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Palm oil in disguise?

How recent import trends of palm residues raise concerns over a key feedstock for biofuels

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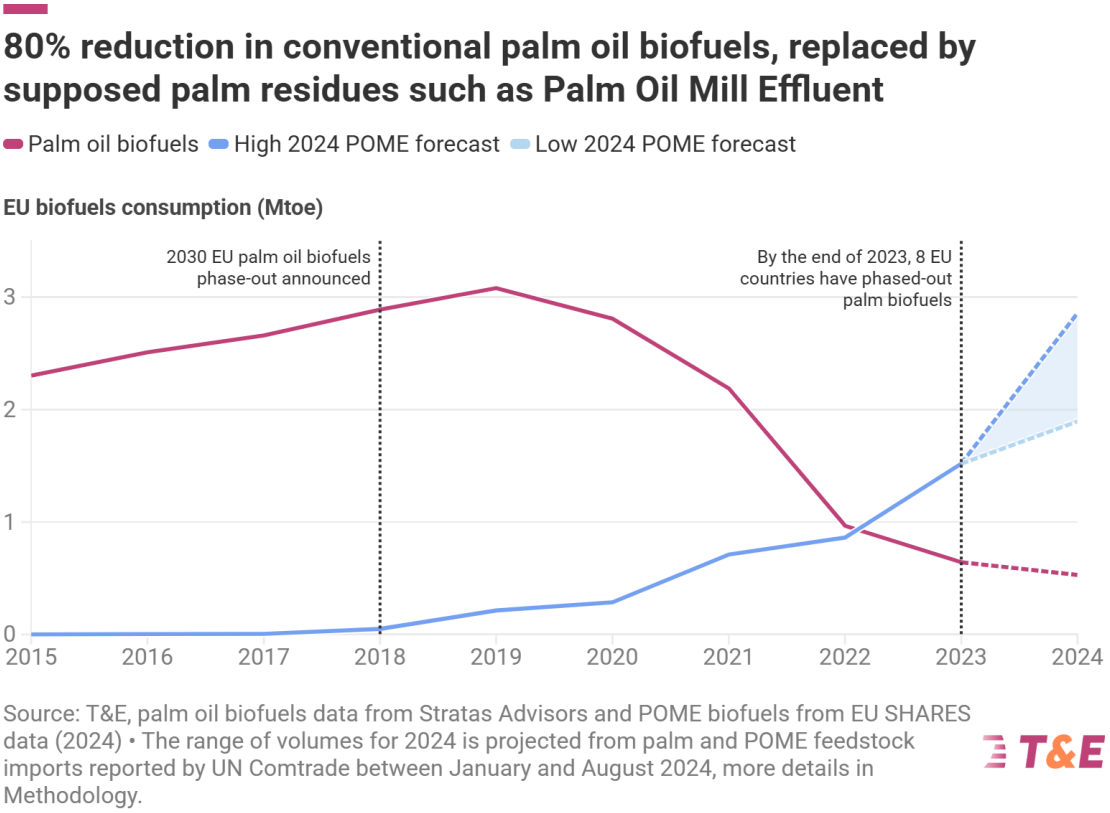
Executive summary

After a decade of biofuel policies contributing to global deforestation, the EU began shifting toward waste-based alternatives like used cooking oil, animal fats, but also palm products, and residues. However, the increasing reliance on these so-called waste materials has raised concerns, particularly over questionable imports. In this report, T&E examines the latest trends in the use of certain palm residues in EU biofuels - Palm Oil Mill Effluents (POME). Data indicate that more palm oil residues are being reported than is actually possible, suggesting a high likelihood of fraud.

Combined EU-wide and early national phase-outs helped reduce our reliance on unsustainable palm oil biofuels

The EU Renewable Energy Directive (RED) initially drove a surge in palm oil biofuels, but the decision in 2018 to phase out these biofuels helped reduce reliance on such damaging commodities. Conventional palm oil biofuel use peaked in 2019 before falling 80% by the end of 2023. Meanwhile, waste-based alternatives have been promoted, like used cooking oil (UCO), animal fats, and residues such as POME, which made up 40% of compliant biofuels in 2023.



Source: T&E, palm oil biofuels data from Stratas Advisors and POME biofuels from EU SHARES data (2024) • The range of volumes for 2024 is projected from palm and POME feedstock imports reported by UN Comtrade between January and August 2024, more details in Methodology.

POME, a wastewater residue from palm oil milling, can cause environmental harm if untreated, releasing methane as it decomposes, which can be captured for biogas production. Its oily

fraction can also be extracted and converted into biofuels, classified as advanced under the RED. Driven by EU biofuels policies, POME biofuels consumption grew fivefold between 2020 and 2023, surging 80% in 2023 alone according to official EU data. Preliminary import data suggest continued growth, with a 90% jump in imported POME volumes in 2024, leading to an expected usage of POME biofuels to reach 1.9-2.9 Mtoe in 2024.

In 2023, nearly two-thirds of POME-based biofuels in the EU were used for Hydrotreated Vegetable Oil (HVO) drop-in fuels, making palm oil residues a significant feedstock for major oil companies like Eni, Repsol, Shell, Total, BP, and Neste, which promote HVO as a low-emission diesel alternative. However, with POME potentially accounting for a quarter of EU HVO consumption, doubts over its true residual nature raise concerns about its environmental benefits.

