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Report Highlights:

In 2023, consumption of bioethanol and biomass-based diesel (BBD) are estimated to have increased by respectively 4.5 percent to 6.58 billion liters and 0.6 percent to 17.98 billion liters. For bioethanol, the expansion is mainly due to gasoline fuel pool growth, while growth for BBD is entirely due to increased blending. Whereas bioethanol use is forecast to further grow in 2024, BBD use is anticipated to fall based on reduced national greenhouse gas (GHG) reduction mandates and the use of BBD types with higher GHG reduction values. About a third of the domestically produced BBD is produced with waste oils and fats. Sustained growth in demand is forecast to support EU bioethanol imports this year. BBD imports are forecast to be restricted by new traceability and reporting rules. As part of the Green Deal, the European Commission (EC) adopted legislative proposals that will affect the uptake of biofuels in the road, aviation, and maritime transport sector on the medium and long term.

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I. Summary

The 2021 EU Biofuels Annual Report contained a biomass chapter, which now is a standalone report *EU Wood Pellets Annual*. It is available at: https://gain.fas.usda.gov/#/

Policy and Programs

In 2018, the European Union (EU) adopted the Renewable Energy Directive II (REDII). Most of the provisions of the REDII entered into force on January 1, 2021. It sets a new overall renewable energy target of 32 percent by 2030 and a 14 percent target for the transport sector. The REDII capped the share of conventional/crop-based biofuels to one percent above Member State 2020 consumption levels, up to the overall cap of seven percent for each Member State. The REDII also set ambitious binding targets for the use of advanced biofuels to 3.5 percent by 2030 and expanded sustainability criteria for biofuels. In October 2023, the REDII was aligned with the EU's Green Deal goals of a reduction of greenhouse gas (GHG) emissions of 55 percent by 2030 and carbon neutrality by 2050, and an overall renewable energy target of at least 42.5 percent by 2030. This revised REDII entered into force on November 20, 2023, with an 18-month period to transpose most of the Directive's provisions into national law.

As part of the Green Deal, the European Commission (EC) also adopted several legislative proposals that will affect the biofuels market in the medium to long term such as the Deforestation-free Supply Chain Regulation (EUDR). The EUDR targets products which are identified by the EC as the main drivers of deforestation including soy and palm derivatives. The requirements for economic operators will start on December 30, 2024. Regulation 2023/851 sets a 100 percent reduction target for CO_2 emissions for new passenger cars and new light commercial vehicles by 2035. Recently, the EU also adopted a Regulation revising CO_2 emission standards for heavy-duty vehicles. To promote the use of renewable and low-carbon fuels in the maritime and aviation transport sector, the EU adopted respectively Regulation (EU) 2023/1805 in September 2023, and Regulation 2023/2405 in October 2023.

Conventional and Advanced Biofuels

With the gradual lifting of the lockdowns and recovering economies, consumption of bioethanol and biomass-based diesel (BBD, which includes fatty acid methyl esters (FAME) and hydrogenation-derived renewable diesel (HDRD)) are estimated to have increased by respectively 4.5 percent to 6.58 billion liters and 0.6 percent to 17.98 billion liters in 2023. For both biofuels, the achieved level in 2023 is respectively 26 percent and 7 percent above the pre-COVID level of 2019, and a new record. The expansion is mainly due to gasoline fuel pool growth for ethanol, while growth for BBD is entirely due to increased blending which is offsetting some of the decline in the diesel fuel pool.

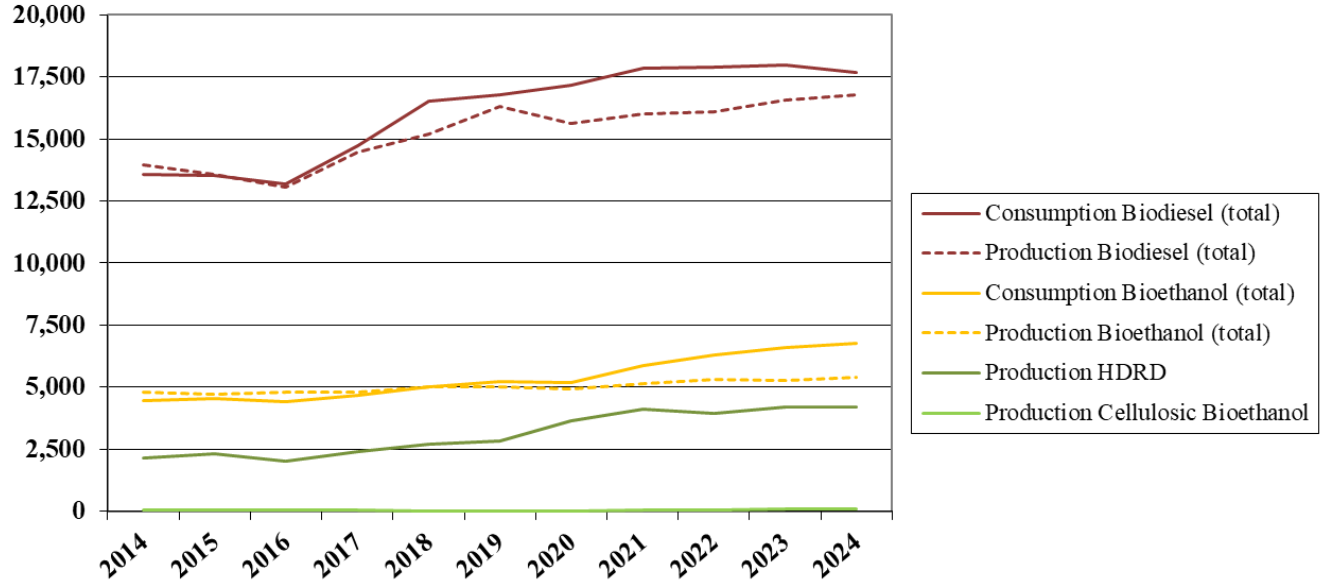
Based on the growth of the gasoline pool and further market introductions and expansion of E10 and E85 in some EU Member States, FAS European posts estimate an increase of bioethanol use of 2.9 percent to 6.77 billion liters in 2024. Countries where a significant growth of bioethanol consumption is anticipated in 2024 are France, Germany, Poland, Ireland, Austria, Spain, Belgium, and the Netherlands.

BBD consumption (FAME and HDRD) is expected to decrease by 1.6 percent to 17.70 billion liters in 2024. The main reasons for this reduction are: 1) Sweden's drastically reduced greenhouse gas (GHG) reduction mandate, 2) Increased use of "advanced" BBD types with higher GHG reduction values which reduces the physical volumes needed to fulfill national mandates, and 3) rising electrical vehicle use. While the total EU consumption of BBD is forecast to fall, an increased use is projected in Germany, Italy, the Netherlands, and Ireland.

Based on falling beet supplies, French bioethanol production declined significantly in 2023. Due to this cut of French production, combined with cuts of German, Hungarian, and Swedish production, total EU bioethanol production fell 0.9 percent to 5.25 billion liters in 2023. In 2024, EU bioethanol production is forecast to recover because of a higher domestic supply of sugar beets and grains. Other supportive factors are further growth of domestic demand for bioethanol and improved profit margins for ethanol production. Overall EU bioethanol production is projected to increase by 2.4 percent to 5.38 million liters in 2024, a new record.

Increased biodiesel exports to the United States gave EU BBD production room to grow in 2023, despite strong competition from cheap imports. This is forecast to continue in 2024 and push EU BBD production up 1.3 percent to 16.79 billion liters. In 2024, HDRD production is expected to grow by 7.9 percent as it has an advantage based on its higher GHG reduction values. In contrast, FAME production is forecast to further decline by 0.8 percent in 2024. The diversification of feedstocks for BBD production continues and in 2024 the category "other" is anticipated to rank third place in the feedstock mix after rapeseed oil and used cooking oil (UCO). In contrast, the use of palm oil is forecast to drop below one percent. While the increasing gap between consumption and production is forecast to further boost bioethanol imports. BBD imports are forecast to fall due to new traceability and reporting requirements for biofuel imports.

Graph 1. Biofuels
EU Supply & Demand (Million Liters)



Source: EU FAS Posts

Based on the minimum blending rates for “advanced” (as defined by the EC) biofuels produced with agricultural and forestry byproducts listed in Part A of Annex IX of the REDII, the consumption of these fuels must increase significantly towards 2030. Currently, EU production of such “advanced” biofuels is limited to roughly 5 percent of BBD and 11 percent of bioethanol. Most of these biofuels are HDRD produced from sewage sludge and waste streams from pulp mills and palm oil production, bioethanol produced from food waste streams, and to a lesser extent cellulosic ethanol. With the introduction of catch and cover crops to Part A of Annex IX potentially a larger share of advanced biofuels (for aviation) will be produced with the use of these feedstocks.

A larger portion of biofuels is produced using waste oils and fats listed in Part B of Annex IX of the REDII. Nearly a third of the BBD (including HDRD) are produced from UCO and animal fats. The REDII sets a consumption limit of 1.7 percent of all transport fuels for biofuels produced with these waste oils and fats, but EU Member States can modify this limit, if justified, considering the limited availability of the feedstock. Sourcing feedstocks from third countries could support a production expansion to keep these renewable transport fuels competitive.

II. Policy and Programs

The EU’s Renewable Energy Directive (RED)

The EU Energy and Climate Change Package (CCP) ran from 2010-2020. The RED, which was part of the CCP package, entered into force on June 25, 2009 and expired on December 31, 2020. The CCP required the EU to achieve a binding target whereby 20 percent of its overall energy use would be powered from renewable sources and 10 percent energy use in transportation for each EU Member State would come from renewables by 2020. For more information about RED, please see the 2020 Biofuels Annual Report.

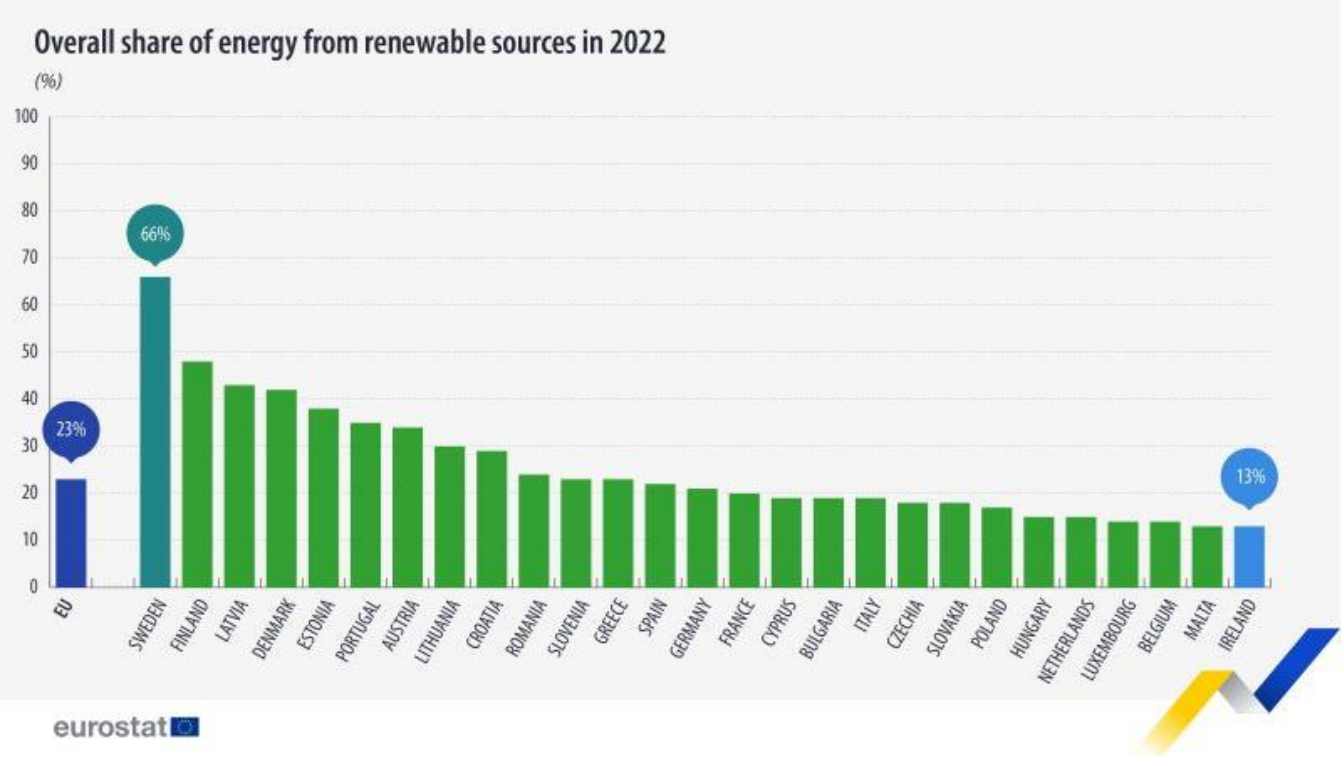
The Renewable Energy Directive II (REDII)

The European Union (EU) adopted the new REDII for the period 2021-2030 in 2018. Most of the provisions of Directive 2018/2001 entered into force on January 1, 2021. The Directive was amended in October 2023 by Directive 2023/2413 to align the REDII with the EU’s Green Deal ambitions of a reduction of greenhouse gas emissions of 55 percent by 2030 (compared to 1990) and carbon neutrality by 2050. The revised REDII (REDII+) entered into force on November 20, 2023, with an 18-month period to transpose most of the Directive's provisions into national law.

Uptake of Renewables in the EU

In October 2023, the European Commission (EC) published a report on the State of the Energy Union 2023. In 2022, the EU reached a 23 percent share of its gross final energy consumption from renewable sources, up 1.1 percent from 2021. The average share of energy from renewable sources in transport was of 9.6 percent in 2022 (this include the double counting of advanced biofuels).

Graph 2.



The REDII Renewables Targets

The revised REDII sets out an overall renewable energy target of at least 42.5 percent binding at EU level by 2030. For transport, Member States can choose between a target of reducing greenhouse gas (GHG) intensity by 14.5 percent up to 2030 (compared to 1990) or ensuring a share of at least 29 percent of renewables in final energy consumption by 2030. The Directive also sets out a binding target on non-crop based advanced biofuels of 1 percent in 2025 and 5.5 percent in 2030, of which a share of at least 1 percentage point is from renewable fuels of non-biological origin in 2030. The EU capped crop-based biofuels at the level consumed in each Member State in 2020, with an additional 1 percent point allowed over present consumption up to an overall cap of 7 percent. Member States can also set a lower limit for conventional biofuels than prescribed in the REDII.

For advanced biofuels, defined as biofuels made from feedstock listed in Table 1, the REDII introduces two different sets of targets for biofuels made from feedstocks listed in Part A of Annex IX and feedstock listed in Part B. Biofuels from feedstocks listed in Part A must be supplied at a minimum 1 percent in 2025 and 5.5 percent in 2030, of which a share of at least 1 percentage point is from renewable fuels of non-biological origin in 2030. Biofuels produced from feedstock listed in Part B will be capped at 1.7 percent in 2030 except in Cyprus and Malta. Advanced biofuels can be double counted although not all countries do this. In May 2024, the EC adopted Delegated Directive (EU) 2024/1405 which adds new feedstock in Annex IX of the REDII. These feedstocks are in italics in the table below.

