Rainforest Foundation Norway

Biofuel to the fire

The impact of continued expansion of palm and soy oil demand through biofuel policy

Rainforest Foundation Norway is one of the world's leading organisations in the field of rights-based rainforest protection. We are working for a world where the environment is protected and human rights are fulfilled.

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Content

Summary

The world is in a dual ecological crisis of climate change and biodiversity loss. It is well understood that deforestation and peat destruction are major contributors to both of these crises, resulting in carbon dioxide emissions from lost vegetation and disturbed soils, and depriving plants and animals of suitable habitats. The global biofuel industry stands at the nexus between these climate change and biodiversity crises. Policy makers have promoted biofuels as a measure to reduce emissions from fossil fuel combustion. The reality is more complicated. Increasing demand for agricultural commodities provides an incentive to expand production. The increase in biofuel production in the period 2015-2018 is equivalent to 90% of the global increase in vegetable oil production over the same period.

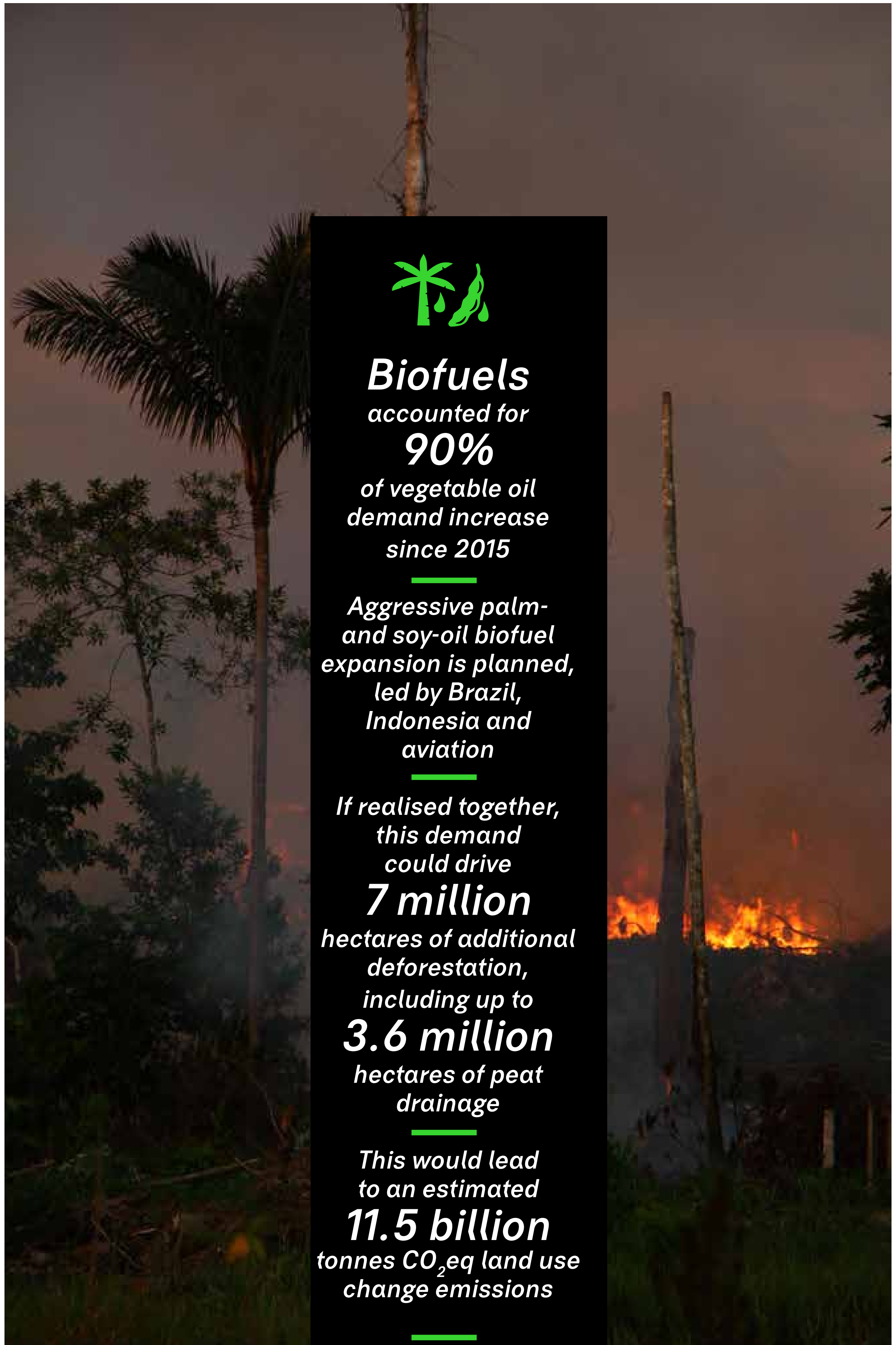
Expanding production can be expected to lead to land use changes including deforestation, especially for forest-risk commodities such as palm oil and soy oil. Over the last two decades, increased production of these vegetable oils has resulted in massive loss of tropical forest. A series of indirect land use change studies for the European Commission have suggested that the use of palm oil and soy oil biofuels instead of fossil fuels results in net emissions increases instead of reductions. Aside from the carbon cost of ill-conceived biofuel policies, ongoing agricultural expansion is the main cause of human-led biodiversity destruction and fuels land conflicts with local communities, often indigenous peoples.

In the EU, after many years of policy debate, this programme of research has led to the designation of palm oil as a 'high ILUC-risk' biofuel feedstock. Support for palm oil biofuel consumption will now be eliminated in the EU by 2030, with some Member States such as France acting even more quickly. After palm oil, soy is the feedstock with the strongest link to forest loss, but at present the European Commission has determined that soy will not be included in the 'high ILUC-risk' category. However, Member States may reduce or even phase out support for both palm-oil and soy-oil based biofuels as early as 2021 should they choose to do so, on the basis of best available evidence on ILUC impact.

« The increase in biofuel production in the period 2015-2018 is equivalent to 90% of the global increase in vegetable oil production over the same period »

While Europe is slowly turning away from the use of these commodities for biofuel production, the picture in the rest of the world is different. Global palm oil consumption for biofuels has continued to increase since our last assessment (Malins, 2018), led in particular by Indonesia, now not only the world's largest palm oil producer but rapidly overtaking the EU as the largest consumer of palm oil for biofuels. Soy oil consumption for biodiesel is increasing across the Americas. Expansion of hydrotreated vegetable oil production from vegetable oil, not subject to any technical limit on the blends that can be used in existing vehicles, creates the possibility of effectively unlimited expansion of vegetable oil consumption for transportation.

This report documents that current global ambition for increased use of biofuels, given the lack of limitations on the use of high deforestation-risk feedstock, is likely to drive increased deforestation and associated increases in greenhouse gas emissions. The report presents low, medium and high scenarios for development of palm and soy oil demand for biofuels in the period to 2030 in the most relevant jurisdictions. Summing demand from the high scenarios for palm oil, consumption for biofuels would grow to 61 million tonnes, a six-fold increase compared to today. Those 61 million tonnes of palm oil are equivalent to about 90% of current global palm oil production. Across the high scenarios



***Biofuels* accounted for *90%* of vegetable oil demand increase since 2015**

Aggressive palm- and soy-oil biofuel expansion is planned, led by Brazil, Indonesia and aviation

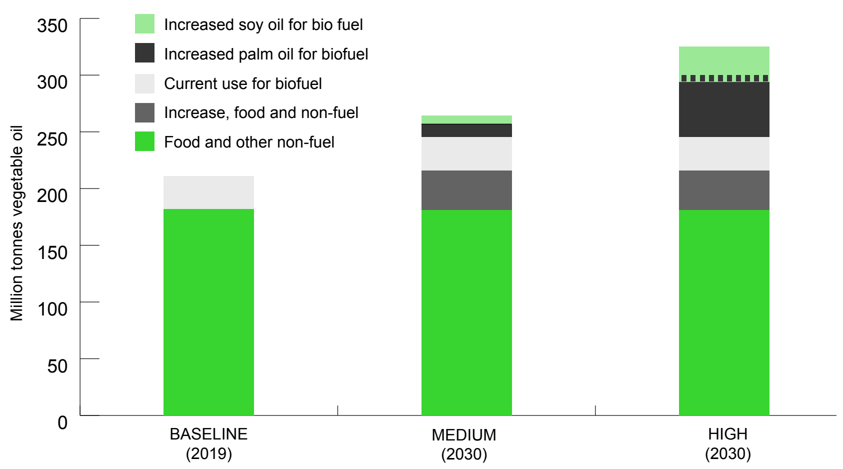
If realised together, this demand could drive 7 million hectares of additional deforestation, including up to 3.6 million hectares of peat drainage

This would lead to an estimated 11.5 billion tonnes CO_2eq land use change emissions

Photo: Edmar Barros/Rainforest Foundation Norway

« Over the last two decades, increased production of these vegetable oils has resulted in massive loss of tropical forest »

FIGURE 1: SCENARIOS (MEDIUM AND HIGH) FOR INCREASE IN DEMAND FOR SOY AND PALM OIL AS BIOFUEL FEEDSTOCK AGAINST CURRENT GLOBAL VEGETABLE OIL CONSUMPTION



Note: Current vegetable oil consumption from (OECD-FAO, 2019)

for soy oil, consumption for biofuels would grow to 41 million tonnes, equivalent to nearly three quarters of current global production.