Spain, Italy, Germany, and the UK were Europe's biggest POME consumers in 2023. POME made up a third of biofuels in Spain, while Italy relied on it for nearly 20%. Germany's POME consumption quadrupled between 2021 and 2022, while industrial waste biofuels saw a sixfold increase in 2023, hinting at possible suspicious shifts in feedstock classification. Ireland's and Belgium's POME biofuel consumption surged 26-fold and 14-fold in 2023, prompting them to join Germany and the Netherlands in urging the EU to investigate fraud and consider restrictions

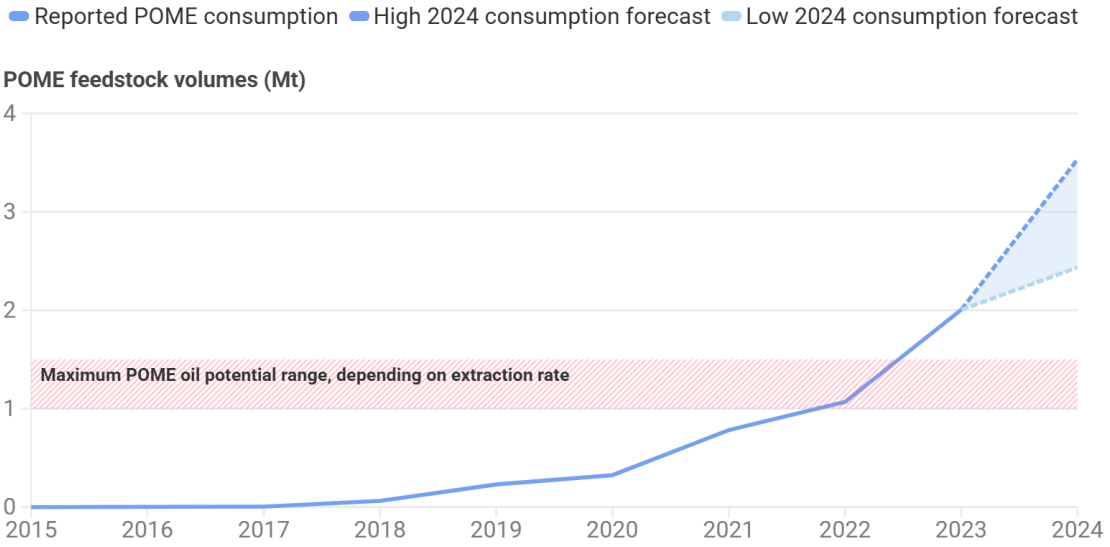
A mismatch between reported palm oil mill effluent biofuels consumption and available volumes raises concerns over fraud

Our analysis highlights that reported POME materials used in EU and UK biofuels reached around 2 Mt in 2023, far exceeding global POME potential estimates of around 1 Mt. Such mismatch suggests that fraudulent practices are likely happening along the biofuels supply chain, as previously flagged by T&E for UCO.

Additionally, we estimate that the actual POME oil production in Malaysia and Indonesia is probably much lower than the maximum potential due to competition with biogas production initiatives in these countries and the likely limited collection across all palm oil mills. This suggests that fraudulent volumes might be even more prevalent in the EU's reported figures, aligning with official statements from Indonesian authorities indicating that exports have been surpassing POME production capacity.

The rapid increase in POME biofuel use in the EU has led to significant economic impacts, with POME prices reaching nearly 90% of palm oil prices by mid-2024, suggesting that a reclassification of POME from residue to by-product may be needed if its value continues to rise. Additionally, the increased use of POME biofuels resulted in over two billion euros in spending in 2023 across the EU, more than double the cost of fossil diesel for the same energy amount, with further increases expected in 2024.

POME use in EU and UK biofuels, nearly double the maximum global potential in 2023



Source: T&E, based on data from EU SHARES, UK RTFO and UN Comtrade • Extrapolated 2024 consumption range based on Jan-Aug 2024 feedstock import increase. Maximum POME potential range based on crude palm oil supply, more details in Methodology. POME biofuels volumes converted to feedstock volumes based on standard yields from GREET.

Finally, despite the EU Commission recognising the high risk of fraud associated with POME biofuels and stricter auditing rules in place since 2022, reports from one of the largest voluntary schemes, the ISCC, also suggest a mismatch between certified POME biofuels volumes and the global potential. Several EU member states, such as Germany or Ireland, have flagged POME fraud risks, discussing the issue in multiple Council energy meetings and proposing stricter enforcement, including removing POME from the advanced biofuels list and rejecting certificates if producers deny inspectors access.

Recommendations

1	Palm oil mill effluent (POME) residues should be prioritised for local decarbonisation efforts in producing countries, especially with emerging uses such as biogas production.
2	POME should be removed from the Annex IX list of double-counted advanced biofuels in the EU Renewable Energy Directive, considering that several EU member states have recommended limiting the amount of POME-based biofuels that can be counted towards the Directive targets.
3	A complete review of the certification system is needed, shifting from industry-led voluntary schemes to more stringent EU and national regulations. National governments should establish supervision procedures, such as cooperation frameworks with third countries.
4	A dedicated EU-level fraud investigation unit that can be triggered by industry whistleblower alerts, suspicious transactions, or suspected market distortions should be established.
5	These recommendations should be complemented with support for cleaner alternatives, with direct electrification preferred for road transport and hydrogen-based fuels for sectors harder to electrify, such as aviation and shipping.

1. The EU has managed to cut damaging palm oil biofuel use, mainly switching to waste and residues

Introduced in 2009 through the Renewable Energy Directive (RED), EU biofuel policies led to an increased reliance on unsustainable feedstocks such as palm and soy which drive indirect deforestation, human rights violations, and food security issues. EU palm oil biofuels consumption reached up to 3.1 million tonnes of oil equivalent (Mtoe) in 2019, according to data from Stratas Advisors. Because of the induced deforestation in producing countries, we estimate that such fuels generated more than 300 $MtCO_{2eq}$ between 2010-2019 in the EU, three times more than would have emitted the equivalent amount of fossil fuels.

