



Carbon footprint of diesel from used cooking oil (“UCO”)

**New study reveals the real total emissions
of HV0100 and co.**

Background

Fill up on old chip fat to protect the climate? With this promise, the industry and politicians are promoting diesel made from used cooking oil and other “waste and residues” as a sustainable solution for the future. Used cooking oil (“UCO”) is processed in large quantities into “bio” diesel, currently mainly into conventional biodiesel (fatty acid methyl ester / “FAME”) but also into “HVO” (hydrotreated vegetable oils). After industrial waste, UCO is currently the most common residual material to find its way into German fuel tanks.¹

Since May 2024, HVO in its pure form is permitted to be sold in Germany as HVO100. In Europe, a quarter of HVO is already produced from used cooking oil.² In Germany, two thirds of HVO currently comes from palm oil residues – but their use is to be politically restricted from 2026. Biogenic diesel, especially HVO from chip fat, is often touted by the industry and some politicians as a sustainable alternative to fossil diesel. German fuels, especially FAME, the classic “bio” diesel, but also HVO, already contain significant levels of used cooking oil.

These fuels are considered to be particularly climate-friendly: Officially, 88% and 87% fewer greenhouse gas (GHG) emissions are reported compared to fossil diesel.³ A new study by the Institut für Energie- und Umweltforschung (ifeu) on behalf of Deutsche Umwelthilfe (DUH) now disproves the climate-friendly image of biogenic diesel fuels such as HVO.

What is the study about?

The study examines whether these high CO₂ savings are actually true from a macroeconomic point of view – or whether the fuel only looks good on paper.



Important results

1. What normally happens with UCO?

Used cooking oil is not thrown away – it is used in heating fuel, lubricants and cleaning agents, for example. If these oils are used for transport fuel, their potential use elsewhere is lost. As a result, fossil raw materials or fresh vegetable oil (e.g. palm oil) are often used in the aforementioned alternative applications (Fig. 1).

2. Where does UCO come from?

A total of 89% of the used cooking oil used for biogenic diesel in Germany is imported. Around half of the used cooking oil for fuels in Germany comes from Asia, primarily China, Indonesia and Malaysia. However, in those countries long-established uses for used cooking oil already exist; the volumes of used cooking oil that end up in German fuel tanks are therefore not collected specifically for fuels in Europe, but are withdrawn from existing uses. As a result of the UCO export, there is a gap in these countries, which is usually filled by palm oil. Palm oil is cheap, but ecologically highly problematic (s. info box “The destructive effect of palm oil”). In principle, this also applies to imports from countries outside of Asia, i.e. primarily from Europe: Used cooking oil has sufficient potential uses in all export countries and is not “lying around” unused. Moreover, both the tapped and untapped potential is limited.

