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REDUCTION OF GHG EMISSIONS FROM SHIPS

Considering the risks to global food security posed by an unrestrained increase in demand of food- and feed-based biofuels in international shipping

Submitted by Pacific Environment, CSC and EDF

SUMMARY

Executive summary:	This document provides information on the risks to global food security that may be incurred by the potential unconstrained demand for food- and feed-based biofuels in international shipping. It invites the Committee to request inclusion of a dedicated assessment of the food-price and food-security impacts of IMO's decarbonization policies, treating this as distinct from trade-cost impacts due to the IMO mid-term measures.
Strategic direction, if applicable:	3
Output:	3.2
Action to be taken:	Paragraph 25
Related documents:	MEPC 82/7/4/Add.2, MEPC 82/7/4/Add.3, MEPC 82/7/14, MEPC 82/7/15, MEPC 82/7/8; MEPC 83/7/20, MEPC 83/17; ISWG-GHG 18/2/21 and ISWG-GHG 22/3/11

Introduction

1 Throughout the negotiations around IMO mid-term measures and the draft amendments to MARPOL Annex VI referred to as the IMO Net-Zero Framework (NZF), several delegations expressed concerns on the potential impact of IMO policies on food security in certain geographies. Following the comprehensive impact assessment as reported in documents MEPC 82/7/4/Add.2 and MEPC 82/7/4/Add.3 (Secretariat), document MEPC 82/7/15 (Egypt) highlighted the sensitivity of food prices to trade costs, document MEPC 82/7/14 (Bangladesh and Togo) requested further detailed analysis and consideration of food security in particular, while MEPC 82/7/8 (OECD) drew attention to uncertainties in agricultural supply and demand patterns.

2 The NZF acknowledged the need to address potential food security impacts resulting from its implementation in draft regulations 41 and 43 of the draft amendments to MARPOL Annex VI, as found in Circular Letter No.5005, and subsequent Circular Letters Nos.5214, 5215, and 5216, which require MEPC to "address, prevent, and mitigate any disproportionate negative impacts (DNI) of this chapter on food security". Yet, the discussion has so far only considered the indirect effect of transport cost increases on staple food prices, whereas further

work conducted by the World Maritime University, as set out in document MEPC 83/7/20 (Secretariat), acknowledged that biofuel production and use policies can contribute to volatility in food prices due to increased demand for feedstock.

3 MEPC 83 recognized the outcome of the further work on food security, particularly concerning essential food commodities and critical agricultural inputs in net food-importing developing countries, and agreed that further assessment should be conducted between the adoption and entry into force of the adopted framework (MEPC 83/17, paragraph 7.5.2). Most recently, document ISWG-GHG 22/3/11 (Democratic Republic of the Congo and MOESNA) identified the need to further define and operationalize how to address DNI and food security and suggested guiding principles.

4 While Member States continue their consideration of the draft amendments to MARPOL Annex VI on the mid-term GHG reduction measures, this document seeks to provide information on the potential risks to global food security that may be incurred by increased demand for food-and feed-based biofuel as a result of the adoption of IMO's global regulatory measure.

5 While biofuels currently represent a marginal share of the marine fuel mix, large-scale adoption by international shipping could generate an unprecedented surge in demand for first-generation biofuels derived from food and feed crops that are commercially available and cost-competitive today. Estimates suggest that under the IMO's draft regulatory framework, demand for virgin vegetable oil-based biofuels could reach approximately 135 billion litres by 2035, more than two times the entire current global biofuel production from feedstocks such as rapeseed oil, soy oil, and palm oil across all sectors and uses.[1] Such demand could increase pressure on agricultural markets and food prices, threatening food security, especially in net food-importing countries, as they rely heavily on international markets for staple crops.

Food security and its relation to first generation biofuels

6 Food security "exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life".[2] The Food and Agriculture Organization (FAO) recognizes food security as a multidimensional concept under four main pillars: availability, access, stability, and utilization or consumption.[3] In the context of biofuels, the most relevant pillars are "access" and "stability" focusing on food prices and their volatility.