In 2018, the revised version of the RED attempted to reduce the share of biofuels with high indirect land use change risks and a delegated act introduced an EU-wide phase-out of palm oil from the RED targets by 2030. Combined with early phase-outs implemented in several EU countries[1], conventional palm biofuels were down 80% in the EU at the end of 2023 compared to 2019, as shown by data from Stratas Advisors.

At the same time, so-called advanced and waste biofuels have been promoted across the EU as more sustainable solutions. Waste oils such as Used Cooking Oil (UCO), animal fats, or some palm residues like Palm Oil Mill Effluent (POME) have been increasing in particular. Such biofuels reached more than 40% of all compliant biofuels in 2023, according to official Eurostat's Short Assessment of Renewable Energy Sources (SHARES) data.

What kind of palm products can be used in biofuels?

While palm biofuels are conventionally derived from Crude Palm Oil (CPO), the main product from palm fruit crushing, other palm products can be used as biofuel feedstocks.

Palm Fatty Acid Distillates (PFAD) are for instance lower quality palm oil by-products resulting from CPO refining for the food sector. Incorrectly considered by biofuels producers as residues to benefit for waste-biofuels incentives, PFADs are associated with similar impacts on deforestation as CPO. While their use in EU biofuels is not explicitly promoted as other advanced and waste materials, PFADs can still count towards RED targets, and their official consumption is not reported.

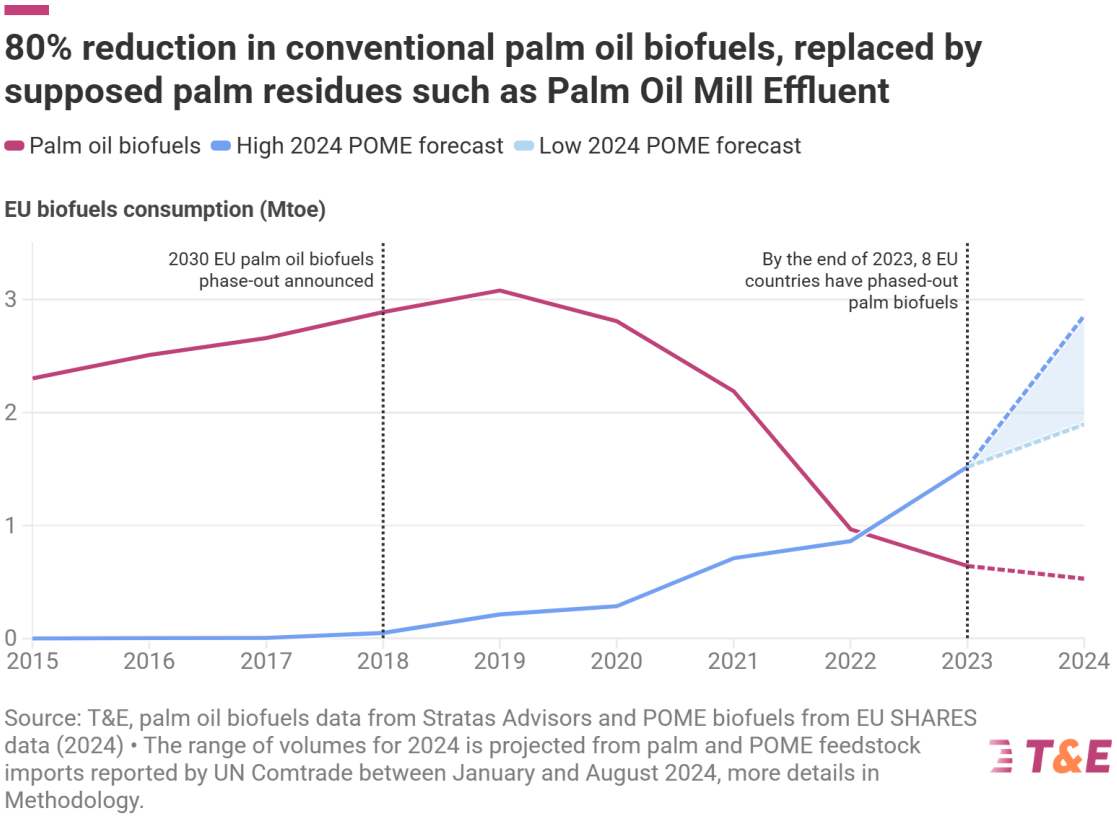
Palm Oil Mill Effluent (POME) is wastewater generated from palm oil milling activities that can be harmful to the environment. Nowadays, such waste is often treated in anaerobic open ponds to limit the hazardous pollution before being discarded, but the decomposition of POME releases methane, which has a significant climate impact. While such methane can be captured for biogas production, the oily fraction of POME can also be extracted and converted into biofuels. Such POME biofuels might provide around 70% emissions savings compared to fossil diesel according to the ICCT.

Finally, Empty Fruit Bunches (EFB) and other palm residues can also be recuperated to produce biofuels, either via extracting some limited oily fractions or through advanced biofuels technologies

[1] Austria, Denmark and France in 2021, Netherlands, Portugal and Sweden in 2022, Germany and Belgium in 2023 as well as Lithuania in 2024.

that are not yet developed at large scale. EFB are [currently partly used] as fertilisers or as heat and power sources in palm mills.

