

# UCO Imports: Unfair Competition with EU UCO Industry?

June 11, 2024

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## Introduction

Sparked by high subsidies due to its waste status, the biofuels industry has come to dominate the Used Cooking Oil (UCO) market in recent years. UCO is one of the most sought-after feedstocks for advanced biofuel production owing to its lower carbon intensity scores and inclusion in the Annex IX-B feedstock list under EU legislation. However, there is a finite amount of UCO to be obtained in the market due to limited availability. Additionally, much of the global supply ends up directed into high paying countries in Europe and North America.

Between late 2023 and early 2024, while European UCO supply reached its limits, the European Commission (EC) commenced a formal investigation into suspicious trade dynamics. During the first half of 2023, allegations of dumping UCO-based products from Asian countries into the EU market were made. The allegations centered around reports from European biofuel producers that profit margins had been shrinking due to the influx of the relatively cheaper and purportedly mislabeled Asian UCO-based biodiesel entering the European market.

This study will zoom into the European trade flows of UCO and biodiesel from Asia and their impact on the European biofuel market from 2021 to 2023. Furthermore, Stratas Advisors will assess the market outlook with consideration of the economic and regulatory factors that may incentivize the export of non-waste-based products to Europe under the guise of mislabeled UCO-based biodiesel.

## Assessment of Supply, Demand and Trade Dynamics

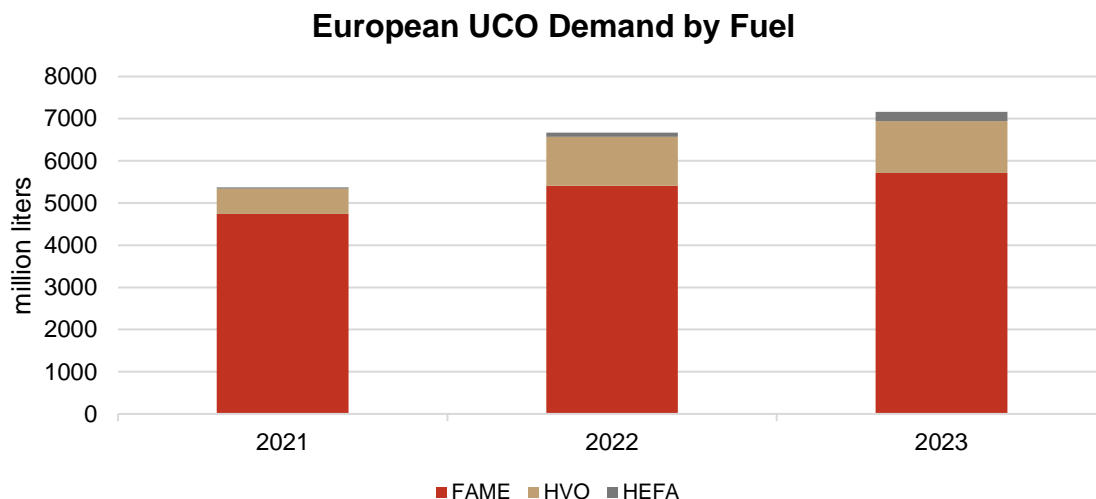
### European Biofuel Supply and Demand Fundamentals

Demand for biomass-based diesel (BBD) used in the European road segment stagnated between 2021 and 2023, growing just 3.7% to 21.4 billion liters per year (bly), on the heels of substantial growth prior to 2019. In 2023, the dominant biofuel, by far, was fatty acid methyl ester (FAME) at 16.2 bly compared to hydrotreated vegetable oil (HVO) at 5.2 bly.

During the study period, FAME demand was driven by increased demand from the United Kingdom (UK) which grew by 31.8%, which was partially offset by a 9.4% decrease from the large German market. Overall, FAME demand increased by just 4.2% between 2021 and 2023 largely due to temporary reductions to mandates across Europe following the Russian invasion of Ukraine.

Prior to 2021, increasing HVO demand was partially supported by ambitious mandates requiring BBD blending beyond the FAME blending limit. Over the study period, slight decreases to the diesel pool partially offset these increases resulting in slow growth at 2%. Large swings were observed in the major HVO markets including decreases in Germany (32%), and Italy (33.1%) and increases in France (80%) and the UK (303%). Historically, around half of European HVO demand came from Nordic markets, notably Sweden, which consumed 26% of European HVO with only 5% of total population. However because of the shrinking diesel pool and temporary mandate reduction measures, demand in Sweden, Finland, and Norway fell during the study period by 3.9%, 17.6%, and 15.6% respectively.

The European sustainable aviation fuel (SAF) market is still in its infancy, but growing demand from the hydrotreated esters and fatty acids (HEFA) SAF production pathway will have a significant impact on future HVO supply. With both HVO and HEFA vying for the same feedstocks, a growing share of HVO producers are shifting output to the aviation segment to benefit from higher margins. During the study period, demand for SAF in Europe increased by nearly 5 times to nearly 300 million liters per year (mmly), largely due to increased demand from the UK and to a lesser extent from France which saw a nearly 8-fold (162 mmly) and 12-fold (62 mmly) increases, respectively.



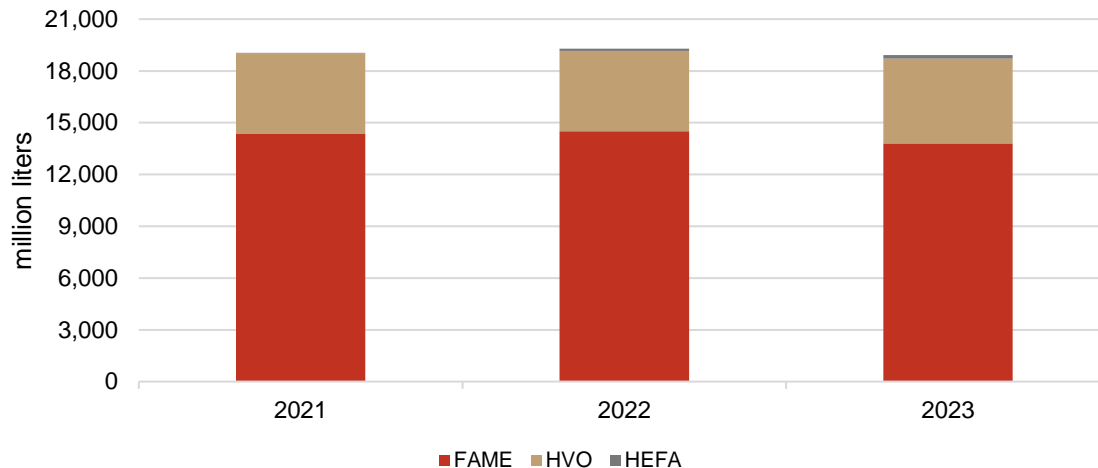
Source: *Stratas Advisors*

During the study period, European FAME production decreased slightly by 4.1% to 13.8 bly, largely due to an elevated feedstock price environment and temporary regulatory measures reducing national mandates. Increases to French (4.5%) and UK (12.8%) production were insufficient to offset the substantial decreases observed across the rest of Europe, including Germany (6.1%) and Spain (16.7%).

Historically, HVO supply and demand in Europe have been balanced, however, in 2020, the differential between supply and demand increased substantially from nearly 300 mmly to around 750 mmly. During the study period, HVO supply increased by 5.8% in Europe thanks to increases in Finland (8.1%), France (15.3%), and Sweden (21.7%) which were only partially offset by small decreases from other major producing countries, including the Netherlands (3.4%), Spain (5.1%), and Italy (1.2%). As most historical HVO supply has been concentrated in Europe, so too has most of the HEFA supply. European HEFA production has been undergoing a phase of rapid expansion, and as a result, supply has increased by just over 14 times during the study period to 202 mmly in 2023. Although HEFA supply is increasing more rapidly than demand, supply in 2023 was still less than half of the total demand volume.

As of 2023, HEFA supply has only been recorded in four European countries: France, the Netherlands, Norway, and Sweden. The Netherlands is the largest producer and saw a 13.5-fold increase in supply during the study period to 143.4 mmly.