Table 1. Advanced Biofuel sources, Part A and Part B of Annex IX in the REDII

Part A	Part B
• 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 glycerin • 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 • Other ligno-cellulosic material except saw logs and veneer logs • *Fusel oils from alcoholic distillation* • *Raw methanol from kraft pulping stemming from the production of wood pulp* • *Intermediate crops, such as catch crops and cover crops that are grown in areas where due to a short vegetation period the production of food and feed crops is limited to one harvest and provided their use does not trigger demand for additional land, and provided the soil organic matter content is maintained, where used for the production of biofuel for the aviation sector* • *Crops grown on severely degraded land, except food and feed crops, where used for the production of biofuel for the aviation sector* • *Cyanobacteria*	• Used cooking oil • Some categories of animal fats • *Damaged crops that are not fit for use in the food or feed chain, excluding substances that have been intentionally modified or contaminated in order to meet this definition* • *Municipal wastewater and derivatives other than sewage sludge* • *Crops grown on severely degraded land excluding food and feed crops and feedstocks listed in Part A of this Annex, where not used for the production of biofuel for the aviation sector* • *Intermediate crops, such as catch crops and cover crops, and excluding feedstocks listed in Part A of this Annex, that are grown in areas where due to a short vegetation period the production of food and feed crops is limited to one harvest and provided their use does not trigger demand for additional land and provided the soil organic matter content is maintained, where not used for the production of biofuel for the aviation sector*

Implementation of the REDII and Advanced Biofuels

Some EU Member States plan to achieve higher blending rates of advanced biofuels than required by the REDII. The Netherlands imposed a mandate of 2.4 percent blending of advanced biofuels in 2023 and seven percent in 2030 (with a cap of ten percent for Annex IX-B biofuels). In Italy, the targets for

advanced biofuels are set at 3.4 percent in 2023 increasing to 8.0 percent in 2030. In Portugal, the targets for advanced biofuels are set at 0.7 percent in 2023 increasing to 7.0 percent in 2030. In the two main fuel markets in the EU (Germany and France), the mandates for advanced biofuels are more conservative. In Germany, the advanced biofuels target is 0.3 percent in 2023 and gradually increasing to 2.6 percent in 2030. But it should be noted that in Germany HDRD and waste-based biodiesel enjoy competitive advantages based only on their higher greenhouse gas (GHG) reduction characteristics compared to so-called first generation (food and feed-based) biofuels. In France, the blending objective of advanced biofuels is 1.2 percent in gasoline and 0.4 percent in diesel in 2023 – 2027 and are set at respectively 3.8 percent and 2.8 percent by 2028 and. For more information about the mandates see our FAS GAIN report: Biofuel Mandates in the EU by Member State – 2024, published June 27, 2024.

The REDII Sustainability Criteria

To qualify for counting towards the REDII targets, biofuels, bioliquids, and biomass consumed in the EU must comply with strict sustainability criteria provided in article 29 of the REDII. This article sets requirements on the minimum level of GHG savings, safeguarding against the conversion of high-carbon content lands and protection of biodiversity.

High-Risk Indirect Land Use Change (ILUC) Biofuels: The REDII introduces specific criteria for high-risk ILUC biofuels through Delegated Act 2019/807, which determines high-risk ILUC biofuels. The EC defines high ILUC-risk feedstock as feedstock for which the share of expansion of the production into land with high-carbon stock is higher than ten percent since 2008 with an annual expansion of more than one percent. Given the calculations of the EC, only palm oil falls under this definition. The use of high-risk ILUC biofuels were capped at the 2019 level thru 2023 and will then be phased out by 2030. The Delegated Act also sets out criteria for certifying low-risk ILUC biofuels, which were already defined in article 2 of the REDII. The delegated act provides the possibility for producers to certify their feedstock as low-risk ILUC. Palm oil producers can certify their feedstock as low risk if they comply with the general sustainability criteria of the REDII and produce through additional "measures" such as cultivation on unused or abandoned land or if fruit bunches are collected only from small holders (less than two hectares).

The REDII Greenhouse Gas (GHG) Savings

The REDII introduces new compliance measures for GHG emission criteria for biofuels used in transport and counted towards the target. The EC is allowed to revise and update the default values of GHG emissions when technological developments make it necessary. Economic operators have the option to either use default GHG intensity values provided in the REDII or to calculate actual values for their pathway which must then be certified.

Table 2. Greenhouse gas emissions savings thresholds in the REDII for the transport sector

Plant operation start date	Transport biofuels	Transport renewable fuels of non-biological origin
Before October 2015	50%	70%
After October 2015	60%	70%
After January 2021	65%	70%
After January 2026	65%	70%

Compliance With Sustainability and GHG Emission Saving Criteria – Voluntary Schemes

Voluntary schemes and national certification schemes of EU Member States help to ensure that biofuels, bioliquids and biomass fuels are sustainably produced by verifying that they comply with the EU sustainability criteria. Following the entry into force of the REDII, voluntary schemes recognized under the RED must adjust the certification approaches to meet the new requirements. Those additional rules are enshrined in Implementing Regulation 2022/996 which lays down the rules to verify sustainability and GHG emissions saving criteria and low ILUC change-risk criteria. This Regulation lays down implementing rules to ensure economic operators comply with the sustainability criteria and provide accurate data on GHG emission savings of the REDII. The Regulation also lays down the rules to comply with the criteria for certification of low ILUC-risk biofuels as foreseen by Delegated Regulation 2019/807. More information about the recognition process can be found on the EC website. The updated assessment protocol can be found here.

Recognition by the EC is not a pre-requisite for certification. Member States may accept evidence from voluntary schemes or national certifications schemes set up by Member States not recognized by the EC if the competent authorities in those countries are confident about the quality of the certification services provided by these schemes.

Additional National Sustainability Requirements

The REDII allows Member States to establish additional sustainability criteria for biomass fuels. Before December 31, 2026, the EC will assess the impact of such additional criteria on the internal market, accompanied, if necessary, by a proposal to ensure harmonization at EU-level. The REDII also allows Member States to set a limit lower than the seven percent allowed for biofuels, bioliquids and biomass fuels produced from food and feed crops. Member States can also distinguish between different biofuels, bioliquids and biomass fuels produced from food and feed crops, considering the best available evidence on indirect land-use change impact. EU Member States may, for example, set a lower limit for the share of biofuels, bioliquids and biomass fuels produced from certain oil crops or ban them entirely as France has done with palm oil.

EU Database for Biofuels

The REDII required the EC to set up a Union Database for Biofuels (UDB) to enable the traceability of liquid and gaseous biofuels in the EU. This database was established in part to respond to product mislabeling (fraud) concerns over imports of some biofuels, in particular biomass-based diesel (BBD) certified made from used cooking oil. It went live on January 15, 2024, and economic operators are now required to digitally report their transactions when selling biofuels into the EU market. More information can be found on the Commission's website.

The Fuel Quality Directive (FQD)

The FQD required a reduction of the GHG intensity of transport fuels by at least six percent by 2020 (from 1990). It was amended by the revised REDII. This amendment removed the GHG intensity reduction target from the FQD and into the REDII. In addition, the FQD limits ethanol blends to ten percent or less when ethanol is used as an oxygenate in standard gasoline burning internal combustion engines (not applicable for flex-fuel engines).

Sustainable Aviation Fuels (SAF)

In October 2023, the EU adopted Regulation 2023/2405 on sustainable aviation fuels. The Regulation requires aviation fuel suppliers to ensure all aviation fuel made available to aircraft operators at each EU airport contains progressively an increasing minimum share of SAF, including a minimum share of synthetic aviation fuels (renewable fuels of non-biological origin), in accordance with the values and dates of application set below:

Table 3. Targets in the proposed SAF Regulation

Date of application	Minimum share of SAF	Minimum share of synthetic fuels
January 1, 2025	2%	N/A
January 1, 2030	6%	1.2%
January 1, 2035	20%	5%
January 1, 2040	34%	10%
January 1, 2045	42%	15%
January 1, 2050	70%	35%

The EC defines SAF as aviation fuels that are either synthetic aviation fuels, recycled carbon aviation fuel, advanced biofuels as listed from feedstock listed in part A and B of Annex IX or biofuels produced from the feedstock other than food and feed crops which comply with the sustainability and GHG emissions criteria. The EU decided not to include first generation biofuels such as feed and food and crop-based biofuels for sustainability reasons. The EC defines synthetic aviation fuels as renewable fuels of non-biological origin.

Sustainable Maritime Fuels

In September 2023, the EU adopted Regulation (EU) 2023/1805 on the use of renewable and low-carbon fuels in maritime transport. This Regulation aims to promote the use of renewable and low-carbon fuels and alternative energy sources in maritime transport throughout the EU. To achieve this, it sets a limit on the intensity of GHG emissions from the energy used on board, which becomes stricter over time. First generation biofuels such as feed and food and crop-based biofuels cannot be used to reach the targets set by the Regulation. However, advanced biofuels and renewable fuels of non-biological origin which comply with sustainability criteria and GHG emissions laid down in REDII can count towards the targets.

The European Green Deal

On December 11, 2019, the EC presented its Communication on the European Green Deal. On July 9, 2021, Regulation 2021/1119, also known as the EU Climate Law, was published in the EU Official Journal. The Climate Law enshrines a legally binding target of net zero GHG emissions by 2050. EU Institutions and Member States are bound to take the necessary measures at EU and national level to meet the target. The Climate Law includes measures to keep track of progress and adjust the EU's actions accordingly. The text also includes a reduction of net GHG emissions by at least 55 percent compared to 1990 levels by 2030. The Law also includes a process for setting a 2040 climate target.

New CO_2 Emissions Standards for Vehicles

In April 2023, the EU adopted Regulation 2023/851 which requires a 100 percent reduction target for CO_2 tailpipe emissions from new passenger cars and new light commercial vehicles by 2035. This Regulation effectively bans the sale of new internal combustion engine passenger cars and vans by 2035. The agreed text sets intermediate 2030 targets of a 55 percent fleet-wide CO_2 emissions reduction (compared to 2021 levels) for new cars and a 50 percent reduction for vans.

In June 2024, the EU adopted Regulation 2024/1610 revising CO_2 emission standards for heavy-duty vehicles. Under the Regulation, CO_2 emissions must reduce on average compared to 2019 levels by 45 percent from 2030, 65 percent from 2035, and 90 percent from 2040 onwards. The new Regulation also sets a 100 percent zero-emission target for urban buses by 2035 and an intermediate target of 90 percent by 2030. These new requirements will impact bioethanol and biodiesel consumption in the EU in the medium to long term.

Revision of the Energy Tax Directive

The EC also announced a revision of the Energy Tax Directive (ETD). The EC noted that biodiesel and especially ethanol are disadvantaged by the volume-based taxation (rates expressed per liter), because one liter of these fuels has a lower energy content than one liter of the fossil fuels they replace while the same tax rate applies. Therefore, the EC proposed to set different minimum levels of taxation applicable to fossil fuels and biofuels on an energy basis (€/gigajoule). This would be accompanied by a transition period for food and feed crop biofuels and low-carbon fuels. The proposal continues through the legislative process and is not yet adopted.

Table 4. Proposed minimum level of taxation applicable to motor fuels (in €/gigajoule)

	Start of transitional period (01/01/2023)	**Final rate after completion of transitional period (01/01/2033)**
Petrol	10.75	10.75
Gasoil	10.75	10.75
Sustainable food and feed crop biofuels	5.38	10.75
Sustainable biofuels	5.38	5.38
Low-carbon fuels	0.15	5.38
Advanced sustainable biofuels and biogas	0.15	0.15
Renewable fuels of non-biological origin	0.15	0.15

Deforestation-Free Supply Chain Initiative

As part of the Green Deal, the EC adopted Regulation 2023/1115 aimed to prevent products causing deforestation entering the EU market. The proposal targets products which are identified by the EC as the main drivers of deforestation including soy and palm oil. To sell any of the covered products in the EU or export them from the EU, business operators will be required to provide extensive information about the product's origins, including the precise location(s) and general time of production. The Regulation establishes a country benchmarking system through which the EC will assess the risk that countries, or parts thereof, produce relevant commodities and products that contribute to deforestation.

Products sourced from standard- or high-risk origins must comply with additional risk assessment and mitigation procedures. It is likely that this new Regulation will divert global trade flows of many products including soybeans and products and palm oil and products. It will also likely have an impact on commodity prices in the EU. For more information, please see GAIN Report: European Institutions Finalize Deforestation-Free Supply Chain Regulation. The requirements for economic operators will go into effect on December 30, 2024.

The EU Taxonomy for Sustainable Activities

In order to meet the EU's climate targets for 2030 and reach the objectives of the European Green Deal, the EC adopted the Taxonomy Regulation in June 2020. This Regulation establishes the framework for an EU taxonomy for sustainable activities by setting out four overarching conditions that an economic activity has to meet in order to qualify as 'environmentally sustainable'. The Taxonomy Regulation aims to act as a screening mechanism to define sustainable activities to steer private investment to activities the EC deems sustainable. It creates three different categories: "sustainable activities", "transitional activities and "enabling activities." The EC classifies crop-based biofuels as sustainable activities. More information can be found in GAIN Report: Commission Adopts Taxonomy for Green Investments.

Policy Response to the War in Ukraine

Russia's invasion of Ukraine is putting pressure on global food security because both countries are large producers of oilseeds and trade flows are being disrupted. For more information about the EU's policy response to the situation, please see the European Union: Oilseeds and Products 2024 Annual Report. Note that ongoing inflationary pressures in part due to the war have led several Member States to make 'temporary' changes in biofuel mandates or made them voluntary altogether. See Biofuel Mandates in the EU by Member State – 2024 Report.

In May 2024, the EU adopted an extension of temporary trade liberalization measures for Ukraine with new safeguards measures under which the EC can trigger an emergency limitations on imports for a list of sensitive agricultural products including corn.

Market Access

Duties

Regulation 2017/2321 lays down the EU's anti-dumping and anti-subsidy rule. Duty rates for fuels are listed below; for a historical discussion of how EU harmonized system (HS) customs codes have changed and influenced trade please see the EU Biofuels Annual 2017.

Table 5. Most-Favored Nation (MFN) Duty Rates for Biofuels

HS Code	Description	Duty Rate
38260010	FAME above 96.5% and up to 100% by volume	6.5%
38260090	FAME greater than 30% and up to 96.5% by volume	6.5%
271020	Petroleum oils containing FAME up to 30% by volume	3.7%
220710	Undenatured ethanol	€19.2/hl
220720	Denatured ethanol	€10.2/hl

Antidumping (AD) and Countervailing (CV) Duties Against U.S. Biomass-Based Diesel

In 2009, the EU initiated AD and CV duties of up to €409.2 (around $495) per MT on imports of U.S. biomass-based diesel (both biodiesel and renewable diesel) mainly targeting the U.S. federal blenders tax credit of $1/gallon (Council Regulation 598/2009 and Council Regulation 599/2009). On September 15, 2015, the EU extended the duties against both fuels an additional five years to September of 2020 with Commission Regulation 2015/1519. On September 14, 2020, two days before the expiration of the duties, the EC launched an investigation to extend the anti-dumping measures against both fuels. On August 3, 2021, the EU extended for an additional five years the anti-dumping duties levied on both fuels. Implementing Regulation (EU) 2021/1266 imposes an anti-dumping duty rate of up to €198 per MT. For more information, please see GAIN Report: EU Extends Its Anti-Dumping Duty and Countervailing Duties on Imports of US Biodiesel.

