 2019, that the plant would use less than 300,000 tonnes/year of palm oil, or less than half of its total feedstocks. An additional factor is that the palm oil's tax advantages for biofuel production were removed in January 2020 which will likely result in the plant using more canola oil and less palm oil than expected. Reportedly there are still tax advantages for palm fatty acid distillate (PFAD).

Another project in France is the BioTFueL project, a cooperation of Avril, Axens, CEA, IFPEN, ThyssenKrupp and Total. This project aims to produce 230M litres of advanced biodiesel and bio-jet fuel per year from one tonne of biomass. The demonstration-scale plant is located at Total's former Flandres refinery in Dunkerque.

Italy: In 2014, a HVO plant was opened by Eni in Venice, Italy. Since then, the plant has produced approximately 325M litres/year. Production is forecast to increase to 540M litres in 2021 as a result of additional upgrades. The feedstock will include an increasing proportion of used oils, animal fats, and by-products from palm oil production. Following the model adopted for Venice, Eni converted a Gela refinery in Sicily into a renewable diesel production facility to produce 770M litres/year. The reconversion started in April 2016 and the facility opened in August 2019.

Portugal: Since 2017, GALP has been producing HVO at its facilities in Sines. Production capacity is estimated at 40M litres. Since Portugal's production is palm oil based, it will face limits imposed on this type of feedstock. Palm oil producers may certify their feedstock as low-risk ILUC to keep their presence in the EU market beyond 2023.

Spain: CEPSA (since July 2011) and REPSOL (since 2013) are producing HVO. Spanish HVO production rose to 549M litres in 2019 from 482M litres in 2018.

Sweden: In Gothenburg, Preem produces about 160M litres of HVO/year from tall oil. The company recently expanded its production capacity to 220M litres and is reportedly planning to further expand to 1.3bn litres in 2023. The company is currently investigating the use and sourcing of other raw materials. Preem plans to begin production of up to 300M litres of bio-jet fuel in 2022.

Finnish firm St1 plans to produce up to 250M litres of HVO and jet fuel in Gothenburg from 2022. The feedstocks will likely be UCO and tall oil. St1 is also looking at building another plant with a capacity of 500M litres/year of biofuels, beginning operations in roughly five years.

One of the raw materials which will be used by Preem and St1 for their expanded production is biocrude oil made from tall oil. To increase the supply of biocrude oil, SunPine is planning to increase its production from about 100M litres to 150M litres in 2020.

Pyrocell, owned by Preem and Setra, is also planning to produce nearly 30M litres of pyrolysis oil by 2021 at the earliest.

Industry structure

The structure of the EU biodiesel sector is quite diverse. Plant sizes range from an annual capacity of 2.3M litres owned by a farmer group to 680M litres owned by a large multi-national company.

FAME production facilities exist in every EU member state, with the exception of Finland, Luxembourg and Malta.

In contrast, HVO production is found in only seven countries (*see Table left*).

The majority of HVO capacity consists of dedicated plants, while in Spain and Portugal, HVO is co-processed with conventional fuel in oil refineries.

EU FAME production capacity increased by 0.5% in 2019 due to expansions in Poland and Greece. In 2020, a marginal increase of 0.4% is forecast, again due to increases in Poland and Greece. However, numerous plants throughout the EU are operating below capacity or are temporarily shut down due to negative market conditions, already present before the COVID-19 crisis.

With the start of commercial production in new plants in Italy and France, EU HVO production capacity increased by a remarkable 47% in 2019. For 2020, capacity is expected to remain flat.

Feedstocks

Rapeseed oil is still the dominant biodiesel feedstock in the EU, accounting for 43% of total production in 2019. However, its share in the feedstock mix has continuously decreased since its peak in 2008, when it accounted for 72%.

This is partly due to higher use of recycled vegetable oil/UCO and palm oil. In addition, EU rapeseed methyl ester (RME) has difficulty competing with cheaper imported soyabean oil methyl ester (SME) and palm oil methyl ester (PME). In 2020, rapeseed oil use is forecast to decline further as the prohibition on the use of three neonicotinoid insecticides (clothianidin, imidacloprid and thiametoxam) is expected to take its toll on EU rapeseed production.