7 Global biofuels production has grown sevenfold over the last 20 years[4], and currently proposed biofuel-blending mandates could increase biofuel demand by nearly 70% by 2030.[5] Most commercially available biofuel production pathways (sometimes referred to as

1 Seber, G. Pavlenko, N. 2025 *Estimating the maximum potential vegetable oil demand for international shipping under the International Maritime Organization's Net Zero Framework*. International Council on Clean Transportation.https://theicct.org/wp-content/uploads/2025/09/ID-450-Vegetable-Oil_research-brief_final.pdf.

2 World Bank Group. What is food security? https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security.

3 FAO (2006). The State of Food Insecurity in the World: Eradicating world hunger– taking stock ten years after the World Food Summit, Rome. ISBN 92-5-105580-7, https://www.fao.org/4/a0750e/a0750e00.pdf.

4 Energy Institute- Statistical Review of World Energy (2025)- with major processing by Our World in Data. "Biofuels production" [data set]. https://ourworldindata.org/bioenergy-biofuels.

Song, XP., Hansen, M.C., Potapov, P. *et al.* Massive soybean expansion in South America since 2000 and implications for conservation. Retrieved from https://www.nature.com/articles/s41893-021-00729-z.

5 T&E, Cerulogy (2026) Seeds of crisis. https://www.transportenvironment.org/articles/global-biofuel-demand-set-to-grow-by-nearly-70-as-food-prices-rise.

"food/feed-based" or "first generation" biofuels) are based on converting edible vegetable oils, starches, or sugars into biofuels. This matters for food security because these same commodities are also used for human consumption and animal feed. The impacts of these biofuels production on food security should be properly understood, as their implications could have global effects before decisions are taken that would incentivize the maritime sector to rely on these same fuels.

8 The OECD-FAO agricultural outlook predicts that in 2026, the biofuel industry will consume 46 million tonnes of vegetable oils, about four times more than are consumed for food in the whole of Africa, and 224 million tonnes of grain, about the same as the amount consumed for food in the whole of Africa.[6] While biofuels can create economic opportunities that might improve local food access for some[7], without proper practices, they can also have adverse effects on land productivity and water quality and availability[8], impacting food security negatively.[9]

9 A systematic review of 224 publications on the relationship between bioenergy from crop-based feedstocks and food security found that negative effects were reported more often than positive effects: 56% of publications between 2000 and 2017 reported negative impacts of bioenergy on overall food security when factors such as food availability, price, and production are considered.[10] Only 13% of the publications reported positive effects, 23% found no effect and 8% found both negative and positive effects.[11]

10 Research focused on shorter time horizons may underestimate the accumulating negative consequences of diverting crops to bioenergy. The systematic review found that adverse effects were more pronounced at the global level and worsened over the longer term, with 60% of long-term studies (over a period of > 6 or more years) reporting negative impacts compared to 40% of short-term studies (< 6 years). Food prices emerged as the most vulnerable parameter, with 79% of publications focusing on food prices reporting negative effects, i.e. food price increases.

11 Spatial factors also matter, as the negative implications were not uniform across various sociodemographic index (SDI) levels. Negative effects of bioenergy on overall food security were the most frequently reported outcome across all SDI levels, where 40% to 73% of the corresponding studies showed negative effects on overall food security. A positive effect of food prices could be observed only at the lowest SDI level and only in those geographies close to bioenergy production centres (48% of the 21 relevant studies). This effect does not negate the reduction in food security elsewhere.

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6 OECD/FAO (2025), OECD-FAO Agricultural Outlook 2025-2034, OECD Publishing, Paris/FAO, Rome, https://doi.org/10.1787/601276cd-en.

7 Renzaho, A. M. N., Kamara, J. K., & Toole, M. (2017). Biofuel production and its impact on food security in low- and middle-income countries: Implications for the post-2015 sustainable development goals. Renewable and Sustainable Energy Reviews, 78, 503–516. https://doi.org/10.1016/J.RSER.2017.04.072

8 Hoekman et al. 2018, Environmental implications of higher ethanol production and use in the U.S.: A literature review. Part 1-Impacts on water, soil and air quality, Renew. Sustain. Energy Rev. 81, Part 2, 3140-3158. https://doi.org/10.1016/j.rser.2017.05.050.