Biodiesel AD and CV Duty Actions Against Argentina and Indonesia

On September 19, 2017, the EC removed AD duties on Argentine and Indonesia's biodiesel exports, in response to losing a five-year dispute with said countries in the WTO in October 2016 (for more information about the history of the case, please see EU Biofuels Annual 2019). However, days after lifting the AD duties on biodiesel, in January 2018, the EC announced a Notice of Initiation of anti-subsidy proceedings for Argentina. In February 2019, the EU imposed CV duties on Argentinean biodiesel between 25.0 and 33.4 percent depending on the company (Implementing Regulation 2019/244). Duties are linked to an undertaking offer by the Argentine industry which aims to prevent prices from falling below a certain floor price. Implementing Decision 2019/245 establishes price and volume limits – not disclosed publicly - for Argentinean biodiesel. It spares producers who agree to a minimum price from the imposition of CV duties and if volume limits are not exceeded. This is in line with article 18 of the WTO Agreement on subsidies and countervailing measures. Nevertheless, the EU biodiesel industry is concerned with this managed trade agreement and calls on the EC to be vigilant in monitoring prices. In December 2019, the EU imposed countervailing duty on imports of biodiesel from Indonesia with Implementing Regulation 2019/2092. The CV duty ranges from 8 to 18 percent depending on the company.

Surveillance of Imports of Renewable Ethanol for Fuel

On September 15, 2023, the EC introduced retroactive surveillance measures on imports of bioethanol for fuel from several countries, including the United States. The measures were launched after imports of bioethanol into the EU increased by close to 80 percent between 2021 and 2022. The most important exporting countries in terms of volumes in 2022 were Brazil, the United States, the United Kingdom, and Peru. The introduction of the surveillance measures is the first step that can be taken before the introduction of possible antidumping or countervailing measures.

III. Ethanol

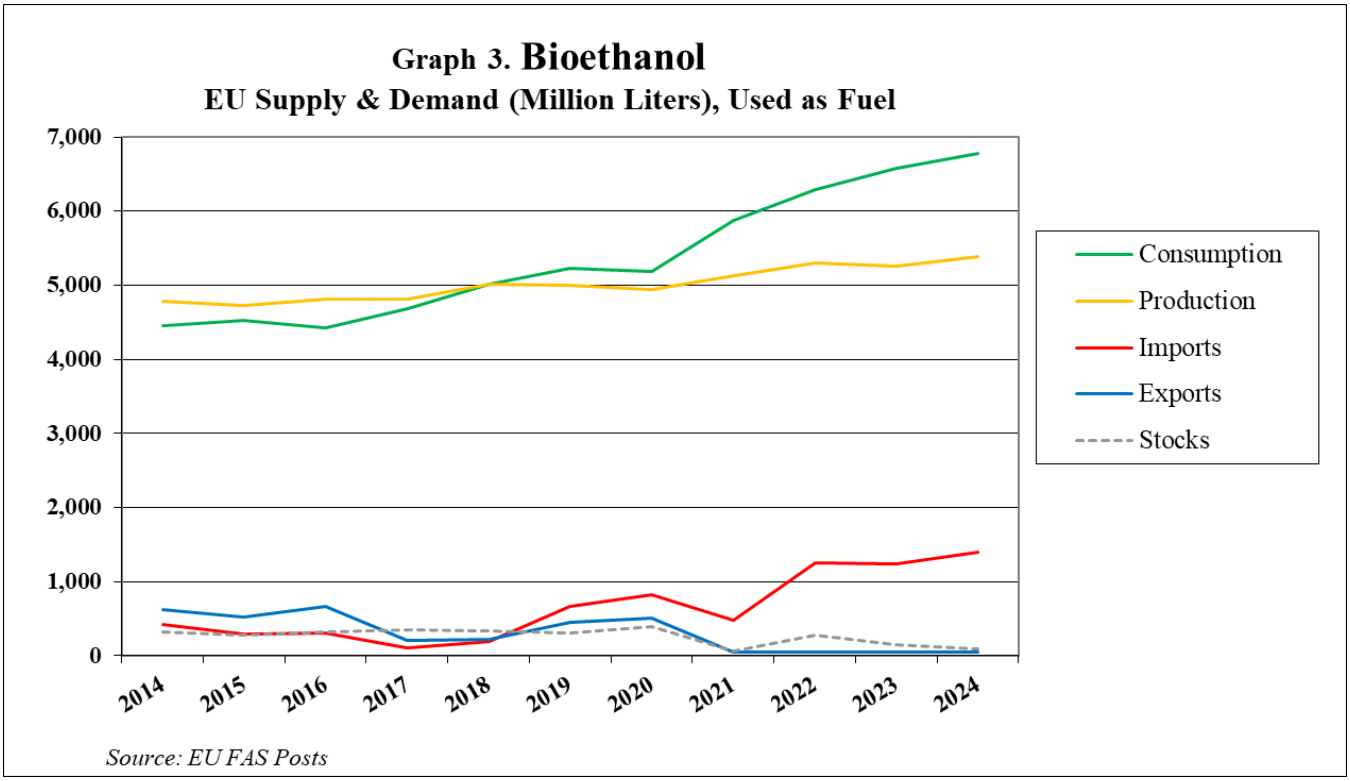
Bioethanol is produced by fermenting the carbohydrate components of plant materials. In the EU, the most used feedstocks are grains (e.g., corn, other coarse grains, and wheat kernels) and sugar beet. 'Synthetic' ethanol made from petroleum fuels is restricted to a very small market and is not included in this report. Ethanol used as transport fuel is referred to as bioethanol in this report.

EU Production, Supply and Demand Table

Table 6. Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023[e]**	**2024[f]**
Beginning Stocks	393	359	390	418	394	368	470	131	340	205
Fuel Begin Stocks	358	317	356	388	366	341	423	102	318	183
Production	5,558	5,497	5,400	5,566	5,549	5,886	5,700	5,736	5,686	5,823
Fuel Production	4,722	4,818	4,806	5,015	5,000	4,947	5,128	5,300	5,253	5,380
>of which is cellulosic (a)	40	40	40	5	5	20	50	50	40	40
Imports	742	856	881	800	1,100	1,490	1,125	1,979	1,938	1,700
Fuel Imports	292	315	110	189	666	832	478	1,262	1,244	1,392
>of which is ETBE (b)	109	24	9	9	14	26	19	18	81	115
Exports	574	712	258	265	508	565	100	100	100	100
Fuel Exports (*c*)	524	662	208	215	458	515	50	50	50	50
Consumption	5,760	5,610	5,995	6,125	6,166	6,709	7,065	7,406	7,659	7,472
Fuel Consumption	4,530	4,432	4,677	5,010	5,233	5,181	5,877	6,296	6,582	6,772
Ending Stocks	359	390	418	394	368	470	131	340	205	155
Fuel Ending Stocks	317	356	388	366	341	423	102	318	183	133
Refineries Producing First Generation Fuel Ethanol (Million Liters)										
Number of Refineries	59	55	57	56	52	54	58	52	55	55
Nameplate Capacity	7,949	7,620	7,418	7,278	7,266	7,456	8,047	8,220	8,475	8,260
Capacity Use	59%	63%	64%	69%	69%	66%	63%	64%	62%	65%
Refineries Producing Cellulosic Fuel Ethanol (Million Liters)										
Number of Refineries	1	1	1	2	2	2	3	3	2	2
Nameplate Capacity	50	50	50	10	10	40	100	100	75	75
Capacity Use	80%	80%	80%	50%	50%	50%	50%	50%	53%	53%
Co-product Production (1,000 MT)										
DDGs	3,154	3,258	3,307	3,518	3,440	3,634	3,655	3,908	3,964	4,065
Corn Oil	142	141	144	186	200	190	194	210	211	219
Feedstock Use for Fuel Ethanol (1,000 MT)										
Wheat Kernels	3,368	3,681	3,955	3,125	2,674	3,003	2,552	2,789	3,050	2,942
Corn Kernels	4,890	4,863	4,967	6,410	6,912	6,563	6,700	7,257	7,268	7,567
Triticale	660	794	736	733	814	1,135	1,323	1,612	1,637	1,583
Barley Kernels	426	400	391	485	362	465	519	457	444	548
Rye Kernels	731	672	518	487	229	444	583	370	266	337

Sugar Beets	9,290	8,838	7,768	7,025	7,225	4,790	6,768	4,461	3,132	3,683
Cellulosic Biomass	160	160	160	20	20	80	200	200	160	160
Market Penetration (Million Liters)										
Fuel Ethanol Use	4,530	4,432	4,677	5,010	5,233	5,181	5,877	6,296	6,582	6,772
Gasoline Pool 1/	89,813	90,208	91,145	96,158	98,291	86,029	93,491	99,103	102,868	105,253
Blend Rate	5.0%	4.9%	5.1%	5.2%	5.3%	6.0%	6.3%	6.4%	6.4%	6.4%

Sources/Notes: r = revised / e = estimate / f = forecast of EU FAS Posts. Footnote :1/ Fuel pool defined as gasoline plus all biocomponents (ethanol, ETBE, methanol). Source: IEA, Oil Market Report, June 2024. Production capacity as of December 31 of year stated. Ethanol use: Eurostat statistics and FAS Posts projections. Trade and stocks data: See Notes section. Footnotes: (a) For more information see section Advanced Biofuels. (b) ETBE HS code 29091910, ETBE contains 45 percent ethanol which is the volume reported. (c) From 2021 to 2024, EU bioethanol and ethanol exports are anticipated to be minimal at estimated at respectively 50 million liters and 100 million per year. (d) Calculated co-product production (theoretical maximum) based on estimated feedstock use in fuel ethanol production.



Consumption

Table 7. EU27 Fuel Ethanol Consumption Main Consumers (million liters)								
Calendar Year	**2017[r]**	**2018[r]**	**2019[e]**	**2020[e]**	**2021[e]**	**2022[e]**	**2023[e]**	**2024[f]**
France	963	1,084	1,239	1,087	1,378	1,648	1,750	1,815
Germany	1,465	1,491	1,435	1,378	1,467	1,508	1,580	1,645
Netherlands	253	335	366	430	444	477	495	505

Poland	329	299	372	359	409	456	470	505
Belgium/Luxembourg	208	228	228	215	234	335	335	340
Sweden	172	224	178	187	229	297	315	305
Spain	277	319	257	195	248	224	230	235
Hungary	133	138	189	167	180	184	180	175
Total	4,677	5,010	5,233	5,181	5,877	6,296	6,582	6,772

r = revised / e = estimate / f = forecast EU FAS Posts. Source: EU FAS Posts and Eurostat

With the absence of the United Kingdom, the EU27 (referred further as EU) was a net producer of bioethanol from 2014 to 2018. As from 2019, the EU became a net bioethanol importer as consumption outpaced production (see graph 3).

The Impact of the COVID-19 Outbreak and Recovery

According to the International Energy Agency (IEA), the EU gasoline pool (including additives, most importantly ethanol) declined 12.5 percent in 2020, then recovered exceeding pre-pandemic 2019 demand by 2022. COVID-19 lockdowns and reduced light-duty vehicle activity in 2020 and 2021 had a limited effect on EU bioethanol use due to a concurrent increase in average EU-wide ethanol blending supported by measures in select EU Member States to advance mid and high ethanol blending (E10 and E85). With the gradual lifting of the COVID-19-related lockdowns in 2021, EU bioethanol consumption picked up with increased gasoline consumption growth buoyed by rising gasoline consumption. For more information about the impact of the COVID-19 outbreak and recovery see the previous EU Biofuels Annual, published August 14, 2023.

The Effect of Russia's War in Ukraine in 2022

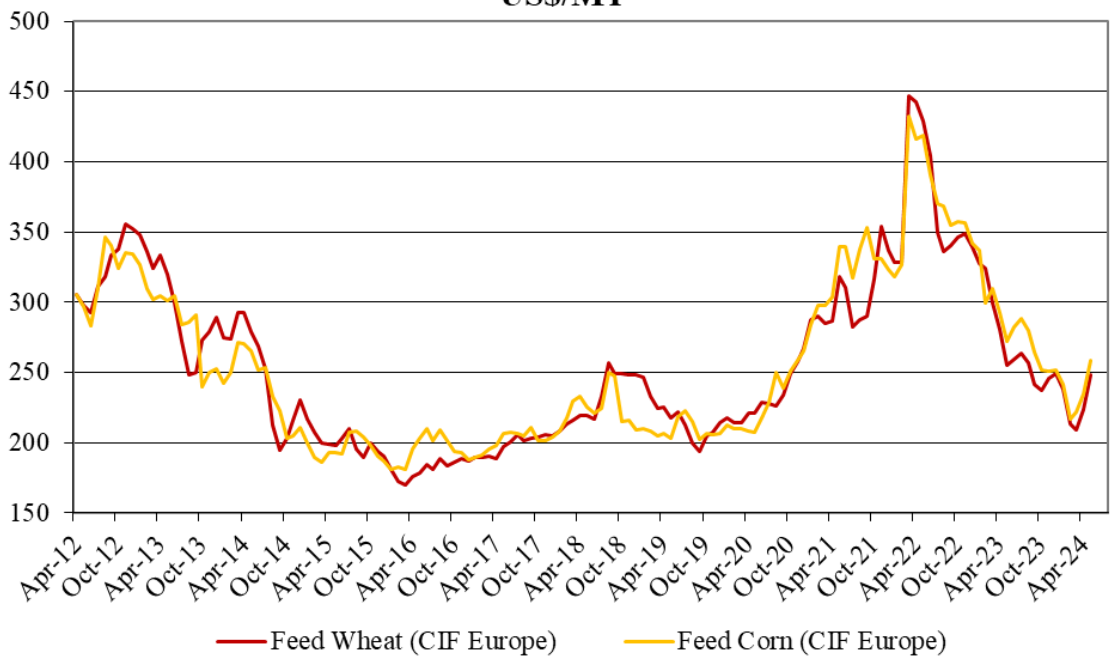
During the first quarter of 2022, when Russia invaded Ukraine, fossil fuel and feedstock prices as well as associated biofuel prices continued to surge (see graphs 4 and 5). Cereal and ethanol prices fell during the spring of 2022, while crude oil and gasoline prices peaked during the summer of 2022. This created a competitive advantage for bioethanol in mid-2022 by boosting demand. As a result, EU bioethanol consumption increased by 7.1 percent to nearly 6.30 billion liters in 2022. This expanding bioethanol use was also driven by the introduction and/or higher sales of high blends such as E10 and E85. Most of the market expansion was reported in the France (expansion E10 and E85) and Germany (E10). In 2022, France surpassed Germany as the largest bioethanol market in the EU.

The Past and Current Year

Based on the further market introductions or continued expansion of E10 in many countries, rising availability of E85 in France, and an overall increase in the gasoline fuel pool across the EU, FAS EU posts estimate an overall EU increase in bioethanol use of 4.5 percent in 2023 and 2.9 percent in 2024. Increased sales of the higher blends in France are the main driver for total EU bioethanol consumption.