Expanding demand for palm and soy oil for biofuel is not about finding markets for existing production or about avoiding market shrinkage, it is about accelerating the growth of those industries. As can be seen from Figure 1, if the high or medium scenarios for all jurisdictions were delivered together then consumption of palm- and soy-oils for biodiesel would increase more than the total predicted increase in consumption for food in the same period (OECD-FAO, 2019). In the high case there would be an increase in vegetable oil consumption for biofuels 30 times larger than OECD-FAO currently expects. In the medium scenario, the vegetable oil demand increase for biofuels is over six times larger than OECD-FAO currently expects. Clearly, such large increases in consumption could not be accommodated without rapid expansion of agricultural production, perhaps accompanied by significant reductions in use for food. This would inevitably drive global vegetable oil prices higher, with significant welfare impacts. This aggressive demand growth would be led by Indonesia and the aviation industry for palm oil; by Brazil and the aviation industry for soy oil.

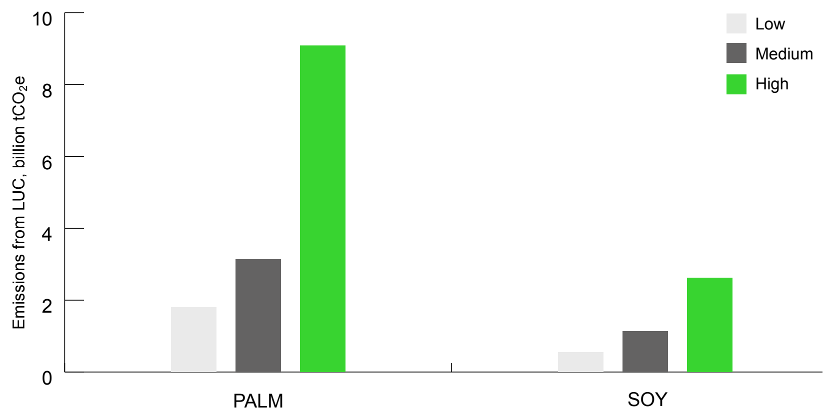
If such large consumption increases could indeed be delivered by 2030, given the link between these commodities and deforestation it would have severe impacts on global forests. It is estimated that achieving the high scenario for palm oil consumption could cause 5.4 million hectares of additional deforestation compared to eliminating palm oil biofuel production, nearly twice the area of Belgium, and 2.9 million hectares of additional peat drainage (these areas would overlap to a significant extent). Achieving the high scenario for soy oil consumption could cause 1.8 million hectares of additional deforestation compared to eliminating soy oil biofuel production, about the area of Wales.

« This aggressive demand growth would be led by Indonesia and the aviation industry for palm oil; by Brazil and the aviation industry for soy oil »

Deforestation and peat loss on this scale have a CO_2 cost. As shown in Figure 2, the high palm oil demand scenario could lead to 9.1 billion tonnes of CO_2 emissions from land use change, with the high soy oil scenario leading to 2.6 billion tonnes.[1] Combined, this is equivalent to about a year of China's total emissions from burning fossil fuels.[2] This value represents land use change emissions only, and would be partly offset by displacement of fossil fuel use by biofuels.

1) Emissions from removal of tree cover plus twenty years of degradation of peat soils. Peat degradation can continue for decades, resulting in further ongoing emissions not counted here.
2) https://edgar.jrc.ec.europa.eu/overview.php?v=booklet2019

FIGURE 2: POTENTIAL EMISSIONS FROM FOREST LOSS AND PEAT DRAINAGE DUE TO 2030 LEVELS OF BIOFUEL DEMAND



Note: these emissions numbers include twenty years of peat degradation, in line with EU land use change accounting practice. Peat degradation may continue to cause CO_2 emissions for decades following this period.

The magnitude of these deforestation, peat loss and emissions risk ought to be enough to give pause to policy makers considering supporting aggressive growth in the biodiesel and hydrotreated vegetable oil industries (including for hydrotreated aviation fuels). We recommend that:

- Palm oil, soy oil and PFAD are unsuitable as biofuel feedstocks due to their link to deforestation and biodiversity loss. Consumption should be phased out as soon as possible.
- EU Member States should adopt policies to rapidly phase out support for high ILUC-risk biofuels.
- The European Commission should lower the level at which the threshold for "significant expansion into land with high carbon stock" is set.
- In Europe, the use of biodiesel other than that produced from approved waste or by-product feedstocks should be reduced. Member States should take measures to favour lower-ILUC biofuels and reduce incentives for the use of soy oil biofuels.
- In the United States, palm oil biodiesel should continue to be excluded from being supported as an advanced biofuel.
- Indonesia should reassess its rapidly increasing biofuel mandate, and refocus its biofuel programme on advanced biofuels from wastes and residues, including those produced by the palm oil industry.
- Other countries should avoid creating new renewable fuel incentives without strong environmental safeguards to ensure that genuine emissions savings are delivered, and that both direct and indirect deforestation impacts are avoided.
- The aviation industry should focus on the development of advanced aviation biofuels from wastes and residues.
- Any national targets or incentives for aviation biofuel use should not support HEFA production from vegetable oils, instead focusing on advanced, cellulosic biofuel pathways in the short to medium term.
- Policy makers and the aviation industry should prioritise investment in other emission reduction technologies such as electrical planes and electrofuels, and consider demand management approaches.
- The shipping industry should avoid widespread use of biofuels, unless advanced biofuels based on waste and residues.
- Sustainability initiatives for oil palm agriculture should be supported for food and oleochemical applications, but must not be used as an excuse for driving further demand growth in the biofuel sector.
- Improved tropical forest governance, in particular Indonesia, Malaysia and South American countries, should be supported to break the link between vegetable oil production and environmental destruction.

Introduction

Photo: Araquém Alcântara/Rainforest Foundation Norway

The world is confronted by two linked environmental crises. On the one hand, climate change caused by anthropogenic CO_2 emissions promises to bring global heating, extreme weather and ecosystem destruction. While in principle the Paris Agreement (UNFCCC, 2015) commits the world to limit average global heating below 2 degrees Celsius and to pursue efforts to limit heating to 1.5 degrees Celsius, global CO_2 emissions continue to increase annually. The United Nations Environment Programme's annual 'Emissions Gap' report highlights that unless this trend is rapidly reversed the 1.5-degree goal will become impossible to reach (UNEP, 2019). In parallel to the climate crisis, and exacerbated by climate change, is an ongoing biodiversity collapse primarily caused by human activity. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) reports that human action threatens more species with extinction than at any time in history, with a quarter of species assessed being rated as 'threatened'. The assessment states that, "For terrestrial and freshwater ecosystems, land-use change has had the largest relative negative impact on nature since 1970," and links this explicitly to agricultural expansion, "Agricultural expansion is the most widespread form of land-use change, with over one third of the terrestrial land surface being used for cropping or animal husbandry. This expansion, […], has come mostly at the expense of forests (largely old-growth tropical forests), wetlands and grasslands." There is therefore a continuous tension between demand for agricultural outputs and halting the global biodiversity decline, "The great expansion in the production of food, feed, fibre and bioenergy has occurred at the cost of many other contributions of nature to quality of life, including regulation of air and water quality, climate regulation and habitat provision."

Against this background, biofuel production has expanded dramatically since the year 2000, driven in part by the desire to mitigate climate change by reducing the consumption of fossil fuels. While biofuel policies have been developed in the context of climate change goals, they have become controversial because of a concern that increased biofuel demand drives agricultural expansion. The IPCC recognises that, "the use of land to provide feedstock for bioenergy … could greatly increase demand for land conversion. … Widespread use at the scale of several millions of km^2 globally could increase risks for desertification, land degradation, food security and sustainable development" (IPCC, 2019). Agricultural expansion leads to carbon stored in biomass and soils being released into the atmosphere as carbon dioxide, and contributes to biodiversity loss. These concerns are particularly strong in the case of palm oil and soy oil, where the production of biofuel feedstocks is directly associated with tropical deforestation, risking the loss of carbon and biodiversity from some of the richest ecosystems on the planet. Many organisations and experts have called for a fundamental re-examination of bioenergy policy. For example, the Food and Land Use Coalition (2019) recommend countries to, "Phase out … biofuels mandates that directly or indirectly promote deforestation".

◂◂ Biofuel policies have become controversial because of a concern that increased biofuel demand drives agricultural expansion ▸▸

Despite the strong association between these crops and carbon emissions from deforestation and peat loss (cf. Malins, 2019b), their oils continue to be consumed systematically for the production of biodiesel[3], HVO and HEFA.[4] While biofuel promotion policies are seen by policy makers partly as a climate mitigation tool, there is extensive evidence that fuels produced from vegetable oils, and in particular from palm and soy oils, may actually contribute to net increases in GHG emissions due to indirect land use changes (ILUC) (Malins, 2017a; Valin et al., 2015). Indirect land use change refers to the fact that when agricultural commodity demand increases, land use will expand, and even if the specific plantations supplying biofuel facilities have not been expanded at the expense of forests or grasslands, somewhere in the system such expansion is inevitable.