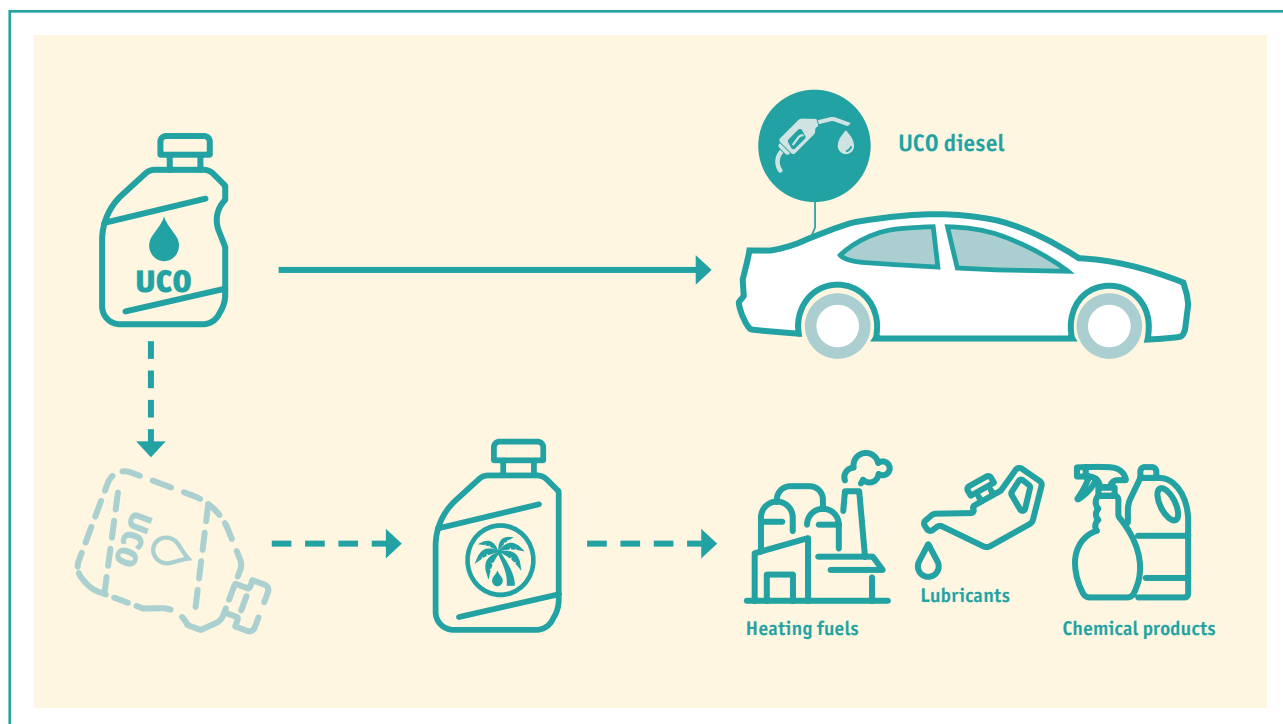


Fig. 1: When used cooking oil (UCO) is used for diesel, it is no longer available for other applications and is often replaced by palm oil

3. What does this mean for the actual carbon footprint?

- » If used cooking oil is processed into HVO and FAME, this does not save any net emissions, even if based on the official calculation logic with an assumed “GHG reduction” of over 80%.
- » If the export of used cooking oil triggers additional demand for palm oil in the exporting country, HVO and FAME from used cooking oil are more harmful to the climate than fossil diesel. This is because the climate and environmental impacts associated with palm oil cultivation lead to higher CO₂ emissions than are supposedly saved through the use of diesel produced from used cooking oil.

4. Why does UCO diesel not result in CO₂ savings or leads to more CO₂?

From a macroeconomic perspective, i.e. in reality, HVO100 and co. have no climate benefit or may even have a negative climate effect:

- » No climate benefit: The claim that HVO and FAME from used cooking oil cause over 80% less greenhouse gases than the fossil alternative is only true under specific circumstances that do not reflect real-world conditions. It only applies if the used cooking oil is newly collected and has not previously been used for any other purpose. In reality, however, used cooking

oil is already being utilised, e.g. as a heating fuel for energy generation to substitute fossil heating oil or it is processed into cleaning agents. In this application, the use of used cooking oil already saves CO₂ by replacing fossil raw materials. If the used cooking oil is instead processed into HVO and other fuels and CO₂ is saved compared to fossil diesel fuel, but this used cooking oil is then missing somewhere else, the bottom line is that UCO fuel has no climate benefit. The potential savings that already exist from using used cooking oil for other applications simply move from the left pocket to the right pocket when it is used as fuel. There are no additional savings. This is because a certain amount of used cooking oil can only reduce emissions once. The allegedly enormous greenhouse gas savings from HVO and co. from chip fat are therefore merely fiction. Depending on the alternative use, the result is even clearer: If you want to achieve maximum emission savings with used cooking oil, it is more beneficial, for example, to replace fossil heating oil for generating energy and heat (Fig. 2).

- » Negative climate effect: The officially reported savings of 87% and 88% only apply if the replacement effects and displacement effects are ignored. If more used cooking oil is put into transport, there will be a shortage elsewhere. This gap is often filled by palm oil, the cheapest vegetable oil, or by fossil raw materials. The ifeu study shows that fuels made from used cooking oil, which trigger increased use of palm oil in other sectors, are even more harmful to the climate than fossil diesel. This is because more CO₂ is emitted overall than if the used cooking oil had not replaced the fossil diesel in the tank in the first place (additional emissions of 12 g for HVO and as high as 14 g CO₂ Eq per MJ UCO for FAME).

