BRIEFING - FEBRUARY 2025

Shipping: Fuelling deforestation

Why the IMO's Global Fuel Standard risks incentivising the worst biofuels

Summary

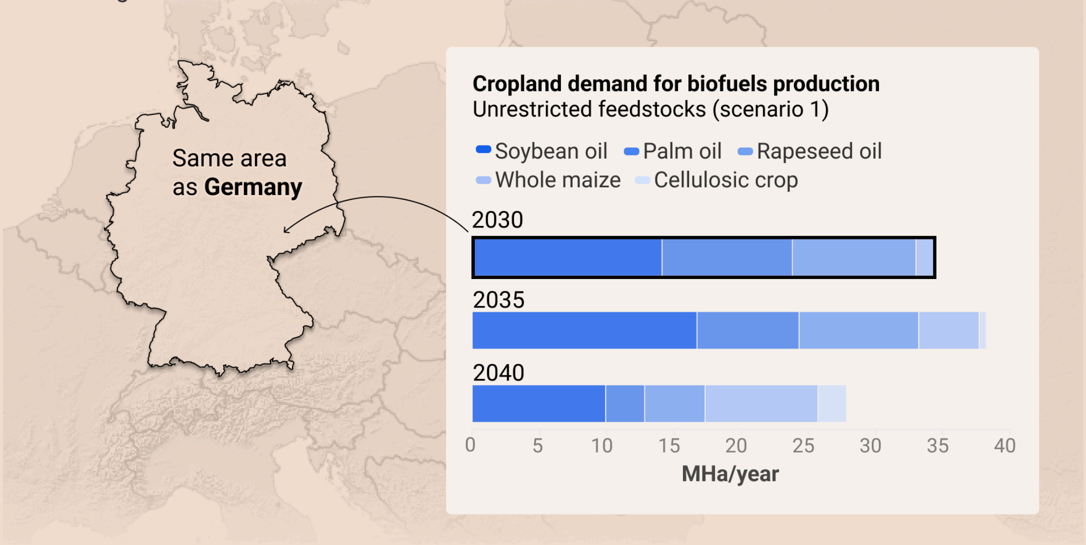
The International Maritime Organization (IMO) has set ambitious targets to achieve net-zero emissions by/around 2050, however, the specifics to reach that objective remain to be decided. One approach is to incentivize ships to switch to alternative fuels via the Global Fuel Standard, but in the absence of clear criteria on biofuels, this framework could worsen shipping's climate impact.

Nearly a third of global shipping could run on biofuels in 2030. Palm and soy oil could make up nearly two-thirds of the biodiesel used to power the shipping industry in 2030 as they represent the cheapest fuels to comply. This is a problem as palm and soy oil-based fuels are associated with indirect land use change emissions which makes those fuels' climate impact worse than heavy fuel oil – the typical shipping fuel used today. In total, the **GFS could result in an additional 270 Mt CO2e emissions in 2030 compared to the current fossil fuel mix.**

The study shows that a biofuel-dependant shipping industry would need vast amounts of farmland. Around 35 million hectares in 2030 -- the total area of Germany – could be needed to produce enough crops to meet the increased biofuels demand from the shipping industry.

Shipping's 2030 global biofuel demand could require an area the size of Germany

Assuming that all feedstocks are allowed to contribute



Source: T&E (2025) & Cerulogy (2025)

Many in the shipping industry state that they will use waste biofuels instead such used cooking oil, animal fats, or agricultural residues. But waste biofuels will only be able to cover a small proportion of shipping's projected biofuels demand as their availability is limited.

1. Context

As part of its 2023 GHG Strategy, the IMO agreed to deliver a package of rules that will compel ships to reduce their climate impact to eventually reach net-zero emissions by or around 2050. Achieving this objective partly rests on the Global Fuel Standard (GFS), a framework that will compel ships to gradually switch from fossil fuels to cleaner alternatives by meeting GHG intensity targets on their energy use.

Considering that some biofuels are already commercialised, fuels such as biodiesel, biomethane and biomethanol produced from crops and waste material are likely to be the first alternative shipowners will turn to to reduce their GHG emissions. This trend could continue if IMO member states fail to agree on early political and financial incentives to promote green e-fuels within the GFS or enforce energy efficiency measures.