In 2018, Cerulogy worked with the Rainforest Foundation Norway (RFN) to publish the report *Driving deforestation* (Malins, 2018), highlighting the risk to forests and peatlands from biofuel-policy-driven increases in palm oil demand. In 2019, RFN published the follow up report *Destination deforestation*, which focused on the specific potential for the aviation industry to drive deforestation if hydrotreated jet fuels from palm and soy oils become a major contributor to jet fuel demand (Malins, 2019a). In this report we present an updated review of the current global market for palm and soy oils as biofuel feedstocks (including for aviation and shipping fuels), and present scenarios for increases or reductions in that level of demands in the period to 2030. The analysis also considers demand for 'palm fatty acid distillates' (PFADs), a by-product of the palm oil refining process resulting from the separation of free fatty acids. PFAD is a lower quality oil than palm oil that typically sells for about a fifth less, but it is 100% utilised and in many cases is an alternative to the use of palm oil. Consuming PFAD as biofuel feedstock takes it away from its current uses, creating additional demand for other products such as palm oil and heavy fuel oil. Malins (2017d) estimates that consuming a tonne of PFAD for biofuel creates about 0.6 tonnes of displaced palm oil demand.

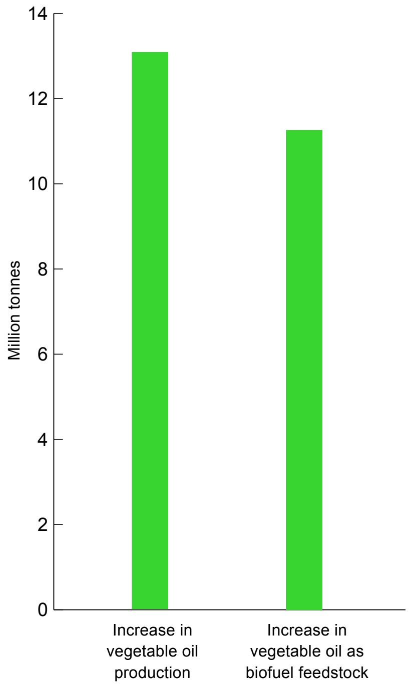
A focus on soy oil as a potential deforestation driver is particularly timely given that the election of a new administration in Brazil seems to have led to a relaxation of anti-deforestation measures, and has seen Amazon deforestation rates increase to the highest level recorded for more than a decade[5].

In *Driving deforestation* it was noted that global production of biodiesel and HVO had risen from about a billion litres in the year 2000 to about 37 billion litres in 2015 (32 billion litres of biodiesel and 5 billion litres of HVO). Despite concerns about indirect

3) Fatty acid methyl ester (FAME), produced from vegetable oils or animal fats reacted with methanol, which can be blended with conventional diesel fuel primarily for on-road use.
4) Synthetic hydrocarbon fuels chemically similar to fossil hydrocarbons, produced by reaction of hydrogen with vegetable oils and animal fats, often referred to as HVO (hydrotreated vegetable oil, 'renewable diesel') for on-road use, and HEFA (hydroprocessed esters and fatty acids, 'renewable jet') for aviation use.
5) See https://www.theguardian.com/environment/2019/nov/18/amazon-deforestation-at-highest-level-in-a-decade

land use change, global production has increased by a third in the intervening period to about 48 billion litres in 2018, with biodiesel production reported at 41 billion litres and the production of HVO (including small volumes of HEFA as a co-product) reaching 7 billion litres (REN 21, 2019). That increase in biofuel production is equivalent to 90% of the increase in global vegetable oil production over the same period (see Figure 3) as reported by (OECD-FAO, 2019). It is clear that biofuel production remains a major driver supporting increases in global vegetable oil production.

FIGURE 3: INCREASE IN GLOBAL VEGETABLE OIL PRODUCTION AND USE AS BIOFUEL FEEDSTOCK, 2015-18



High ILUC-risk biofuel feedstocks

In early 2019, the European Union published its assessment (European Commission, 2019b) of which biofuel feedstocks should be treated as 'high ILUC-risk'. The EU's recast Renewable Energy Directive (RED II) defines high ILUC-risk feedstocks as those for which at the global level there is, "a significant expansion into land with high carbon stock". In the Commission's report, a threshold was set determining that a feedstock would be treated as high ILUC-risk if 10% or more of global expansion of that feedstock was identified as occurring at the expense of high-carbon-stock areas. This threshold proportion is adjusted up for crops with high productivity (palm oil, sugar beet, sugar cane and maize), and is adjusted down if part of the high carbon stock area is peatland. The 10% threshold is intended to represent the point at which expansion into high carbon stock land would eliminate most of the climate benefit from use of that biofuel feedstock[6], assuming that the direct emissions were 45% of those of a fossil fuel. It should be noted that conversion of high carbon stock land is not the only source of ILUC emissions. ILUC modelling (Laborde, 2011; Valin et al., 2015) clearly shows that significant emissions can arise even from widespread conversion of land with relatively low carbon stocks compared to forests, such as grassland or abandoned agricultural land. Setting the threshold at this level could therefore be seen as still allowing the use of biofuel feedstock with very significant overall ILUC emissions.

The assessment determined that globally 45% of palm oil expansion occurs at the expense of forests, and 23% at the expense of peatland (in many cases a given area would be both peatland and forested). Palm oil is therefore identified as high ILUC-risk, and between 2023 and 2030 EU Member States must phase out support for palm-oil-based biofuels. For soy oil, the assessment determined that 8% of expansion occurred at the expense of high-carbon-stock land. While this confirms that there is indeed a demonstrable connection between soybean expansion and forest loss, it is below the 10% threshold set by the Commission, and so soy oil is not defined as high ILUC-risk at this time. These assessments are to be reviewed in 2021. While the use of soy oil for biofuel production is not currently subject to the rules on high ILUC-risk feedstocks, Member States have discretion within the RED II to put in place additional measures to discriminate between biofuels based on the ILUC impacts associated with the feedstocks used. Soy oil is identified as having higher ILUC-risk than other oils in the Commission assessment, and therefore Member States would have grounds to remove support for soy-oil based fuels.

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Future demand for palm and soy oil for biofuels

In this chapter, we present an assessment of the potential future demand (to 2030) for palm oil and soy oil as feedstocks for biodiesel and HVO/HEFA. Low, medium and high demand scenarios are presented for each region considered.

This section considers only direct demand for palm oil (or palm fatty acid distillate, PFAD) and soy oil as feedstock for biofuels. Indirect demand resulting from the removal of other types of oil from the global market are discussed in the following section.

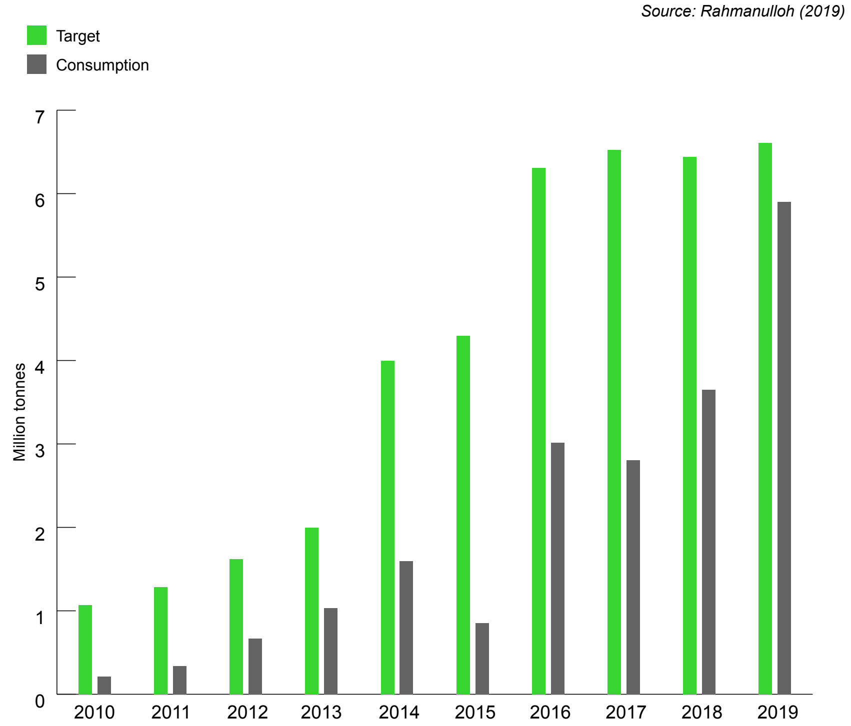
Indonesia

The domestic market for palm oil biodiesel in Indonesia continues to grow, with the adoption of a B20 blend standard (allowing up to 20% biodiesel to be included in on-road diesel fuel). The government has also added power generation from palm oil to its list of renewable electricity technologies eligible for support. The government targets remain unchanged since 2018, aiming for 30% blending of biodiesel in diesel for transport, industry and electricity generation by 2020. While these targets are nominally mandatory the actual supply of biodiesel continues to lag the target levels despite robust growth in the volumes supplied. The levy on palm oil exports that was introduced in 2015 with the intention of cross-subsidising domestic palm oil use has been revised at the end of 2018 due to relatively low palm oil prices on the world market[7], and has not collected any further levy funds since.

Palm oil biodiesel supply in 2018 was 3 million tonnes, against a requirement of about 5.5 million tonnes to meet the nominal 20% target. This did however reflect an increase of 50% over 2017, and analysis by the USDA Foreign Agricultural Service (Rahmanulloh, 2019) suggests that with the full expansion of the biodiesel mandate to private diesel suppliers (with associated fines for non-compliance) in addition to the state owned Pertamina consumption could reach 5.3 million tonnes in 2019 (Figure 7). This would be consistent with most of the country using a B20 blend. USDA identify an additional 270 thousand tonnes consumed for electricity generation.

FIGURE 4: INDONESIA BIODIESEL CONSUMPTION, WITH PROJECTED VALUE FOR 2019

Source: Rahmanulloh (2019)



6) Specifically, the point at which 70% of a 55% emissions reduction would be eliminated by emissions from conversion of high carbon stock areas.