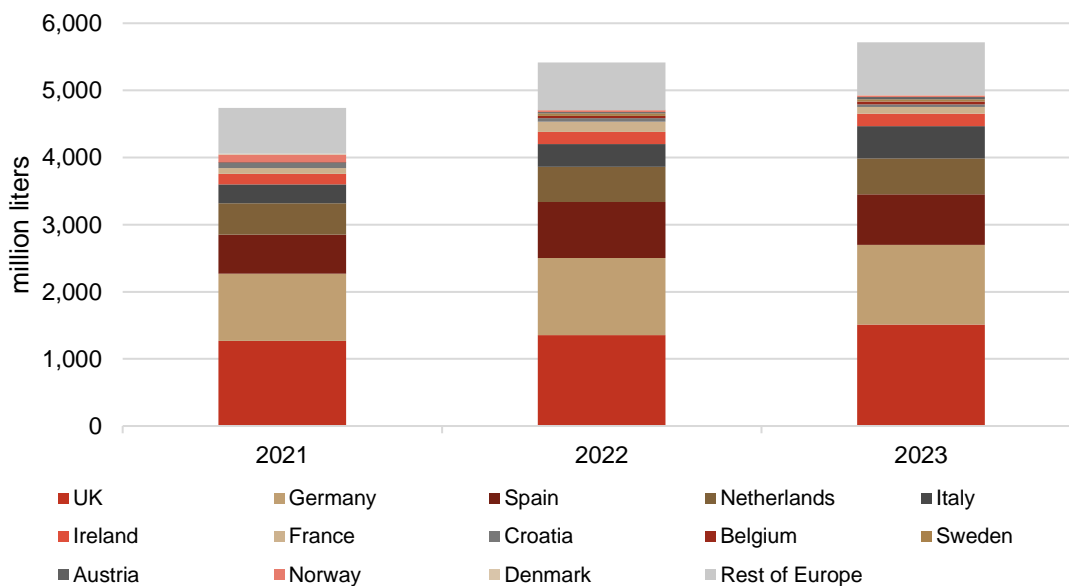
## European Lipid-Based Biofuel Supply



Source: *Stratas Advisors*

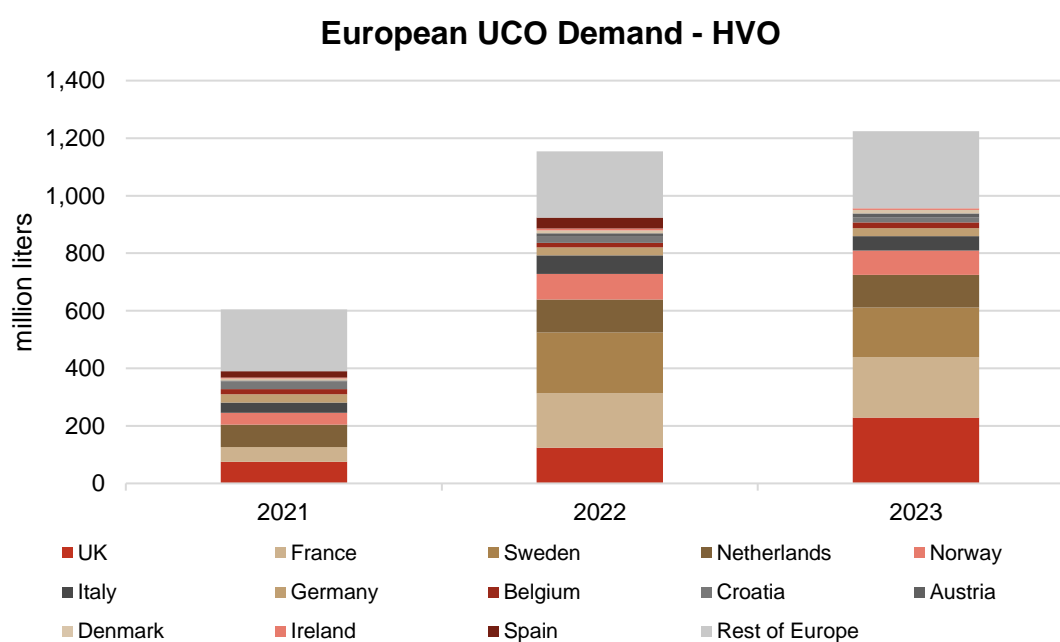
Historically, European FAME demand has been dominated by rapeseed oil, representing almost half of total European consumption, although the share decreased to an average of 40.8% during the study period. The increased demand for waste-based feedstocks, along with the rising influx of allegedly labeled UCO-based biofuel products from Asia, has driven up the demand for UCO-based FAME (UCOME). This has resulted in UCOME accounting for 32.8% of the total FAME consumed. Most waste-based feedstocks saw similar increases in utilization, except for palm oil mill effluent (POME) which share decreased from 3.1% to 2.9% because of France's ban on palm by-products, which came into effect in mid-2023. Broadly speaking, the share of crop-based feedstocks in FAME decreased from 57.5% in 2021 to 49% in 2023, while the share of waste-based feedstocks increased from 37.9% to 43.5%.

## European UCO Demand - FAME



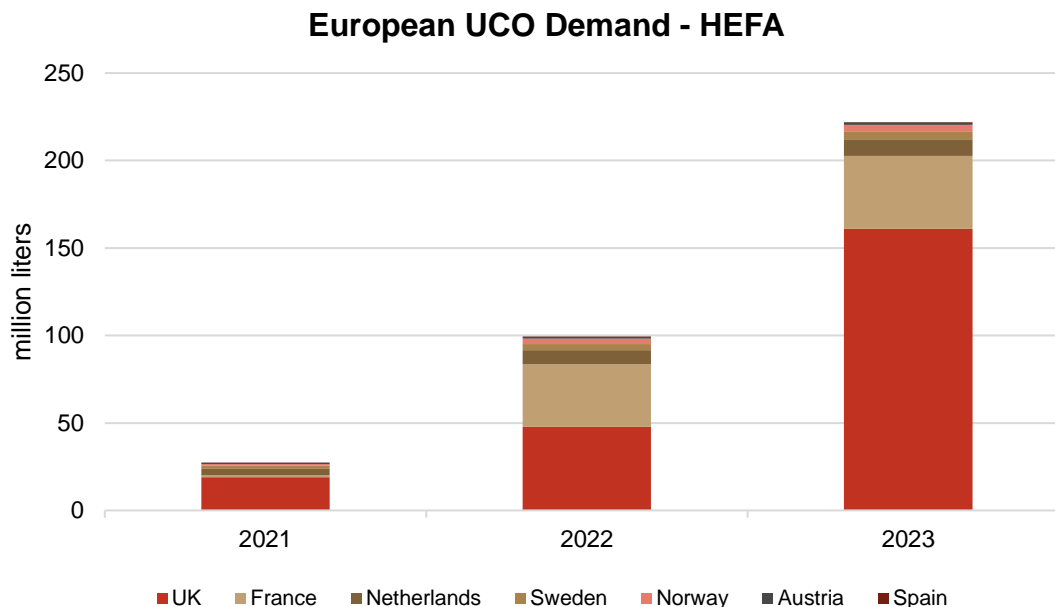
Source: *Stratas Advisors*

Despite limited waste-based feedstock availability, the increasing volume of UCOME imports between 2022 and 2023 has led to a greater share of the available non-refined UCO being redirected towards advanced biofuel production instead, such as HVO and HEFA. Between 2021 and 2023, waste feedstocks accounted for an average of 70.8% of European HVO consumption compared to 21.5% for crop feedstocks. Animal fats and UCO alone represented, on average, nearly half of HVO demand. The impact of crop caps and palm oil bans can be seen more strongly in the feedstock shares of HVO than of FAME. The share of palm oil HVO dropped from 26.3% in 2021 to 6.8% in 2023, while the overall crop feedstock share fell from 32.8% in 2021 to 10.4% in 2023. Although palm by-products currently make up relatively large percentages of HVO demand, averaging 11.2% for POME and 7.1% for PFAD, potential bans or restrictions on usage are likely to drive down shares. While soybean oil also faces bans in some jurisdictions, it is not strongly represented in the HVO feedstock slate compared to FAME. Due to high HVO demand from the Nordics, tall oil is more strongly represented in HVO with an average of 3.7% compared to just 0.1% of total FAME.



Source: *Stratas Advisors*

Used cooking oil is by far the dominant feedstock for European HEFA followed by animal fats and palm fatty acid distillate (PFAD). Over the study period, UCO shares increased from 10.7% in 2021 to 81.8% driven by increased demand from the UK which almost uniquely uses UCO-based HEFA. Relative to UCO, shares of animal fats and PFAD have fallen from 26.8% and 10.7%, respectively, in 2021 to 9.3% and 1.8% in 2023. PFAD has long been a popular feedstock for HVO refiners like Neste and Eni, but it has fallen out of favor in recent years as it is not included on the list of feedstocks qualifying for SAF production and cannot be double counted in any EU country. Rapeseed is the only crop feedstock with relevant shares with an average of just 1.9% during the study period. Use of energy crops for HEFA production is expected to decrease in line with EU legislation that aims to avoid the use of dedicated energy crops for SAF production. As a result, alternative waste-based feedstocks are expected to assume a sizeable role in the European HEFA feedstock matrix.



Source: *Stratas Advisors*

## Used Cooking Oil Fundamentals

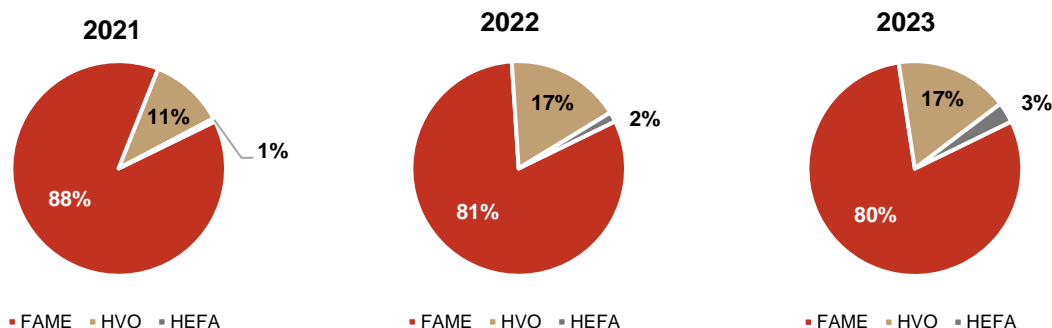
The Renewable Energy Directive (RED) II has been the main driver of higher transport sector UCO uptake between 2021 and 2023. In addition to the 14% overall renewable energy target for transport by 2030, the RED II regulatory package includes a 1.7% cap on Annex IX-B-based biofuels (i.e., those produced from UCO or category 1 and 2 animal fats). The RED II permits a degree of flexibility with respect to this cap by allowing member states to modify the limit to better reflect regional feedstock availabilities. As a result, some countries have a higher national Annex IX-B cap.

There is significant variation among member states in the type and scale of incentives used. In addition to the RED mandates, non-compliance penalties and tax incentives – such as tax excise duty, carbon tax exemptions, and tax reductions – play a significant role in supporting UCO-based biofuel consumption in member states. The UK, Germany, Spain, the Netherlands, and Italy are the main European UCO consumers, averaging 1.5 bly, 1.1 bly, 0.7 bly, 0.6 bly, and 0.4 bly, respectively, across FAME and HVO products during the study period. All the countries have a system of incentives to support this demand, but each country has approached the task using different methods.