Graph 4. Feedstock Prices

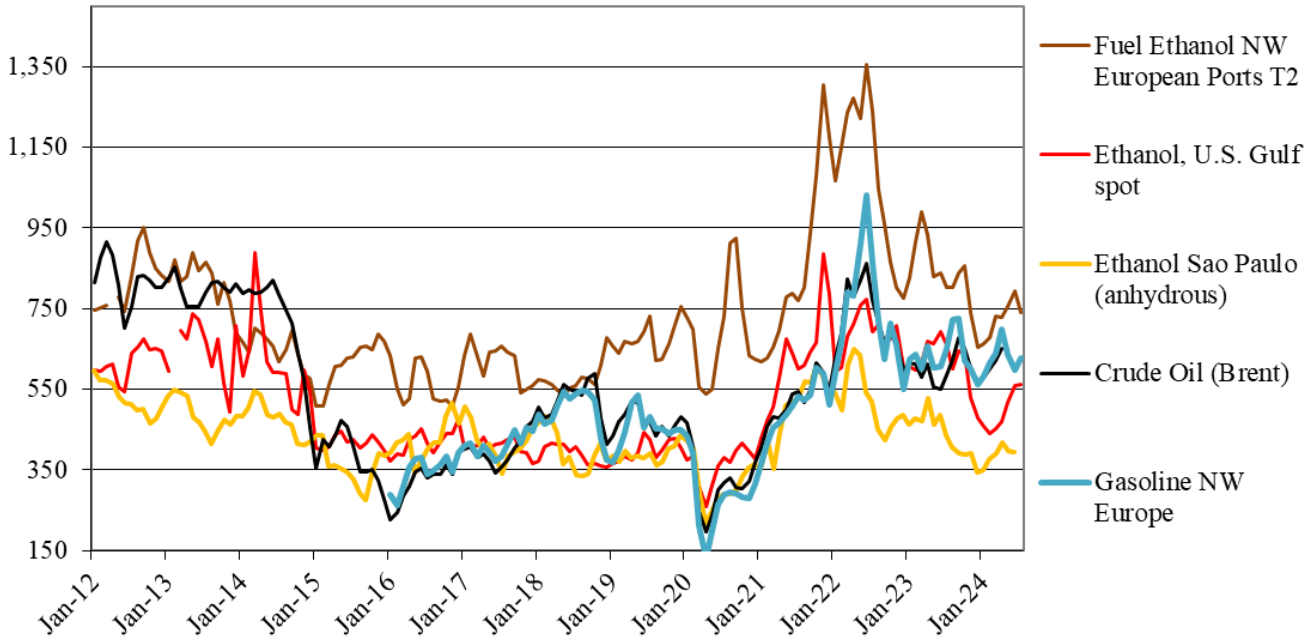
US$/MT



Based on statistics of Dutch Agricultural Research Institute

Graph 5. Product Prices

Ethanol, Crude Oil & Gasoline US$/M³



Statistics of Licht (crude oil, gasoline and ethanol T2 and U.S. Gulf) and CEPEA (ethanol Brazil)

Currently, E10 is available in the following fifteen EU Member States: Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Romania, Slovakia, and Sweden (source ePURE). EU Member States which have not introduced E10 are mainly located in the Mediterranean region (Spain, Portugal, Italy, Croatia, and Greece). For more information about the introduction of high bioethanol blends and blending mandates the FAS GAIN report: Biofuel Mandates in the EU by Member State – 2024, published June 27, 2024.

In France, consumption of E85 is supported by an increase in the number of flex-fuel cars. Superethanol-E85 is a fuel composed of 65 to 85 percent of bioethanol. The absence of taxes makes E85 about half the price of E10. In 2023, French sales of E10 increased by 9 percent to about 8 billion liters, while sales of E85 increased by 5 percent to about 900 million liters. The sales of E85 are forecast to further increase during 2024 given its continued competitive pricing. Reportedly the abolishment of the warranty on flex-fuel cars have been lifted, and the number of gasoline stations has risen markedly. Since 2019, France is a net consumer of bioethanol and the need for imports are forecast to continue rising.

Other countries where significant growth of bioethanol use is anticipated during 2023 – 2024 are Germany, Poland, Ireland, Austria, Spain, Belgium, and the Netherlands. Currently, Germany has the largest deficit of all. Germany's introduction of E10 in 2010 was met with skepticism due to reports it could harm the engines. But the increasing price difference between E5 and E10 and recent post-pandemic high price inflation is shifting consumer choice to the higher blend. In 2023, the share of E10 increased to 26 percent (from 24 in 2022). For 2024, bioethanol consumption in transport is expected to increase only marginally despite some growth in the gasoline fuel pool. The increase in the GHG reduction mandate from 8 to 9.4 percent is leading to a higher share of electric vehicles.

The increased use of bioethanol in Poland, Ireland, and Austria is driven by the recent introduction of E10. In Poland, ethanol was introduced on January 1, 2024, but Polish bioethanol consumption was already on the rise before the introduction of E10. Factors causing this expansion were revived tourism and increased Polish – Ukrainian traffic. Austria and Ireland introduced E10 in April 2023. Irish legislation requires that where bioethanol is blended with gasoline, a minimum of 5.5 percent blend (by volume) is mandatory. The increased use of bioethanol in Spain, Belgium, and the Netherlands is mainly a result of the growth of the gasoline pool.

In 2024, bioethanol consumption is forecast to decline in Sweden, Finland, and Hungary. In Sweden, the blending mandate for ethanol was reduced beginning 2024 (from 7.8 percent in 2023 to 6 percent during 2024–2026), which will likely lower the use of bioethanol, somewhat tempered by the higher anticipated gasoline consumption. The new government of Finland lowered the blending mandate from 30 percent to 19.5 percent in 2030. Sweden and Finland are both net consumers of bioethanol, and with the change of mandates, Swedish and Finnish imports are likely to fall in 2024. In Hungary, the gasoline consumption was supported by a fuel price cap until December 2022. But due to the phasing out of the price control, Hungarian bioethanol consumption fell in 2023 and is anticipated to further drop in 2024 as the fuel pool shrinks. Based on the market factors and trends described above, total EU bioethanol consumption is projected to increase by more than thirty percent during 2020 - 2024.

Production and Capacity

Table 8. EU27 Fuel Ethanol Production Main Producers (million liters)								
Calendar Year	**2017[r]**	**2018[r]**	**2019[e]**	**2020[e]**	**2021[e]**	**2022[e]**	**2023[e]**	**2024[f]**
France	1,000	1,138	1,103	975	962	1,111	1,040	1,140
Germany	810	799	676	700	738	759	725	760
Hungary	633	646	734	666	730	700	685	690
Belgium	620	646	620	620	633	700	825	825
Spain	377	522	547	501	553	497	545	545
Netherlands	519	519	519	481	519	506	505	505
Poland	258	259	286	276	338	404	430	440
Austria	235	251	254	222	246	246	250	250
Total	4,806	5,015	5,000	4,947	5,128	5,300	5,253	5,380

r = revised / e = estimate / f = forecast EU FAS Posts. Source: EU FAS Posts and Eurostat

In 2021 and 2022, EU bioethanol production recovered from the demand dip during the COVID-19 pandemic, with the most significant increase reported for the Belgian and French production. However, based on falling beet supplies, French bioethanol production fell significantly in 2023 (for more information see the section of Feedstock Use and Production of Co-products). Due to this cut in French production combined with cuts in German, Hungarian, and Swedish production, total EU bioethanol production fell 0.9 percent to 5.25 billion liters in 2023. In Germany, lower production volumes were reportedly caused by maintenance shutdowns and reduced ethanol sales prices. Although in Hungary ethanol plants increased their producing capacities, producers were more focused on starch and non-fuel ethanol products. Lower Swedish bioethanol production was mainly caused by the lower availability of cereals in the Nordic region during the 2023/2024 marketing season.

In 2023, production increases were reported for Spain, Poland, and Bulgaria. In Spain, the reduction in prices of energy (for processing) and grains, combined with the increased size of the domestic gasoline pool led to recovery in 2023 but no change is expected in 2024. Also, Polish production increased in 2023 driven by further fuel demand increase and high availability of corn in Central Europe. Polish production is forecast to further increase this year. In Bulgaria, the local ethanol production capacity has expanded considerably due to opening of a new plant with an annual capacity of 60 million liters. The plant has the technical ability to produce conventional and advanced bioethanol (for more information see the Chapter Advanced Biofuels of this report). In Romania, an opposite trend is reported with falling production due to plant closures. Overall, EU bioethanol production is projected to increase by 2.4 percent to 5.38 million liters.

Feedstock Use and Production of Co-products

In the EU, nearly all bioethanol is produced from grains and sugar beet derivatives. Wheat is predominantly used in Germany and France. An abundance of corn in Central Europe, particularly in Hungary and Poland, supports corn-based ethanol production in that region. Corn is also the preferred grain in the Netherlands, Spain, and recently Belgium, where most ethanol plants are located at seaports, and corn is sourced from third countries. Due to the widespread use of genetically engineered (GE) corn

varieties in Argentina and the United States, these sources are not preferred, and corn is mainly imported from the Ukraine and Brazil. There is an incentive to use non-genetically engineered (non-GE) corn as ethanol producers in northwestern Europe prefer to market their distillers dried grains (DDG) as non-GE for the domestic feed market.

In 2024, the use of corn is projected to increase at the expense of wheat. Producers achieve reportedly higher profit margins with corn versus wheat as feedstock. An increased use of corn is mainly forecast in Poland and Belgium. In Poland, the availability of Ukrainian corn was reportedly one of the factors which influenced the decision of introducing E10, which is assessed by the industry to increase bioethanol production and, and consequently, increase the annual need of 500,000 MT of corn as feedstock. The main producer in Belgium, almost doubled its production capacity (to about 285 million liters) and switched to producing fuel from corn instead of wheat.

In France, Germany, the Czech Republic, Belgium, and Austria, sugar beets and their derivatives are also used to produce bioethanol. In France, sugar beets are only processed for bioethanol in sugar beet processing plants that have on-site ethanol distillation capacity. In some other EU Member States, like Austria and Belgium, beet pulp or concentrated juice may serve as a feedstock for ethanol production. Overall, the use of sugar beets for bioethanol was sharply lower in 2023. This was due in part to the ban on neonicotinoids, used to combat aphid attacks that damage yields, which negatively affected beet production in 2023. The other factor was high sugar prices, which shifted use away from bioethanol. Finally, the use of grains, in particular Ukrainian wheat, as feedstock for bioethanol production rose compensating for reduced sugar beet availability. In 2024, the use of sugar beets as feedstock to produce bioethanol is forecast to rebound based on an anticipated higher EU beet supply. For more information see the FAS GAIN EU Grain and Feed Annual, published on April 17, 2024, the FAS EU GAIN Sugar Annual, published April 17, 2024, and the latest World Agricultural Supply and Demand Estimates (WASDE) reporting.

In the EU, to reach the estimated 2024 production of 5.38 billion liters of bioethanol, the required cereals volume that will be needed is estimated at 12.9 MMT, an increase of about 233,000 MT compared to 2023. This is roughly 4.7 percent of total EU cereal production. Co-products from the bioethanol production process are DDG, wheat gluten, and yeast concentrates. In 2024, the maximum theoretical production level (calculated, using the conversion factors listed at the end of this report) of co-products is forecast to reach 4.0 MMT, an increase of roughly 73,000 MT from 2023. This accounts for 2.5 percent of total EU feed grain consumption. The volume of sugar beets to produce bioethanol is estimated at 3.1 MMT in 2023, and 3.7 MMT in 2024. This is roughly 3.3 percent of total EU sugar beet production.

Trade

U.S. bioethanol exports to the EU are subject to the Most Favored Nation (MFN) import tariff and the sustainability requirements when fuel ethanol is shipped. For more information see the Policy and Programs Chapter of this report and the EU Biofuels Annual of 2020.

In November 2020, the EU started a surveillance program for fuel ethanol after complaints by the industry that arrivals had been rising disproportionately. According to the EC trade data, EU bioethanol imports totaled 550 million liters during the last ten months of 2020 and totaled 478 million liters in

2021. In February 2022, the EC stopped reporting the bioethanol imports under the HS 2207 code but restarted the reporting as from September 2023.

Since 2022, EU bioethanol imports surged and have remained at relatively high levels up to the publication of this report. During 2022 and 2023, the United States and Brazil were respectively the first and second supplier. Based on the methodology described in Chapter VIII – Notes on Statistical Data, 2023 EU bioethanol imports are estimated at 1.24 billion liters. In 2023, the EU imported roughly 115 million liters of bioethanol as ethyl-tert-butylether (ETBE), a significant increase compared with the 18 million liters in 2021 and 81 million liters in 2022. Note that any "light (petroleum) oils" found under HS code 2710.12 (gasoline) that may contain ethanol are not included in the balance or trade estimates, but preblended gasoline volumes arriving in Europe are deemed to be small (thus not appreciably affecting the balance).

During the first four months of 2024, EU ethanol (total imports of both undenatured and denatured ethanol) were 21 percent lower than reported during the first four months of 2023. This import decline is mainly due to lower imports from Brazil. During the remainder of 2024, EU ethanol imports from Brazil are forecast to remain at a lower level based on a strong domestic demand for bioethanol in Brazil. In 2024, EU imports from North America are forecast to increase due to limited exportable supplies from other sources. FAS Posts projects EU bioethanol imports to increase to 1.39 billion liters in 2024. This forecast is based on a further expansion of bioethanol consumption and domestic production, despite a record, is not keeping up with this trend.

IV. Biobased Diesel

Bio-based diesel (BBD) includes biodiesel (fatty acid methyl esters, aka FAME) and renewable diesel. Renewable diesel, a full drop-in fuel replacement for fossil diesel, can be produced thru various feedstock-technology platform pathways, but the renewable diesel commercialized at scale today is hydrogenation-derived renewable diesel (aka HDRD). HVO (hydrotreated vegetable oil) is an older yet still frequently used term for HDRD. HDRD plants are typically designed to also produce sustainable aviation fuel (SAF). Due to the lack of readily available and accurate supply/demand data on SAF, this report includes SAF (volumes remain very small) in HDRD statistics and therefore BBD statistics as well.