POME and EFB biofuels are included in sub-category (g) in Part A of the RED Annex IX which lists advanced biofuel feedstocks. SHARES data show that POME and EFB biofuels reported by EU Member States have been multiplied by five between 2020 and 2023, while volumes jumped by close to 80% in 2023 only. Preliminary POME [import data] suggest that POME biofuels use has likely been continuing to rise, increasing by 90% in January-August 2024 compared to the same period in 2023. We thus expect that reported POME biofuels might reach 1.9-2.9 Mtoe in 2024. More on our approach and assumptions in the Methodology section.



Source: T&E, palm oil biofuels data from Stratas Advisors and POME biofuels from EU SHARES data (2024) • The range of volumes for 2024 is projected from palm and POME feedstock imports reported by UN Comtrade between January and August 2024, more details in Methodology.

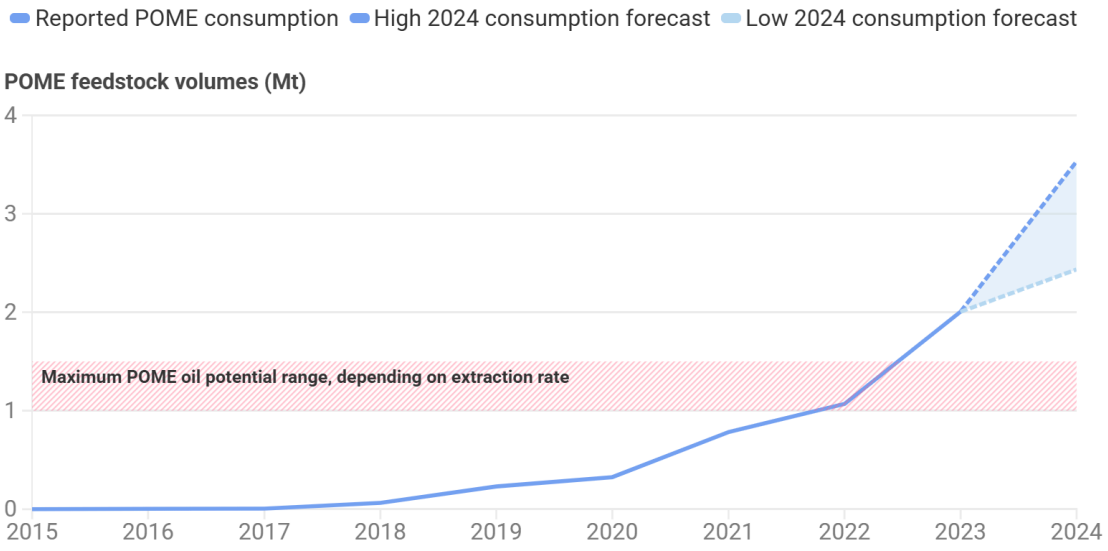
2. POME growing use in EU biofuels, a new sign of potential fraud?

While POME and EFB biofuels are officially reported under the same category, we understand that EFB biofuel volumes are currently very limited because of the advanced and costly pathways required to process such materials. Hence our assumption is that most of the reported 1.5 Mtoe biofuels from SHARES in 2023 are derived from POME oil. Such biofuel volumes convert into approximately 1.7 Mt of POME oil being processed, or 2 Mt when accounting for POME biofuels used in the UK.

In addition, global palm oil supply was around 80 Mt in the past years according to [FAOstat data]. Various sources indicate that palm oil sludge [usually represents] around 2% of the CPO volumes, while 60% of the oily fraction is [typically extracted] and can then be used for biofuel production. This leads to a maximum global POME potential of around 1 Mt today. If extraction rates reached 100%, this potential could theoretically be closer to 1.5 Mt.

As a result, it appears that the reported consumption of POME biofuels in the EU and the UK exceeded the maximum global POME potential in 2023. We expect that this trend continued in 2024 since POME imports kept increasing, as explained earlier. This mismatch between consumption and maximum potential suggests that materials other than POME might have been reported instead, raising suspicions of fraudulent practices as it has already been flagged for UCO.

POME use in EU and UK biofuels, nearly double the maximum global potential in 2023



Source: T&E, based on data from EU SHARES, UK RTFO and UN Comtrade • Extrapolated 2024 consumption range based on Jan-Aug 2024 feedstock import increase. Maximum POME potential range based on crude palm oil supply, more details in Methodology. POME biofuels volumes converted to feedstock volumes based on standard yields from GREET.

Suspicious POME is primarily used in so-called "renewable diesel"

According to Stratas Advisors estimates, almost two-thirds of POME biofuels in 2023 were used in "renewable diesel" or Hydrotreated Vegetable Oil (HVO). Unlike conventional biodiesel, namely Fatty Acid Methyl Esters (FAME), HVO can be used as a drop-in fuel in diesel engines and is more and more often promoted as a clean solution, in particular for the road sector.

Eni's "HVOlution", Neste's "MY Renewable diesel", as well as Repsol, Shell, Total Energies, BP, and other large fuel suppliers' HVO solutions advertise high emissions savings from residual oils turned into biofuels. More and more European countries, including Germany, France, Italy, and Spain, now promote drop-in HVO100 to be used in fleets as well as private diesel cars, with several thousand refuelling stations supplying such fuel across the EU today.

Based on reported POME biofuel usage in 2023, we estimate that such palm residues may have accounted for a quarter of all HVO biofuels consumed in the EU that year. By comparison, data from Stratas Advisors indicate that used cooking oil and animal fats accounted for over half of the HVO used on EU roads in 2023. However, as shown earlier, concerns about whether POME or waste-based biofuels are produced from genuine residual oils cast doubt on the claimed emission savings of promoted HVO solutions across the EU.