While some biofuels could indeed have climate benefits, the majority of those currently available globally come with significant environmental and climate impacts ranging from direct and indirect GHG emissions, deforestation, food security, among other environmental and social concerns. Some of those issues have led jurisdictions such as Norway, France, the Netherlands and others to restrict or ban biofuels produced from feedstocks such as palm or soy. In addition, regulations such FuelEU Maritime and RefuelEU exclude the use of feed- and food-based biofuels.[1]

2. Which biofuels and feedstocks could the GFS incentivise

To estimate the potential uptake of biofuels resulting from the GFS – and the potential feedstock used to meet that that demand – T&E modelled a simplified fuel mix assuming that the overall shipping fuel mix would meet the GHG fuel intensity "striving" targets from the EU & Japan IMO proposal (ISWG-GHG 17/2/2). In the absence of established fuel emissions factors at the IMO, T&E relied on the fuel emissions factors from FuelEU Maritime Annex I. Our model concludes that biofuels could make up 36% of the global fuel mix by 2030, with that share increasing to 59% by 2035 and 76% by 2040.[2]

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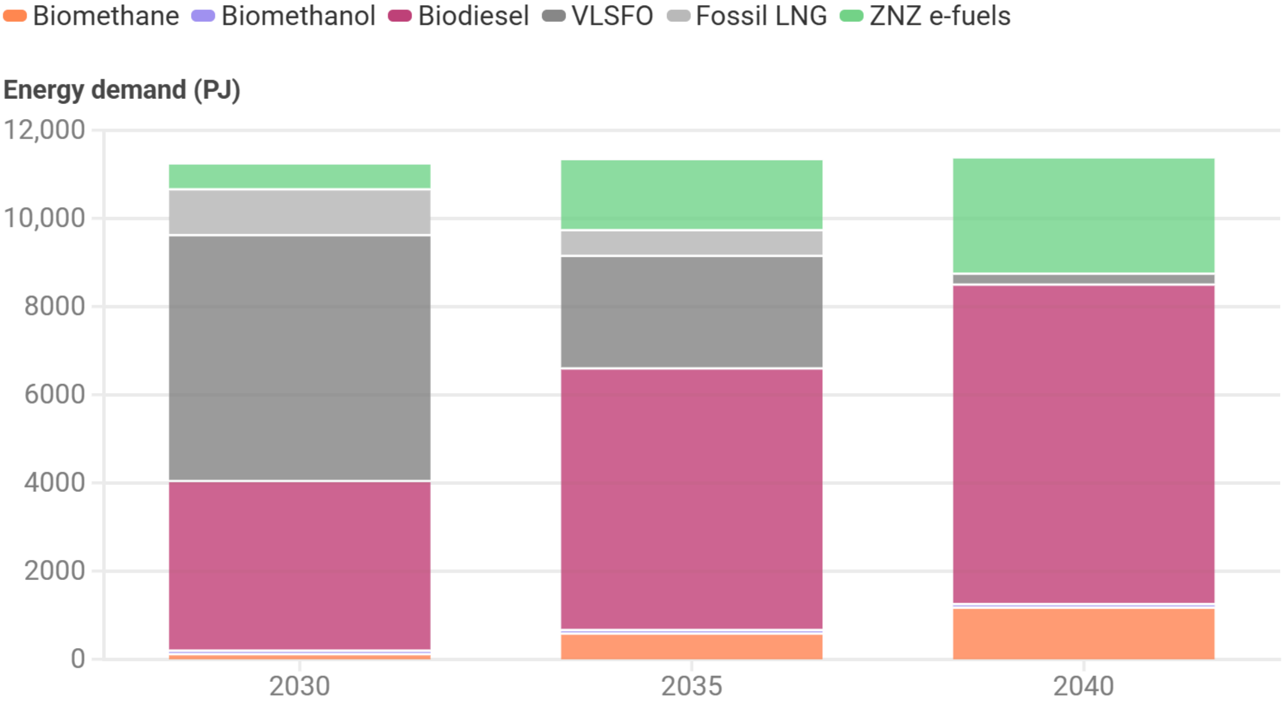
[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1805&qid=1739110416133 & https://eur-lex.europa.eu/eli/reg/2023/2405/oj/eng

[2] An overview of the methodology and assumptions on the fuel mix, associated feedstock, and other parameters in the report by Cerulogy (2025) *Full steam ahead? Environmental impacts of expanding the supply of maritime biofuels for the International Maritime Organisation targets.*

Biofuels could make a third of the global fuel mix by 2030

Based on striving targets



Source: T&E (2025) • Scenario assumes compliance with global fuel standard (GFS) based on targets from EU/Japan submission to IMO ISWG-GHG-17. 2.2. Shipping energy demand and efficiency improvements based on data from the IMO 4th Greenhouse Gas Study (2020). Fuel emissions factors are based on FuelEU Maritime Annex I, using RED II WTW values, and zero/near-zero fuel factor proposed by T&E.