The EU is the world's largest BBD market for both production and consumption. However, its lead has now narrowed to the smallest of margins as the U.S. market has nearly closed the gap with the recent surge in U.S. production and consumption of HDRD. While the EU was an early adopter of HDRD, U.S. HDRD production now exceeds that of the EU by more than double. Finland's *Neste* pioneered the modern commercialization of this drop-in, fully replaceable alternative to fossil diesel, and opened its first plants in 2007 and 2009. FAME plus HDRD represent, on a volume basis, roughly three-quarters of the total transport biofuels market. FAME was the first biofuel developed and used in the EU, introduced at commercial scale to the transportation sector in the 1990s. At the time, the rapid expansion was driven by increasing crude oil prices, the *Blair House Agreement (aimed at reducing agricultural protectionism),* resulting provisions on the production of oilseeds under Common Agricultural Policy (CAP) set-aside programs, and generous tax incentives, mainly in Germany and France. Transposed into

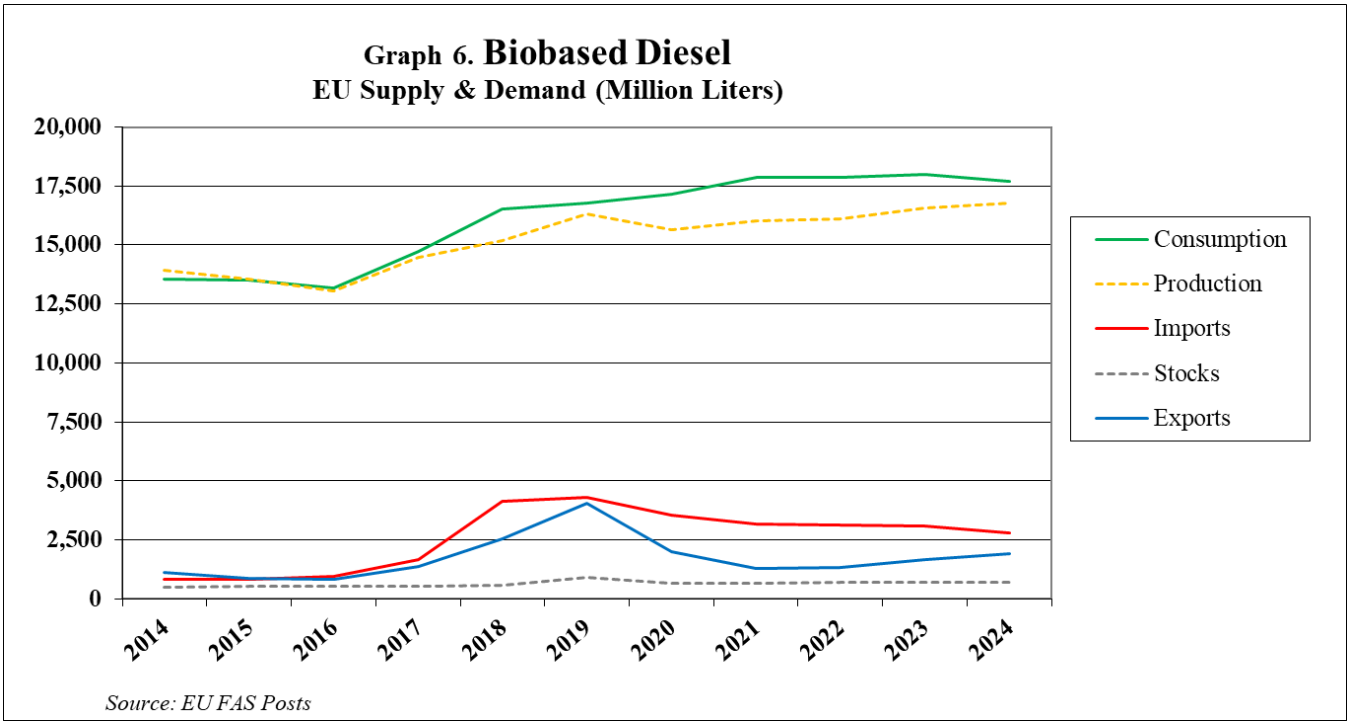
Member State use and carbon reduction mandates, biofuel goals for the transportation sector set out in EU-wide legislation (RED and REDII) further pushed the use of FAME and later the commercialization of HDRD.

EU Production, Supply and Demand Table

Table 9. Biodiesel (FAME) & Renewable Diesel (HDRD) & SAF (Million Liters)										
Calendar Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023[e]**	**2024[f]**
Begin. Stocks (excludes SAF)	550	540	530	590	900	670	680	715	715	720
Production	13,555	13,058	14,464	15,200	16,325	15,629	16,023	16,110	16,580	16,790
>HDRD+SAF	2,310	2,029	2,421	2,702	2,842	3,629	4,121	3,494	3,885	4,190
Biodiesel Imports	817	958	1,669	4,148	4,286	3,539	3,175	3,120	3,078	2,800
Biodiesel Exports	863	841	1,364	2,530	4,061	2,003	1,297	1,350	1,673	1,900
Consumption	13,519	13,185	14,709	16,508	16,780	17,155	17,866	17,880	17,980	17,700
Ending Stocks (excludes SAF)	540	530	590	900	670	680	715	715	720	710
Production Capacity, Biodiesel (Million Liters)										
No Biorefineries	194	187	180	179	173	174	171	162	162	162
Capacity	21,185	20,733	20,109	20,442	19,827	19,781	19,977	20,086	20,169	20,100
Capacity Use	53.1%	53.2%	59.9%	61.1%	68.0%	60.7%	59.6%	62.8%	62.9%	62.7%
Production Capacity, Renewable Diesel (HDRD) +SAF (Million Liters)										
No Biorefineries	11	11	13	14	15	15	16	17	17	17
Capacity	3,395	3,395	3,600	3,600	5,326	5,454	6,049	6,178	6,200	7,568
Capacity Use	68.0%	59.8%	67.3%	75.1%	53.4%	66.5%	68.1%	56.6%	62.7%	55.4%
Feedstock Use for Biodiesel + Renewable Diesel (HDRD) + SAF (1,000 MT)										
Rapeseed oil	6,300	5,850	6,300	6,100	5,950	5,800	6,075	6,200	6,375	6,400
UCO	1,950	2,200	2,600	2,700	3,360	3,500	4,000	3,740	3,530	3,680
Animal fats	1,200	1,000	860	1,000	1,190	1,250	1,300	1,045	1,000	1,020
Soybean oil	500	550	700	1,200	1,070	900	780	950	1,090	900
Sunflower oil	210	250	230	250	270	240	225	300	260	270
Palm oil	2,000	2,020	2,300	2,250	2,600	1,500	890	380	240	100
Other	415	304	279	507	603	1,412	1,711	2,363	2,525	2,726
Biodiesel + Renewable Diesel (HDRD) + SAF Use Compared to Fuel Pool Demand 1/ (Million Liters)										
Biodiesel + HDRD, On-road	12,779	12,531	13,457	15,045	15,596	15,811	16,208	16,046	16,000	15,650
Biodiesel + HDRD+SAF, Total	13,519	13,185	14,709	16,508	16,780	17,155	17,866	17,880	17,980	17,700
Diesel Pool, On/Off-road /2	219,808	224,738	241,920	244,676	245,680	219,016	232,749	234,509	227,914	219,213

Diesel Pool, Total 3/	301,632	305,558	310,932	309,419	311,480	288,351	299,503	300,834	288,907	279,192
Jet Fuels/Other Kerosene 4/	51,434	53,845	57,384	60,189	61,357	28,407	34,277	51,966	58,147	59,110

Sources/Notes: r = revised / e = estimate / f = forecast EU FAS Posts. 1/ Fuel pools are defined as fossil fuels plus all "bio-components" (biofuels). 2/ All on/off-road transport incl. construction & agriculture; excludes rail, heavy marine diesels 3/ Covers all on/off-road uses as defined above plus rail & heavy marine diesels and stationary power. 4/ Covers all private-commercial-military kerosene-type jet fuels (both fossil and bio-based) + other kerosene fuel applications. Sources: see chapter VII. Production capacity as of December 31 of year stated. HDRD and SAF trade cannot be accurately tracked under existing trade codes and is therefore excluded from this table. The feedstock category “other” includes pine oil, tall oil, tall oil pitch, palm fatty acid distillates (PFAD), palm oil mill effluents (POME), empty palm fruit bunches, free fatty acids, and sewage sludge. Beginning/ending stocks: In the absence of reliable data and except for and 2018, data assumes that average stocks equal two weeks of consumption.



Consumption

BBD consumption[1] is driven almost exclusively by Member State blending and GHG reduction mandates and, to a lesser extent, by tax incentives. In 2020, a six percent GHG reduction mandate became applicable for all fuel suppliers in the EU (see Policy and Programs chapter). This favors the use of FAME with high GHG reduction values and HDRD, and especially the latter in countries already

[1] For some Member States (e.g. Bulgaria, Germany, Romania) the consumption number given in this report refers strictly to on-road transport while for other countries (e.g. Austria, Belgium, Italy) it includes on/off-road transport (including rail/agriculture/aviation.)

close to the seven percent volumetric blending limit for FAME (stipulated in the FQD[2]). This and the practice of double counting select biofuels that meet certain criteria limits the effect of increasing mandates on physical blending volumes as less biofuel is needed to fulfill the mandate. As a result, actual physical blend rate gains have slowed even as GHG emission savings continue to rise at a faster rate. Thus, physical blending remains quite a bit lower than the nominal mandates recorded as records of achievement toward EU and Member State renewable energy goals and blend/GHG reduction goals.

Mandates were raised from 2023 to 2024 in Austria, Finland, Germany, Ireland, Italy, Lithuania, the Netherlands, Poland, Portugal, Slovakia, Slovenia, and Spain, while Sweden lowered its mandates substantially. In all other countries the mandates remain the same as in 2023. In 2022 and 2023, the EU granted Member States some flexibility to temporarily reduce or lift mandates in response to the economic impacts from Russia's invasion of Ukraine. The following countries made use of this option: Croatia, Czech Republic, Finland, Latvia, Poland, and Sweden. For more information about national mandates see our FAS GAIN report: Biofuel Mandates in the EU by Member State - 2024_Berlin_European Union_E42024-0016 , published June 27, 2024.

In 2024, EU BBD consumption is expected to decrease by 1.6 percent to 17.7 billion liters. This is mainly a result of the drastically reduced mandate in Sweden. Sweden lowered its GHG reduction mandate for diesel from 30.5 percent in 2023 to 6.0 percent in 2024. This is expected to cut Sweden's BBD consumption in half. Additional minor reductions in consumption are forecast for Greece, Romania, and Denmark. The largest increase in consumption is forecast for Germany as a result of a higher GHG reduction mandate and the approval of B10 and HDRD100 in May 2024. Positive effects from increased mandates are also forecast for consumption in Ireland, the Netherlands, Italy, Bulgaria, and Hungary (in decreasing order of magnitude). However, double counting of certain feedstocks and a higher share of other fulfillment options[3] limit the increase that higher mandates could otherwise generate and the combined projected increase in these countries (roughly 500 million liters) is not enough to compensate for the huge decline in Sweden.

In 2023, EU BBD consumption is estimated to have increased by 0.6 percent. Positive effects from increased mandates were largely countered by: 1) a drop in on/off road diesel demand (and concurrent drop in renewables use in diesel pool) due to high fuel prices resulting from global and regional supply/demand imbalance and Russia's war against Ukraine; and 2) a high share of BBD eligible for double counting which reduced the physical volume needed to fulfill the mandates. The top six consumers of BBD in the EU in 2023 were France, Germany, Spain, Sweden, Italy, and Poland. Together they accounted for 69 percent of the total EU BBD consumption (see table below).

Table 10. EU BBD[1] Consumption
Main Consumers (million Liters)

Calendar Year	2017	2018	2019 [r]	2020 [r]	2021[r]	2022[r]	2023[e]	2024[f]
Germany	2,522	2,669	2,621	3,583	2,974	2,952	3,045	3,185
France	3,276	3,542	3,553	2,997	3,142	3,169	3,181	3,180
Spain	1,546	1,979	2,045	1,810	1,774	1,676	1,640	1,640

[2] Annex II of the FQD limits the volumetric FAME content in diesel fuel to seven percent. Higher percentages are possible but only if the resulting fuel is labelled accordingly.
[3] Examples of other fulfilment option include: electric vehicles, e-fuels, upstream emission reduction projects

Italy	1,388	1,322	1,257	1,366	1,450	1,436	1,542	1,590
Poland	551	951	1,025	1,076	1,076	1,200	1,247	1,250
Sweden	1,922	2,342	1,744	1,596	1,691	1,770	1,680	870
Belgium	487	625	625	454	650	650	650	650
Finland	385	354	424	381	692	532	513	510
Romania	278	254	386	384	453	521	506	500
Austria	572	529	578	444	498	472	475	475
The Netherlands	261	426	526	375	456	375	377	440
Portugal	358	387	379	350	499	401	436	435
Ireland	166	170	206	201	194	266	295	385
Czechia	345	315	272	394	401	377	370	370
Hungary	151	181	199	248	251	272	245	250
Others	500	462	941	1,496	1,664	1,810	1,779	1,970
Total	**14,709**	**16,508**	**16,780**	**17,155**	**17,866**	**17,880**	**17,980**	**17,700**

1) Contains small amounts of SAF in most recent years. r = revised / e = estimate / f = forecast EU FAS Posts. Source: FAS EU Posts based on information collected in MT using a conversion rate of 1 MT equals 1,136 liters.

Production and Production Capacity

BBD production is forecast to increase by 1.3 percent to 16.8 billion liters in 2024, largely driven by strong demand from export markets such as the United States and United Kingdom. However, this masks different developments for FAME and HDRD. HDRD production is expected to grow by 7.9 percent powered by increases in Sweden and Italy, as capacity increases in both countries. The *OMV* modified plant in Schwechat, Austria, started production in June 2024, albeit not yet at commercial scale. In contrast, EU-wide FAME production is forecast to marginally decline by 0.8 percent.

Preliminary data for 2023 suggests that EU BBD production increased by 2.9 percent compared to 2022. High exports of FAME to the United States (1.28 billion liters) enabled EU companies to increase their production despite strong competition from competitively priced imports particularly from China. Imports from China put a high pressure on the EU production as they came with certificates for advanced biofuels (annex IX-A feedstock). Incentivized by double counting toward GHG reduction targets in Germany, these imports had especially large impact in the German market where they satisfied a large portion of the GHG reduction requirement for all biofuels. As a result, GHG reduction ticket prices in Germany dropped from € 445 (USD 476) in mid-January 2023 to € 234 (USD 256) in mid-April and margins for EU domestically produced BBD dropped substantially. EU biodiesel producers have consequently voiced concerns about potential fraud and mislabeled certificates.

Table 11. EU FAME Production
Main Producers (Million Liters)

Calendar Year	2017	2018	2019[r]	2020[r]	2021[r]	2022[r]	2023[e]	2024[f]
Germany	3,644	3,799	4,070	3,875	3,837	3,790	4,226	4,200
Spain	1,721	2,008	1,853	1,698	1,429	1,529	1,320	1,300

France	2,211	2,512	2,353	1,851	1,203	1,074	1,136	1,136
Netherlands	1,112	1,010	1,136	1,136	1,136	1,136	1,136	1,136
Poland	1,019	1,001	1,091	1,081	1,138	1,110	1,102	1,110
Belgium	511	511	568	568	568	568	568	600
Italy	353	508	616	618	560	551	568	570
Austria	335	326	340	333	335	361	364	365
Portugal	404	413	448	381	363	401	372	350
Czechia	178	220	282	294	278	275	296	300
Others	554	191	728	165	1,054	1,821	1,608	1,533
Total	**12,043**	**12,498**	**13,483**	**12,000**	**11,902**	**12,615**	**12,695**	**12,600**

Ranked by production in 2024, r = revised / e = estimate / f = forecast.
Source: FAS EU Posts based on information in MT using a conversion rate of 1 MT equals 1,136 liters.

Table 12. EU HDRD[1] Production
(Million Liters)

Calendar Year	2017	2018	2019	2020	2021[r]	2022[r]	2023[e]	2024[f]
Netherlands	1,218	1,218	1,156	1,203	1,247	1,099	1,154	1,150
Italy	323	323	328	797	750	562	827	890
France	-	128	150	476	641	641	641	640
Finland	383	354	424	381	753	610	641	600
Sweden	-	160	208	208	312	278	295	580
Spain	465	482	545	535	409	299	300	300
Portugal	32	37	30	30	10	5	27	30
Total	**2,421**	**2,702**	**2,842**	**3,629**	**4,121**	**3,494**	**3,885**	**4,190**

1) Contains small amounts of SAF in more recent years. Ranked by production in 2024; e = estimate / f = forecast. Source: FAS EU Posts based on information in MT, converted to liters using a conversion rate of 1 MT equals 1,282 liters.