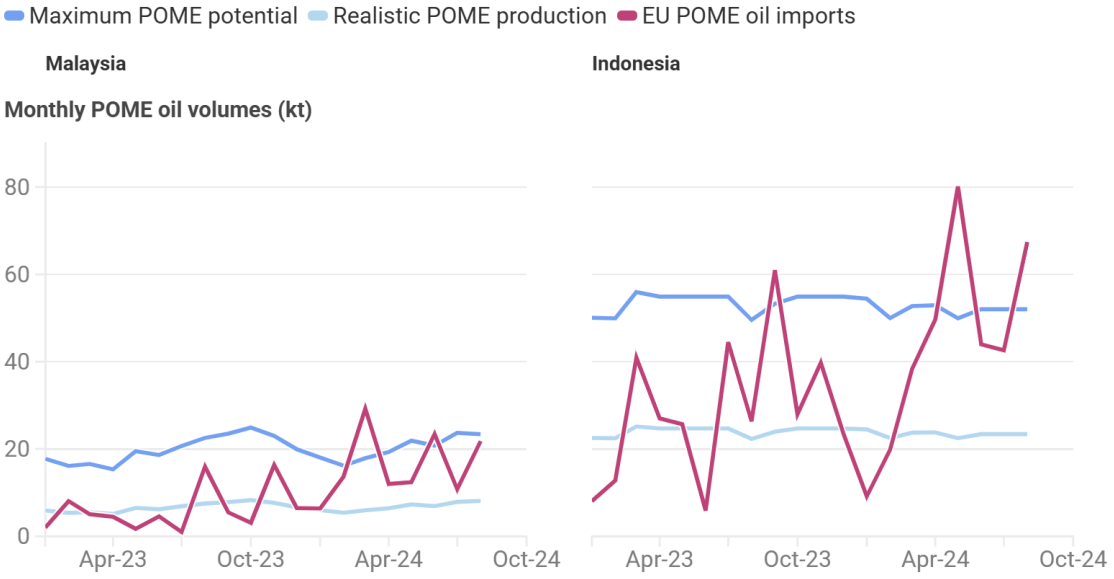
3. POME potential in producing countries likely far from being met

While global maximum POME potential can be estimated from CPO supply, actual production is more complicated to access, as POME oil is today likely not recuperated in all palm oil mills and biogas can also be produced from POME for power or heat generation. For instance, it is estimated that around one-third of Malaysian palm oil mills are currently equipped with biogas capture facilities in POME wastewater treatment plants, thanks to national support for clean power generation and the reduced methane emissions they provide. Biogas recuperation is likely to be more limited in Indonesia, where facilities are located in more remote areas, with estimated 10% of mills being equipped.

Similarly, because POME oil extraction is not the main business of palm oil mills and because POME oil collection is decentralised, it is likely that not all mills recuperate POME today. Indonesian government's estimates mention that the current POME production capacity might be around 0.3 Mt per year, suggesting that only half of POME potential would be collected today.

Combining these different factors, we thus estimate the realistic POME oil supply in Malaysia and Indonesia to be much lower than the maximum potential. Comparing assessed monthly POME supply and EU imports over 2023 and 2024 indicates suspicious trends, where higher imported volumes might be explained by virgin oils being blended in as residues. Such questionable patterns have been recognised by Indonesia's Ministry of Trade, while the USDA estimates that palm oil mixed with POME could have reached up to 1.7 Mt between 2020 and 2024.

Indonesian and Malaysian POME production, likely lower than EU POME imports, without taking into account biofuels imports



Source: T&E, based on available conventional palm oil data from Malaysia's MPOB and Indonesia's GAPKI, POME feedstock imports from UN Comtrade • Realistic POME supply based on estimated collection rate and POME use for biogas production.

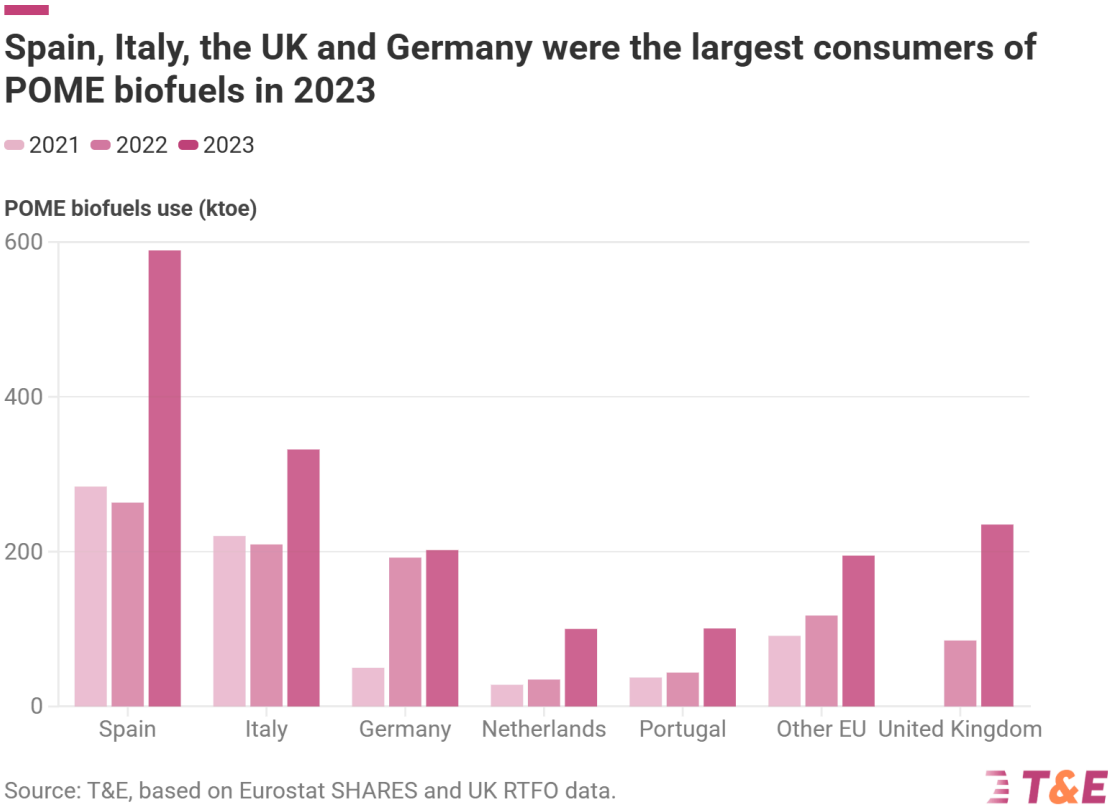
We expect that this mismatch might be greater if imports of refined POME biofuels are accounted for, including from other biofuels producing countries such as China. China has indeed been increasing significantly its imports of palm oil residues since 2023, while increasing its exports of biofuels to the EU, raising concerns over fraudulent practices, as for UCO biofuels.