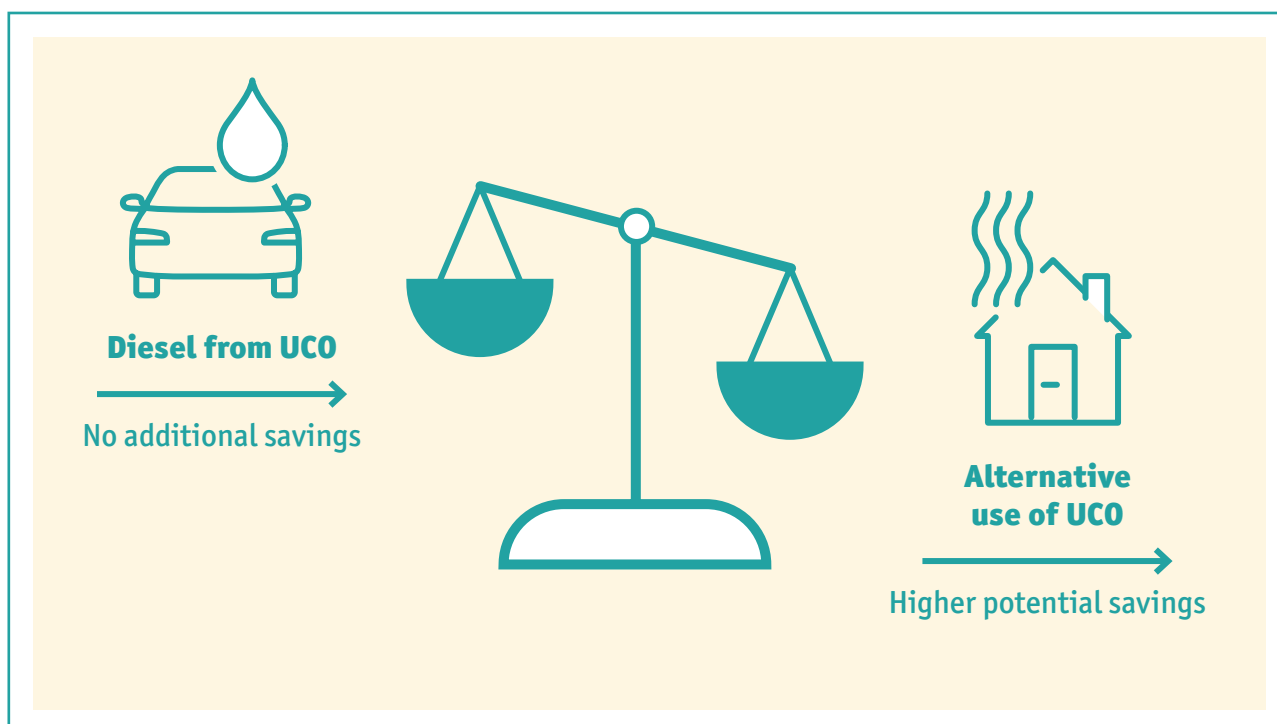


Fig. 2: HVO100 and FAME from UCO do not benefit the climate

Calculation

The study calculates that 87.7 g CO₂ Eq are emitted per 1 MJ of palm oil. This contrasts with emissions of 0.2 g CO₂ Eq for the provision of 1 MJ of used cooking oil. The latter must be deducted when calculating the total emissions of diesel from used cooking oil. This takes into account the emissions that would result from the use of used cooking oil if it were not replaced by palm oil. In total, additional emissions of 87.5 g CO₂ Eq remain due to the caused palm oil production.

If we therefore assume a saving of 75.6 g CO₂ Eq for HVO from used cooking oil calculated in accordance with RED III, emissions of just under 12 g CO₂ Eq remain, taking into account the increase in emissions from the additional production of palm oil (Fig. 3). If the same calculation is made for FAME from used cooking oil, there are even additional emissions of over 14 g CO₂ Eq.