Production Capacity

The structure of the EU biodiesel sector is quite diverse. Plant sizes range from an annual capacity of 2.3 million liters owned by a group of farmers to 680 million liters owned by a large multi-national company. FAME production facilities exist in every EU Member State, except for Finland, Luxembourg, Croatia, and Malta. In contrast, HDRD production occurs in only seven countries (see table above), plant size is uniformly larger scale, and the plants are owned and operated by oil majors.

The majority of HDRD capacity consists of dedicated HDRD plants some of which have been expanded over time to include SAF production. The main producers are Finland's *Neste* (most production is located in the Netherlands) and *UPM*, *Eni* of Italy, *Total Energies* of France, and *Preem* of Sweden. Additionally, co-processing of HDRD with conventional fuel at their oil refineries occurs in Spain (11 plants), Portugal (*GALP*), Hungary (*MOL* at its Szazhalombatta refinery), and the Netherlands (*BP*). Production capacity remained flat in 2023 and is projected to increase in 2024 by 22 percent, driven by expansions in Italy and Sweden.

EU FAME production capacity marginally increased by 0.4 percent in 2023 through capacity increases of existing plants in Poland, Bulgaria, Romania, and Hungary. In 2024, small capacity reductions are projected for Belgium and Sweden, resulting in 0.3 percent contraction in EU FAME production capacity.

HDRD and FAME facilities throughout the EU are operating below capacity and some FAME plants are temporarily shut down because of the competition from competitively priced imports, especially from China.

Feedstock Use and Co-products Production

Official data on biodiesel, HDRD, and SAF feedstock use is not available in most Member States. The figures and analysis presented below are based on FAS EU Post estimates. In recent years, EU biofuel producers have substantially diversified their feedstocks away from crop-based vegetable oils towards waste oils and fats. The two main factors behind this are 1) the eligibility of some waste materials for double counting in some Member States, and 2) more recently the phase out of palm oil which will be completed by 2030. As a result, over the course of the ten years covered by this report the share of virgin vegetable oils (rapeseed oil, soybean oil, palm oil, and sunflower oil) in the feedstock mix has decreased from 72 percent in 2015 to 52 percent in 2023 and is forecast to drop to 50 percent in 2024. For details on the vegetable oil market, please see the latest FAS GAIN report - Oilseeds and Products Annual, published April 8, 2024.

Rapeseed oil is still the dominant biodiesel feedstock, accounting for 41 percent of total BBD feedstock use in 2023. The year-over increase in volume and can be attributed to the higher availability due to the higher EU rapeseed harvest in 2022. For 2024, rapeseed oil use is forecast to increase by 1.6 percent as the phase-out of palm oil progresses. The popularity of rapeseed oil is grounded in its domestic availability, as well as in the higher winter stability of the resulting rapeseed methyl ester (RME) compared to biodiesel made from other feedstocks. This is more important in the northern Member States than for those situated in Mediterranean region with warmer winters. However, rapeseed oil's share in the feedstock mix has substantially decreased since its peak in 2008, when it accounted for 72 percent. This is partly due to the double counting advantage of various waste-stream feedstocks.

Used Cooking Oil (UCO) was the second most important feedstock in 2023, accounting for 24 percent of the total feedstock. This is reduction of one percent both in share and volume compared to 2022. The decrease is partially a result of Spain and Portugal partially replacing UCO with Palm Oil Mill Effluent (POME) and brown grease. Additionally, the increased import of competitively priced finished UCO-Methyl Ester (UCOME) left less space for domestic production of the biodiesel type. Widespread concerns about product mislabeling and fraud with product certified as UCOME coming from China has led to investigations, albeit so far without conclusive results. However, the launch of the EU Union Database for Biofuels (UDB) in January 2024, resulted in a reduction of UCOME imports from China in the first four months of 2024, while imports of UCO increased. Assuming this trend continues, it leads to a partial rebound of UCO in 2024 as illustrated in table 13.

EU UCO imports decreased by 27 percent in 2023. This was a direct result of the high UCOME imports and possibly diversion of UCO to the United States. Industry sources report that at some point during

2023, it was cheaper to import the finished UCOME product than the UCO feedstock. China was still the number one supplier, but its market share decreased from 47 percent to 24 percent of EU UCO imports and imported volumes almost halved compared to 2022. The other major supplier was Malaysia. And it is unclear if product from Asia was transshipped via United Kingdom as UK shipments were elevated in 2023 and 2022. Together the top seven suppliers accounted for 72 percent of EU UCO imports.

Table 13. Import of Used Cooking Oil (UCO)
(HS Code 1518 0095 in 1000 MT)

	2019	2020	2021	2022	2023	2023 Jan - April	2024 Jan - April
China	481	273	619	935	346	127	134
Malaysia	101	285	201	204	242	87	111
United Kingdom	99	153	150	235	204	69	68
Saudi Arabia	70	65	67	81	85	30	27
Russia	60	99	87	80	84	24	30
Indonesia	52	75	113	74	47	19	9
Thailand	-	-	-	7	45	11	10
Other	417	673	372	363	400	129	146
World Total	**1,280**	**1,625**	**1,609**	**1,980**	**1,451**	**496**	**533**

Source: Trade data Monitor (TDM), LLC

In 2023, the largest EU producers of UCOME, accounting for some 90 percent of EU UCOME production, were Germany, Italy, the Netherlands, Finland, Spain, France, Portugal, and Austria. Smaller amounts of UCOME were produced in Poland, Czechia, Bulgaria, Ireland, Hungary, and Slovakia.

Soybean oil was third in terms of feedstock use in 2023, accounting for eight percent. The 26 percent increase in soybean oil use compared to 2022 was a direct result of higher biodiesel exports to the United States, in response to rising U.S. BBD demand supported by stacked policy support (blenders' credit, RINs, and California's low carbon fuel standard (LCFS) credits). For the EU domestic market, the use of mid-to-high free fatty acid (FFA) content fats and oils like soybean oil, palm oil, and tallow as the sole feedstock in FAME is limited by the EU biodiesel standard DIN EN 14214 due to concerns over performance in colder weather conditions. However, the standard can be met by using a feedstock mix of rapeseed oil and mid-to-high FFA fats and oils. On its own, soybean oil methyl ester (SME) does not comply with the iodine value prescribed by this standard (the iodine value functions as a measure for oxidation stability). Most of the soybean oil is used in Germany, Spain Belgium, and the Netherlands. For 2024, a decrease in soybean oil use is expected as provisions in the U.S. blenders' credit change in 2025 from a blenders' tax credit to a U.S. producer-only credit. As a result, exports of EU BBD to the United States are expected to decrease towards the end of 2024.

The volume of **animal fats** used for BBD production is difficult to assess and post estimates presented here should viewed as an indication rather than reliable data. That said, animal fats are estimated to have accounted for approximately seven percent of total BBD feedstocks in 2023. This ranked them fourth place in the feedstock mix. Animal fats benefit less from double-counting as only Slovenia allows Annex IX-A feedstocks for double counting. Additionally, in Germany, tallow methyl ester (TME) does not count against the biofuel mandate at all, and all TME produced in Germany is exported to other Member States. In 2023, Italy, the Netherlands, and France are estimated to have been the largest user of animal fat for BBD production, together accounting for roughly three-quarter of TME production. Germany, Denmark, Czechia, Spain, Austria, Finland, Ireland, and Hungary also used animal fats but to a much lesser extent. Some tallow is imported to produce TME however exact import volumes used in TME are unknow as there are multiple uses for tallow.

Sunflower oil accounted for only 1.7 percent of the total biodiesel feedstock in 2023 and is mainly used in Greece and Bulgaria - together accounting for 59 percent of EU sunflower oil-based biodiesel production. Smaller amounts of sunflower oil are also used in France, Hungary, Poland, Romania, and Lithuania.

Palm oil use as a BBD feedstock has been in sharp and steady decline since 2020 and its phase out is nearly complete. After years of growth, and an estimated record use of 2.6 MMT was reached in 2019. By 2023, its use had dropped to 240,000 MT and only accounted for 1.5 percent of total feedstock. In 2024, palm oil use is forecast to further decline by 57 percent, contributing less than one percent to the EU feedstock mix. The reason being that more and more countries phase out biofuels deriving from high-risk ILUC crops (see the Policy and Programs chapter of this report). The phase-outs only affect the eligibility for counting against mandates (i.e., consumption) and not production. Therefore, palm oil-based BBD can still be produced in Member States with a ban but will have to be exported either to another market which have yet to ban palm oil use or outside the EU. However, with more Member States applying a phase-out, the remaining market for PME severely contracted. Several countries applied bans earlier than the EU prescribed phase-out fully effective by 2030. France spearheaded this movement having excluded palm oil-based biofuels effectively since January 2020. Austria followed effective July 2021. Germany banned palm oil in January 2023 after having introduced a 0.9 percent cap on high-ILUC feedstocks in 2022.

"**Other**" feedstock listed in the table account for the highest increase in volume used in 2023. This miscellaneous group benefitted from 1) the palm oil phase out as BBD producers looked for alternatives as well as 2) from higher GHG-reduction mandates. Many of the feedstocks included in this category are waste products and qualify for double counting. The category includes pine oil and wood (Sweden); free fatty acids (Germany and Finland); tall oil (Finland); sewage sludge (Belgium/Netherlands); residues from palm oil production including palm oil mill effluent (POME), palm fatty acid distillates (PFAD), and fresh and empty fruit bunches (FFB and EFB respectively) (Spain); and cottonseed oil (Greece).

Origin of Feedstocks and Volume of Generated Byproducts

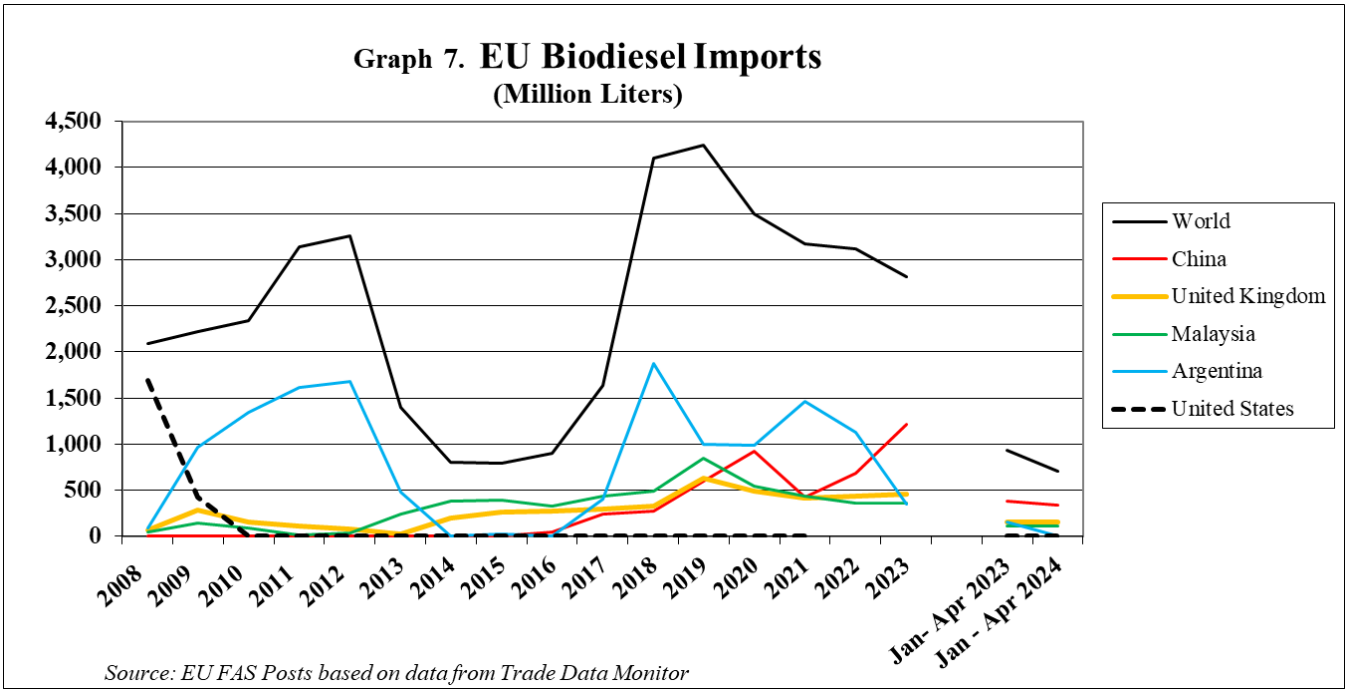
A large share of EU soybean oil is crushed from imported soybeans. In contrast, most of the rapeseed oil is of domestic origin. The 2024 projection of 6.4 MMT of rapeseed oil used in RME is equivalent to about 16 MMT of rapeseed. This also generates roughly 9.6 MMT of rapeseed meal as a byproduct, most of which is used for animal feed. Similarly, 5 MMT of soybeans are crushed to generate the 1

MMT of soybean oil with about 4 MMT soybean meal as a byproduct (see also the latest FAS GAIN report - Oilseeds and Products Annual, published April 8, 2024).

Trade

Trade flows discussed below are limited to biodiesel and petroleum oil containing biodiesel codes CN 38.26.00 and CN 27.10.20 converted to a B100 equivalent and should not include HDRD which should be classified elsewhere because it is chemically different from biodiesel. Currently, EU Customs combines HDRD with other products under a single 10-digit code that falls under CN 2710.19, and countries known to export HDRD to Europe and elsewhere also have no HDRD-specific code yet. Therefor exact EU HDRD trade (import and export-) volumes remain difficult to determine with any useful degree of precision. It is confirmed by the industry that HDRD is traded under CN 27.10.19, but it is not clear which 10-digit code is used. China's HDRD industry, mainly using UCO feedstock apparently, reportedly first shipped product to the EU in 2017 and continues to ship, albeit not consistently. Neste's Singapore's HDRD plant, having targeted mainly California and less so Canada for over ten years is currently completing an expansion of its sustainable aviation fuel (SAF) production capacity, and has reportedly also shipped limited volumes of HDRD to Europe.

In 2023, the dominant suppliers of biodiesel to the EU were China, the United Kingdom, Malaysia, Argentina, and South Korea, accounting for 43, 16, 13, 13, and 4 percent of EU biodiesel imports, respectively. Imports from China increased by 76 percent in 2023 (compared to 2022) at the expense of shipments from Argentina and Indonesia. Chinese biodiesel exports benefit twice, first from a 70 percent VAT rebate that the Chinese government grants if it is produced from waste material and second from double counting provisions in the EU when certified as UCOME. A substantial amount of the imports from the United Kingdom are believed to have consisted of re-exports from Asia benefiting from the United Kingdom inward processing tax exemption that was in place throughout 2023.