The 2020 projection of 6.1M tonnes of rapeseed oil used in RME is equivalent to about 15.3M tonnes of rapeseed. ▶

Calendar year	2013	2014	2015	2016	2017	2018	2019	2020
Production	12,064	13,549	14,397	14,950	15,818	15,110	16,099	15,955
– HVO production	1,604	2,311	2,470	2,190	2,582	2,606	2,986	3,412
Consumption	13,100	13,954	14,668	15,151	16,718	17,989	19,136	18,000
Biodiesel production capacity (million litres)								
Number of biorefineries	244	220	201	196	188	187	187	188
Nameplate capacity	25,024	22,834	21,928	21,476	20,338	21,248	21,350	21,441
Capacity use	41.8%	49.2%	54.4%	59.4%	65.1%	58.8%	61.4%	58.5%
HVO production capacity (million litres)								
Number of biorefineries	5	10	11	11	12	12	15	15
Nameplate capacity	1,828	2,831	3,395	3,395	3,446	3,446	5,049	5,049
Capacity use	87.7%	81.6%	72.8%	64.5%	74.9%	75.6%	59.1%	67.6%
Feedstock use for biodiesel and HVO ('000 tonnes)								
Rapeseed oil	5,710	6,100	6,400	6.700	6,900	6,450	6,300	6,100
Used cooking oil (UCO)	1,150	1,890	2,400	2,644	2,660	2,460	2,990	2,790
Palm oil	2,340	2,240	2,340	2,300	2,800	2,590	2,410	2,400
Soyabean oil	870	840	540	630	700	750	950	900
Animal fats	420	900	1,030	730	785	900	1,000	1,110

Figure 1: EU biodiesel and HVO production, consumption, capacity and feedstock use

Source: USDA Foreign Agricultural Service (FAS) posts

Main FAME producers (million litres)

Calendar year	2012	2013[r]	2014[r]	2015[r]	2016[r]	2017[r]	2018[r]	2019[e]	2020[f]
Germany	3,106	3,307	3,808	3,505	3,543	3,644	3,578	3,862	3,300
France	2,175	2,170	2,386	2,866	3,152	3,135	2,806	2,556	2,045
Spain	538	659	1,017	1,103	1,319	1,721	2,008	1,835	1,600
Poland	673	736	786	861	985	1,019	1,000	1,091	1,110
Netherlands	974	790	1,056	795	638	1,112	1,022	1,079	1,080
UK	352	640	554	572	496	490	500	510	510
Italy	326	521	452	625	398	599	511	511	450
Other	1,214	1,638	1,179	1,600	2,229	1,516	1,077	1,669	2,443
Total	**10,422**	**10,460**	**11,238**	**11,927**	**12,760**	**13,236**	**12,504**	**13,113**	**12,543**

HVO production (million litres)

Calendar year	2012	2013	2014	2015	2016[r]	2017[r]	2018[r]	2019[e]	2020[f]
Netherlands	410	872	1,013	1,192	1,154	1,218	1,218	1,218	1,218
Italy	0	0	323	323	323	323	323	451	590
Spain	73	179	377	262	418	465	482	549	480
France	0	0	0	0	0	0	0	128	449
Finland	317	392	483	533	135	383	354	385	385
Sweden	160	160	160	160	160	160	192	218	256
Portugal	0	0	0	0	0	32	37	37	35
Total	**960**	**1,604**	**2,311**	**2,470**	**2,190**	**2,582**	**2,606**	**2,986**	**3,412**

Ranked by production in 2020 – r=revised, e=estimate, f=forecast. Information in metric tonne and converted to litres –1M tonne = 1,136 litres (FAME) and 1,282 litres (HVO)

Figure 2: Main EU producers of FAME and HVO (million litres)

Source: USDA Foreign Agricultural Service (FAS) posts

Country	Biofuel	Feedstock	Capacity (million litres/year)	Year of opening
Finland	HVO	Oils and fats	430 (2 lines)	2007
Spain	HVO	Palm oil	945 (7 plants)	2011
Netherlands	HVO	Oils & fats	1,280	2011
Italy	HVO	Palm oil and by-products, other oils & fats	465 (770 in 2020)	2014
Finland	HVO	Tall oil	115	2015
Sweden	HVO	Tall oil	220	2015
Portugal	HVO	Palm oil	40	2017
France	HVO	Oils & fats (50% palm oil)	640	2019
Italy	HVO	Used vegetable oil, animal fats, algae and by-products	965	2019