The Netherlands is the main trading hub for European UCO and UCO-based biofuels and has one of the highest mandates for the transport sector. In 2021, a 17.5 cal% (percentage energy content) overall biofuel mandate was in place rising progressively to 18.9 cal% in 2023 before jumping to 28.4 cal% in 2024. The Netherlands also has a high Annex IX-B ceiling of 10%, compared to the 1.7% cap which is commonly applied in most member states. A multiplier of 1.6 for Annex IX-B feedstocks is also applied further encouraging UCO-based BBD uptake. Finally, a EUR 450,000 non-compliance penalty for failure to fulfill the quota obligation is also applied. In Italy, although the overall mandate is not particularly high (10 cal% in 2023), the use of Annex IX-B-based biofuels is capped at 2.5%, resulting in relatively high UCO demand for FAME production. In 2023, a new provision was introduced by the Italian government requiring the production of at least 300 kt/y of pure biofuels, increasing 100 KT per year through 2030. German regulation

focuses on GHG reduction potential and ambitious regulations were introduced in 2021, which increased the obligation from 6% GHG reduction to 8% in 2023. As Germany has a 1.9% Annex IX-B cap, UCOME (and to a lesser extent HVO from any feedstock) is commonly favored due to its relatively high GHG reduction potential. As a result, UCO has a higher proportional usage in FAME than in HVO in Germany. Fuel suppliers failing to fulfill the GHG reduction quota obligation are fined 600 EUR/t CO<sub>2</sub>eq.

### European UCO Demand by Biofuel



Source: *Stratas Advisors*

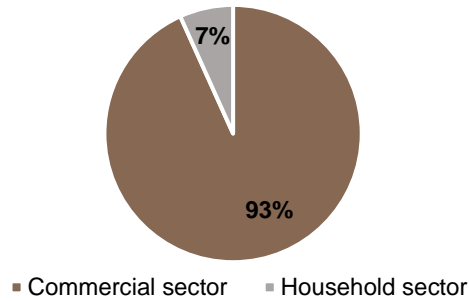
While there is no direct relationship between individual incentives and the share of UCO consumed in each country, we can nevertheless observe that the countries with the highest mandates are among the countries with the highest proportional UCO consumption. The types of mandates introduced, and the restrictions placed on those mandates, also affect UCO uptake, and determine which fuels use higher shares of UCO. Generally speaking, a low cap on the use of Annex IX-B feedstocks tends to result in higher usage in FAME than in HVO – from considerations on where UCO best helps meet obligations and targets. Higher usage of UCO in FAME in the short term is also likely tied to existing supply contracts. Where not specifically excluded, multipliers (i.e., the ability to count volumes of biofuel used more than once towards an obligation) also encourage higher UCO uptake. Of course, the many layers of mandates and incentives in each country cloud the individual importance of each measure on overall UCO demand.

### European and Asian UCO Availability

Most of the UCO collected and processed in Europe comes from restaurants and food manufacturers, which usually get a discount on fresh frying oil in return for their waste oil. Often the food manufacturers are vertically integrated companies that filter and/or pretreat the product, and in some cases convert it into biofuels themselves. Households represent less than 10% of total European supply. Even though the theoretical waste oil availability from households is significantly larger, collection is more difficult and quality is often poorer. For those households where the waste cooking oil is successfully recycled, central delivery points at the municipal level are generally the norm. The remainder of UCO supply comes from schools, homes for the elderly, prisons, sport stadiums, airports, and other public or private entities for which food processing is a non-central part of their business.



### UCO Sources by Sector in Europe (2023)

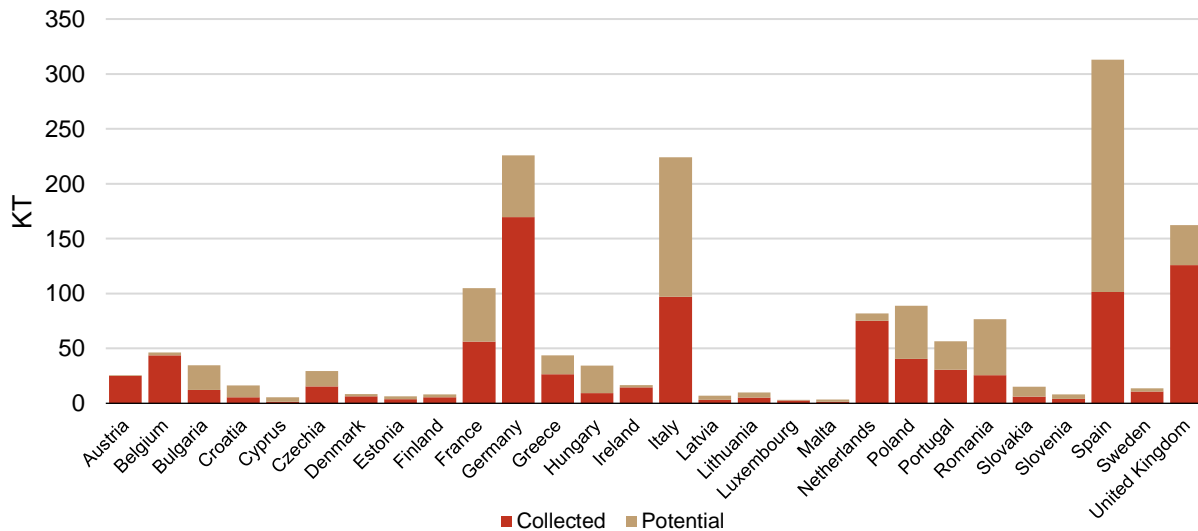


Source: *Stratas Advisors*

UCO supply is driven by vegetable oil consumption, dietary habits, population density, and available infrastructure. UCO supply availability is minimal in scarcely populated areas and regions with limited industrial activity. Household UCO collection costs increase with demographic fragmentation while available volumes decline in the absence of large food processing centers. Less populated areas of Eastern European countries typically rely on municipal recycling programs for household UCO recycling, with limited private UCO collection services in place. In contrast, in Northwestern European countries, the volumes of collectable UCO from the household sector, as well as from the commercial sector tend to be notably higher, owing to the populational concentration, available transport infrastructure, and significant industrial activity.

The EU and UK’s UCO collection industry is relatively mature, with high competition among collectors. The combined UCO collection rate is about 55% of the total collectable potential – estimated at 1,669 KT in 2023 – with 798 KT collected in the EU and 126 KT in the UK. Spain, Germany, Italy, and the UK are the main UCO suppliers in Europe, accounting for more than 50% of the total volume of UCO.

### European UCO Availability (2023)



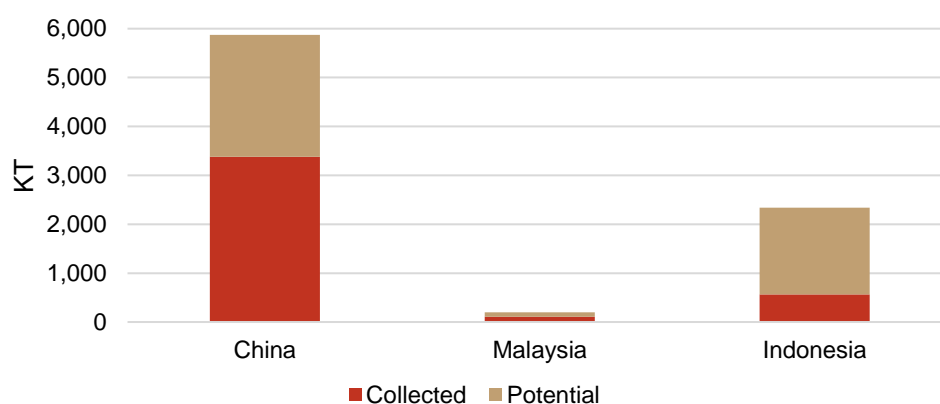
Source: *Stratas Advisors*

Note: *Potential volume estimates represent the theoretical collectable volumes.*

UCO supply in Europe is nearing its maximum capacity, with an estimated 75% UCO collection rate in the commercial sector. While the collection rate within the household sector is estimated at just 12%, significant improvements are not expected due to limited collection infrastructure in most urban areas, elevated transport costs in less densely populated areas, and poor social awareness in most countries.

Conversely, major vegetable oil-consuming countries in Asia have been improving their UCO collection rates to satisfy the growing demand for low-carbon fuels in high paying regions. The combined UCO potential from China, Indonesia, and Malaysia is estimated at 8,409 KT in 2023, of which only a portion is currently collected. China's UCO supply is the highest in the region with supply estimated at 3,377 KT in 2023, followed by Indonesia at 565 KT and Malaysia at 104 KT. The commercial sector is the main UCO supplier in China, Indonesia, and Malaysia, with a combined UCO collection rate of 48%. With most household UCO either re-used as “gutter oil” for frying or discarded down drains, UCO collection volumes from the household sector are negligible in these countries.

### Main Asian Countries UCO Availability (2023)



Source: *Stratas Advisors*

Based on the estimated UCO supply and demand figures and associated trade flows for 2023, China and Indonesia exhibited significant UCO surpluses, while Malaysia experienced a deficit of 558 KT, indicating higher export volumes than locally collected and imports. Malaysia's substantial deficit has been notable since 2022, estimated at 317 KT during that year, indicating the latent risks of fraud and palm oil potentially compensating for the shortfall. Conversely, a considerable portion of the reported UCO surplus in China and Indonesia is commonly diverted to the gutter oil market, an illicit practice with severe negative implications for human health. This is due to inadequate policy support, limited consumer and small business awareness, and inefficient distribution infrastructure in more sparsely populated areas.

### UCO Market in Major Asian Countries, 2023

Country	Unit	Estimated potential	Collection rate	Estimated collection	Collection + Imports	Exports + domestic use	Net
China	KT	5,874.3	57%	3,376.6	3,388	2,260	1,128
Malaysia	KT	196.4	53%	103.8	366.9	924.6	-557.6
Indonesia	KT	2,338.4	24%	565.4	570.0	219.3	350.7

Source: *Stratas Advisors, Comtrade database*

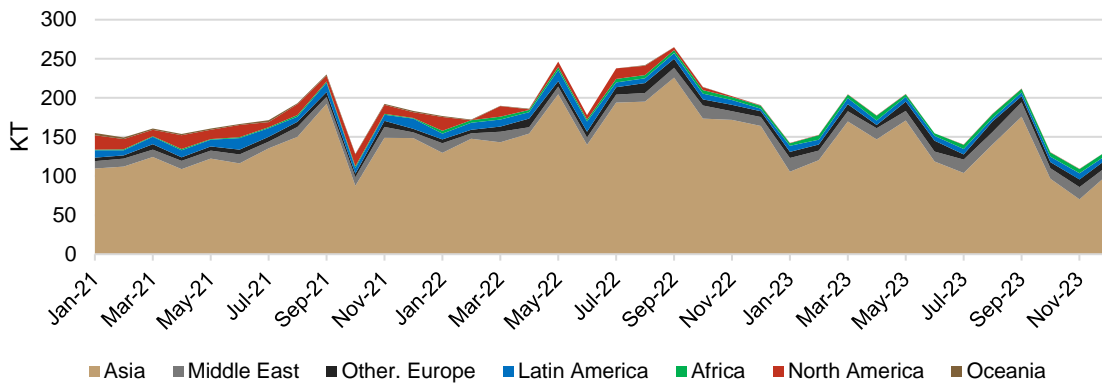
Note: *UCOME trade estimates are not included in the table.*

## European UCO and Biodiesel Imports of Asian Origin

As Europe taps into its maximum UCO supply potential, Asian countries have been increasing UCO and biodiesel exports to meet the growing appetite from the European low-carbon fuels industry. During the last three years, the EU and the UK combined registered average monthly inter-regional import volumes of 180 KT of UCO and 272 KT of biodiesel.