In 2024, EU biodiesel imports are forecast to decrease as the launch of the EU's UDB requires operators to supply additional documentation. According to TDM, LLC., between January and April 2024, biodiesel imports from China decreased by 11.2 percent, while imports from Brazil tripled, albeit on a much lower level. Imports from Argentina declined in 2023 as they were unable to compete with the cheap Chinese product. They were zero in the first quarter of 2024, as it was more lucrative for Argentine exporters to export soybean oil rather than biodiesel. Imports from Argentina are expected to pick up again later in the year but to remain below the levels of 2022 and prior years.

In 2023, exports to the United States more than doubled compared to 2022 from 565 million liters to 1.28 billion liters. This provided a significant market for EU BBD production that was otherwise squeezed by cheap imports. These exports were motivated by consumption incentives in the United States (see soybean oil section). They are expected to continue through the fall of 2024 and fall back to previous levels thereafter, as provisions for the blenders' tax credit change in 2025 and it will then only apply to product produced domestically in the United States.

V. Advanced Biofuels

The EU's Renewable Energy Directive (RED), extended under REDII and revised on November 20, 2023, establishes an overall policy for the production and promotion of energy using "advanced" (as defined by the EC) biofuels in the EU. Lower-carbon emission biofuels are replacing higher-carbon emission fossil fuels and biofuels (based on full life-cycle analysis) in the transportation. EU and national Member State policy is structured to limit further expansion of fossil fuels as well as "conventional" biofuels and incentivize expanded use of "advanced" biofuels. Advanced biofuels (defined as food and feed-based biofuels) are less likely to result in land use change because they are made from waste-stream feedstocks or feedstocks that don't require arable land use. Please refer to the Policy and Programs chapter of this report for more information.

Hydrogenation-derived renewable diesel (HDRD, also known originally as hydrogenated vegetable oil (HVO)), is a drop-in fuel that can fully replace fossil diesel, and, with some modification in the production process at the plant, some level of sustainable aviation fuel (SAF) can be substituted for HDRD. All HDRD and SAF are treated as an advanced biofuel in this report but would only be considered "advanced" under EU policy when made with qualifying feedstocks including waste-stream feedstocks.

To date the commercialization of advanced drop-in biofuels has remained limited to HDRD, and cost competitive cellulosic fuels remain an exclusive goal. The race to electrify mobility has already narrowed the role biofuels can play and will continue to account for an increasing share of EU and Member State energy use in transportation in the ongoing transition to renewable energy. Hydrogen and so called eFuels (Electrofuels) made with renewable electricity are longer term decarbonization solutions poised to shrink market opportunity for biofuels further, but larger market impacts are not expected within the coming decade.

Commercial Production

EU production of HDRD began with Neste Oil in Finland in 2007, then a large expansion followed in 2011 as its Rotterdam plant came online. The feedstock for HDRD are lipids (plant oils and animals fats, both virgin and waste stream products) and hydrogen. It is fully substitutable for diesel fuel. Pressured to lower the Carbon Intensity (CI) score of HDRD further, European plants continue efforts to use substitute waste-stream feedstock for virgin vegetable oils and are investing in renewable hydrogen production to replace existing fossil-derived hydrogen. In 2023, HDRD (including a small volume SAF) production increased eleven percent to 3.89 billion liters based on increased production in Italy, the Netherlands, Finland, and Sweden. In 2024, HDRD production is forecast to increase by eight percent to 4.19 billion liters based on anticipated expansion of production in Sweden and Italy (for more information see Chapter IV Biobased Diesel). As a result of projected capacity expansion in Sweden, Finland, Spain, and Italy in 2024 (see Table 14), and in the Netherlands, Spain, and Italy in 2025, production is forecast to further increase in 2025 and 2026. A major but unknown share of the capacity will be used to produce SAF.

The forecast production expansion will cause an increase in the demand of feedstocks, in particular the feedstocks listed in Part A and B of Annex IX of the RED. Food and feed are not permitted in SAF used to comply with targets. In Finland and Sweden, there are plants that refine crude tall and pine oil into intermediate feedstocks for the HDRD/SAF production. The current combined annual capacity of those plants is estimated at 300 million liters. Since 2022, production in the Netherlands has partly switched from used cooking oil (UCO), palm oil, and palm fatty acid distillate (PFAD) to sewer sludge.

The commercialization of cellulosic ethanol has lagged far behind the development of HDRD and is essentially not progressing. The main factors that prevent operators from investing in cellulosic ethanol are high plant construction costs and operational challenges, insufficient regulatory support (financial incentives), and the challenges of delivering large volumes of bulky, low energy content feedstock. The 2023 EU capacity for cellulosic ethanol production is estimated at 125 million liters in 2023. It should be noted that several ethanol plants reprocess byproducts, in many cases from their own process, such as starch sludge, which can be counted as advanced biofuels. Production of advanced ethanol from waste materials listed in Part A of Annex IX of the REDII, such as food waste, is estimated at about ten percent of the total ethanol production (for all uses 2022 estimated by ePURE). The table below outlines the operational or close to operational advanced biofuel plants, at a commercial scale, in the EU.

Table 14. Advanced Biofuels Plants in the EU

Country	**Biofuel**	**Feedstock**	***Annual Capacity* (million liters)**	**Year of opening**
Finland	HDRD	Oils and fats	430 (2 lines)	2007
The Netherlands	Methanol	Biogas	75	2010
Spain	HDRD	Palm oil products and UCO	945 (7 plants)	2011
The Netherlands	HDRD	Oils and fats	1,280	2011
Italy (Venice)	HDRD	UCO, animal fats, and residues from the agri-food industry	513[a] to 770 in 2024	2014

Finland	HDRD	Tall oil	115	2015
Sweden	HDRD	Tall oil	220	2015
Portugal	HDRD	UCO and animal fats	50	2017
Finland	Ethanol	Saw dust	10[b]	2018
Germany	Bio-CNG	Straw	-	2018
France	HDRD	Oils and fats	640	2019
Italy (Gela)	HDRD	UCO, animal fats, and residues from the agri-food industry	962	2019
Sweden	Methanol	Pulp mill side-streams	6	2020
Italy	Ethanol	Biomass	32[c]	2020
Austria	Ethanol	Wood sugar	30	2020
Romania	Ethanol	Wheat Straw	65[d]	2021
Sweden (Preem/Lysekil)	HDRD	Pyrolysis Oil	65[e] to 950 in 2024	2021
Austria	HDRD	Oils and fats	200	2023
Spain (Cartagena)	HDRD	UCO or ag waste	315	2024
Sweden	HDRD	UCO and tall oil	250	2024

Source: EU FAS Posts. a. Capacity will be increased to 770 million liters in 2024 (with a production of about 540 million liters). b. Stopped production in 2023. c. Not for transport use. d. Stopped production in December 2023. e. Capacity will be increased to 950 million liters in 2024.

HDRD, SAF (where applicable), and Pyrolysis Oil

Finland and the Netherlands: In Finland, Neste operates one plant with two lines each producing roughly 200,000 MT of biofuels and intermediate feedstocks per year (of which about 215 million liters of renewable diesel). In 2011, Neste opened a renewable diesel plant with an annual capacity of roughly one billion liters in Rotterdam. In addition to renewable diesel, the Neste plant produces renewable feedstock (naphtha, propane, and alkanes) to produce polymers and other chemicals. Current annual production capacity at the plant in Rotterdam is a maximum of 1.4 MMT. In 2022, roughly 90 percent of the feedstock used by Neste to produce HDRD consisted of waste and residue feedstocks. The waste and residues consist of used cooking oil (UCO), by-products of vegetable oil refining such as palm fatty acid distillate (PFAD), and oils and fats removed from wastewater. Neste is expanding its refinery in Rotterdam increasing capacity to roughly 1.3 MMT of HDRD/SAF. This investment brings the total annual renewable (biofuels and intermediate feedstocks) production capacity in Rotterdam to 2.7 MMT, of which roughly 1.5 billion liters of SAF. The company's target is to start up the new production unit during the first half of 2026. In addition to Neste, also UPM and Shell are planning to build a HDRD/SAF plants in Rotterdam of about 640 million liters and 1 billion liters, respectively. The three prospective plants will partly produce SAF, with plans to be fully operational in 2025 or later. Recently, Shelltemporarily halted the construction of its biofuel plant in Rotterdam.

Finland: In 2015, UPM opened a HDRD plant in Lappeenranta. The capacity of the plant is roughly 115 million liters of advanced biofuels per year, and the plant is using tall oil, a residue of pulp production, as a feedstock. Biocrude oil as feedstock for HDRD production is produced by two refineries in Finland. Green Fuel Nordic Oy partnered with a Dutch company, BTG, to produce 25 million liters of pyrolysis oil at its plant in Lieksa. Fintoil is building a crude tall oil refinery with a capacity of 200,000 MT (as

feedstock for roughly 100 million liters of renewable diesel), which became operational in the fall of 2022.

Spain: Spanish HDRD production is mainly from co-processing by petroleum refineries (crude oil refineries co-fed with biogenic lipids). Both CEPSA (since July 2011) and REPSOL (since 2013) are producing HDRD. During the first quarter of 2024, Repsol started to produce HDRD in Cartagena. The annual production capacity is estimated at about 315 million liters. Repsol is reportedly planning to open other plants in Puertollano (2025), Coruna (2027), and Tarragona (2027). Cepsa is reportedly planning to open a new plant in Huelva in 2026. In March of 2024, Repsol and Bunge announced a partnership agreement to develop new opportunities to meet the growing demand for lower carbon intensity feedstocks in renewable fuel production.

Italy: In 2014, Eni opened a HDRD plant in Venice, Italy. Since then, the plant has produced approximately 325 million liters per year. In 2024, the capacity is forecast to increase from about 510 to 770 million liters per year. Production is forecast to increase to 540 million liters in 2024. Following the model adopted for Venice, Eni converted their petroleum refinery in Gela, Sicily, into a renewable diesel production facility, with an annual capacity of 960 million liters, to produce at least 600 million liters per year. As of October 2022, Eni has stopped importing palm oil for its Gela and Venice refineries ahead of the deadline set by European regulations for 2023. Instead of palm oil, the plant processes waste and residue feedstocks (e.g. used cooking oil, animal fats, and residues from the agri-food industry. Eni plans to increase its total HDRD/SAF global annual capacity to 3 MMT by 2026 and over 5 MMT by 2030. To ensure feedstock supply, Eni reportedly developed a network of agi-hubs in Africa.

Sweden: In Gothenburg, Preem produces nearly 160 million liters of HDRD per year from tall oil. The company recently expanded its production capacity to 220 million liters. Preem sources a variety of raw materials, including raw tall oil diesel from SunPine, and food waste including UCO. The company is reportedly planning to further expand its HDRD/SAF production to five million liters in 2035. To achieve this, a plant of 950 million liters is expected to become operational in 2024 in Lysekil. Recently, Preem announced the second in a series of large-scale projects that expand Preem's total renewable production capacity to approximately 2.5 million liters annually and is planned to be completed in 2027. This can be compared to the current total capacity of about 530 million liters per year. The investment decision involves Preem’s reconstruction of the so-called IsoCracker plant (ICR) at the refinery in Lysekil.

The newly formed Swedish government lowered the greenhouse gas (GHG) reduction target in biofuels beginning January 1, 2024. This policy change will significantly affect the domestic demand for HDRD (for more information see Chapter IV Biobased Diesel).

In April 2024, the Finnish company, St1 and SCA opened a plant to produce up to 250 million liters of HDRD/SAF in Gothenburg (Sweden). The feedstocks will likely be UCO, animal fats, and tall oil fatty acids, the latter from SCA's paper and pulp mills. St1 is also investigating the construction of another plant with a capacity of 500 million liters to begin 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 increased its capacity from about 100 million liters to 150 million liters in 2021. Pyrocell, owned by Preem and Setra, constructed a plant

to produce nearly 30 million liters of biocrude oil from saw dust. In September 2021, production of the non-fossil oil started. The pyrolysis oil is refined into renewable diesel and gasoline at Preem's refinery in Lysekil.

France: Total Energies' HDRD plant located in La Mede (Southern France) began producing HDRD in July 2019. This plant has a maximum capacity of 640 million liters per year. In 2021, production was estimated at 385 million liters. Another project in France is the BioTFuel project, a cooperation of Avril, Axens, CEA, IFPEN, ThyssenKrupp, and Total Energies. This project aims to produce 230 million liters of HDRD/SAF per year from 1 MMT of biomass. The demonstration-scale plant is located at Total Energies' former Flandres petroleum refinery in Dunkerque.

Portugal: Portuguese HDRD production is mainly produced through co-processing of vegetable oils by petroleum refineries. Since 2017, GALP has been producing HDRD in their facilities in Sines. Production capacity is estimated at 35 million liters per year. Galp is considering the installation of a second HDRD unit in Sines which could have an annual production capacity of over 345 million liters. If this project finally materializes, it will be operational in 2025. Since Portugal's production is palm oil based, it faces legislative 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.

Austria: In June 2024, OMV has announced it started its HDRD production. In the final production phase, the plant should have a capacity of about 200 million liters per year.

Czech Republic: Unipetrol RPA produces HDRD at an intermediate commercial scale of roughly 6 million liters per year with the option to scale up to about 12 million liters per year.

Cellulosic Ethanol

Italy: On February 16, 2022, Versalis, Eni's chemical subsidiary, restarted the production of bioethanol from lignocellulosic biomass at Crescentino, the former Beta Renewables plant that shut down in 2017. The plant is capable of processing 200,000 MT of biomass per year, with a maximum production capacity of approximately 32 million liters of bioethanol per year. Currently, the cellulosic ethanol is used as an additional fuel in the biomass thermoelectric power plant.

Finland: The Cellunolix® biorefining concept of St1 processes sawmill side products, such as sawdust and chips from soft wood. The plant in Kajaani has an annual production capacity of 10 million liters and started production in 2017. St1's Etanolix® concept refines waste and residues rich in starch and sugar into advanced ethanol. An Etanolix® plant can be set up as stand-alone plant or it can be integrated at a food processing plant such as a bakery or brewery. There are three Etanolix® biorefineries in production in Finland (in Lahti, Vantaa and Hamina). The annual production capacity varies between 1 to 9 million liters. In October 2023, St1 announced it will end production at the site in Vantaa, Lahti, and Kajaani. Other companies which are reportedly planning to erect advanced bioethanol plants in Finland are Nordfuel and BioEnergo. Nordfuel is planning to build a biorefinery producing annually 80 million liters ethanol from woody materials. The biorefinery is planned to be operational in 2028. BioEnergo is planning to build a similar plant with an annual capacity of approximately 60 million liters.

Austria: The company Austrocel, a cellulose producer, started building an advanced bioethanol plant at the beginning of 2020. The feedstock comes from the remainders of its cellulose production. The plant went into operation by the end of 2020 and delivered its first advanced biofuels shipment of 1.3 million liters in January 2021. The Austrocel plant has a capacity of 30 million liters per year. The Austrian sugar, starch, and ethanol producer Agrana, uses residuals of its own starch production as feedstock. Currently, about 30 percent of the feedstock to produce about 250 million liters of bioethanol is starch sludge.

Romania and Bulgaria: In the fall of 2021, Clariant opened an advanced ethanol plant with a capacity of 65 million liters in Romania. In December 2023, this plant stopped production due to lack of profitability. Wheat straw was the major feedstock. An advanced bioethanol plant with the same feedstock is being considered by OMV Petrom. In Bulgaria, ADM opened an advanced ethanol plant with a capacity of 60 million liters. The plant has the technical ability to produce conventional, advanced, and industrial chemical bioethanol making use of byproducts from starch production. However, the plant is not yet categorized as producing advanced biofuels.