4. Italy, Spain, and Germany are responsible for three-quarters of the EU's POME biofuels consumption

According to official EU reporting, POME biofuel consumption has particularly been increasing in Spain, Italy, and Germany over the past few years. In 2023, these three countries represented three-quarters of all POME biofuel volumes. Spain alone consumed 40% of EU POME and such palm residues reached one-third of the country's biofuels consumption in 2023. Similarly, in the same year, close to a fifth of Italy's total biofuel consumption was covered by POME.

While POME used in Germany has been multiplied by four between 2021 and 2022, reported 2023 volumes appear to be similar to the previous year. Such a constant trend is surprising given POME and POME-biofuels imports have been reported to be surging in Germany in 2023 by market analysts, leading to a sharp decrease in biofuel ticket prices. However, German biofuels statistics show a six-fold jump in industrial waste biofuels, reaching more than 0.9 Mtoe in 2023. We suspect that such an increase might include some POME or UCO volumes that would be misclassified to benefit from double-counting incentives, given POME biofuels are not double-counted in Germany and UCO volumes are capped.

Ireland and Belgium saw the most significant relative growth in reported POME biofuels consumption, with volumes in 2023 increasing 26-fold and 14-fold respectively, compared to 2022. As a result, these two countries, along with Germany and the Netherlands, formally requested the European Commission to investigate potential fraud and consider limiting the amount of POME biofuels eligible for renewable energy targets during the Energy Council meeting in October 2024.

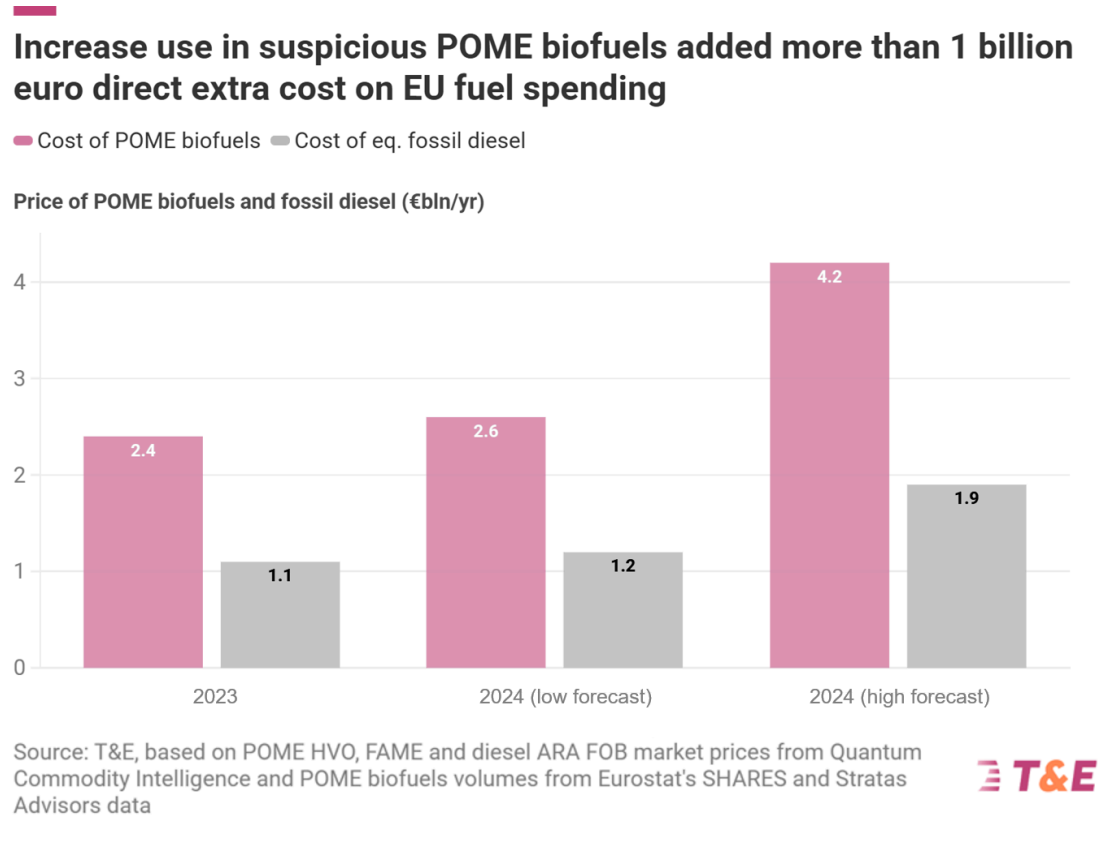


Besides the EU, biofuels statistics from the UK Renewable Transport Fuel Obligation (RTFO) show similar trends with POME biofuels use tripling in 2023 compared to 2022. As in the EU RED, POME is also double-counted towards the UK renewable energy targets, providing a significant incentive to classify biofuels under this category, which increases the risk of fraudulent practices.