- » The calculation of emissions from palm oil includes emissions resulting from the release of methane from palm oil mill effluent (POME) during production as well as emissions from direct and indirect land use change (iLUC). Direct land use change means that an area is newly cleared for the cultivation of palm oil plants and this new area can be assigned to a specific use, e.g. agrodiesel production. Indirect land use change refers to the effect whereby expansion of plant cultivation for fuels displaces production for other purposes, e.g. for food and animal feed, to previously uncultivated land. This results in the cultivation of further areas, e.g. by clearing forests. The EU has identified palm oil as having a particularly high risk of iLUC and as a key driving factor for the loss of high carbon stock land.

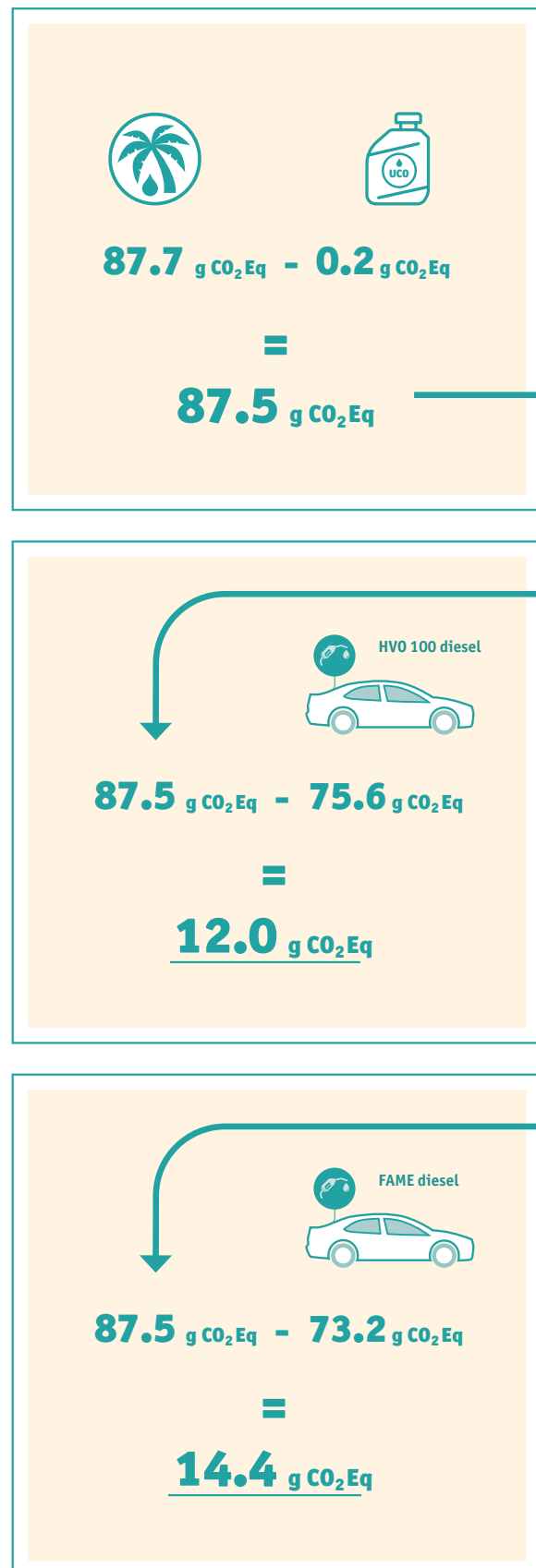


Fig. 3: Calculation of the increase in emissions (slight discrepancies in totals due to rounding of decimal places)

The destructive effect of palm oil

Palm oil is extracted from the fruit of the oil palm and is considered the most commonly used vegetable oil in the world. Production is ever increasing. However, as soon as oil palms are grown on newly cleared areas, the cultivation of palm oil is considered to be extremely harmful to the climate.

As oil palms grow almost exclusively in rainforest regions, millions of hectares of vital rainforest have already been irreversibly and in some cases illegally cleared. This not only fuels global climate change, because deforestation causes carbon stored over thousands of years to escape (Fig. 4). It also contributes to the displacement of the indigenous population, the destruction of natural habitats and the loss of biodiversity.

In Indonesia alone, the world's largest palm oil producer, there are now around 16 million hectares of

palm oil plantations. This is equivalent to almost half the area of Germany. The decline in around 400 animal species is associated with the loss of habitat due to the expansion of oil palm plantations. Of these, 193 animal species are considered endangered, critically endangered or threatened with extinction.