7) Global vegetable oil prices have fallen to a level not seen since before the food price crisis of 2008, but are still high compared to the preceding two decades.

The large increase in domestic consumption from 2018 to 2019 suggests that the government is committed to pursuing its consumption targets with greater vigour than in previous years. Although Indonesia will be three years behind schedule in reaching a B20 blend, the Indonesian government has indicated an intent to move rapidly to a B30 blend to pursue the 30% target for 2020[8], although this remains subject to on-road testing and it would not be surprising if full roll out of B30 was delayed past the January 2020 target that has been suggested. Nevertheless, the promise of increased blending has been associated with an uptick in local Indonesian palm oil prices[9], and if that price increase is sustained is thereby likely to encourage further plantation expansion.

There has been some discussion of moving beyond B30, with President Widodo pledging before his re-election in April to target 100% replacement of imported fossil diesel[10] and assigning the objective of B100 roll out to the Minister of Industry[11]. A 100% replacement of diesel use with palm oil biodiesel would be extremely ambitious given likely engine compatibility issues and the impact it would have on palm oil available for export, but the continued political support for the program suggests that utilisation may well move beyond the currently mandated B30 blend. A recent ministerial statement suggest that a B40 blend may be targeted as an interim goal for 2021/22, but that the palm oil supply may not support blending rates higher than B50[12].

In the scenarios, the low demand case reflects slower than intended deployment of higher blends, with only a slight increase in blending from 2019 to 2020 and falling short of the B30 blend target by 2030. The medium case reflects achieving B20 in 2020 and then moving to a B30 blend in 2025 but going no further. The high demand case reflects achieving the stated target of B30 blending in 2020 (therefore assuming a large increase in consumption in 2020), and moving to a national B50 blend by 2030. We assume no demand for soy oil for biofuels.

TABLE 1: SCENARIOS FOR PALM OIL DEMAND FROM THE INDONESIAN BIODIESEL MANDATE

Scenario	Description	Palm oil demand (million tonnes)		
		2020	2025	2030
High	Go beyond B30 to B50 (on average) by 2030	9.7	15.0	25.5
Medium	Achieve B30	6.8	12.5	15.3
Low	Modest growth after 2020	5.7	7.3	8.9

Note: excludes aviation use of palm oil HEFA, which is discussed separately in the aviation section below.

Malaysia

As in Indonesia, 2019 is expected to bring a significant year-on-year increase in domestic palm oil biodiesel consumption in Malaysia, as the roll out of B10 fuel originally scheduled for 2016 finally took effect early in 2019. The government is committed in principle to achieving B20 by 2020, and to rolling out B7 biodiesel blends for industrial diesel consumption (originally due to be achieved by early 2019). It has been reported that the government is also assessing the possibility of delivering a B30 blend without causing damage to older vehicles[13]. USDA predicts full delivery of B10 in 2019, resulting in 840 thousand tonnes of palm oil biodiesel consumption, a 50% year-on-year increase (Wahab, 2019).

The low scenario assumes a gradual increase to B15 blending by 2025, and no further blend growth. The medium scenario assumes partial roll out of B20 in 2020, with B20 fully delivered by 2024 and then no further demand growth. The high case assumes that B20 blending is achieved in 2020 (representing a rapid consumption increase) and full B30 for on-road and industrial use by 2026. We assume no demand for soy oil for biofuels.

TABLE 2: SCENARIOS FOR PALM OIL DEMAND FROM THE MALAYSIAN BIODIESEL MANDATE

Scenario	Description	Palm oil demand (million tonnes)		
		2020	2025	2030
High	B30 by 2026	2.2	3.3	3.6
Medium	B20 by 2024	1.3	2.4	2.4
Low	B15 by 2025	1.1	1.8	1.8

8) https://www.reuters.com/article/us-indonesia-biodiesel/indonesia-president-wants-b30-in-use-by-january-2020-cabinet-secretary-idUSKCN1V20VR
9) https://www.ft.com/content/ead601a6-ff15-11e9-b7bc-f3fa4e77dd47
10) https://www.reuters.com/article/us-indonesia-election-palmoil/indonesian-presidential-hopefuls-vow-energy-self-sufficiency-through-palm-idUSKCN1Q60M9
11) https://www.cnbcindonesia.com/news/20191023175827-4-109534/tuntaskan-program-b100-jadi-target-menperin-baru
12) https://in.reuters.com/article/indonesia-biodiesel/indonesia-eyes-biodiesel-with-40-bio-content-during-2021-2022-idINKBN1YE0DQ
13) https://www.thesundaily.my/local/b20-biodiesel-implementation-to-start-in-langkawi-next-year-BJ1469470

Thailand

Thailand has targets to increase palm oil biodiesel production based on expansion of the domestic palm oil estate, but delivery has lagged targets. A transition from B7 to B10 scheduled for 2018 has not yet been achieved, and the ambitious target for consumption of 4.5 million tonnes of domestic palm oil biodiesel by 2036 is being reconsidered (Sakchai Preechajarn, Prasertsri, & Chanikornpradit, 2019). Consumption for 2019 is forecast by USDA (Ibid) at a bit below one million tonnes. Thailand does not have the same strong association between palm oil expansion and deforestation as Malaysia or Indonesia, and has very little available peatland. By actively targeting palm oil expansion onto previously farmed areas (Sakchai Preechajarn et al., 2019) Thailand is expected to avoid the direct environmental impacts associated with palm oil expansion in its Southeast Asian neighbours. The low scenario assumes no growth compared to current demand levels. The medium scenario assumes delivery of B10 by 2025, and then modest ongoing consumption growth. The high scenario assumes B10 by 2020 and that a reduced 2030 target is set and achieved. We assume no demand for soy oil for biofuels.

TABLE 3: SCENARIOS FOR PALM OIL DEMAND FROM THE THAILAND BIODIESEL MANDATE

Scenario	Description	Palm oil demand (million tonnes)		
		2020	2025	2030
High	B10 in 2020, reduced 2036 target	1.3	2.0	3.0
Medium	B10 by 2025, followed by moderate growth	1.0	1.3	1.6
Low	No growth	0.9	0.9	0.9

European Union

Based on analysis by the USDA (Flach, Lieberz, & Bolla, 2019), we estimate that about 4 million tonnes of palm oil will have been used for biodiesel and HVO in Europe in 2019. Two thirds of that is crude palm oil imported and processed in the EU, and the other third imported as biodiesel from Indonesia and Malaysia. This puts current EU driven palm oil demand above the high scenario for 2020 from Driving deforestation (3.3 million tonnes).

Despite this short-term increase in palm oil consumption for the EU market, early in 2019 the Delegated Act on high and low ILUC-risk biofuels confirmed (subject to review in 2021) that palm oil will be classified as a high ILUC-risk feedstock, and that support for the use of palm oil biofuels will be phased out in the EU between 2023 and 2030. It is possible that this decision could be overturned, but only if evidence could be presented showing a dramatic weakening of the link between palm oil expansion and deforestation in Indonesia and Malaysia. Such evidence would be welcome, but without a gear change in local governance policy and enforcement seems unlikely to be achieved by the time of the review. We therefore assume that the phase out happens in all but the high scenario.

The low scenario assumes complete elimination of palm oil from the feedstock mix by 2025, and of PFAD by 2030. The medium scenario assumes linear phase out from 2023 without affecting PFAD consumption, and the high scenario assumes steady consumption at current levels.

The EU also consumes a smaller but significant volume of soy oil biodiesel (Flach et al., 2019), resulting in 2.4 million tonnes of soy oil demand in 2018 (split more or less evenly between imported biodiesel from Argentina and domestically processed biodiesel). Soy oil has not been identified as high-ILUC risk by

TABLE 4: SCENARIOS FOR PALM AND SOY OIL DEMAND FROM THE EU RED (million tonnes)

Scenario	Description	2020		2025		2030	
		Palm	Soy	Palm	Soy	Palm	Soy
High	For palm oil, steady consumption at 2019 levels; for soy, transfer of existing palm oil demand to soy oil demand	4.0	2.6	4.0	4.6	4.0	6.4
Medium	For palm oil, phase out of support with some residual PFAD demand; for soy, partial transfer of existing palm oil demand to soy oil demand	4.0	2.5	2.9	3.2	0.3	4
Low	Both palm oil and soy oil use phased out as high ILUC-risk	4.0	2.4	0.3	2	0	0

Note: the high scenarios for palm and soy oil demand are mutually exclusive.

> ◂◂ *It is unlikely that evidence will be presented showing a dramatic weakening of the link between palm oil expansion and de-forestation* ▸▸

the European Commission (although this decision could be reviewed) and therefore use of soy oil is likely to be more stable to 2030 than use of palm oil.

In the low scenario, it is assumed that 2020 soy demand is the same as 2019, and that following review soy oil is identified as high-ILUC risk and phased out by 2030. In the medium scenario, Soy oil demand is assumed to increase moderately to partly replace phased out palm oil. In the high scenario, it is assumed that soy oil fully replaces current palm oil demand.

Spain
Palm oil is a key feedstock for the Spanish biodiesel industry, which is much more dependent on imported vegetable oils than the industry in most of the rest of the EU. Palm oil and soy oil together accounted for 90% of Spanish biodiesel feedstock in 2018, 55% of which was palm oil and the other 35% soy oil (CNMC, 2019). This represented a significant increase in soy oil use year-on-year. The role of Spain is discussed further below in the section on producers of palm- and soy-oil based biofuels. Far from being proactive in finding ways to reduce the use of high ILUC-risk feedstocks, the Spanish Government reportedly sided with palm oil producers in opposing the identification of palm oil as high ILUC-risk by the European Commission[14].