5. Suspicious POME biofuels, an economic burden

The suspicious jump in POME biofuel use across the EU also came with significant economic impacts. Induced by EU incentives for waste-based biofuels, the high demand for POME biofuels led to a progressive increase in average POME market prices throughout 2023 and 2024. In addition, POME prices reached close to 90% of palm oil spot prices in the first half of 2024 according to data from Quantum Commodity Intelligence. Such a narrow gap needs to be carefully monitored as high demand and high prices for POME might require a reclassification from residues to by-products if POME becomes as valuable as conventional palm oil, as it has already been discussed for PFADs.

Moreover, combining average POME-based FAME and HVO prices with reported volumes in the EU, we estimate that the increased use of POME biofuels cost exceeded two billion euros in 2023, more than twice the fossil diesel bill that would have been spent for the same amount of energy, excluding taxes. We foresee that such additional spending caused by suspicious POME biofuels might even be greater in 2024 according to UN Comtrade import data.



Finally, more recent trends suggest that POME market spot prices might reach close to 1000 $/mt, as a result of the Indonesian government implementing higher duties on POME and UCO exports in September 2024. Such new taxes are now based on CPO price reference and aim to prioritise national feedstock to meet increasing domestic biofuel mandates, as well as to prevent traders from mislabelling CPO as POME which previously benefited from lower taxes.

6. Certification and the high risk of fraud

Certification verifies whether a biofuels product, like POME, complies with the sustainability criteria defined in renewable fuels policies, such as RED in the EU and RTFO in the UK. All biofuel operators along the supply chain must be certified by independent, recognised voluntary schemes or national certification schemes enabling them to produce "proofs of sustainability" for their biofuels to count towards renewable energy targets. However, in practice, these schemes are industry-led entities that work independently from EU and national authorities. Furthermore, the certification process is primarily based on auditing paperwork including self-declarations of compliance, to verify whether the biofuels product is sourced and processed sustainably. Importantly, this means that chemically or physically testing the biofuels product is not a mandatory criterion for certification to be granted. Certification is the primary means currently used at the EU level to determine if a biofuel product is authentic and not fraudulent.

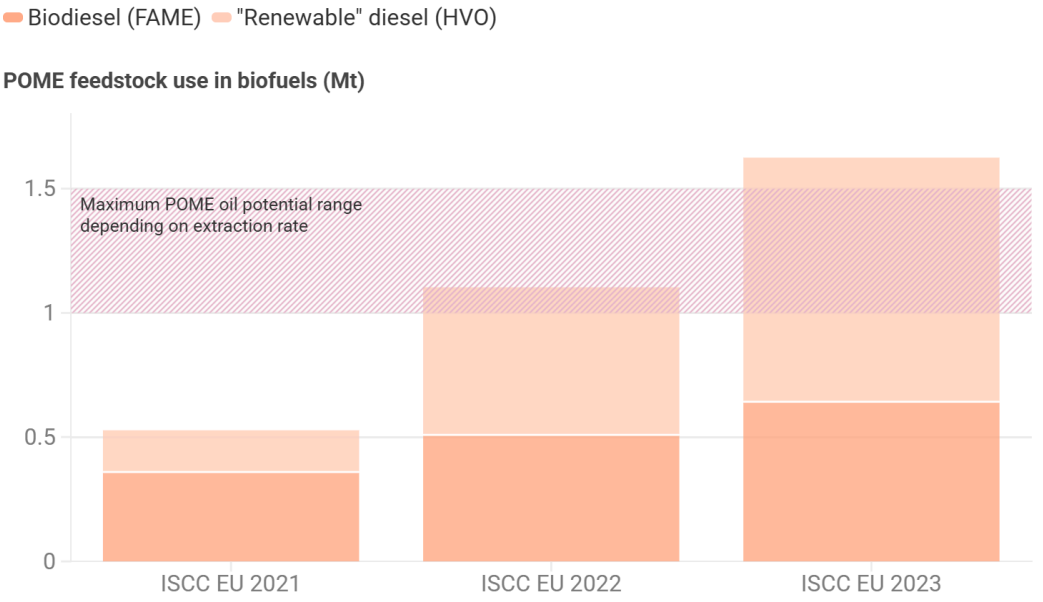
The European Commission's report on the assessment of advanced feedstocks defined POME as having a high risk of fraud. The report states this is because different materials can be altered to appear as POME and because the feedstock is not uniformly defined across all regions where it is traded, with several different labels being used, such as Palm Sludge Oil, Minyak Kolam, Palm Acid Oil, and POME.

The issue of POME fraud has been recognised by one of the largest voluntary schemes, International Sustainability and Carbon Certification (ISCC). After receiving stakeholder feedback in 2021 to adjust the auditing process of palm oil mills to better reflect the risk of POME fraud, ISCC agreed to no longer allow POME sources to be certified based on self-declarations. Since 2022, all palm oil mills generating and supplying wastes and residues as sustainable under ISCC must now be individually certified and audited on-site annually.