Poland: On March 1, 2022, the Polish oil company, ORLEN Group, announced that they will build an installation to produce advanced bioethanol from non-food products, mainly straw. Its planned annual capacity is 32 million liters. The plant is anticipated to be operational in 2025. The bioethanol plant will be built together with a biomass (mainly lignin as a byproduct of the ethanol production) fueled combined heat and power (CHP) plant. In the next stage of the project, a biogas plant will be built. The biogas facility will process stillage, also a byproduct of bioethanol production.

Biomethanol

Biomethanol can be used as a platform chemical to produce other biochemicals such as lactic acid and formaldehyde. It can also be used as a transport fuel and blended with biofuels, diesel, and gasoline, or used to produce bio-methyl tertiary butyl ether (bio-MTBE) or bio-dimethyl ether (bio-DME). In the Netherlands, the advanced biofuel plant of OCI Methanol Europe produces biomethanol from biogas. The plant produces about 75 million liters of biomethanol annually. In 2020, Södra began production of biomethanol at a pulp mill in southeastern Sweden. The plant has an annual capacity of six million liters which is extracted from pulp mill side-streams. As planned, the first deliveries will be shipped to Denmark and used to produce biodiesel.

Biomethane

A wide range of plants are producing biogas and bio-LNG some of which used in transport across much of Europe. An example is the bio-LNG plant of Renewi in the Netherlands. In Germany, Verbio is producing biomethane from straw at its plant at the Schwedt/Oder site. The plant has capacity to produce approximately 140 GWh of biomethane per year. This is equivalent to 14 million liters of diesel on an energy basis– using approximately 40,000 MT of straw. The biomethane is destined for use in the transport sector as bio-CNG/LNG and will qualify to count against the THG-reduction sub-mandate for advanced biofuels under the national implementation of REDII in Germany.

Sustainable Aviation Fuel (SAF) and Marine Biofuels

In October 2023, the EU adopted Regulation 2023/2405 on sustainable aviation fuels. The Regulation requires aviation fuel suppliers to ensure all aviation fuel made available to aircraft operators at each EU airport contains progressively an increasing minimum share of SAF. Please refer to the Policy and Programs chapter of this report for more information.

In 2021, the EU production of SAF totaled 210 million liters (source: Eurostat), with Finland (205 million liters) and France (5 million liters) as the only producers. Neste planned to increase its worldwide SAF production capacity to 1.5 billion liters in 2024, which includes its capacity at its Rotterdam plant. The Swedish company, Preem, also expressed its intention to begin producing SAF in 2023. In Rotterdam, UPM and Shell are also planning produce SAF at their plants.

Since 2022, Eni has reportedly supplied the Rome Fiumicino Airport with jet fuel blended with renewable raw material components. The jet fuel is produced through a co-feeding process at the refinery in Taranto with 0.5 percent made up of UCO. The Livorno refinery of Eni plans to produce about 12 million liters using bio-components produced in Eni's Gela and Venice bio-refineries. In Venice, a plant to produce Sustainable Aviation Fuel (SAF) is awaiting the necessary permits. The processed bio-components, after distillation, will produce Eni Biojet, a fuel that can be blended with conventional products.

Spain is also anticipated to ramp up SAF production. Cepsa (Huelva) plans to open a HDRD/SAF plant with a capacity of 640 million liters in 2026, and Repsol (Coruna) plans to open a plant with a capacity of 500 million liters in 2027. In September 2023, the Portuguese Galp announced the construction of a new unit for UCO-based SAF production, with an annual capacity of 240 million liters adjacent to the refinery in Sines.

SkyNRG is planning to produce SAF for Schiphol Airport in Delfzijl, a seaport in the Northern part of the Netherlands. With the technical expertise of Shell Aviation, the plant will convert waste fats and oils with a SAF production capacity of nearly 125 million liters. The company reportedly has an offtake agreement to deliver the SAF to KLM for ten years.

Another opportunity for biofuels is the marine fuel market. In September 2023, the EU adopted Regulation (EU) 2023/1805 on the use of renewable and low-carbon fuels in maritime transport (for more information see Chapter Policy and Programs). At this juncture it seems clear the space will become crowded with different renewable fuel solutions for the maritime sector as time passes. HDRD and biodiesel have the advantage that ship engines require no modifications, but these fuels are not cost competitive. According to the European Maritime Safety Agency, biofuels offer medium and long-term marine fuel alternatives that can enter the market relatively quickly. HDRD has the potential to replace conventional fossil maritime fuels without substantial modifications to ship engines and related infrastructure such as storage tanks and fuel pumps. The Dutch biofuel distributor, GoodFuels, has partnered with several ship owners to supply marine biofuels to ships in the Port of Rotterdam and other European ports.

VIII. Notes on Statistical Data

Bioethanol

Production
Historical fuel ethanol production capacity, production and consumption figures are based on statistics of Eurostat and the European Renewable Ethanol Association (ePURE). Production of fuel ethanol: Eurostat statistics cover indigenous "bioethanol" production (ethanol produced from biomass and/or the biodegradable fraction of waste, to be used as biofuel). Missing MS production figures of Eurostat are estimated by FAS Posts.

Consumption
Eurostat statistics of final consumption (energy use by transport sector) of blended "biogasoline," which includes biomethanol and ETBE. Ethyl tert-butyl ether (ETBE) is not included in ethanol production but is included in the consumption and trade figures. ETBE is predominantly consumed in France, Spain, the Netherlands, and Poland. Individual Member State statistics and EU current and out year forecasts are FAS Post estimates. FAS Posts based their estimates on intel from national industry organizations and government sources.

Trade
Fuel ethanol import figures are based on Trade Data Monitor (TDM) data (sourced from Eurostat). As the EU has no Harmonized System (HS) code for ethanol used as fuel, actual trade in ethanol used as fuel vs other industrial chemical applications are difficult to assess. From 2014 to 2019 and for 2022 to 2023, the estimation of the EU fuel ethanol import figures is based on EU imports through preferential trade under HS 2207 (Bolivia, Costa Rica, Guatemala, and Peru), and the imports from Brazil, Canada, and the United States. The monthly shipments larger than one million liters plus a unit value of less than $1.20 per liter are counted as fuel ethanol, the remainder is treated as non-beverage, non-fuel ethanol. HS code 29091910 covers ETBE which contains 45 percent ethanol by volume. For 2020 and 2021, EU fuel ethanol import figures are based on the surveillance program for fuel ethanol of the European Commission (EC). From 2021 to 2024, EU bioethanol exports are anticipated to be minimal at estimated at 50 million liters per year. Stocks are the residual of the production, supply, and demand balance.

Feedstock and Co-products
Official data for feedstock use is scarce and generally unavailable from industry and government sources. The figures in this report represent FAS Posts estimates supported by staff assessments of grain and sugar markets which are published. Feedstock and co-product figures are cross-checked with fuel ethanol production figures as published in the ethanol balance table using known feedstock yield rates (listed in the Appendix II) to ensure accuracy.

Biodiesel/HDRD

Production and Consumption
Original biodiesel/HDRD data collected in MT, then converted to liters using a conversion rate of 1 MT = 1,136 liters for biodiesel; 1,282 liters for HDRD. 2014-2022 figures are based on Eurostat and MS

official statistics and adjusted by EU FAS Posts using additional information obtained from national industry organizations and government sources. 2023 and 2024 figures are FAS post estimates/forecasts.

Trade
Figures are based on Trade Data Monitor (TDM) data (sourced from Eurostat) and the U.S. Bureau of Census and adjusted for U.S. exports of biodiesel blends. A specific customs code for pure biodiesel (B100) and biodiesel blends down to B96.5 (HS 3824.90.91) was first introduced in the EU in January 2008. In January 2012, the code was changed to HS 3826.00.10 for blends containing at least 96.5 percent biodiesel, HS code 3826.00.90 (containing between 30 and 96 percent of biodiesel), and HS 2710.20.11 for blends containing at most 30 percent biodiesel. In this report it is assumed that these codes represent a blend of 99, 95, and 5 percent, respectively. In January 2012, the U.S. Bureau of the Census introduced the export code HTS 3826.00.0000 exclusively for biodiesel blends greater than 30% by volume and up to and including B100, and export code HTS 2710.20.0000 exclusively for petroleum oils containing biodiesel up to 30% by volume. There have been no changes since.

Feedstock
Official data for feedstock use is scarce and generally unavailable from industry and government sources. The figures in this report represent FAS Posts estimates supported by staff assessments of oilseed markets which are published. Feedstock figures are cross-checked with biodiesel/HDRD production figures as published in the biodiesel/HDRD balance table using known feedstock: biofuel yield rates (listed in the Appendix II) to ensure accuracy.

Fuel Pools
Source for all fuel pools: IEA, Oil Market Report, June 2024.

Appendix I – Abbreviations

BBD = Bio-based diesel (BBD) includes biodiesel (fatty acid methyl esters, aka FAME) and renewable diesel. Renewable diesel, a full drop-in fuel replacement for fossil diesel, can be produced thru various feedstock-technology platform pathways, but the renewable diesel commercialized at scale today is hydrogenation-derived renewable diesel (aka HDRD).
Biodiesel = Fatty acid methyl ester (FAME) produced from agricultural feedstock (plant oils, animal fat, recycled cooking oils) used as transport fuel to substitute for petroleum diesel
Bioethanol = Ethanol produced from agricultural feedstock used as transport fuel
BtL = Biomass to Liquid
Bxxx = Blend of mineral diesel and biodiesel with the number indicating the percentage of biodiesel in the blend, e.g. B100 equals 100% biodiesel, while B5 equals 5% biodiesel and 95% conventional diesel.
CEN = European Committee for Standardization (Comité Européen de Normalisation)
DDG = distillers dried grains
EBB = European Biodiesel Board
EC = European Commission
EU = European Union. “EU” in this report refers to EU27.
Exxx = Blend of mineral gasoline and bioethanol with the number indicating the percentage of bioethanol in the blend, e.g. E10 equals 10% bioethanol and 90% conventional gasoline.

FAME = fatty acid methyl ester
FFA = Free fatty acids
FQD = Fuel Quality Directive
GHG = greenhouse gas
GJ = Gigajoule = 1,000,000,000 Joule or 1 million KJ
Ha = Hectares, 1 hectare = 2.471 acres
HDRD = hydrogenation derived renewable diesel (also known originally as hydrotreated or hydrogenated vegetable oil or HVO)
HS = Harmonized System of tariff codes
KTOE = 1000 MT of oil equivalent = 41,868 GJ = 11.63 GWh
MJ = Megajoule
MMT = Million metric tons
MS = Member State(s) of the EU
MT = Metric ton (1,000 kg)
Mtoe = Million tons of oil equivalent
MW = Mega Watt = 1,000 Kilo Watt (KW)
MWh = Mega Watt hours= 1,000 Kilo Watt hours (KWh)
MY = Marketing Year
Nordics = Denmark, Sweden, Finland, Norway and Iceland
PFAD = Palm fatty acid distillate
PME = Palm oil-based methyl ester biodiesel
RED = EU Renewable Energy Directive 2009/28
REDII = EU Renewable Energy Directive 2018/2001
Revised REDII = RED II as revised by EU Directive 2023/2413
RME = Rapeseed oil methyl ester
SAF = Sustainable aviation fuel
SME = Soybean oil methyl ester
TME = Tallow methyl ester, biodiesel made from animal fat
Toe = Tons of oil equivalent = 41,868 MJ = 11.63 MWh
UCO = Used cooking oil/recycled vegetable oil
UCOME = UCO-based methyl ester biodiesel
UDB = Union Database for Biofuels
US$ = U.S. Dollar

Appendix II - Energy Content and Conversion Rates

1 MT Gasoline = 1,342 Liters = 1.03 toe
1 MT BtL = 1,316 Liters = 0.80 toe
1 MT of HDRD = 1,282 Liters = 1.00 toe
1 MT Ethanol = 1,267 Liters = 0.64 toe
1 MT Diesel = 1,195 Liters = 1.02 toe
1 MT Biodiesel = 1,136 Liters = 0.90 toe
1 MT Pure veg Oil = 1,087 Liters = 0.83 toe

Feedstock: Ethanol Conversion Rates
Corn kernels: 1 MT = 402 to 417 liters (has risen since 2006)
Wheat kernels: 1 MT = 393 liters
Rye/Barley kernels: 1 MT = 241 liters
Sugar beets: 1 MT = 95 liters

Feedstock: Biodiesel Conversion Rates
Soybean oil, crude: 1 MT = 1,113 liters
Soybean oil, 1x refined: 1 MT = 1,128 liters
Crude palm oil (CPO): 1 MT = 1,087 liters
Animal fats/grease: 1 MT = 1,043 liters
Used cooking oil (UCO): 1 MT = 1,043 liters

Ethanol: Co-product Yield Rates (maximum theoretical yield)
Corn kernels: 1 MT = 313 kg of DDG + up to 29 kg of corn oil
Other grain kernels: 1 MT = 313 kg of DDG (negligible vegetable oil)

Appendix III - Related Reports from USEU and MS Posts

Country	Title	Date
EU	Wood Pellet Annual 2024	07/05/24
EU	Biofuel Mandates in the EU by Member State - 2024	06/27/24
Denmark	Markets for Wood Chips in Northwestern Europe	04/23/24
EU	Sugar Annual	04/17/24
EU	Grain and Feed Annual	04/17/24
EU	Oilseeds and Products Annual	04/08/24
EU	Wood Pellet Annual 2023	08/20/23
EU	Biofuels Annual	08/14/23
EU	Biofuel Mandates in the EU by Member State - 2023	07/06/23
Spain	Spanish Wood Pellet Market Outlook 2023	05/08/23
EU	Oilseeds and Products Annual	05/02/23
EU	Sugar Annual	04/21/23
EU	Grain and Feed Annual	04/19/23
EU	EU Parliament Adopts Negotiating Positions on Deforestation-Free Supply Chains and Renewable Energy	09/30/22
EU	EU Wood Pellet Annual 2022	07/13/22
EU	Biofuels Annual 2022	07/13/22
EU	Biofuel Mandates in the EU by Member State – 2022	07/05/22
Netherlands	Dutch Government Lays Out New Biomass Policy	04/29/22
Germany	Fuel of the Future Congress Concludes Biofuels are Indispensable for	03/02/22
Netherlands	Sustainable Marine and Aviation Fuels in Northern Europe	12/13/21
EU	EU Extends Its Anti-Dumping Duty and Countervailing Duties on	08/23/21
EU	EC Adopts its EU Taxonomy for Green Investments	05/14/21
Netherlands	Dutch Wood Pellet Imports Reach New High	04/26/21
Belgium	Belgium To Ban Palm and Soya Oil for Use in Biofuels from 2022	04/08/21

The GAIN Reports can be downloaded from the following FAS website:
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Disclaimer:

This report presents the situation and outlook for biofuels in the EU. This report presents the views of the authors and does not reflect the official views of the U.S. Department of Agriculture (USDA). The data are not official USDA data. Official government statistics on biofuels are not available in many instances. This report is based on analytical assessments, not official data.

Attachments:

No Attachments