Based on that fuel mix, T&E commissioned the consultancy Cerulogy to assess which feedstocks could be used to meet this biofuels uptake in three scenarios:

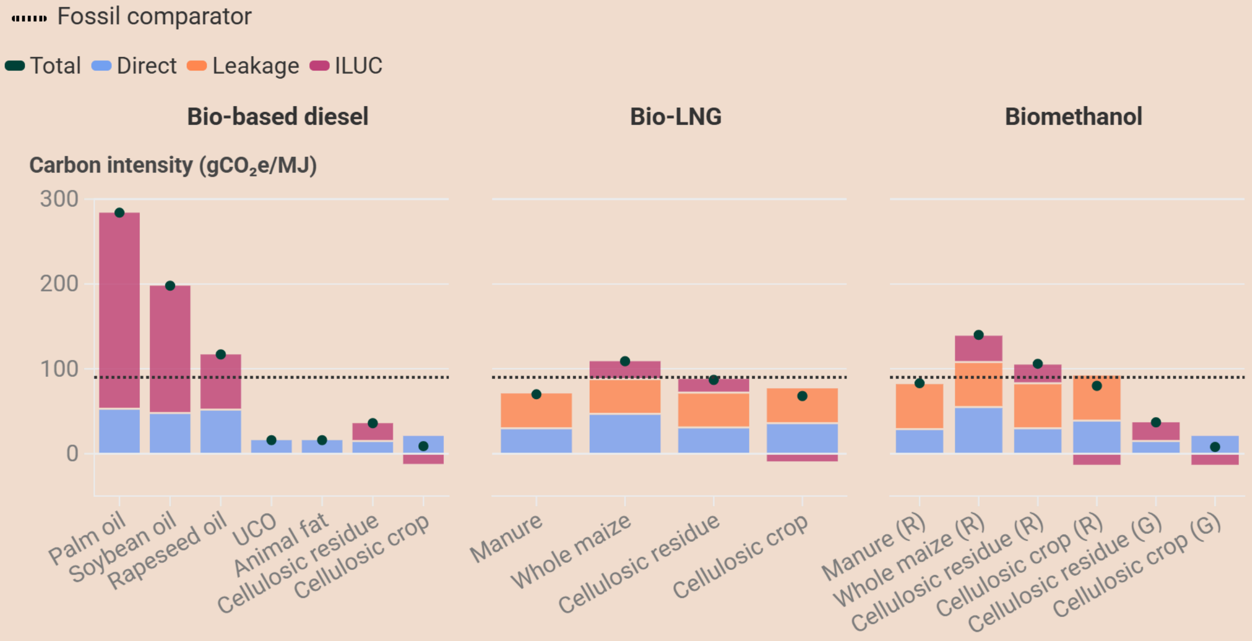
1. **Scenario 1 - “unrestricted feedstocks”:** All feedstocks are allowed under the GFS provided that they meet the GFI striving targets. ILUC emissions are not considered.
2. **Scenario 2 - “high-ILUC feedstocks excluded”:** Feedstocks with the highest ILUC emissions (e.g. palm and soybean oil) are excluded, and replaced by other vegetable oils with lower ILUC emissions (e.g. rapeseed oil)
3. **Scenario 3 - “food cap”:** Feedstocks with the highest ILUC emissions (e.g. palm and soybean oil) are excluded and a cap on food and feed crops is included (for biodiesel, the cap restricts rapeseed oil’s share to 70% by energy in 2030, 40% in 2035, and 10% in 2040).

What are ILUC emissions and why do they matter?

ILUC is the acronym for indirect land-use change, and refers to the GHG emission resulting from the displacement of agricultural production – for food and feed purposes – when land is used instead for biofuel crops. Expanding land for crop planting often occurs at the expense of carbon-rich environments (e.g. natural lands, forests) resulting in a loss of carbon stocks. As a consequence, a significant quantity of GHG emissions stored in the vegetation and soil is emitted in the atmosphere.

ILUC emissions are an important variable to consider when assessing the GHG profile of biofuels, as some are associated with high-ILUC emission factors that can negate their overall GHG savings. ILUC emission factors can be assessed and quantified via modelling, and have already been included in LCA regulatory frameworks, including at the global level. For example, the CORSIA LCA emission values include ILUC factors to determine the GHG impact of aviation's alternative fuels. Similarly, the EU Renewable Energy Directive (RED) acknowledges the impact of ILUC emissions and sets a maximum threshold for relying on food and feed crop-based biofuels.