France
At the other end of the spectrum of EU states, France has already taken measures aiming to reduce the consumption of palm-oil based fuels. Despite opposition from the French Government, the French Parliament has approved measures to remove biodiesel tax breaks for palm-oil based fuels from 2020 onwards[15]. The loss of favourable tax treatment is likely to make palm oil uncompetitive with alternative vegetable oils for biodiesel production in France. Soy oil use has not been excluded from tax advantages, and thus soy oil could replace palm oil to a significant extent from 2020.

Germany
Germany is the EU's largest manufacturer of biodiesel (Flach et al., 2019). In 2018, palm oil represented 21% of feedstock for German biodiesel consumption and nearly all of German HVO consumption generating about 500 thousand tonnes of palm oil demand (Federal Office for Agriculture and Food, 2019). Almost all palm oil used was Indonesian. Soy oil use was minor. The German biofuel support system offers certificates in proportion to reportable GHG savings of the fuel, which are calculated without ILUC emissions. Most palm oil biofuel consumed in Germany had a reportable emission saving of 75-85%, performing better than rapeseed- or soy-oil based fuels. Given this strong reportable emissions performance due to the lack of ILUC accounting, palm oil is likely to continue to be favoured as a feedstock in the absence of new policy. We are not aware of any German government initiative to accelerate the introduction of limits on palm oil use.

14) https://www.nst.com.my/news/nation/2018/02/335111/spain-backs-malaysias-palm-oil-biofuel-stand
15) https://www.reuters.com/article/us-total-palmoil/france-to-end-tax-breaks-for-palm-oil-in-biofuel-idUSKBN1XP1NG

Photo: Araquém Alcântara/Rainforest Foundation Norway

Norway

At the end of 2018, the Norwegian Parliament voted to require the government to phase out support for biofuels with 'high-deforestation risk'[16], most importantly palm oil which had previously been a mainstay of Norway's biofuel consumption (cf. Malins, 2018). The Norwegian government is yet to implement this policy, but the use of palm oil as feedstock by the Norwegian industry has fallen significantly, with palm oil demand for biofuels reduced from over 300 thousand tonnes in 2017 to 90 thousand tonnes in 2018. This reflects most Norwegian fuel retailers adopting policies against palm oil use. PFAD consumption as biofuel feedstock has also been drastically reduced with the reclassification of PFAD as non-waste in 2016. However, this trend is fragile, as the regulatory framework still in theory allows the use of significant volumes of palm oil-based biofuels. Revision of the Norwegian biofuel policy is expected to be launched in 2020, and it is uncertain whether government will implement changes that will lead to the formal removal of support from biofuels from palm oil and other feedstocks with high deforestation risk. Given the explicit ambition to phase out high deforestation risk biofuels, for the analysis in this report we assume that Norway will not be a significant source of palm oil demand for biofuel between now and 2030.

Soy oil was reported as feedstock for 6.8% of Norwegian biofuel consumption in 2018 (Miljødirektoratet, 2019), representing about 25 thousand tonnes of soy oil demand. This is small compared to soy oil demand from other markets discussed here.

It is possible that restrictions on the use of palm oil in the Norwegian biodiesel market without any accompanying restriction on soy oil use could result in a shift from palm to soy oil as feedstock. We therefore include Norwegian soy demand in the scenario assessment. In the low case, soy is excluded from the market alongside palm and there is no demand. In the medium and high cases 50% of the potential palm oil demand identified by Malins (2018) is transferred to soy oil.

TABLE 5: SCENARIOS FOR SOY OIL DEMAND FROM NORWAY (million tonnes)

Scenario	Description	Soy oil demand (million tonnes)		
		2020	2025	2030
High	Soy oil consumption increases to 2030	0.1	0.1	0.2
Medium	Modest increase in soy oil consumption to 2020, then steady	0.1	0.1	0.1
Low	No soy oil for biodiesel	0.0	0.0	0.0

16) https://www.independent.co.uk/environment/norway-palm-oil-fuels-deforestation-rainforests-orang-utans-biofuels-a8666646.html

U.S.

In April 2018, the U.S. introduced anti-dumping tariffs on Indonesian biodiesel, essentially eliminating the import of palm oil biodiesel. While palm biodiesel imports have disappeared, the EPA reports 85 thousand tonnes of imported HVO counted as 'renewable fuel' rather than 'biomass-based diesel' under the Renewable Fuel Standard (RFS) in 2018, down from 370 thousand tonnes in 2017 (U.S. EPA, 2019). All reported HVO imports to the U.S. are from Singapore (U.S. EIA, 2019d) (presumably Neste's production facility). This volume is likely to be palm oil or PFAD based, as these are used by Neste and are the main HVO feedstocks that do not have approved pathways to count towards the biomass-based diesel mandate in the RFS (qualifying as biomass-based diesel for credits requires an estimated GHG emission saving of 50% or more).

Given the combination of the anti-dumping measure and the fact that palm oil biodiesel does not qualify for support from the biomass based-diesel mandate of the RFS due to land use change concerns, the U.S. seems unlikely to become a major consumer of palm oil for biofuels in the near future. We therefore assume no significant palm oil demand in any year from the U.S. in the low and medium scenarios, while the high scenario assumes that significant policy changes in the RFS create a space for palm oil biodiesel to attain a new market after 2020.

« While the U.S. is not a major source of palm oil demand, soy oil is the primary feedstock for biodiesel production in the U.S. »

While the U.S. is not a major source of palm oil demand, soy oil is the primary feedstock for biodiesel production in the U.S. U.S. biodiesel consumption has grown from a minimal volume in 2000 to about 7 million tonnes in 2018 while HVO consumption has grown to 2 million tonnes, led by the biomass-based diesel mandate under the RFS (U.S. EPA, 2018). Countervailing tariffs were introduced against Argentinian soy biodiesel imports at the same time as against Indonesian palm biodiesel imports, and at present the main exporters of biodiesel to the U.S. are Canada and Germany, where rapeseed is the more likely feedstock (U.S. EIA, 2019c). U.S. EIA (2019b) reports 3.4 million tonnes of soy oil consumption for biodiesel in 2018. Given that biodiesel exports are very limited (U.S. EIA, 2019a), almost all of this is consumed domestically. We do not have detailed feedstock statistics for HVO production, but it is known that soy oil is used by some U.S. HVO producers (Malins, 2019a). We therefore assume that 50% of U.S. HVO is soy based, requiring 1 million tonnes of soy oil.

In the coming decade, biodiesel production and consumption can be expected to continue to follow the biomass-based diesel mandate of the RFS, and there is currently no reason to expect the contribution of soy oil biodiesel to shrink. Indeed, the capacity to increase the use of U.S. by-product and residual oils for biodiesel is limited as, "Most of the waste oils, fats, and greases that can be recovered economically are already being recovered and used in biodiesel and renewable diesel production or for other purposes" (U.S. EPA, 2018). On the other hand, U.S. EPA has expressed caution about relying on increased soy oil production to feed a growing biomass-based diesel mandate, stating that, "We do not believe that the increased demand for soybean oil or corn oil caused by a higher 2019 advanced biofuel standard would result in an increase in soybean or corn prices large enough to induce significant changes in agricultural activity" (U.S. EPA, 2018). The three scenarios therefore reflect in the low case a slight reduction in soy oil use for U.S. renewable fuels through to 2030, in the medium case a slight increase consistent to 2030, and in the high case a doubling over the decade.

TABLE 6: SCENARIOS FOR PALM AND SOY OIL DEMAND FROM THE U.S. RFS (million tonnes)

Scenario	Description	2020		2025		2030	
		Palm	Soy	Palm	Soy	Palm	Soy
High	Doubling of soy oil use; market growth for palm oil after 2020	0.1	4.5	1.0	6.0	2.1	9.0
Medium	Modest growth in soy oil use; no demand for palm oil	0.0	4.5	0.0	5.0	0.0	5.5
Low	Modest reduction in soy oil use; no demand for palm oil	0.0	4.5	0.0	4.0	0.0	3.5

Brazil

Brazil's sugarcane ethanol programme is famous for being one of the largest biofuel programmes in the world, but it also has a growing biodiesel mandate, with the mandated blend reaching B11 in 2019 and scheduled to increase to B15 by March 2023 (subject to engine testing). USDA forecasts 3.7 million tonnes of biodiesel consumption in 2019, of which 70% is soy oil based, representing about 2.7 million tonnes of soy oil demand. Palm oil is not used for any significant amount of biodiesel production in Brazil. For the low scenario, we assume continued use of B11 biodiesel through to 2030 with 70% soy oil feedstock. For the medium scenario, an increase to B15 by 2025 with 80% soy oil feedstock is assumed. For the high scenario, it is assumed that the blend is pushed beyond 15%, reaching B25 in 2030 with 90% from soy oil.

« USDA forecasts 2.7 million tonnes of soy oil-based biodiesel consumption in Brazil in 2019 »

TABLE 7: SCENARIOS FOR ADDITIONAL SOY OIL DEMAND FROM BRAZIL'S BIODIESEL MANDATE (million tonnes)

Scenario	Description	Soy oil demand (million tonnes)		
		2020	2025	2030
High	Increase to B25 by 2030	3.3	6.5	10.2
Medium	Reach B15 by 2025	2.9	5.0	5.4
Low	Stay at B11	2.9	3.2	3.5

Argentina

Similar to Brazil, Argentina has (since 2016) a mandate for B10 biodiesel blending. USDA reports that the local industry is keen for this to be increased to at least B12 and potentially B20, but anticipates that the government would be reluctant to invest more in biodiesel subsidisation (Joseph, 2019). Almost all biodiesel in Argentina is soy oil based. For the low scenario, we assume a slight fall in average blending rates to B9 for the rest of the decade. For the medium scenario we assume steady use at B10, while the high scenario assumed that the industry is successful in having B12 blending introduced by 2025, and B20 blending introduced by 2030.