Palm oil in the form of fuel can be up to three times more damaging to the climate than fossil diesel⁴.

Since 2019, the EU has therefore classified fuels made from palm oil as having a high risk of causing environmental damage. The EU Member States must end incentives completely by 2030. Palm oil should therefore no longer appear in EU fuel tanks. De facto, however, the European market is still full of palm oil, hidden in alleged "waste and residues" and in industries other than transport.

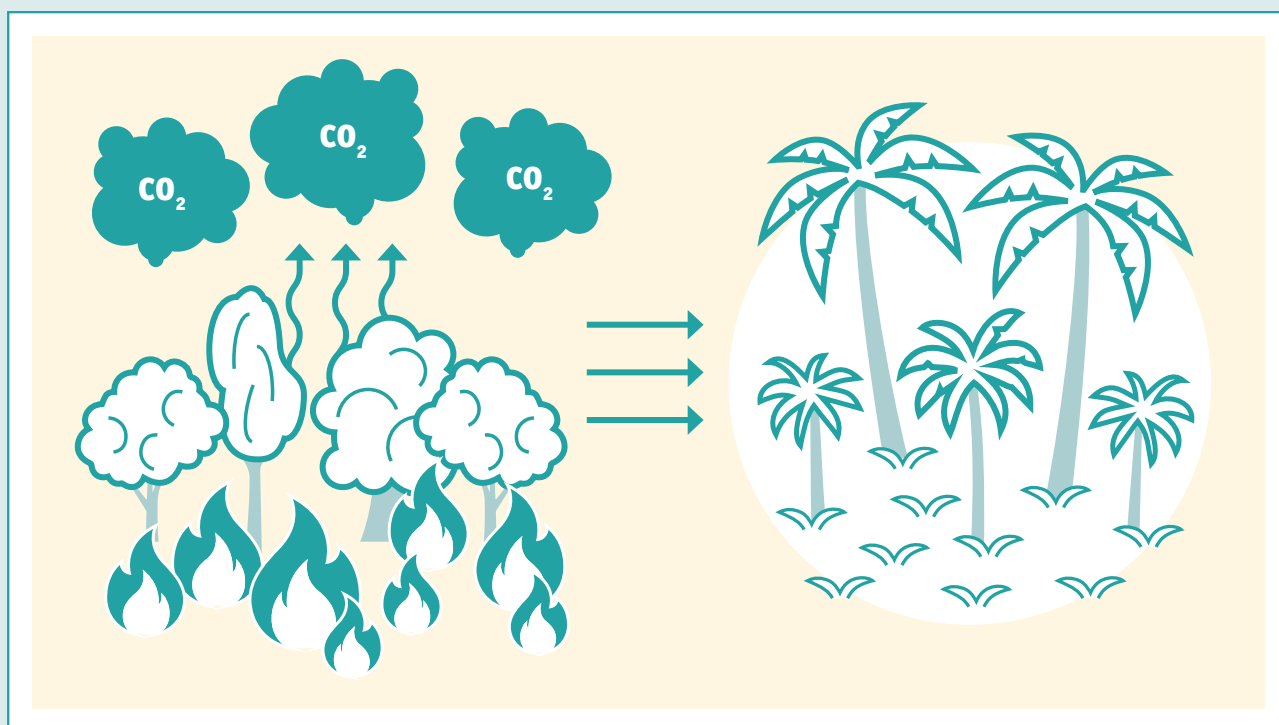


Fig. 4: Release of greenhouse gases through deforestation for oil palm cultivation

5. Additional problems

There are numerous indications of fraud: Fresh palm oil is declared as “used cooking oil” in China so that it can be brought to Europe as climate-friendly fuel. This further distorts the market. The alternative uses and displacement effects for diesel from used cooking oil presented in the study already mean that the climate benefit is zero or even negative. If we now take into account the falsely declared volumes of “used cooking oil”, which probably contain palm oil, the carbon footprint becomes even worse.

Furthermore, used cooking oil is not the only culprit. In Germany in 2023, there was a sharp increase in fuels from industrial waste, mostly from China, which were imported without sufficient evidence

of origin⁵. It is completely unclear which raw materials are contained in this industrial waste.