Palm and soybean oil are biofuel feedstocks with the highest ILUC emission factors

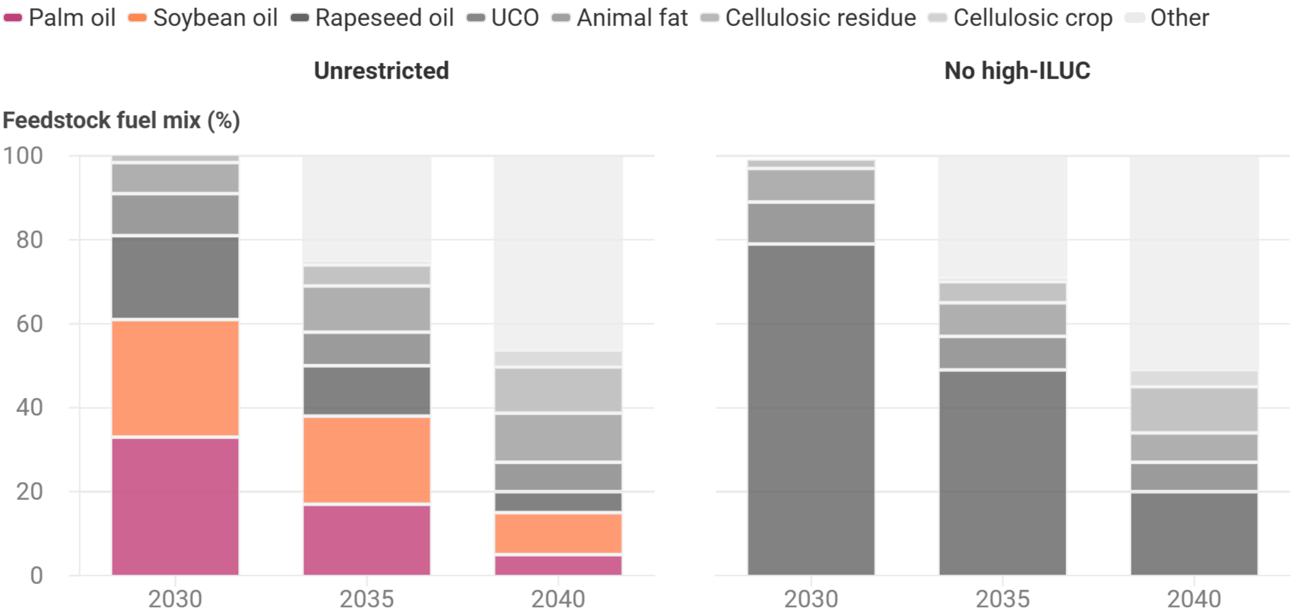


Source: Cerulogy (2025) • The letters indicate different production pathways: R for reforming and G for gasification.

Will the IMO LCA framework incorporate ILUC emissions in its emission factors?

ILUC emissions will be discussed in the GESAMP group and will be considered from a qualitative or risk-based approach whose specifics remain vague (MEPC 83/7/1). While some members consider this approach appropriate, many have pointed out its shortcomings. In fact, a qualitative approach is likely to be too broad to take into consideration the GHG impact of ILUC emissions which will instead be based on contextual factors that are subjective and challenging to assess and certify.

Palm and soy oil could make up 60% of the global marine biodiesel use by 2030



T&E (2024). Biodiesel: Calculated as required volume to meet the GFS targets with a mix of waste and food-based biodiesel feedstocks. Waste-based emissions factor calculated using FuelEU methodology based on RED II default value for UCO, Food-based calculated using average of EU RED II default values for rapeseed, soybean and palm oil biodiesel (with methane capture).

3. GHG emissions impact from biodiesel

Under the first scenario, **palm and soybean oil could make up 60% of the global biodiesel feedstock mix by 2030**, with rapeseed oil making 20% and the rest being fulfilled by smaller quantities of UCO (10%), animal fat (8%), and cellulosic residue (2%). From 2035 until 2040, the share of palm and soybean oil reduces, eventually reaching 15% of the global biodiesel feedstock share by 2040. This is mainly due to the GHG factor assigned to those feedstock which remains the same across the years (53 gCO_{2e}/MJ for palm oil and 48 gCO_{2e}/MJ for soybean oil). Due to their limited availability, waste-based feedstock quantities remain relatively constant across the years, except for a small increase of cellulosic feedstocks. Most importantly from 2035 onward, the share of hypothetical biodiesel feedstock increases significantly up 52% by 2040. This is due to the uncertainty of where those feedstocks could originate from if these had to be bio-based.[3]