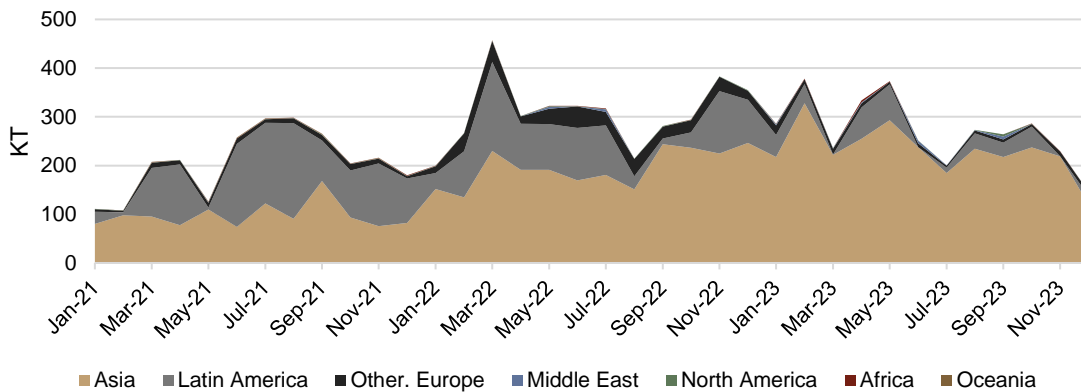
Asia is Europe's main source for UCO and biodiesel imports, accounting, respectively, for approximately 80% and 72% of the EU's and UK's combined inter-regional imports between 2021 and 2023. Between 2022 and 2023, Asian-origin UCO imports to Europe declined slightly, with a growing share of Asian UCO export volumes redirected to the US to capitalize on increased incentives following the introduction of the Inflation Reduction Act (IRA). Conversely, Asian biodiesel exports passing through the European market exhibited a consistent increase until June 2023. After Asia, Latin America is Europe's second largest biodiesel trade partner. However, the uncompetitive price of Argentine biodiesel has led to limited arbitrage opportunities, reducing the overall import volumes of Latin American biodiesel entering the EU.

**EU-27 and UK Inter-regional UCO Imports by Region**



Source: *Stratas Advisors*

**EU 27 and UK Inter-regional Biodiesel Imports by Region**

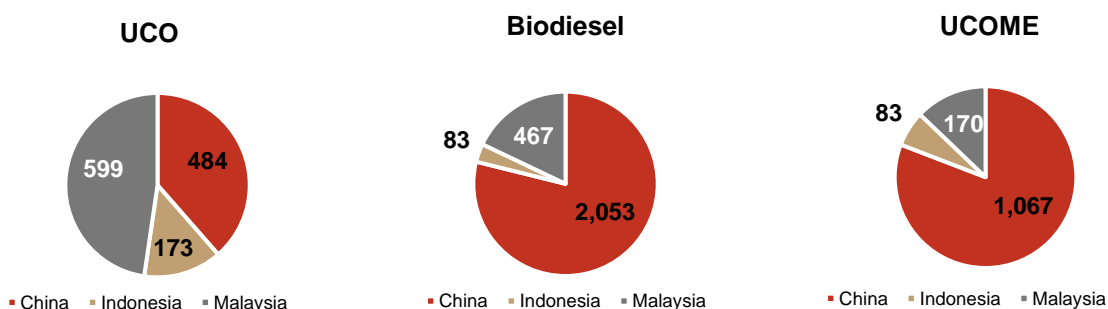


Source: *Stratas Advisors*

Europe's primary UCO and biodiesel trade partners in Asia are Malaysia, China, and Indonesia, with a significant share of their total export volumes directed to the European market.

Despite a limited domestic UCO supply of about 100 KT, Malaysia serves as one of the region's major UCO export hubs, with nearly two-thirds of the total exports directed to the EU and the UK combined. In 2023, Malaysia reported a total import volume of 263 KT of UCO while exporting 925 KT globally (599 KT to the EU and UK combined), accentuating suspicions of fraudulent UCO exports due to insufficient UCO collection capacity and import volumes. Malaysia also exported a significant volume of biodiesel to the EU and the UK, totaling 467 KT in 2023, with approximately 40% estimated to be UCO-based. In the same year, China emerged as the second-largest UCO exporter to the EU and UK, totaling 484 KT combined. China is Asia's leading biodiesel import partner for the European market with imports of 2,053 KT in 2023 to the EU and UK combined, of which nearly 1,067 KT is estimated to be UCO-based biodiesel. In 2023, EU countries and the UK reported limited import volumes of Indonesian origin UCO and biodiesel. During that year, Indonesia exported 173 KT of UCO and 83 KT of biodiesel to the EU and UK combined. While Indonesia's strong UCO collection capacity suggests these exports were UCO-based, the presence of significant crop-based biodiesel production introduces some uncertainty about the exact composition of the biodiesel exports.

### EU and the UK Combined Product Import Volume of Asian Origin in 2023 in (KT)



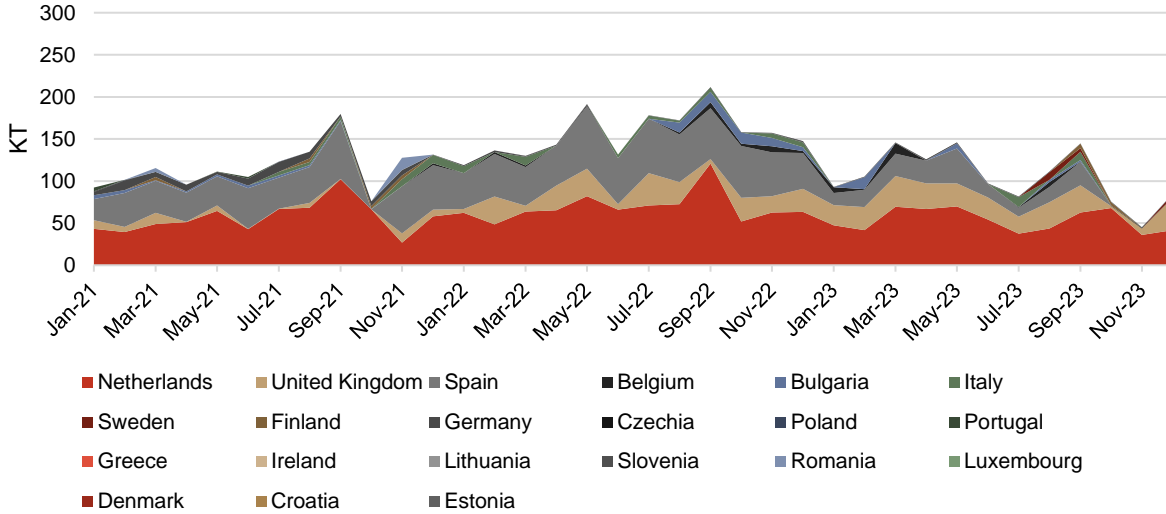
Source: *Stratas Advisors, Union Database, and Comtrade Database*

Asian-origin UCO imports from the main studied Asian markets demonstrated stability during the studied period, peaking at 211 KT in September 2022. However, following the US implementing the IRA in August 2022, there was a discernible decline in export volumes entering into the EU, as Chinese UCO was redirected toward the US market, while Malaysia stepped in by slightly increasing their overall export volume to Europe. As one of the major global trade hubs, the Netherlands emerged as the main recipient of Asian UCO and the second biggest biodiesel European importer from 2021 to 2023, leveraging the country's logistic infrastructure to redistribute products to northern and central European countries. The UK, also played an important role, leading Europe's biodiesel imports from Asia, while being the second biggest UCO European destination for Asian countries. Spain, Germany and the port of Antwerp in Belgium, followed, importing a significant portion of the remaining UCO and biodiesel imports of Asian origin.