Figure 3: HVO plants in the EU

Source: USDA Foreign Agricultural Service (FAS) posts

UCO was the second most important feedstock in 2019, accounting for 21% of total feedstock. The use of UCO was boosted after some member states allowed double-counting (Austria, Belgium, Croatia, France, Hungary, Ireland, the Netherlands, Poland, Portugal, Slovenia, and the United Kingdom) and others introduced a greenhouse gas (GHG) reduction component to their use mandates (Germany and the Czech Republic).

However, since 2016, annual increases have grown smaller. In 2019, the largest EU producers of UCO methyl ester (UCOME) were the Netherlands, Germany, the UK, Portugal, Spain and Austria. Together they accounted for 90% of the use of this feedstock.

Smaller amounts were produced in France, Italy, Poland, Ireland, Bulgaria, and Hungary. The use of UCO is forecast to fall by 7% in 2020 because of reduced availability of this feedstock. Throughout the EU, UCO collection dwindled during the COVID-19 pandemic as many member states ordered restaurants to temporarily close down or restricted their services to take-away and delivery.

While this leaves room for increased imports, China, one of the main suppliers of UCO to the EU, was also heavily affected by COVID-19 and related restaurant closures.

Palm oil ranked third in terms of feedstock use in 2019 (16%). Its use in 2019 fell by 7% compared to the previous year because of the availability of cheap PME from Indonesia.

Palm oil was mainly used in Spain, Italy, France, and the Netherlands and, to a much lesser extent, in Finland, Germany, and Portugal. In 2020, palm oil use is forecast to remain unchanged, as lower use in Spain is offset by increased HVO production in France.

The use of **soyabean oil** and palm oil in conventional biodiesel is limited by the EU biodiesel standard DIN EN 14214 and colder weather conditions. SME does not comply with the iodine value prescribed by this standard (the iodine value functions as a measure for oxidation stability). Additionally, PME has a higher cloud point than RME and SME, and does not provide enough winter stability in northern Europe. However, the incentive persists to maximize the use of SME and PME due to their lower cost.

The standard can be met by using a feedstock mix of rapeseed oil, soyabean oil and palm oil. The vast majority of soyabean oil is used in Spain, followed by Germany and the Netherlands.

Animal fats benefitted less from double-

counting than UCO, as there are fewer member states that allow double-counting for animal fat (Denmark, Finland, France, the Netherlands, and the UK) than for UCO. In addition, in Germany, tallow methyl ester (TME) use does not count against the biofuel mandate and its production is exported to other member states. Increased animal fat use is the result of new plants (or capacity increases at existing plants) rather than a function of feedstock prices, as using animal fat requires changes to the technical equipment. In 2019, Italy was by far the largest user of animal fat for biodiesel production, followed by the Netherlands and France. Finland, the UK, Germany, Denmark, Spain, Austria, Ireland, Hungary, and Poland also used animal fats but to a lesser extent.

Sunflower oil comprised only 1% of the total biodiesel feedstock, and is mainly used in Greece, France, and Bulgaria - collectively accounting for 63% of EU sunflower oil-based biodiesel production.

Trade

In 2019, EU imports of biodiesel/HVO fell by 3.8% compared to 2018. Despite the EU imposing countervailing duties on biodiesel from Argentina in February 2019, Argentina was able to defend its place as the largest supplier of biodiesel to the EU. This was possible as Argentina offered an undertaking (an offer to prevent prices from falling below a certain floor price) which provided planning certainty for Argentine exporters and EU importers.

In 2019, the dominant suppliers of biodiesel to the EU were Argentina, Indonesia, Malaysia, and China, accounting for 28%, 25%, 23% and 16% of EU biodiesel imports, respectively. Imports from China more than doubled in 2019 compared to 2018, all of which is believed to be UCO methyl ester and PME.