TABLE 8: SCENARIOS FOR ADDITIONAL SOY OIL DEMAND FROM ARGENTINA'S BIODIESEL MANDATE (million tonnes)

Scenario	Description	Soy oil demand (million tonnes)		
		2020	2025	2030
High	Increase to B20 by 2030	1.3	1.5	2.5
Medium	Settle at B10	1.2	1.3	1.3
Low	Settle at B9	1.1	1.1	1.1

China

China uses relatively little biodiesel fuel at present. An uptick in imports of palm-oil-based biodiesel in 2018, reportedly based on low prices rather than local incentives, has subsided somewhat in 2019 to about 320 thousand tonnes (Kim, 2019). Given that the Indonesian Government appears to be achieving some success in using the domestic biodiesel market to inflate the palm oil price, these imports could disappear entirely if no new policy is introduced. For the updated scenarios, the low case assumes that there will be no significant imports next year or for the next decade, the medium case assumes 400 thousand tonnes per year of imports, and the high case reflects a full adoption of palm-oil-based B5 in China by 2030. We assume no demand for soy oil for biofuels.

TABLE 9: SCENARIOS FOR ADDITIONAL PALM OIL DEMAND FROM CHINA (million tonnes)

Scenario	Description	Palm oil demand (million tonnes)		
		2020	2025	2030
High	Palm oil B5 by 2030	1.0	4.0	9.0
Medium	Steady	0.4	0.4	0.4
Low	Palm oil price recovery removes market	0.0	0.0	0.0

Japan

In Driving deforestation it was noted that the Japanese government had given approval in principle to build up to 5 GW of palm oil burning power plants, creating up to 9 million tonnes a year of demand, but that it seemed unlikely that all of these facilities would actually be constructed. Demand from Japan was therefore not included in that analysis. The construction of palm oil fired power plants remains controversial in Japan[17], and we have not been able to find documentation of such plants becoming operational to date. As previously, no palm oil demand for power in from Japan is considered in the further analysis, but the potential for Japan to become a significant source of demand remains.

Photo: Araquém Alcântara/Rainforest Foundation Norway

17) See e.g. https://www.change.org/p/mr-hideo-sawada-h-i-s-co-ltd-chairman-ceo-do-not-construct-the-palm-oil-power-plant-that-ruins-tropical-forests

Aviation

Aviation biofuels can be seen as potentially one of the largest sources of new palm oil demand, but also as a market with very large demand uncertainty, with 2030 demand scenarios from 0.1 million tonnes (low) to 11.6 million tonnes (high). The specific case of aviation demand for palm oil and soy oil is discussed in more detail in Destination deforestation. The global aviation industry remains committed in principle to delivering large CO_2 emissions reductions by 2050[18], alternative fuels remain the main pathway identified to deliver those targets, and to date the only alternative aviation fuel pathway close to commercial volumes is HEFA biofuel from hydrotreated vegetable oils. There is a considerable discrepancy between the nominal ambition for alternative fuel use of the aviation industry, the much lower volumes that would be implied by alternative aviation fuel mandates that are actually being discussed, and the even lower volumes that are actually being supplied at the moment. This gap between aspiration and progress is carried into the scenarios, with the high scenario involving many times more palm and soy oil demand than the low scenario. There is great uncertainty at the moment regarding what path the aviation industry may follow for alternative aviation fuels. If no limits are introduced on the use of vegetable oils and the stated ambition is pursued seriously, there is a real possibility that a very large new demand for palm and soy oils could be created. On the other hand, if the use of vegetable oils as feedstock is restricted or if no action is taken to force the industry to utilise alternative fuels, there may be very little demand by 2030.

Existing national policies suggest that development could go either way. Norway has introduced a 0.5% mandate for aviation biofuel for 2020[19] that is limited to fuels from feedstocks on Annex IX of the RED II, prohibiting the use of virgin vegetable oils or PFADs. In contrast, Indonesia has set nominal targets that, if successful, would be expected to be met with palm HEFA. In the middle, Spain (in a proposed climate change and energy transition law[20]) has suggested a mandate for advanced biofuels and electrofuels only. This which would exclude virgin oils if introduced as proposed, but we understand[21] that the suggested restriction to advanced biofuels may be relaxed before a mandate is implemented.

Demand and feedstock assumptions follow the demand potentials and feedstock assumptions detailed in Table 5 of Destination deforestation.

The low scenario is based on the potential demand identified from proposed national mandates in Sweden, Spain and France, and on 50% achievement of the Indonesian mandate. The medium scenario assumes that Indonesia and the EU both achieve 5% biofuel in aviation fuel (with palm oil excluded from supply to the EU due to the high ILUC-risk categorisation). Finally, the high scenario assumes that the global aviation industry embraces alternative fuel use, following a trajectory towards 50% aviation biofuel use by 2050 (with a quarter of required feedstock from each of soy oil and palm oil). No significant production of aviation fuel from either palm or soy oil is assumed in 2020. This is based on the very low volumes currently being produced (in the low tens of thousands of tonnes per annum) and the statement by Neste, the current largest aviation HEFA producer in the world, that no palm oil is used for aviation fuel production (we do not believe Neste use any soy oil), although it is likely that Neste include PFAD in the feedstock mix for aviation fuels.

TABLE 10: SCENARIOS FOR ADDITIONAL PALM AND SOY OIL DEMAND FROM AVIATION (million tonnes)

Scenario	Description	2020		2025		2030	
		Palm	Soy	Palm	Soy	Palm	Soy
High	Trajectory to global 50% biofuel in aviation, plus Indonesia meets targets	0.0	0.0	4.6	4.3	13.8	12.8
Medium	EU and Indonesia move to 5% biofuel for aviation by 2030	0.0	0.0	0.2	0.5	0.5	1.5
Low	Sweden, France and Spain introduce mandates, Indonesian mandate 50% achieved	0.0	0.0	0.1	0.2	0.3	0.5

18) Although it is important to note that there are no targets to reduce non-CO_2 global heating impacts, for instance from induced cloudiness, and that these non-CO_2 impacts may be larger on a hundred-year timescale than the impacts from fuel combustion.
19) https://www.regjeringen.no/en/aktuelt/mer-avansert-biodrivstoff-i-luftfarten/id2643700/
20) https://www.miteco.gob.es/es/cambio-climatico/participacion-publica/marco-estrategicoenergia-y-clima.aspx
21) From private correspondence with relevant officials.

Shipping

The shipping industry is sometimes identified as a major potential consumer of biofuels, both with a view to CO_2 emissions reductions and in respect of biofuels as a low-sulphur compliance option. To date, however, use has been very limited, and the shipping market is made more challenging by the fact that marine fuel is the cheapest transport fuel, leaving a large price gap to bio-alternatives. The International Maritime Organisation has recently stepped up progress towards the option of international decarbonisation targets, but it is difficult to predict at this stage what role biofuels would play in meeting industry targets.

A recent report by Sustainable Shipping Initiative (2019) discusses the potential for sustainable biofuels to contribute to meeting maritime GHG reduction targets, stating that, "When asked for their views on the percentage of which shipping's energy needs would be met by biofuels in 2030 and 2050, the majority of stakeholders agreed this would fall in the 10-30% range," and that, "There remains no clear consensus on whether there is sufficient sustainable biomass for shipping as well as other sectors." The report acknowledges that palm and soy oil biofuels are understood to have high associated ILUC emissions and reports that, "the significant majority of the stakeholders consulted have a clear preference for any biofuels to be sourced from municipal, agricultural and/or forestry waste streams rather than purpose-grown crops."

Given the very large uncertainty about whether any significant volume of biofuel will be supplied for the marine sector by 2030, and if so what fuels and what feedstocks would be used, we do not include scenarios for palm and soy oil demand from shipping in this report.