Between 2021 and 2023, the total biodiesel export volume to the EU and the UK combined from the three major Asian exporting countries increased sharply between June 2022 and mid-2023, peaking in February 2023 at 302 KT, up 163% compared to February 2022. Trade data showed that this trend continued through June 2023, with European biodiesel import volumes from the main Asian countries being 98% higher than the same period in between June 2021 and June 2022. From mid-2023 onwards, Asian biodiesel exports

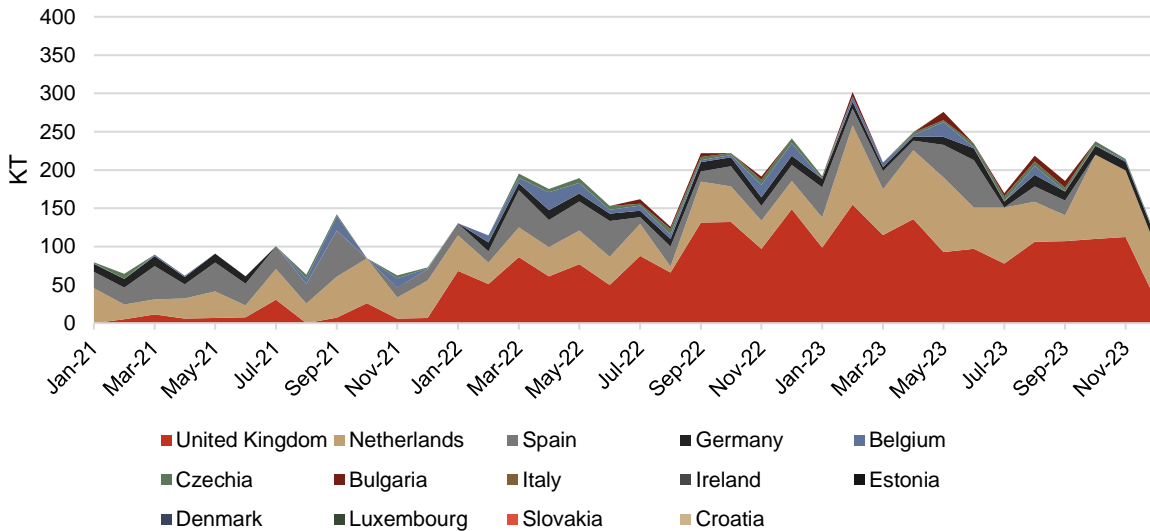
volumes to the EU and the UK declined steadily following the announcement of the ongoing probe into Chinese biodiesel exports due to allegations of possible fraud of mislabeled UCO-based biodiesel produced from vegetable oils such as palm oil. During the second half of 2023, Chinese origin biodiesel imports declined 26% compared to the first half 2023 amid concerns over introduction of potential retroactive measures against Chinese imports. During the same period, Malaysian-origin biodiesel imports saw, on average, a similar pattern, although slightly less pronounced with biodiesel imports declining 15%, while Indonesia’s biodiesel imports remain marginal due to active countervailing duties.

### EU 27 + UK UCO Imports from China, Indonesia, and Malaysia



Source: *Stratas Advisors*

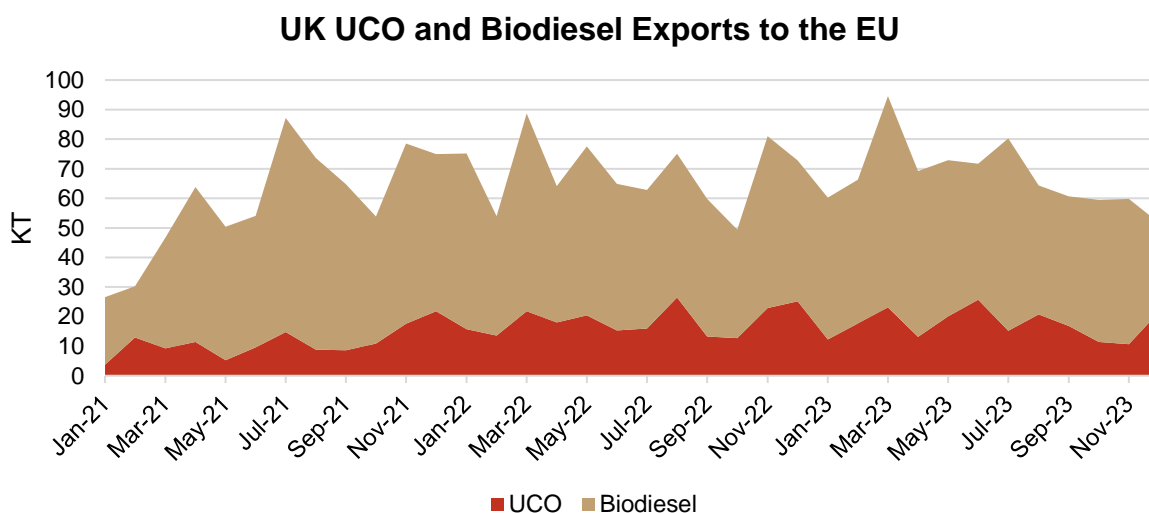
### EU 27 + UK Biodiesel Imports from China, Indonesia, and Malaysia



Source: *Stratas Advisors*

In August 2023, the EC formally opened an investigation into reports regarding Indonesian exports circumventing existing trade measures by making transshipments through China and the UK. Indonesian biodiesel exports entering the EU are subject to an 8-18% countervailing duty to offset producer subsidies from the Indonesian government. Between May 2022 and May 2023, 361 KT of Indonesian biodiesel was exported to China, up 233% YoY, and then thought to be re-exported to Europe to avoid countervailing duties imposed in November 2019. Additionally, trade data confirm an unusual uptick in Chinese-origin increase of biodiesel exports to the UK between June 2022 and June 2023 with a 184% YoY increase to 1,253 KT.

UCO and biodiesel export from the UK flowing into the EU witnessed a comparable pattern to that of Asia, albeit with a slightly less pronounced trajectory, with the Netherlands emerging as the leading destination. The UK's exports of UCO and biodiesel to the EU increased during the first half of 2023, gradually stabilizing downwards in the latter part of the study period due to lower level of imports arriving from Asian countries.

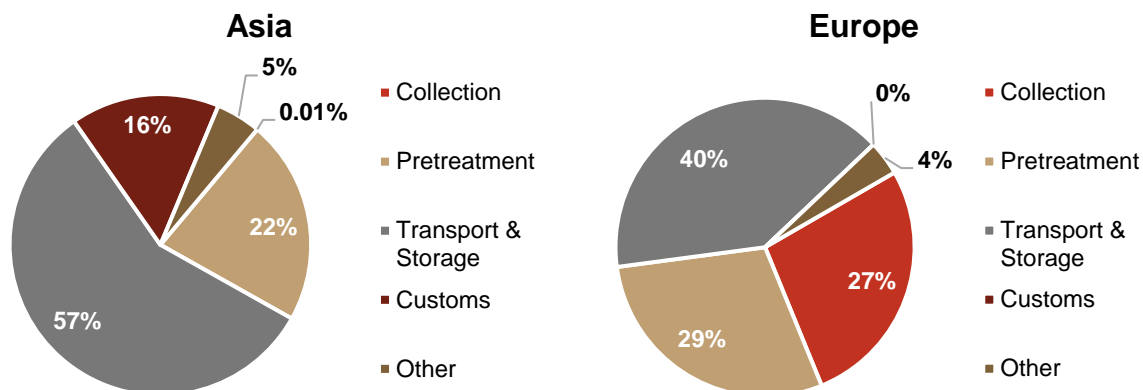


Source: *Stratas Advisors*

## Evaluation of UCO and UCOME Pricing Dynamics

### UCO Supply Chain Economics

The UCO supply chain can be broken down into three main parts: collection, feedstock pretreatment, and transportation and storage. Alongside duties and taxes, these are the four major areas where costs associated with UCO supply are accrued. Excluding transport costs and tariffs, supply chain costs are generally lower for UCO sourced in Asia than in Europe, at an estimated 130 EUR/t and 185 EUR/t, respectively.

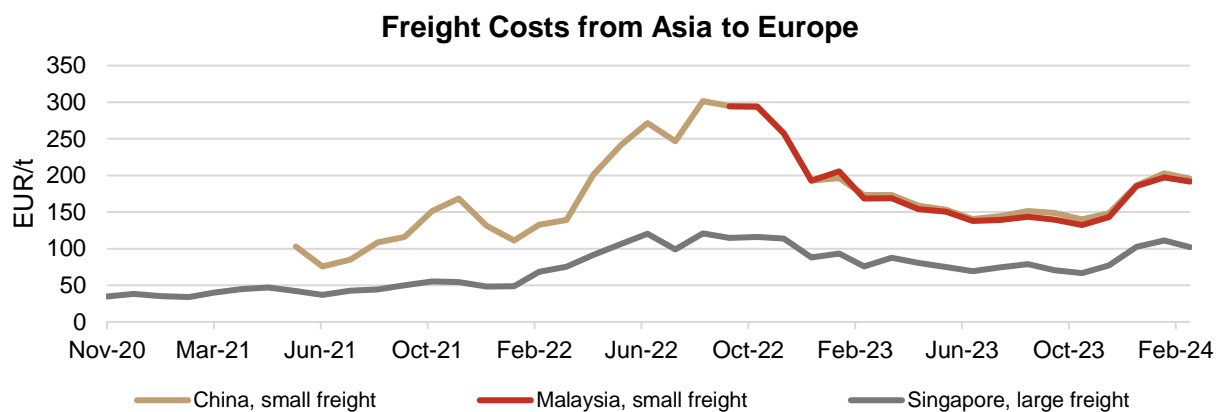


Source: *Stratas Advisors*

In most European jurisdictions, UCO collectors pay a collection “fee” to UCO producers for their waste oil. This cost varies widely, and it can take different forms (such as a rebate for clean cooking oil), with the range of the collection “fee” estimated at 60-120 EUR/tonne collected. In Asian countries, while there may be a nominal fee paid to producers on an irregular basis and promotions associated with government drives to increase collection are common, there is no evidence that a regular collection fee is paid. In China, the widespread use of “gutter oil” indicates that limited to no collection fee is provided by UCO collectors. Such as fee would likely divert more UCO towards biofuel production as it would provide a competing revenue stream to gutter oil for UCO producers. The labor costs associated with collection are also lower in China, Indonesia, and Malaysia than in Europe. In 2022, the average minimum labor costs in those countries were 82.3% lower (at 253.10 EUR/month) than in Europe (at 1,472.96 EUR/month). While labor costs vary widely across Europe, they tend to be higher in countries with higher concentrations of UCO collection and biofuel production.

Generally, while feedstock pretreatment may take place in either the country of origin or the destination, it is more common for UCO pretreatment to occur at the destination. Prior to export, simple pretreatment steps, such as filtration, may be performed to facilitate transport. However, as products from different source countries are often blended upon arrival in Europe, it is more economically efficient to conduct the main pretreatment steps post-import. The most common pretreatment method is an esterification reaction of free fatty acids (FFA) with alcohol in the presence of sulphuric acid. Costs associated with this process increase with increasing FFA content in the original UCO from 11 EUR/t for 2.5% FFA content to 66 EUR/t for 15% FFA content. Unlike collection costs, estimates suggest that pretreatment costs are lower in Europe (95 EUR/t) than in Asia (125 EUR/t) as many European biofuel producers and collectors conduct their own pretreatment operations allowing them to reduce overall costs for this step.