The large share of palm and soybean oil under scenario 1 is driven by their affordability compared to any other types of oils, whether it is other vegetable oils or waste oils. Such a large share of palm and soybean oil would have negative consequences for climate change. In fact, Cerulogy estimates that by 2030 **emissions from palm and soybean oil combined to other**

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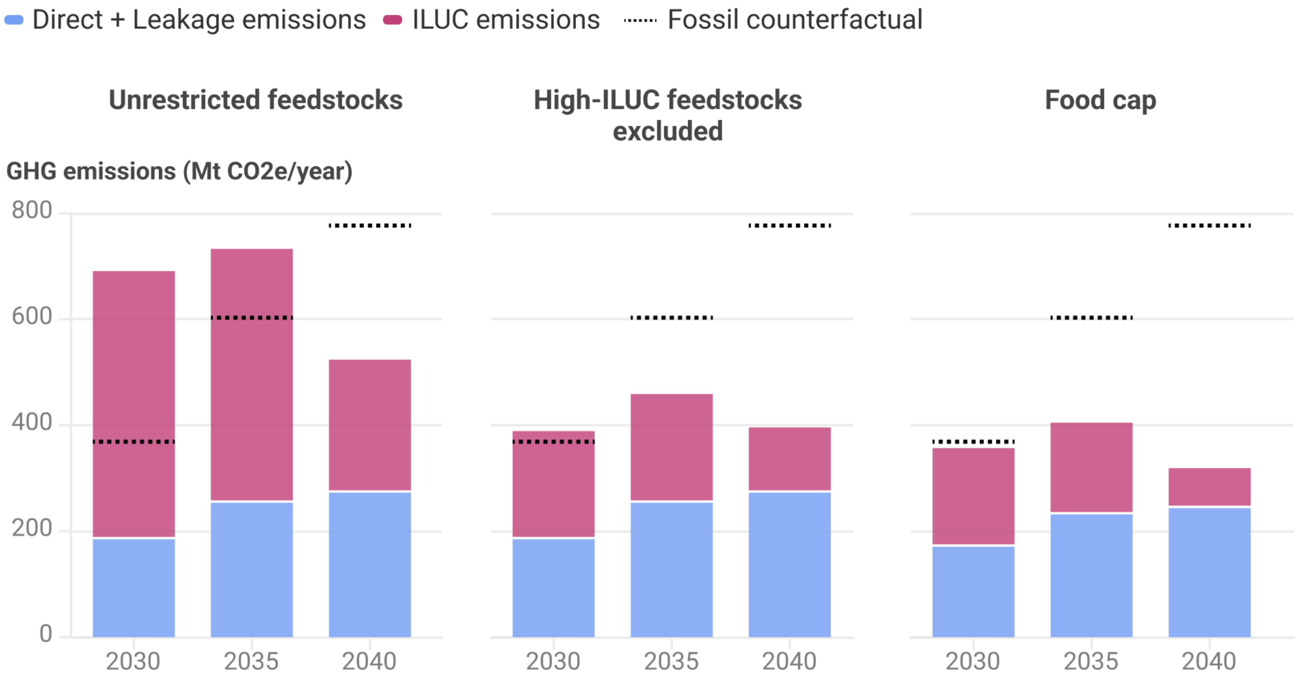
[3] In the graph, this share of hypothetical biodiesel feedstock falls under the category "other". It could be replaced by a bigger share of another fuel type such as ZNZ e-fuels.

feedstocks could result in GHG emissions 87% *higher* than if ships relied on fossil fuels instead. Those emissions would still be 21% higher than fossil fuels by 2035, and would only decrease significantly by 2040.

Biofuels could emit more than fossil fuels if ILUC emissions are ignored in the LCA framework