Overview of direct demand

TABLE 11: OVERVIEW OF POTENTIAL DIRECT PALM OIL DEMAND ACROSS ALL SCENARIOS CONSIDERED

Demand in million tonnes	2020			2025			2030		
	Low*	Medium	High	Low	Medium	High	Low	Medium	High
Indonesia	5.7	6.8	9.7	7.3	12.5	15.0	8.9	15.3	25.5
Malaysia	1.1	1.3	2.2	1.8	2.4	3.3	1.8	2.4	3.6
Thailand	0.9	1.0	1.3	0.9	1.3	2.0	0.9	1.6	3.0
EU	4.0	4.0	4.0	0.3	2.9	4.0	0.0	0.3	4.0
U.S.	0.0	0.0	0.1	0.0	0.0	1.0	0.0	0.0	2.1
China	0.0	0.4	1.0	0.0	0.4	4.0	0.0	0.4	9.0
Aviation	0.0	0.0	0.0	0.1	0.2	4.6	0.3	0.5	13.8
Total	**11.7**	**13.5**	**18.3**	**10.4**	**19.7**	**33.9**	**12.0**	**20.5**	**61.0**

TABLE 12: OVERVIEW OF POTENTIAL DIRECT SOY OIL DEMAND ACROSS ALL SCENARIOS CONSIDERED

Demand in million tonnes	2020			2025			2030		
	Low*	Medium	High	Low	Medium	High	Low	Medium	High
Brazil	2.9	2.9	3.3	3.2	5.0	6.5	3.5	5.4	10.2
Argentina	1.1	1.2	1.3	1.1	1.3	1.5	1.1	1.3	2.5
U.S.	4.5	4.5	4.5	4.0	5.0	6.0	3.5	5.5	9.0
EU	2.4	2.5	2.6	2.0	3.2	4.6	0.0	4.0	6.4
Norway	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.2
Aviation	0.0	0.0	0.0	0.2	0.5	4.3	0.5	1.5	12.8
Total	**10.9**	**11.2**	**11.8**	**10.5**	**15.0**	**23.0**	**8.6**	**17.8**	**41.0**

Photo: Araquém Alcântara/Rainforest Foundation Norway

FIGURE 5: HIGH SCENARIO FOR INCREASE IN DIRECT DEMAND FOR PALM OIL AS BIOFUEL FEEDSTOCK FROM 2020 TO 2030

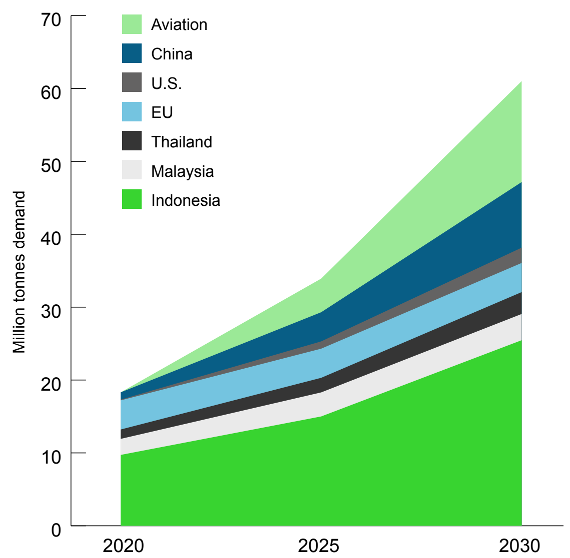
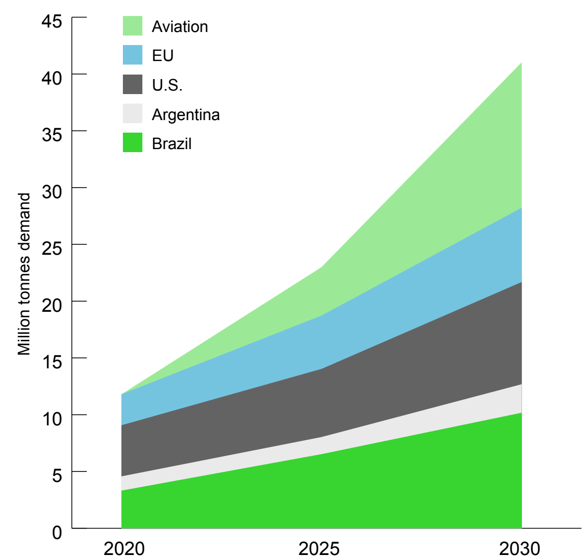


FIGURE 6: HIGH SCENARIO FOR INCREASE IN DIRECT DEMAND FOR SOY OIL AS BIOFUEL FEEDSTOCK FROM 2020 TO 2030



Indirect palm and soy oil demand due to biofuels policy

Photo: Araquém Alcântara/Rainforest Foundation Norway

In the previous section the direct demand for palm and soy oil as biofuel feedstock was reviewed. In addition to this direct demand, there is the potential for additional indirect palm oil demand. This reflects the case that palm oil use for food or cosmetics could be increased in some regions when other oils are removed from the market. For example, Searle (2017) reports econometric analysis demonstrating that increases in rapeseed oil prices in the EU and soy oil prices in the U.S. are both associated with increases in palm oil imports.

> *The strongest transfer of demand to palm oil would come from soy oil use for biofuel*

Globally, it is expected that the strongest transfer of demand to palm oil would come from soy oil use for biofuel. This is because most of the value of soy crops comes from the meal, and so many experts believe that increasing soy oil demand will only weakly affect total soy production. If soy oil production does not increase to meet demand increases, the market is likely to turn to alternate oils for which production is more responsive, such as palm. For example, modelling by Laborde (2011) estimated that about 50% of the increase in vegetable oil production in response to soy biodiesel demand would come from palm oil, and Valin et al. (2015) estimated that 60% of additional vegetable oil production in response to soy biodiesel demand would be palm oil. Driving deforestation therefore included an assessment of the potential level of indirect demand for palm oil resulting from mandates using soy and rapeseed oil.

In this report, soy demand scenarios have already been explicitly assessed, in the previous section and are not covered here. The largest other potential source of indirect demand is the EU's use of rapeseed oil for biodiesel. There is also likely to be further indirect demand from the use of other vegetable oils and due to the use of waste and residual oils (cf. Malins, 2017d), but we have not attempted to expand this assessment to that level of detail. Similarly, other national biodiesel mandates have either already been considered (e.g. U.S., Brazil) or are relatively small compared to markets in the countries explicitly assessed. Given the limits to the scope of the indirect demand scenario it can be considered a low-end estimate of the potential impact.

In the chapter below that details the potential impact of these demand scenarios on forest and peatland, the indirect transfer of demand between soy and palm oils is integrated into the assessment, so it is assumed that part of direct soy oil demand is expressed as increased palm oil production, leading to the deforestation impacts associated with palm oil.

European Union

Rapeseed oil remains the largest feedstock for EU biodiesel consumption, with 5 million tonnes of demand expected in 2019 (Flach et al., 2019). Laborde (2011) estimates that 44% and 9% of rapeseed oil demand are indirectly transferred to increased palm oil and soy oil production respectively, while Valin et al. (2015) gives an 11% transfer to palm oil production and no transfer to soy. Scenarios for additional indirect demand from the EU biofuel market are constructed assuming that the EU continues to consume 5 million tonnes a year of rapeseed oil for biodiesel, taking the (Valin et al. (2015) transference values for the low scenario, the Laborde (2011) values for the high scenario and the average for the medium scenario. R

TABLE 13: SCENARIOS FOR ADDITIONAL INDIRECT PALM OIL DEMAND FROM THE EU

Scenario	Description	Palm oil demand (million tonnes)		
		2020	2025	2030
High	Demand transference based on Laborde (2011)	2.2	2.2	2.2
Medium	Average demand transference	1.4	1.4	1.4
Low	Demand transference based on Valin et al. (2015)	0.6	0.6	0.6

TABLE 14: SCENARIOS FOR ADDITIONAL INDIRECT SOY OIL DEMAND FROM THE EU

Scenario	Description	Soy oil demand (million tonnes)		
		2020	2025	2030
High	Demand transference based on Laborde (2011)	0.5	0.5	0.5
Medium		0.2	0.2	0.2
Low		0.0	0.0	0.0

«Certification schemes on their own are not a solution to commodity-demand driven deforestation»