Transport and storage accounts for the majority of supply chain costs for UCO from Asia (330 EUR/t) and a substantial portion of the supply chain costs for European (130 EUR/t) UCO. Many of the top Asian UCO suppliers have strategically located storage and export facilities near some of the major ports in Singapore and Indonesia. It is common for companies to aggregate feedstocks from the wider region at one of these hubs before onward transport. The major UCO suppliers tend to ship feedstocks in bulk to Europe at a pace of one-two times per month to keep the transportation costs to a minimum. During the study period, sea freight rates varied significantly, from lows of nearly 75 EUR/t to highs of over 300 EUR/t for the route between China and Malaysia and Europe. Port congestion, high oil prices, and lingering impacts from the coronavirus pandemic drove freight costs from these two countries to a peak in 2022, however by 2023 prices had collapsed as new ships were delivered pushing up capacity. Costs were lower on routes from Singapore with lows of around 30 EUR/t and highs of 120 EUR/t. Within Europe, UCO and UCO-based biofuel is generally transported onward by truck or by rail, while UCO-based biodiesel may also be blended with diesel at the port and shipped via pipeline. The cost to transport products by truck is the highest at around 1.10 EUR/t-km.



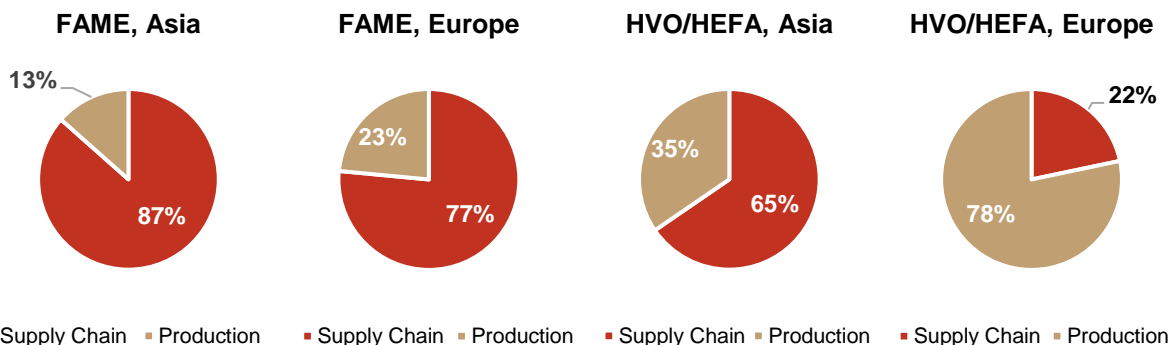
Source: *Stratas Advisors*

Customs duties on UCO and UCO-based biofuels vary based on the HS code applied to a shipment and the origin of the product. Typically, the *Erga Omnes* duty for most of these products originating in Asia is 7.7%. Most Indonesian BBD is subject to an 18% countervailing duty which was introduced following investigations into high imports of subsidized products. While the *Erga Omnes* duty is currently applied to Chinese products, the European Commission has recently opened an anti-dumping investigation following a complaint from EU biodiesel producers. Should the result of this investigation result in new customs duties, the cost of this route would increase substantially. Anti-dumping and countervailing duties typically lead to attempts to circumvent them via trans-shipment, and there is currently an investigation underway into possible transshipment routes for Indonesian biodiesel via China and the UK. Products originating from Singapore receive a preferential duty rate of 0% as agreed in the 2019 European Union-Singapore Free Trade Agreement.

Certification and insurance costs play a relatively small role in the UCO supply chain. As costs for certification do not vary based on location, there is no competitive advantage for Asian suppliers. For example, ISCC fees are 0.00001 EUR/t of product produced on an ongoing basis plus a one-time certification fee between EUR 200-2,000 based on the company's annual turnover. Insurance costs, on the other hand, are much higher for Asian product as payment is required for the shipment to Europe as well as for the shipment from the port of entry to the final destination.



### Estimated Cost Breakdown, 2021-2023



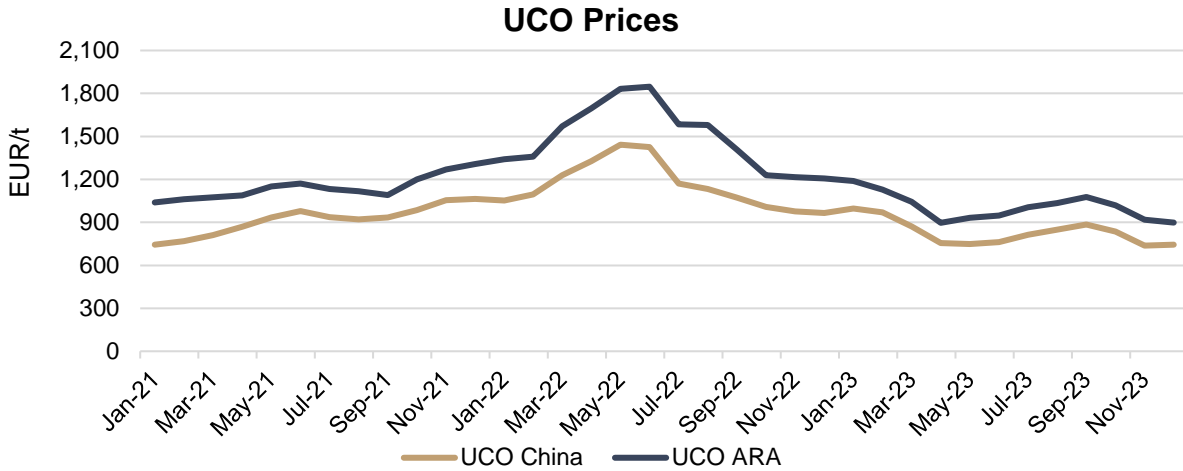
Source: *Stratas Advisors*

While collection costs in Asia are lower than in Europe, the costs associated with transportation from Asia to Europe result in European UCO having a lower total supply chain cost. The Asian competitive advantage is more pronounced with respect to finished products. Due to relatively high energy and labor costs in Europe, the cost of production for both FAME and HVO/HEFA are significantly higher than in Asia. Since FAME is a more established production pathway, costs are lower overall, resulting in production costs which account for a lower share of total product costs. Comparatively, HVO/HEFA production costs are much higher. In Europe this is largely due to high hydrogen costs which account for 41% of total production costs.

## UCO and UCOME Pricing

Between 2021 and much of 2022, heightened competition within the European biofuel industry to decarbonize the transportation sector coupled with the outbreak of war in Ukraine fueled an increasing demand for second-generation feedstocks, which led to unprecedented biofuel feedstock price increases. In the latter half of 2022 through 2023, however, the growing inflow of biodiesel imports entering into the European market coupled with biofuel production overcapacity in both the European and North American markets posed challenges for the European UCO sector, leading to a steady decline in UCO-based product prices.

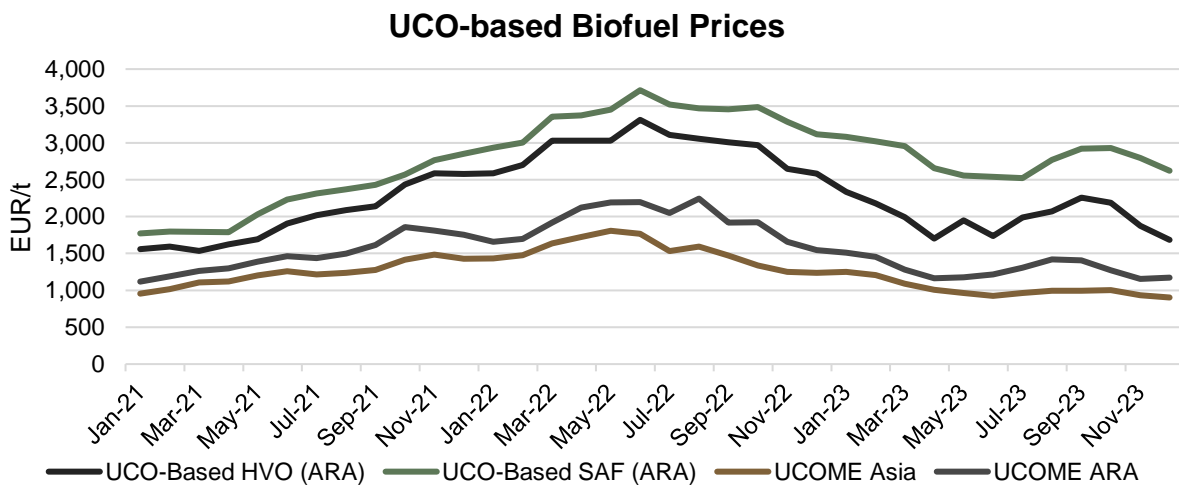
After experiencing a significant recovery throughout 2021 following the Covid-induced decline, European UCO prices rocketed upwards during the first half of 2022, peaking at nearly 1,850 EUR/t in June 2022, followed by a sharp decline in July 2022 to below 1,600 EUR/t, down 14% compared to the previous month. From July 2022 onwards, UCO prices steadily declined at a rate of 3% through 2023, dropping below 900 EUR/t in December 2023. Chinese UCO prices also experienced similar dynamics, declining from nearly 1,430 EUR/t in June 2022 to below 750 EUR/t in December 2023, partly mirroring poor biodiesel fundamentals in Europe.



Source: *Stratas Advisors*

Note: *Transport and distribution costs not included.*

Between 2021 and 2023, UCO-based SAF registered the highest resilience against the generalized UCO price decline, benefiting from supply and demand imbalances. European UCO-based HVO witnessing the highest drop, declining from above 3,300 EUR/t in June 2022 to below 1,800 EUR/t in June 2023, down 48% YoY. By June 2023, European UCOME prices declined below 1,200 EUR/t, down 45% YoY, with UCO-based product prices improved somewhat through the third quarter of 2023 following the announced investigation in June 2023 by the EC regarding the potential fraud associated with mislabeled waste-based biodiesel imports from China. Nevertheless, prices saw a significant downturn once more in Q4 2023, which is primarily attributed to wavering demand, in part, because of the uncertainty resulting from heightened scrutiny by the EU on biodiesel imports originating from Asia and concerns over potential retroactive trade measures initiated by the EU.