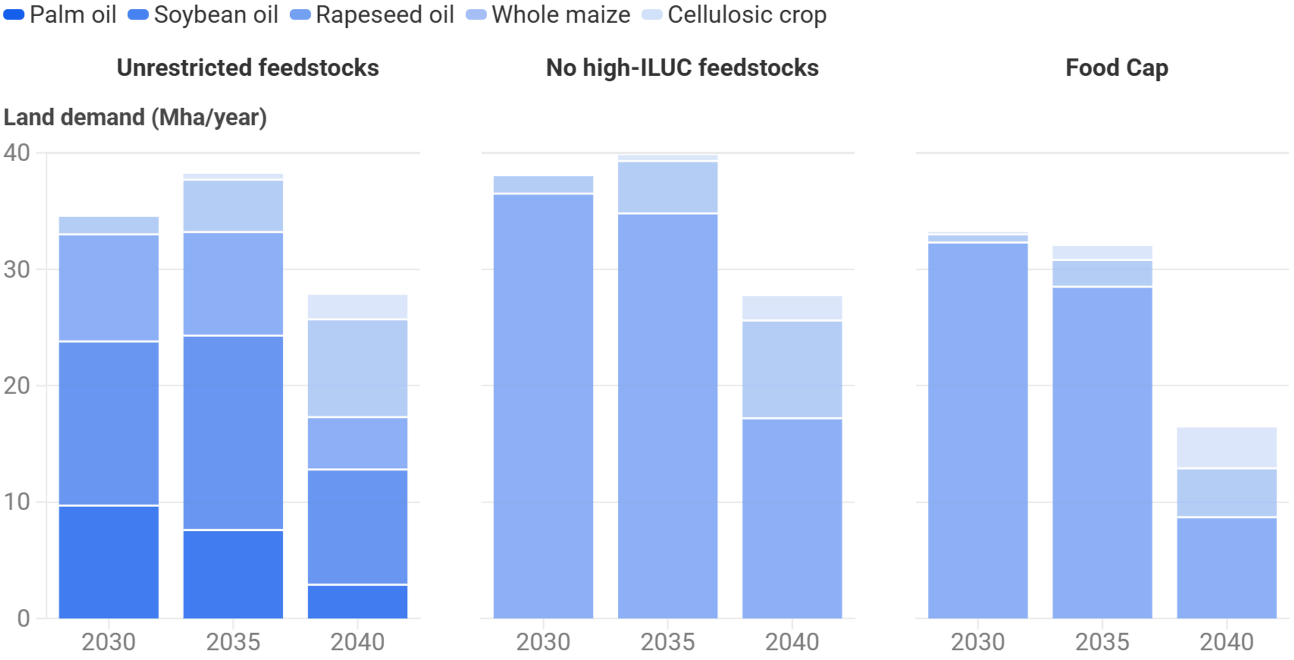


Source: Cerulogy (2025) • The black bar indicates counterfactual emissions if the maritime sector relied instead on petroleum-based fuels to meet this energy demand.

In scenario 2, high-ILUC feedstocks are replaced by the third most-consumed vegetable oil, rapeseed oil, which makes 79% of the biodiesel feedstock by 2030. While excluding high-ILUC feedstocks is not enough to be below the equivalent fossil fuel emissions by 2030, it would eventually be 72% below that level by 2040. In fact, it is worth pointing out that only scenario 3 which excludes palm and soybean oil and includes a gradual food cap could result in emissions being lower than the fossil fuel counterfactual from 2030 onwards.