9 U.S. EPA. Biofuels and the Environment: Third Triennial Report to Congress (Final Report, 2025). U.S. Environmental Protection Agency, Washington, DC, 2025. https://assessments.epa.gov/biofuels/document/&deid=363940.

10 Selena Ahmed et al. 2021, Systematic review on effects of bioenergy from edible versus inedible feedstocks on food security, Science of Food, 5, Article number 9, https://www.nature.com/articles/s41538-021-00091-6.

11 Notably, owing to the range of results and nuanced discussion of this article, it is important to discuss its findings in context. In isolation, select figures would ignore important evidence and may lead to conclusions that, while locally correct, misrepresent global trends. The author explicitly identified food prices as the parameter most negatively affected by crop-based bioenergy production.

12 The FAO estimated that between 700 and 830 million people were undernourished in 2021 and identified the cost of food as a contributing factor to worsening food security.[12] Notably, food commodities currently used as biofuel feedstocks contain enough calories to meet the basic dietary requirements of approximately 1.3 billion people annually.[13] While these resources would not necessarily be reallocated to hunger eradication in the absence of biofuels production[14], additional demand for these feedstocks can increase competition for agricultural commodities and inputs such as land, water[15], and fertilizer.[16] Modelling suggests this dynamic could work in reverse, where recent work by OECD found that a 20% reduction in maize and vegetable oil use as biofuel feedstock could dampen price spikes from extreme weather events by 53–67%, while a 50% cut could fully offset the resulting increases in maize and wheat prices.[17]

Food price implications of increased first-generation biofuel demand

13 Since the biofuel "boom" began in the 2000s, food- and feed-based biofuel mandates have been widely linked to food-security concerns. The primary mechanism through which food- and feed-based biofuel demand can affect food security is by increasing demand for agricultural commodities, thereby raising international commodity prices and reducing access to staple foods, especially in import-dependent developing countries.[18] Spikes in food prices from 2006 to 2008 and again from 2010 to 2012, occurring in parallel with rapid expansion of the biofuel market under the original EU Renewable Energy Directive (RED I) and the US Renewable Fuel Standard (RFS), led to extensive discussion of the role of biofuel demand in driving "food price crises". A meta-analysis of the 2006 to 2008 food crisis concluded that biofuel demand played a moderate to dominant role in 22 of 26 analyses, and a low to moderate role in the remaining four.[19]

14 Basic economic theory holds that, provided all other factors remain constant, an increase in demand for a product will lead to a corresponding rise in its price. Inflation-adjusted food commodity prices have been higher in the period since the 2007 food price crisis than in the period six years before.[20] OECD-FAO Agricultural Outlook data indicate that biofuel use accounted for 36% of the increase in maize consumption and 42% of the increase in vegetable oil consumption between 2000 and 2022.

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12 FAO, IFAD, UNICEF, WFP, & WHO. (2022). The State of Food Security and Nutrition in the World 2022. In *The State of Food Security and Nutrition in the World 2022*. FAO. https://doi.org/10.4060/cc0639en.

13 After considering co-products. Malins, 2024. *Biofuels and food markets*. https://www.cerulogy.com/biofuels-and-food-markets/.

14 Araujo Enciso et al. 2016, Abolishing biofuel policies: Possible impacts on agricultural price levels, price variability and global food security, Food Policy, 61, pp 9-26. https://www.sciencedirect.com/science/article/pii/S0306919216000166?via%3Dihub.

15 Aha et al. (2017). "Biofuels and the hazards of land grabbing: Tenure (in)security and indigenous farmers' investment decisions in Ghana", Land Use Policy, 60, pp 48-59, https://www.sciencedirect.com/science/article/abs/pii/S0264837715302180;
WRI (2024) One-Quarter of World's Crops Threatened by Water Risks. Retrieved from https://www.wri.org/insights/growing-water-risks-food-crops; FAO (2022). The state of the world's land and water resources for food and agriculture-Systems at breaking point. https://doi.org/10.4060/cb9910en.

16 T&E (2026) Feeding the fuel crop: Fertilisers are powering more than just food. https://www.transportenvironment.org/articles/feeding-the-fuel-crop-fertilisers-are-powering-more-than-just-food.