Source: *Stratas Advisors*

Besides the relatively stable but upward trending imports observed in unprocessed UCO flows originating from Asia, trade data highlights an atypical surge in biodiesel imports from Asia, exerting a significant influence on Europe’s UCO-based biofuel prices. The increasing biodiesel exports from Asia to the EU,

coupled with a substantial share of this volumes being UCO-based biofuel, led to an oversaturation of the European biodiesel market.

Industry sources believe that a significant share of Asian biodiesel exports was allegedly mislabeled as UCO-based, with Indonesia re-routing flows through China and the UK to circumvent countervailing duties. As a result, accusations were made by stakeholders that those benefiting from relatively cheaper prices were sending European physical premiums into a nosedive. Limited trade data disaggregation, which commonly groups all FAME biodiesels under the same Harmonized System (HS) code, prevents the direct causation of fraudulent activity; however, the analyzed excessive influx of biodiesel and UCOME entering into the EU shows a significant correlation with the assessed price dynamics.

Stratas Advisors has identified an unusual influx of biodiesel with Chinese origin entering into the EU. China has an estimated UCOME to FAME export ratio of 50%, amounting to about 1,067 KT of UCOME exports entering the EU and the UK combined in 2023. Malaysia, as the second-largest biodiesel exporter in the region, also plays a significant role in the European biodiesel market. However, its contribution to the downturn in European UCO-based product prices remained limited because of relatively stable level of exports from June 2022 to June 2023. Conversely, available trade data confirms an unusual surge in Indonesian biodiesel exports to China between May 2022 and May 2023, totaling 361 KT, marking a 233% YoY increase. While the effectiveness of Indonesia's circumvention of European trade measures remains uncertain due to product traceability constraints, the significant rise in Chinese biodiesel exports entering the UK, coupled with the increasing UK biodiesel exports to the EU during the same timeframe, seems to indicate the possibility of Indonesia circumventing EU trade measures.

## Appraisal of Export Potential of Palm-Based Products

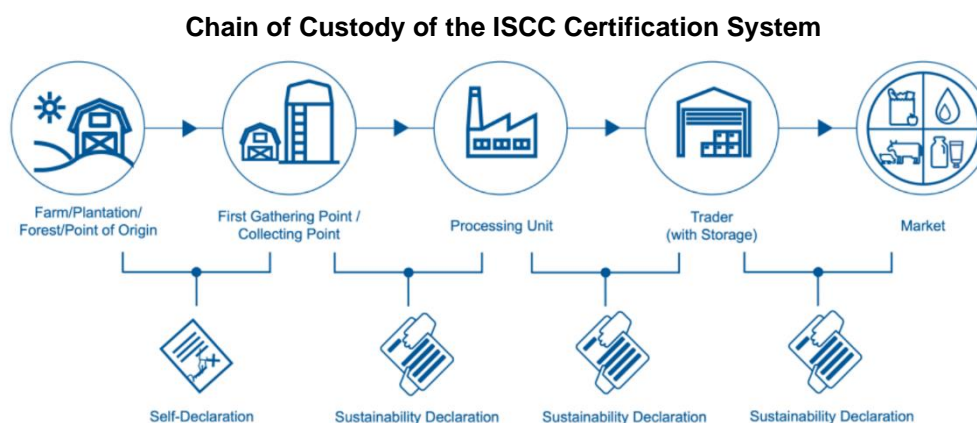
### Prevailing Control Practices by Major Certification Bodies

Biofuels counted towards the EU RED II targets must obtain a 'proof of sustainability' (i.e., sustainability declaration) from any of the 15 European Commission-approved voluntary and national biofuel certification schemes. The ISCC EU, RSB EU, and REDcert-EU are the most widely used certification schemes among Asian UCO and UCOME producers to certify their products when exporting to the European market.

To safeguard independence and prevent conflicts of interest, certification systems generally engage third-party 'certification bodies' (CBs) to conduct on-site and/or desk-based audits to verify the compliance of 'economic operators' along the biomass/biofuel supply chain ('chain of custody') with their scheme requirements. Before the audit, operators are required to provide the CBs with records of their incoming and outgoing biomass/biofuel based on the 'mass-balance' system to guarantee traceability of their materials. Every site belonging to the same company that handles sustainable materials must obtain its own certification and operate its own mass-balance system. Upon successful certification, the operator will receive a certificate carrying the logo of the scheme.

For waste and residues such as UCO, the chain of custody extends from the points of origin (PoOs) (e.g., restaurants or food processing plants), through collection points, feedstock processing units (e.g., UCOME plants), to traders or storage facilities. Individual certification is only compulsory from the first collecting point onwards, as they will provide supporting evidence back to their feedstock suppliers (i.e., PoOs). A list

of all their suppliers, including information on the volumes of material each PoO can provide monthly or annually, must be submitted for verification purposes. CBs will have to verify the existence and reported volumes of a sample of the listed PoOs remotely prior to the audit. The sample size is typically at least the square root of the total number of PoOs on the list. However, this information is not made publicly available for the time being as it is considered confidential or commercially sensitive. PoOs are given the flexibility to participate in the certification system through either individual certification, group certification, or by providing a signed 'self-declaration' to the collecting point. By signing a self-declaration, the PoO declares its compliance with the scheme requirements, confirms the sustainability of the supplied material, and gives CBs access for conducting verifications. CBs are obliged to take samples for laboratory analysis if the PoO opting for self-declaration delivers more than five tons of waste material per month.



Note: Facilities conducting pre-treatment (e.g., filtration) of waste/residues are not classified as processing units.

Source: ISCC

Operators dealing with waste/residues are typically subjected to more rigorous and frequent audits compared to those handling crop-based feedstocks. In line with EU RED guidance, these operators are subjected to a mandatory on-site surveillance audit six months after the initial certification, on top of the annual re-certification audit. Those dealing with both waste/residues and virgin vegetable oil are required to undergo an additional surveillance audit three months after initial certification. In general, the feedstock may be classified as a waste/residue if it is not a direct product of the production process and is not deliberately modified or contaminated to become a waste, such as by the mixing of virgin vegetable oil in UCO. Under the ISCC EU and REDcert EU, if there are reasonable doubts about the nature of the waste/residues, CBs shall be authorized to take samples from waste collectors and/or suppliers for laboratory analysis for clarification. This requirement has been added rather recently, and it is unknown to what extent it has been practiced by CBs.

To improve transparency, the ISCC, RSB, and REDcert, now publish all valid, expired, withdrawn, suspended, and terminated certificates on their websites. This information helps to prevent operators suspended or withdrawn from their certificate to obtain certification from another scheme (known as “scheme hopping”), as CBs are obliged to evaluate the certification history of the operator prior to any audits. Additionally, these certification systems provide information on fraudulent certificates that have attracted their attention, assisting in the identification of counterfeit sustainability claims.

To enhance the credibility of their systems, the ISCC and RSB conduct integrity or witness assessments to monitor and evaluate the performance and compliance of their CBs in carrying out certification-related activities. These checks are commonly based on risk factors such as reports of non-compliance or fraud. In the case of verified fraud or non-compliance, these certification systems may terminate their cooperation agreement with the CB or suspend auditors from conducting audits. In fact, their websites feature a list of authorized CBs permitted to conduct audits, along with CBs and/or auditors excluded from doing so. The CB will have to check the list of excluded auditors on the website when hiring new auditors to conduct audits. However, the lists of excluded CBs and/or auditors are still at an early development stage and rather incomplete.

To prevent non-complying operators that failed the certification audit from changing their CB (known as “CB hopping”), the ISCC ensures the new CB is provided with all past audit records of the operator and informed about specific conditions that may be applicable for its re-certification. Both the new and previous CBs are to cooperate if problems concerning the certification history of the operator arise during the re-certification.

Despite these control practices, current certification systems commonly rely on auditors to verify the self-documentation of operators periodically, without frequent spot checks on the physical material and infrastructure. Even when samples are taken for laboratory tests, detecting adulteration of UCO and UCOME with other products such as palm oil can be challenging due to their similar chemical composition. Hence, it can be relatively easy for UCO collectors and UCOME producers to provide falsified mass-balance records to auditors without detection. For instance, PoOs opting for self-declaration may include fictitious restaurants as a tactic to obscure larger volumes of collected UCO, resulting from the deliberate mixing of virgin vegetable oils. Similarly, UCOME producers may mislabel palm products as UCOME by deliberately omitting palm oil product deliveries from their mass-balance records. These producers may certify the additional ‘UCOME’ they produced multiple times using different certification schemes (“double/multiple claiming”) due to limited data validation between CBs to verify these transactions.

In early 2024, the European Commission announced the publication of the web-based Union Database (UDB), created to track all transactions of operators along the biofuel supply chain up to the European level and therefore eliminate concerns of double claiming. Introduced in January after several delays, the platform has, however, generated some misleading results and is yet to be fully functional. Meanwhile, the NABISY database, which has been operated by the German Federal Office for Agriculture and Food (BLE) for more than 10 years, is limited to tracking biofuel transactions within Germany.

## Aftermath of 2023 Flooding of Asian Origin UCO in Europe

During the first half of 2023, the growing appetite for waste feedstocks heightened the risk of fraud, with suspicions arising that virgin oils, such as palm oil, were being falsely labelled as UCO to benefit from high waste-based feedstock prices in Europe.

In response to the influx of Asian origin UCO-based products into Europe and criticisms around the issuance of a large number of certificates, the ISCC held 70 unannounced integrity audits at randomly selected Chinese and Singaporean biofuel production sites and withdrew or suspended seven certificates from Chinese companies exhibiting unusual trade volumes or doubtful declarations of feedstock after four months of investigation. In addition, since April 2023, the ISCC has added a series of new requirements to strengthen its waste and residues certification system to detect and sanction non-compliant PoOs with immediate effect. The ISCC defines non-compliant activities of PoOs as:

- False declarations of waste/residues
- Failure to meet self-declaration requirements
- Denying auditors access to their premises

Non-compliant PoOs will be immediately removed from the supply base of collecting points and excluded from obtaining individual certification for five years. The ISCC publishes [a list of non-compliant PoOs](#) on its website and requires CBs to verify if operators are supplied by any non-compliant PoOs prior to the audit.