Palm oil mill effluent (POME) is also a popular raw material that is particularly promoted by the EU⁶. The risk of fraud is particularly high here and there is increasing evidence that POME has been imported into the EU on a massive scale with false declarations. According to a recently published study, twice as much POME fuel was reported in Europe than there can possibly be in the world⁷.

Ultimately, the volume and type of raw materials contained in HVO and “bio” diesel in general are crucial to their carbon footprint. In reality, however, many of the raw materials currently in use are highly problematic.

Conclusion

The use of fuels such as HVO100 from used cooking oil, which is being promoted by industry and some politicians as a solution for the future, does not help the climate – and can even harm it once all effects are taken into account. In addition, the raw materials available are very limited. Therefore, even beyond the sustainability concerns, HVO and FAME diesel can hardly be described as a solution for transport.

Eight times more used cooking oil was consumed than collected in Europe in 2023⁸; the majority was imported. And the demand for used cooking oils continues to rise in the market, including in the aviation industry⁹. However, unlike road and rail transport with electrification, many of the sectors demanding these resources have little or no alternative to residual feedstocks.

Policymakers should therefore abandon the mass use of “waste and residues” in road and rail transport and adjust subsidies aimed at this, such as the German GHG quota (“THG-Quote”), accordingly.

Endnotes

- 1 Evaluation and experience report by the Federal Office for Agriculture and Food (BLE) for the year 2023 (BLE 2024).
- 2 Briefing "Unknown Cooking Oil", Transport and Environment, June 2024, available at: <https://www.transportenvironment.org/articles/uco-unknown-cooking-oil-high-hopes-on-limited-and-suspicious-materials>, last accessed on 06.08.2025.
- 3 Savings of 87.16 % (HVO) or 88.38 % (FAME) from waste and residual feedstocks according to BLE 2024.
- 4 The possible range of emissions from agrodiesel from palm oil is wide. The actual emissions depend heavily on how many emissions are generated during production from the release of methane from palm oil mill effluent (POME). While hardly any methane release is prevented in Indonesia, Malaysia, for example, is already much further ahead. In addition, the carbon footprint depends on how high the emission effect of indirect land use change is assumed to be.
- 5 According to the German government, there was no verification of origin (audits) despite them being required as part of the prescribed certification procedure: see the Federal Government's response to the written question submitted by the CDU/CSU parliamentary group, Parliamentary Document 20/7103, available at: <https://dserver.bundestag.de/btd/20/073/2007327.pdf>, last accessed on 06.08.2025.
- 6 Both POME and industrial waste are classified as "advanced biofuels" by RED III, Annex IX Part A.
- 7 Report "Palm Oil in disguise?", Transport and Environment, March 2025, available at: <https://www.transportenvironment.org/articles/palm-oil-in-disguise>, last accessed on 06.08.2025.
- 8 Briefing "Unknown Cooking Oil", Transport and Environment, June 2024, available at: <https://www.transportenvironment.org/articles/uco-unknown-cooking-oil-high-hopes-on-limited-and-suspicious-materials>, last accessed on 06.08.2025.
- 9 To fulfill the Sustainable Aviation Fuel (SAF) quotas according to the ReFuelEU Aviation, Regulation (EU) 2023/2405.

Design

DUH & Stephanie Kaiser, www.stephaniekaiser.de

Cover picture

Assembly DUH & Stephanie Kaiser

Picture credits: Kultivat / Adobe Stock, AI supported

Status: 06.08.2025



Deutsche Umwelthilfe e.V.

Head office Radolfzell
Fritz-Reichle-Ring 4
78315 Radolfzell
Tel.: 07732 9995-0

Head office Berlin
Hackescher Markt 4
10178 Berlin
Tel.: 030 2400867-0

Contact persons

Caroline Tiefenbach
Policy Advisor Transport & Air Pollution Control
Tel.: 030 2400867-764
E-Mail: tiefenbach@duh.de

Kathrin Anna Frank
Team Leader Food and Land Use
Tel.: 030 2400867-884
E-Mail: frank@duh.de

<https://www.duh.de/englisch/>

info@duh.de



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