17 Rielaender, J. et al. (2025), "Biofuels and trade policies to mitigate food price shocks: Reinforcing global food markets", *OECD Development Centre Working Papers*, No. 357, OECD Publishing, Paris, https://doi.org/10.1787/40c49187-en.

18 Oxfam (2024) Biofuel Blunders: Time to fix two decades of EU policies driving food insecurity. https://policy-practice.oxfam.org/resources/biofuel-blunders-time-to-fix-two-decades-of-eu-policies-driving-food-insecurity-621622/.

19 Malins, 2017. *Thought for Food – A review of the interaction between biofuel consumption and food markets*. Cerulogy, http://www.cerulogy.com/food-and-fuel/thought-for-food/.

20 World Bank, 2023. *Commodity Markets – "Pink Sheet."* https://www.worldbank.org/en/research/commodity-markets.

15 Food consumption is more sensitive to underlying food commodity prices in poorer countries, where rising prices can lead to increased levels of malnutrition and poverty.[21] For economically disadvantaged populations, including many in rural areas, increased food prices often result in some combination of reduced food intake and decreased spending on non-food goods and services, such as healthcare and education. However, welfare benefits may accrue to a subset of low-income farmers who are net food sellers.

16 Equilibrium economic modelling has been used to estimate the possible medium-term-price impacts of increased food/feed-based biofuel demand. A comprehensive literature review conducted in 2014[22] identified 121 studies that estimated the impact of first-generation biofuel demand on food prices. The review concluded that, "There is unequivocal evidence — supported by basic economic theory — that increased demand for biofuels leads to higher prices in agricultural commodity markets...". Although subject to uncertainty, the study concludes that a one exajoule (EJ) annual increase in demand for ethanol and biodiesel raises the global average price of coarse grains and vegetable oils by 23% and 38%, respectively.

Biofuels under the Net Zero Framework: Estimating the effect on food prices

17 The NZF could create a large additional source of demand for biofuels and hence food and feed commodities.[23] Scenario analysis by the International Council on Clean Transportation suggests that the NZF's 2035 GHG fuel intensity (GFI) target could be met with biomass-based diesel (BBD) produced from 14 billion litres of used cooking oil and 140 billion litres of virgin vegetable oil; together corresponding to half of the projected energy demand that year for international shipping. These fuels can be supplied cheaper than alternative compliance through Tier 2 remedial units (RUs), which are priced at $380/tonne of carbon dioxide equivalents (CO_2eq). At the same time, this incentive price allows for high profit margins when compared to biofuel incentives in other modes of transportation, additionally incentivizing production for the marine market.[24]

18 This implied growth of vegetable oil demand is very large compared to existing biofuel markets: 140 billion litres are roughly three times the current global use of vegetable oil biofuels and are equivalent to approximately 4.6 EJ of energy. This projected increase in vegetable oil demand also exceeds the total global growth in food-based biofuels between 2000 and 2010, which amounted to 79 billion litres of ethanol and biomass-based diesel produced from 17 billion litres of vegetable oil, according to the Agricultural Outlook. [25]

19 Assuming the linear estimate from Persson (2014) that global vegetable oil prices will increase by 38% for each EJ/year of additional biodiesel demand, an additional 4.6 EJ of biodiesel demand from maritime shipping would approximately triple (+175%) equilibrium

[21] Baptista, D. et al. (2022), Climate Change and Chronic Food Insecurity in Sub-Saharan Africa, *IMF Departmental Papers*, https://www.imf.org/-/media/files/publications/dp/2022/english/cccfissaea.pdf.

[22] Persson, 2014. The Impact of Biofuel Demand on Agricultural Commodity Prices: A Systematic Review. *Advances in Bioenergy: The Sustainability Challenge*, 465–482. https://doi.org/10.1002/9781118957844.ch30.

[23] Seber, G. Pavlenko, N. 2025 *Estimating the maximum potential vegetable oil demand for international shipping under the International Maritime Organization's Net Zero Framework*. International Council on Clean Transport, http://www.theicct.org/publication/estimating-the-maximum-potential-vegetable-oil-demand-for-international-shipping-under-the-imo-net-zero-framework-sept25

[24] Argus (2026) Alternative marine fuels. https://www.argusmedia.com/en/news-and-insights/topical-market-themes/alternative-marine-fuels.