Under the revised ISCC system, if an operator didn't conduct any certified activities in the previous certification period, their scope (i.e., the type of certified operation) must be removed from the new certificate. For example, if an operator didn't collect any feedstock during the mandatory surveillance audit from at least one PoO with a self-declaration, its scope will be revoked. However, the scope can be reinstated if the operator demonstrates expected deliveries from PoOs for the next certification period. Additionally, collecting points must verify the traceability and accuracy of the feedstocks received from PoO.

Meanwhile, REDcert added new measures to tighten its re-certification process. If a certificate gap larger than six months occurs, the re-certification must be conducted in the way of an on-site initial audit. In these cases, auditors will have to retrospectively check for at least 12 months to what extent the operator handled the material in compliance with the regulations during the period it was not covered by a valid certificate. To ensure the audit accurately reflects the current situation of the operator, REDcert requires the audit to be fully repeated if the process has exceeded four months and six months for individual certification and group certification, respectively. In addition, CBs must rotate the lead auditors they assign to audit the same operator after a maximum of three consecutive years to ensure independence of judgement. The CB may request an extension for a maximum of one extra audit if an alternative lead auditor is unavailable.

The RSB added a rule to prohibit its CBs from outsourcing certification decisions and stressed that major or critical non-conformities found during audits would lead to the indefinite suspension or termination of the certificate of an operator. Certification suspension due to a major non-conformity will be immediate in the case of an RSB EU audit. Once the RSB EU certificate has been suspended for over 90 days, it shall be withdrawn unless all major non-conformities have been corrected. Moreover, to increase traceability to the points of origin, the RSB requires first collecting points to:

- Set up a procedure to register new suppliers
- Ensure that all their suppliers understand the RSB requirements and processes
- Maintain an up-to-date register of their suppliers
- Exclude suppliers in the case of non-compliance
- Inform their suppliers about relevant changes to requirements

Furthermore, the ISCC, REDcert, and RSB onboarded their operators and certificates onto the UDB before its official launch on January 15, 2024, and added a new requirement for operators to register their transactions on the database after this date. Based on the UDB guidelines, operators must register their transactions on the database within 72 hours of the traded date/shipment and update the accompanying sustainability certificates before the end of the mass-balance period. CBs are held responsible for verifying



if the entries of operators in the UDB are consistent with the mass-balance records they provide during the audits – discrepancies may result in the suspension of a certificate.

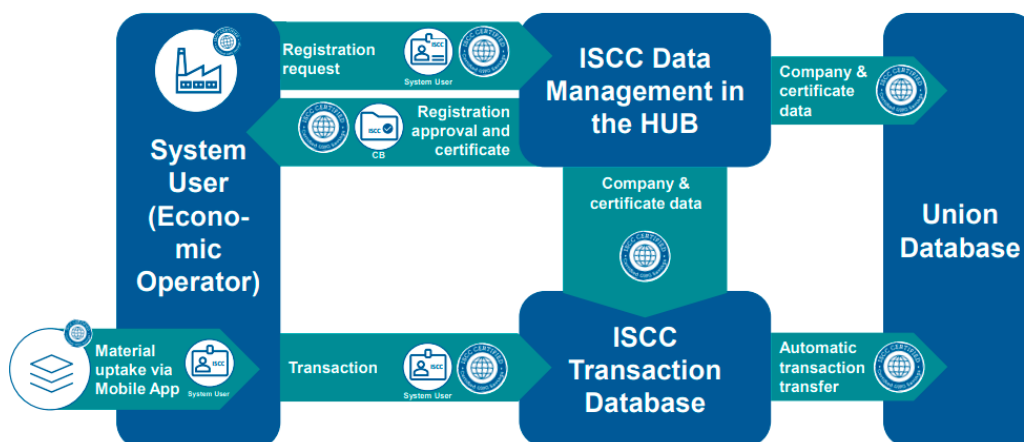
## Forthcoming Initiatives to Address this Emerging Issue

Following the ongoing investigations around purportedly mislabeled advanced feedstocks entering the EU, the ISCC has maintained continuous dialogue with various stakeholders to prevent the recurrence of this situation. It started engaging other voluntary schemes, including RSB, REDcert, 2BSvs, and KZR Inig, to enable a systemic and immediate exchange of their certification-related information and prevent operators from ‘scheme hopping’. These voluntary schemes will also be establishing a collaboration platform to enable regular discussions and harmonization of system updates.

The ISCC is developing mandatory product yield thresholds for specific waste and residues, as has already been implemented for POME and is expected to become a mandatory audit requirement. Implausible quantities of material supplied by the PoOs that cannot be verified will be considered a critical non-conformity and result in certificate withdrawal. To complement this, the ISCC is also creating a mapping tool for auditors to visualize the locations of operators along the supply chain and provide evidence of the distances and travel time between PoOs and collecting points. This is expected to enable auditors to identify uneconomical routes and facilitate detection of false information provided by collecting points and associated feedstock suppliers. Other planned functions include plausibility checks of waste/residue quantities on a regional and national level, and the verification of the existence and reported collection volumes of PoOs.

More recently, the ISCC announced the digitalization of its certification process through the development of the “ISCC Hub”, the “ISCC Transaction Database”, and the ISCC Mobile App. The ISCC Hub, which was the first tool to come online in December 2023, manages the registrations and certificates of operators, such as for CBs to upload issued certificates of operators and operators to register and update their basic information. The ISCC Transaction Database, currently in its first pilot phase, provides an interface for all ISCC-certified operators to upload their sourcing contacts, initiate transactions, convert materials, and manage their stock balance. The ISCC Mobile App enables collectors (e.g., truck drivers) for a collecting point to keep track of their material collection from PoOs in real-time. Collectors will be able to easily record information such as the timestamp of collection, the geo-coordinates of the PoO, and the quantities and types of materials collected in the mobile app in place of manually filled forms or spreadsheets that are prone to error and fraud. When fully operational, the ISCC Mobile App and the ISCC Hub will be interconnected to the ISCC Transaction Database, which is ultimately integrated with the UDB.

### Digitalization of the ISCC Certification Process



Source: ISCC

### Associated Impact on Market Conditions

Stratas Advisors forecasts that uncertainties around the UDB and forthcoming control measures in combatting fraudulent activities are to continue. The reliance of the UDB on inputs from voluntary schemes leaves room for potential flaws, such as inadequate data verification, which could allow fraud to persist. Additionally, the influx of a large volume of transaction data into the UDB presents challenges in processing and managing this information to generate meaningful insights and effectively monitor trade imbalances. Furthermore, uncertainties surround the exact launch date of upcoming ISCC control measures and whether these tools will be harmonized across other certification schemes. There are also increasing concerns about whether users in developing countries will be left behind in the digitalization process. These uncertainties highlight the need for continued vigilance and proactive measures to address potential loopholes and ensure the integrity of the system.

Should any event of mislabeling reoccur, Stratas Advisors believes that it would have more likely taken place at the point of UCOME production rather than during UCO aggregation. Control measures added to certification systems in recent years have mainly focused on tightening the certification of UCO collectors. During the audit of a UCO collector, auditors are obliged to conduct sample inspections on any suppliers providing the collector with more than five tons of UCO per month or suspected of fraud. In addition, since auditors will have to verify the existence and collected volumes of at least a square root of the total number of suppliers, it is much less likely for UCO collectors with a smaller supplier base to include fictitious restaurants as a tactic to obscure larger volumes of collected UCO resulting from the deliberate mixing of virgin vegetable oils. Conversely, audits of UCOME producers emphasize the verification of their mass-balance records and delivery documents and rarely conduct a sample inspection on their incoming UCO feedstocks. However, technically speaking, both UCO collectors and UCOME producers would still have similar chances of mislabeling their products, such as by deliberately omitting palm oil deliveries from their mass-balance records while certifying the additional UCO or UCOME they provide using different certification schemes, an act known as “double/multiple claiming”. This may go undetected due to limited data validation between CBs to verify these transactions and the lack of physical checks on the actual content of their outgoing products, while the UDB struggles to provide reliable results at the current stage.



## Conclusion

Our research indicates that there is a limited correlation between unprocessed UCO trade flows and the unusually low-price environment in the European waste-based market. During the study period, European imports of Asian-origin UCO have consistently declined, as the focus on Asian UCO exports has shifted towards the US to capitalize on enhanced economics following the implementation of the IRA. However, significant concerns arise due to the limited data traceability of certified waste-based biodiesel trade flows, which constrains the development of transparent and timely solutions to ensure fair competition between European and Asian operators.

While available trade data does not allow for establishing direct causation due to constrained product categorization, it does provide substantial evidence of potential misconduct by Asian UCO-based biodiesel exporters, leading European waste-based biodiesel producers to struggle against thin to negative margins. This was particularly evident through an unusual increase in the export of relatively cheaper Chinese UCO-based biodiesel to major European-consuming countries, including the UK, the Netherlands, or Germany. Despite ample UCO availability in Asia, the continued existence of a still robust gutter oil market and deficient supply chain networks cast doubt on the feasibility of sufficient increases in UCOME production to sustain such a substantial export surge over a short period. Additionally, unusual export volumes of Indonesian palm oil-based biodiesel transiting through China and then re-exported to major European ports lend further credence to allegations of potentially mislabeled advanced biofuel imports penetrating the European market. Moreover, the UK appears to play a significant role in this scenario, given its likely involvement in rerouting Chinese biodiesel to the EU due to unusual trade dynamics, resulting from potential circumvention of EU countervailing duties on Indonesian biodiesel.

In addition, concerns of double claiming arise from insufficient data validation to authenticate transactions between CBs and biofuel producers. This situation creates opportunities for potential misconduct by UCOME producers, who may mislabel palm products as UCOME by intentionally excluding palm oil product deliveries from their mass-balance records. Although several certification bodies have suggested implementing stringent control measures and enhancing transparency following the EU's investigation, the effectiveness of these measures in addressing the issue is uncertain, especially in the short term. This is mainly attributed to the slow pace of modernization within the sector and the insufficient resources available for expanding control mechanisms.

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