In 2020, EU biodiesel/HVO imports are forecast to drop by 31% to 2.5bn litres. The reasons behind the expected drop are countervailing duties that the EU imposed on biodiesel from Indonesia, as well as the new B30 programme in Indonesia and B20 programme in Malaysia that are expected to reduce exportable supplies by these countries.

EU biodiesel exports to destinations outside the bloc are marginal and normally amount to only 1% of production. ●

This article is based on the US Department of Agriculture (USDA) Global Agricultural Information Network (GAIN) EU Biofuels Annual report, published in June 2020

Driven by regulation

The EU's updated **Renewable Energy Directive (RED) II** adopted for the 2021-2030 period sets an overall binding renewable energy target of at least 32% by 2030 with a 14% target for the transport sector.

Within the 14% transport sector target, food-based biofuels are capped at a maximum of up to 1% higher than member states' 2020 levels, but with a maximum cap of 7% for each member state. If the cap on first generation biofuels in a member state is less than 7%, the country may reduce the transport target by the same amount (for example, a country with a food and feed crop cap of 6% could set a transport target at 13%).

For advanced biofuels, the RED II introduces two different sets of targets for feedstocks. **Part A feedstocks** (algae if cultivated on land in ponds or photobioreactors; biomass fraction of mixed municipal waste; biowaste from private households subject to separate collection; biomass fraction of industrial waste not fit for use in the food or feed chain; straw; animal manure and sewage sludge; palm oil mill effluent and empty palm fruit bunches; crude glycerine; bagasse; grape marcs and wine lees; nut shells; husks; cobs cleaned of kernels of corn; biomass fraction of wastes and residues from forestry and forest-based industries; other non-food cellulosic material; ligno-cellulosic material except saw logs and veneer logs) must be supplied at a minimum of 0.2% of transport energy in 2022, 1% in 2025 and increasing to at least 3.5% by 2030. **Part B feedstocks** (used cooking oil - UCO - and some categories of animal fats) will be capped at 1.7% in 2030.

Advanced biofuels can be double-counted towards both the 3.5% target and 4% target. Currently, a double-counting mechanism for advanced biofuels) is in place in 20 member states.

The most important shift in RED II has been the introduction of specific criteria for high-risk indirect land use change (ILUC) biofuels. In May 2019, the EU published the **Delegated Regulation 2019/807** (delegated act) defining high-risk ILUC biofuels. These are feedstocks in which the share of expansion of the production into land with high carbon stock is higher than 10% since 2008 (with an annual expansion of more than 1%). Given the EC's calculations, only palm oil falls under this definition.

The use of high risk ILUC biofuels will be capped at 2019 levels until 2023 and then phased out by 2030. The delegated act allows producers to certify their feedstock as low-risk ILUC if they comply with the RED II's general sustainability criteria as well as "additional measures", such as cultivation on unused or abandoned land or by smallholders (less than 2ha).

The European Green Deal, presented on 11 December 2019, is a draft climate law that will make the EU's 2050 climate neutrality objective binding across the union.

To achieve this objective, there are 50 action items and environmental performance goals that will guide the EC's action for the next five years. The deal includes a Farm to Fork Strategy and a Biodiversity Strategy, published on 20 May 2020, that will shape agricultural production and trade policy objectives.

As part of the Green Deal, the EC also announced that it will re-open, and proposed to revise, the recently completed legislation of RED II by 2021.

It is still unclear if these policy changes will affect oilseeds production and demand in the EU.

The EU Common Agricultural Policy (CAP) funds agricultural and rural development support throughout the EU and currently accounts for 38% of the total EU budget. The current CAP programme entered into force in January 2014 and was supposed to be replaced by a new CAP on 1 January 2021.

The CAP categorises measures into two main 'pillars', the first orientated towards market measures and direct payments to farmers, and the second pillar directed towards rural development.

The EC published its legislative proposal for CAP post-2020 on 1 June 2018. However, due to the economic impacts of COVID-19, policy-makers are now discussing extending the existing CAP past its current mandate into 2022 or 2023, and allowing the EC to put forward a new CAP proposal that would be integrated into the legislative priorities of the Green Deal.