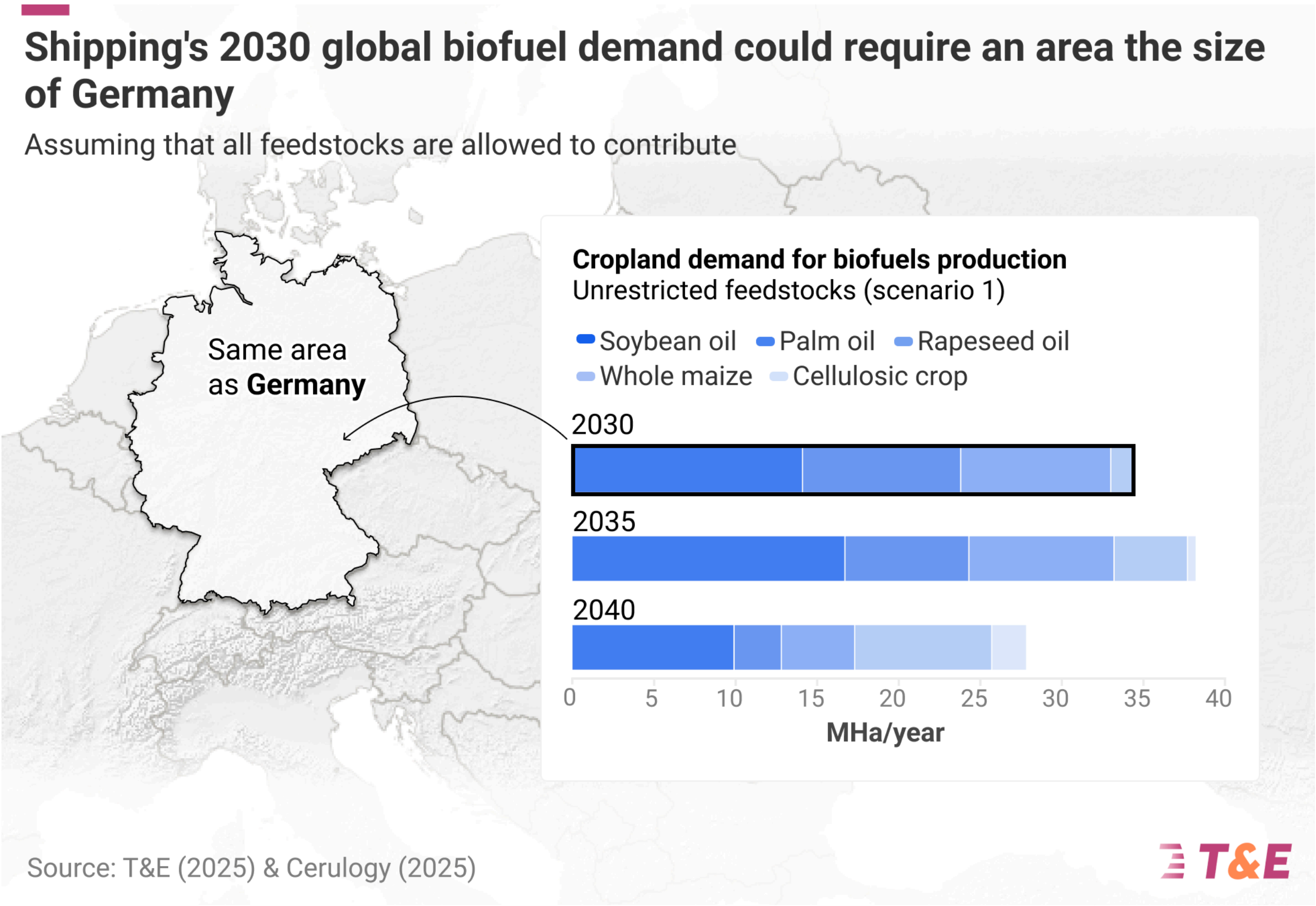
4. How much land would biofuel production require?

Cropland needed to meet shipping's biofuels demand could go up to 40 million hectares by 2035



Source: Cerulogy (2025)

Agricultural land is required for fuels produced from whole maize, soybean oil, palm oil, and cellulosic crops and residues. In the first scenario where all feedstock is allowed, Cerulogy estimates that **the total biofuel production would require the equivalent of 35 million hectares by 2030**. To put things into perspective, this represents approximately the area of Germany or Zimbabwe. Given that this scenario relies heavily on palm oil, a high yield crop, scenario two excluding high-ILUC biofuels would actually have a bigger impact on land use (38 million hectares in 2030 and 40 million hectares by 2035). This is primarily due to the fact that palm and soybean oil would be replaced with rapeseed plantations..



Shipping's 2030 global biofuel demand could require an area the size of Germany

Assuming that all feedstocks are allowed to contribute

Source: T&E (2025) & Cerulogy (2025)

When crops are processed for biofuel, some co-products can/are generated during the process. For example, co-products from soybean processing are/include meal or press cake which can/are be used to feed animals, and vegetable oil processing can result in glycerol. This aspect was considered when calculating the total area of land required for biofuels production by assigning a portion of the land for co-products and removing it from the total land needed to grow biofuel crops.

5. Limited supply of animal fat, UCO, and other waste-based feedstocks

Considering the growing competition over waste-based biofuels notably from the aviation sector, relying on feedstocks such as UCO or animal fat will only offer short-term relief. While several shipping companies have decided to rely on biofuels produced from UCO and animal fat, quantities for those feedstocks remain limited and the growing demand from shipping and other industries will result in price increases.

Across all scenarios, Cerulogy estimates that **the demand for UCO and animal fat would quickly exceed available supply by 2035**. To access the estimated shipping demand for UCO – ranging between 10.9 and 13.7 Mt/year across all scenarios – the shipping sector would need to gain preferential access to these resources which is unlikely to happen in the near-future. It is worth highlighting that there are suspicions that virgin palm oil is being used as a UCO feedstock, which has prompted several countries to launch investigations. Today, it is unclear how certification processes can accurately certify the feedstock used for UCO, given the large number of production sources, and the difficulty to differentiate UCO from virgin palm oil when tested as a final product.