[25] OECD/FAO (2025), OECD-FAO Agricultural Outlook 2025-2034, OECD Publishing, Paris/FAO, Rome, https://doi.org/10.1787/601276cd-en.

global vegetable oil prices by 2035.[26] This would push the price above the record set during the 1973-1974 oil crisis (after adjusting for inflation).[27] OECD-FAO forecasts that the continent of Africa will consume about 15 million tonnes of vegetable oil for food by 2035, so this price increase would imply a total additional annual cost to African consumers of the order of $26 billion (dependent on levels of transmission of global to local prices).

20 This simple calculation may understate the problem. Delivering this level of consumption growth in only 10 years would likely induce non-linear effects and could provoke another food price crisis. In a food price crisis, prices can be expected to spike to levels significantly above the medium-term equilibrium expectation.

21 While IMO's NZF work plan includes a work item on food security, document MEPC 83/7/20 reviewed the impact on food security due to increases in food-transport costs associated with the NZF framework, noting that "food price fluctuations particularly influence poorer households, which spend relatively larger parts of their income on food". MEPC 83/7/20 further found (table 14) that import prices for grains and oilseeds could increase by between 0.2% and 6.9%, with an average of 1.1%, in response to transport cost increases associated with carbon pricing. It can therefore be very roughly concluded that the impact on food prices due to increasing biofuel demand to deliver the NZF could be 100 times or greater than the impact due to increasing transport costs, and the implications for food security correspondingly more severe.

22 Food security and indirect land use change (ILUC) are closely linked because biofuel feedstock demand competes directly with land and crops that would otherwise supply food and feed markets. When biofuel policies drive up demand for food-based feedstocks, this raises global commodity prices and can push agricultural production onto new land (including forests and grasslands) as farmers respond to higher prices. This price transmission disproportionately harms low-income countries, particularly where food makes up a large share of household spending, and governments have limited fiscal buffers to cushion price shocks.

23 Safeguards such as limiting the contribution of high-ILUC feedstocks, capping the share of food and feed crops eligible toward renewable fuel targets can reduce this pressure by limiting the extent to which biofuel policy competes with food markets for land and crops. Policies also incorporate positive levers, such as multipliers or sub-targets for non-food, non-feed fuels. Though frameworks differ in stringency, these safeguards may only partially prevent adverse effects as the economics of feedstock competition may be hard to fully offset.[28]

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26 A price rise of this magnitude would raise the price of vegetable-oil-based fuels, making them less competitive with alternatives like liquefied natural gas (LNG), reducing demand and therefore mitigating some of the price increase. These numbers should therefore be considered illustrative of the possible scale of impact and level of disruption that the NZF targets could imply, rather than predictive.

27 Average of 2024 prices for soy and palm oil from World Bank, 2025. *Commodity Markets – "Pink Sheet."* https://www.worldbank.org/en/research/commodity-markets.

28 Lark et al. 2022, Environmental outcomes of the US Renewable Fuel Standard, PNAS, 119, 9, https://www.pnas.org/doi/10.1073/pnas.2101084119,Rielaender, J. et al. (2025), "Biofuels and trade policies to mitigate food price shocks: Reinforcing global food markets", *OECD Development Centre Working Papers*, No. 357, OECD Publishing, Paris, https://doi.org/10.1787/40c49187-en.

Proposal

24 The Committee is invited to account for the information provided and take the following actions:

.1 request that the Secretariat include, under workstream 8 on "Food Security" of the draft work plan to prepare for the entry into force of the IMO Net-Zero Framework, MEPC/ES.2/3, an assessment of the food price effects of using food/feed-based biofuels in international shipping and the associated potential for negative impacts on food security, in particular for least developed countries (LDCs) and small island developing States (SIDS); and

.2 consider the impact of demand for biofuel feedstocks on food security as a distinct effect from that of potentially increased trade costs when operationalizing DNI on States.

Action requested of the Committee

25 The Committee is invited to consider the proposals in paragraph 24, and take action as appropriate.