Despite this, ISCC annual reports to the EU Commission suggest similar trends as shown previously in this report. POME volumes used in biodiesel and HVO certified under the ISCC EU voluntary scheme likely exceeded the maximum global POME oil potential, even without accounting for likely lower actual supplied volumes, as explained in Section 3. Some voluntary schemes, like RSB, did not provide any data on certified biofuel feedstocks, while others reported only minimal POME biofuel volumes[2]. For example, REDcert and 2BS VS were the only other schemes to report POME biofuels, collectively accounting for less than 4% of ISCC volumes.

[2] Based on official reports updated on February 4 2025.

Reported POME biofuels volumes under ISCC EU voluntary scheme likely exceeeds maximum POME potential in 2023



Source: T&E, based on data from ISCC reporting to the EU Commission (2025) • FAME and HVO volumes converted to feedstock volumes based on standard yields from GREET.

Finally, fraud concerns have been raised by EU member states, with Ireland, Germany, Belgium, and other countries discussing POME fraud and the increase of POME consumption in their countries during the Council of the European Union's energy meeting in October 2024. At a previous Council energy meeting in May 2024, the issue of fraud was also raised, with member states, such as France, Germany, and the Netherlands, proposing that biofuel producers' certificates should be rejected if they refuse access to the premises, of any nature, to the inspecting entities of the competent authorities of the member states. Ireland also announced to end incentives and restrict the use of POME in biofuels.

A total revision of the certification system is needed, shifting from industry-led voluntary schemes to more stringent EU and national regulations. Meanwhile, a dedicated EU-level fraud investigation unit that can be triggered by industry whistleblower alerts, suspicious transactions, or suspected market distortion should be established.

Methodology

1. POME biofuels consumption estimates

POME biofuel use data are taken from Eurostat SHARES database under Annex IX, Part A, sub-category (g), assuming that EFB biofuel use is very limited today in the EU. Such assumption can for instance be verified in Spain, the EU largest POME biofuel consumer, where POME and EFB are reported separately and respectively accounted for 30% and 3% of the country's biofuels volumes in 2023. UK RTFO data shows similar trends, with only 3 ktoe of EFB biofuels reported in 2023, compared to 240 ktoe of POME biofuels. Unlike POME biofuels that rely on conventional processes, EFB biofuels are indeed still limited because of the costly and energy-intensive advanced biofuels technologies required, such as pyrolysis.

2024 EU POME biofuels consumption has been estimated based on available EU POME import data from UN Comtrade between January and August 2024. Our lower end forecast only accounts for the additional POME oil volumes being imported in 2024 on top of the reported 2023 POME biofuel consumption. Our higher end forecast assumes that the 2024 POME biofuel use has been increasing proportionally to the increase of POME oil imports. Such an approach suggests that refined POME biofuel imports would have been increasing similarly as feedstock imports. HVO and FAME shares have been assumed based on Stratas Advisors 2023 Global Biofuels Outlook estimates. Typical FAME and HVO processing yields of 91% and 85% have been respectively assumed to convert POME imports to biofuels volumes from GREET.

2. POME imports

POME imports to the EU have been analysed through reported volumes under HS code 152200 in UN Comtrade data. Such HS code is the most frequently used code for POME exports from palm producing countries. However, POME shipments might also be reported under HS code 230660 with other residues, which volumes have not been accounted for.

It is worth noting that a significant mismatch between EU POME import data and palm producing countries POME import data can be observed for HS code 152200. This might indicate that POME is exported under a certain HS code and imported under another HS code, again raising suspicions over the authenticity of these so-called residues.

Finally, imports of already refined biofuels produced from POME oil have not been accounted for given the complexity of estimating the volumes of the feedstocks being used for FAME or HVO exports.

3. Estimate of POME potential and production

As explained in Section 2, global POME potential has been estimated based on global palm oil production, assuming palm oil sludge supply to be 2% of CPO supply and a 60% oil extraction rate, following the ICCT's approach. Other sources mention that 3 to 3.5 tonnes of POME wastewater is typically produced per tonne of CPO, with a 0.6-0.7% oily content, also leading to around 2% of POME oil per unit of CPO produced. Argus analysts come to similar POME potential figures, with close to 0.8 Mt in 2023.

Monthly POME production figures have been derived from monthly palm oil supply data from the Malaysian Palm Oil Board and extrapolated from Indonesia's GAFKPI press releases, assuming constant outputs for missing monthly data points.

Realistic POME production volumes have been estimated assuming that the share of POME volumes used for biogas production is proportional to the share of palm oil mills equipped with methane capture facilities. As detailed in Section 3, we assume that respectively 30% and 10% of Malaysian and Indonesian palm oil mills produce biogas. We also assume that half of the remaining palm oil mills collect POME oil today, based on statements from Indonesian officials, which might be on the optimistic end according to exchanges with palm oil experts.

4. Economic spending

The gap between POME and palm oil prices was analysed based on Malaysian POME and Refined Bleached and Deodorised (RBD) palm Free On Board (FOB) prices from Quantum Commodity Intelligence (QCI).

POME biofuels prices used to estimate total spending in 2023 and 2024 were based on available POME HVO ARA FOB and Annex IX Part A FAME ARA FOB spot prices from QCI. QCI POME biofuels spot prices were only available starting from June 2023. Because specific POME FAME prices were not available, Annex IX Part A FAME prices were used and specifically refer to biodiesel volumes with a Cold Filter Plugging Point (CFPP) of 0°C, which could slightly overestimate actual POME FAME spot prices.