Scenario	Residual oil	2030	2035	2040
Scenario 1 Unrestricted feedstocks	**UCO**	10.9	13.3	13.7
	Animal fat	8.9	13.2	14.1
	Sum	***19.7***	***26.5***	***27.8***
Scenario 2 No high-ILUC feedstocks	**UCO**	11.5	13.3	13.7
	Animal fat	9.4	13.2	14.1
	Sum	***20.9***	***26.5***	***27.8***
Scenario 3 Capped food crops	**UCO**	12.8	13.3	13.7
	Animal fat	10.5	13.2	14.1
	Sum	***23.2***	***26.5***	***27.8***

Demand for residual oils under the three scenarios (Mt/year)

To put things into perspective, T&E calculated that a 20,000 TEU travelling between Shanghai, China, and Santos, Brazil, powered exclusively with UCO would require 7.6 kt of UCO. This is equivalent to more than the annual cooking oil consumption of 2,000 McDonald's restaurants. Similarly, if animal fat was used instead, we estimate that more than one million pigs would be needed to supply enough fat.

With regards to cellulosic crops, their production would need to be scaled up to make a significant impact on the global shipping industry, while their environmental impacts remain unclear as of today. Relying increasingly on cellulosic residue would require the creation of a collection and supply chain infrastructure with auditing rules to guarantee the traceability and sustainability of the feedstocks. Today, a majority of cellulosic residues are used for other purposes such as soil enhancement (e.g. straw or corncobs), food derivative products, as well as energy (e.g. bagasse from sugarcane for on-site heat and power).[4] Considering the nascent stage of this industry, it is challenging to assess how much of a solution it could be to shipping decarbonization's objectives.

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[4] https://www.transportenvironment.org/uploads/files/202407_TE_advanced_biofuels_report-1.pdf

6. Biomethane and biomethanol to the rescue?

In its simplified fuel mix modelling, T&E estimates that biomethane and biomethanol will make up a small share of the global biofuel use, accounting respectively for 1% and 0.7% in 2030.[5] While the share of biomethane use would gradually increase as more LNG-powered ships come into service and switch to biomethane (10.3% of the total biofuel use mix by 2040), biomethanol use would remain constant over the upcoming years.

Across all scenarios, the two feedstocks used for biomethane and biomethanol production are manure and whole maize. While manure is an agricultural waste product, the emissions savings of this feedstock vary considerably depending on the production practices.[6] Similarly to cellulosic residues, manure is already used for other purposes such as biogas production to power farming operations as well as a fertiliser.[7] Whole maize is a feedstock that could instead be used for food and feed purposes. When used for biomethanol production through a reforming process, whole maize's overall GHG profile is 140 g CO2e/MJ – the third highest emission profile after palm and soybean oil used for biodiesel production.

7. Policy recommendations

This briefing highlights the climate risks linked to an uptake of biofuels associated with high-ILUC emissions, showing the consequences that could happen if a lenient regulatory frame around the use of biofuels was agreed upon under the GFS or the LCA guidelines. It also highlights the limited role that biofuels produced from waste materials such as animal fat or UCO could play in the future. Given those circumstances, T&E recommends to:

1. **Consider excluding high-ILUC crop-based biofuels** from complying under MARPOL ANNEX VI regulations or directly within the LCA framework. This could be operationalised by, for example, assigning quantifiable ILUC emission factors or as a fall-back option the well-to-wake GHG values of the least favourable fossil fuels. Alternatively, **consider capping the use of food-crops for biofuels** production under MARPOL Annex VI or through national legislation in complying with GFS.

2. Establish early and dedicated incentives to **favour the production and uptake of green e-fuels** through mechanisms such as reward factors under the GFS. In the case of funds dedicated specifically to alternative fuels, ensure that green e-fuels are prioritized over biofuels produced from waste material such as UCO or animal fat which are not scalable alternatives.

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[5] Assumptions on biomethanol and biomethane uptake assessed on the basis of LNG- and methanol-powered vessels in the fleet and the orderbooks.

[6] https://theicct.org/wp-content/uploads/2021/10/LCA-gas-EU-white-paper-A4-v5.pdf

[7] https://www.transportenvironment.org/uploads/files/202407_TE_advanced_biofuels_report-2.pdf

3. When defining a zero and near-zero (ZNZ) emission fuels, agree on stringent GHG intensity thresholds that will promote the uptake of green e-fuels:
    1. at least 90% WtW CO_2e emissions reduction relative to the fossil fuel baseline from 2030 onwards, or a maximum of 10 gCO_2e/MJ of energy GHG intensity;
    2. at least 95% WtW CO_2e emissions reduction relative to the fossil fuel baseline from 2040 onwards, or a maximum of 5 gCO_2e/MJ energy GHG intensity;
    3. 100% WtW CO_2e emissions reduction from 2050 onwards.

Further information

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