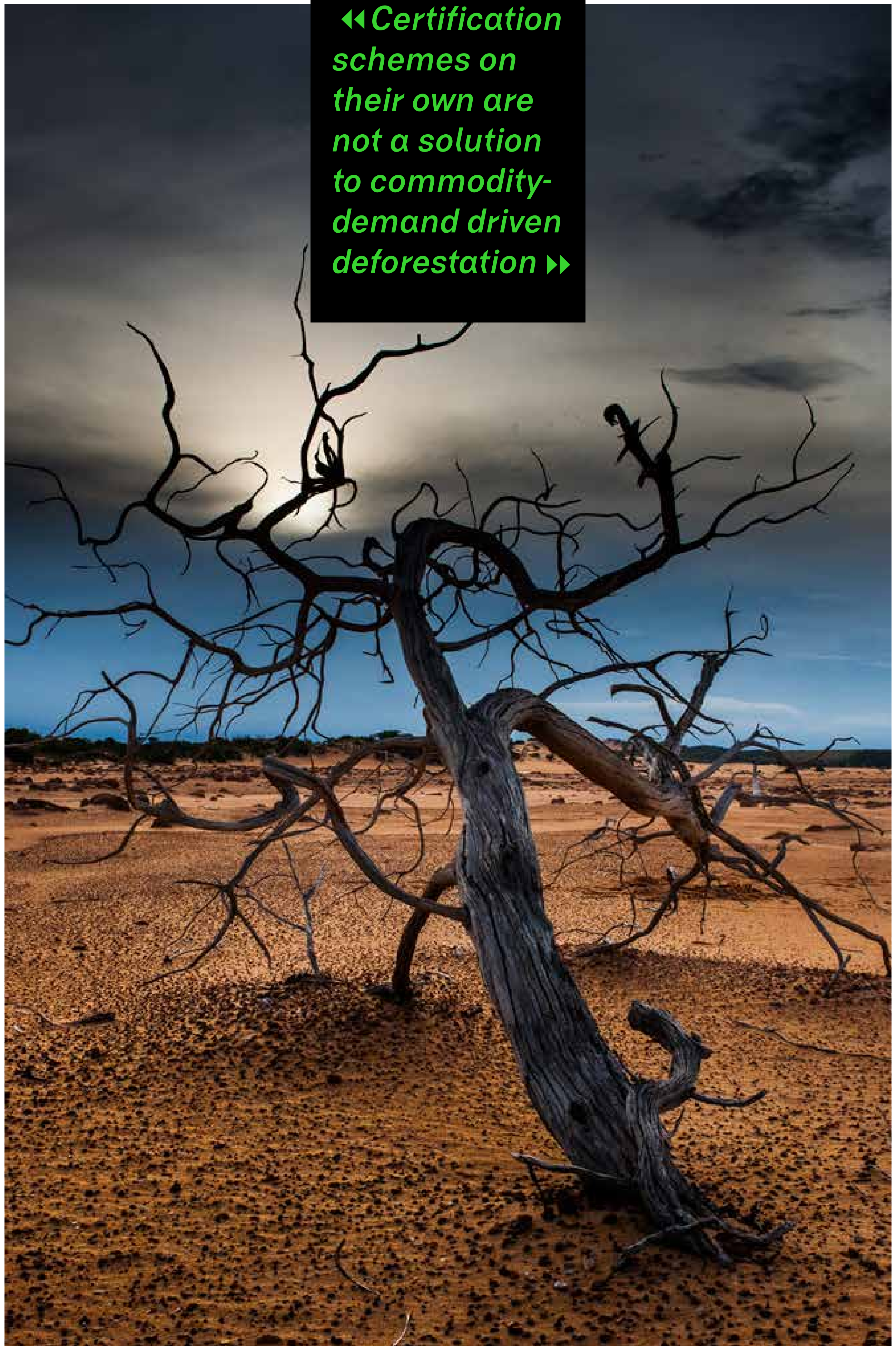


Photo: Araquém Alcântara/Rainforest Foundation Norway

Producers of palm- and soy oil-based biofuels

This section identifies some of the larger biofuel producers generating demand for palm oil, PFAD and soy oil as biofuel feedstocks. It should be noted that several of the companies identified below are engaged with agricultural sustainability schemes such as the Roundtable on Sustainable Palm Oil. While such engagement is positive, as discussed in Malins (2018) certification schemes on their own are not a solution to commodity-demand driven deforestation, as currently it is too easy for the certified material to be "cherry-picked" for export to markets concerned about sustainability while directly deforestation linked material is sold to less fastidious customers. Similarly, several palm oil companies are nominally committed to 'no deforestation, no peat, no exploitation' policies, although as documented by Greenpeace (2018) these commitments may not yet be delivered in practice.

Global

Neste

Neste, formerly the Finnish state petroleum company, is the world's largest operator of vegetable oil hydrotreating plants, with a capacity of about 2.9 million tonnes of HVO and HEFA a year across plants in Singapore, Finland and the Netherlands. This global capacity is set to increase to 4.5 million tonnes by 2022[22]. In 2018, palm oil made up about a fifth of Neste's biofuel feedstock, representing 445 thousand tonnes of palm oil demand[23]. That is about 5% of global use of palm oil for biofuels. The remainder of Neste's feedstocks are described by the company as 'wastes and residues', but this includes PFADs, which are treated as a by-product of palm oil production by most EU Member States (Malins, 2019a). It is unknown what fraction of the remaining 80% of Neste's feedstock is PFAD, but it seems likely that it is a large contribution. For example, in 2017 PFAD was the most used feedstock for HVO supplied in Sweden (510 thousand tonnes, 39%), a major market for Neste[24].

Archer Daniels Midland (ADM)

ADM owns 'refining, packaging, biodiesel and other' facilities in the U.S., Canada, Argentina, Brazil, Peru, several EU Member States and South Africa (Archer Daniels Midland, 2019). Global processing capacity for these facilities is reported as 18 million tonnes per year, but it is not clear how much of this is biodiesel capacity. The company reported annual benefit $123 million from the biodiesel blender's tax credit in 2017, implying over 500 thousand tonnes of vegetable oil processed to biodiesel in the U.S., much of which is likely to have been soy oil.

Southeast Asia

Wilmar

Wilmar is one of Southeast Asia's largest palm oil companies, and operates 3 million tonnes of biodiesel capacity across 13 plants (Wilmar, 2018). Wilmar has a 'no deforestation, no peat and no exploitation' policy, and provides online details of its supply chain management programme (Wilmar, 2017). Wilmar supports the adoption of a B30 biodiesel blend in Indonesia.

Sinar Mas

Sinar Mas is another major palm oil company, and through its subsidiary Golden Agri Resources (GAR) reports about 600 thousand tonnes of biodiesel capacity between Java and Kalimantan (GAR, 2018, 2019). It is an active supporter of increasing biodiesel mandates in Indonesia. GAR is a member of the RSPO, and has made 'no deforestation, no peat and no exploitation' commitments.

Apical Group

The Malaysian Apical Group, owned by Royal Golden Eagle, has five palm oil refineries and three biodiesel plants (including the BioOils plant in Spain, see below). The group's two Indonesian biodiesel plants, both in Sumatra, produced just under 400 thousand tonnes of palm oil biodiesel in 2018 (Apical, 2018). Apical has made 'no

22) https://www.neste.com/releases-and-news/renewable-solutions/neste-strengthens-its-global-leading-position-renewable-products-major-investment-singapore
23) https://www.neste.com/corporate-info/sustainability/sustainable-supply-chain/sustainably-produced-palm-oil
24) https://www.neste.com/releases-and-news/neste-my-renewable-diesel-launched-sweden

deforestation, no peat and no exploitation' commitments (due to be fully implemented by 2020), but is also a supporter of the adoption of a B30 blend mandate for Indonesia.

Europe

Spanish biodiesel industry
Spain is a major importer of vegetable oils for biodiesel production. Stratas Advisors (2019) note that almost all feedstock for biodiesel supplied in Spain in 2018 was imported. Reporting by CNMC (2019) shows that palm and soy oil accounted for 55% and 34% respectively of feedstock for biodiesel consumed in Spain in 2018, Most of the soy biodiesel consumed is reported as Argentinian imports, and based on the CNMC data we estimate that palm oil was the feedstock for 85% of biodiesel processed in Spain in 2018. That is consistent with 1.5 million tonnes of palm oil biodiesel production[25], requiring 1.6 million tonnes of palm oil. That's nearly a fifth of global palm oil demand for biofuel production.

One of the largest biodiesel production plants in Spain is operated by the BioOils company, a facility at La Huelva in Southwest Spain with a capacity of 500 thousand tonnes per year. The plant is described on its website as processing "all available first-use oils" as well as some residual oils, but given that it is owned by the Apical Group, which is a Malaysian palm oil company, it is likely that most of the feedstock for the facility is imported palm oil. Another of the larger biodiesel plants in Spain (300 thousand tonne capacity) is owned by the Indonesian palm oil company Musim Mas via Masol Iberia, and presumably processes mostly palm oil.

Repsol
The Spanish refining company Repsol reports that it has 380 thousand tonnes of HVO capacity[26] (Repsol, 2019). This compares to 480 thousand tonnes of HVO production reported for Spain for 2018 by CNMC (2019). The CNMC shows that essentially all Spanish HVO production (98%) in 2018 used palm oil as a feedstock.

Eni
Eni produces HVO from palm oil at a converted oil refinery in Venice, Italy, with a capacity of about 310 thousand tonnes per year. Eni has stated its interest in finding more sustainable alternatives to palm oil as feedstock, but reported projects on algal oil production and castor bean cultivation are not yet operational at commercial scale.

Total
The oil company Total has recently opened 490 thousand tonnes of HVO production capacity in France, with about 50% of feedstock initially expected to be palm oil[27]. Since the plant was opened, however, France has removed tax breaks for palm-oil based biofuels following a fraught and controversial series of Parliamentary votes[28]. The loss of this tax support may lead Total to consider alternative feedstocks, potentially including soy oil.

U.S.

Renewable Energy Group (REG)
REG identifies itself as the largest biofuel producer in the U.S.[29], and has soy pathways registered with the California Air Resources Board for both biodiesel and renewable diesel.

For 2018, REG's annual report shows soy oil consumption of only 160 thousand tonnes out of 1.8 million tonnes of overall feedstock consumption, with lower-cost oils (used cooking oil, animal fats and distillers' corn oil) accounting for 77% of production volume.

Latin America

Granol
Granol is identified by ANP (2019) as having the largest total biodiesel production capacity in Brazil, up to 1.2 billion litres a year across three refineries, with reported annual production 900 thousand tonnes[30] Granol is active through the soy value chain, and identifies soy oil as the main feedstock for its biodiesel product. The company also operates a used cooking oil collection programme, but it is a minor contribution to the feedstock base – total collection since 2003 is reported at 12 million litres[31]. Total annual soy oil consumption for biofuels is therefore around 900 thousand tonnes.

Renova
Renova operates the largest biodiesel plant in Argentina, with up to 500 thousand tonnes annual production capacity[32]. Total production was reported at 480 thousand tonnes at 2012, more recent data were not available[33]. This is likely to be entirely or almost entirely soy oil based.

25) Note that Spain is a net exporter of biodiesel and HVO, but feedstock data relate to biodiesel consumed on the Spanish market. These calculations are based on an assumption that the statistics are representative of feedstock mix for the exported fuel as well as domestically consumed fuel.
26) This is more than we identified in the report Destination deforestation. It seems that Repsol's total HVO capacity is understated by (Nyström, Bokinge, & Per-Åke, 2019).
27) https://www.greencarcongress.com/2019/07/20190704-total.html
28) http://www.rfi.fr/en/europe/20191116-france-votes-against-proposed-tax-break-palm-oil
29) https://www.globenewswire.com/news-release/2019/06/20/1871801/0/en/Renewable-Energy-Group-Inc-the-Largest-Biodiesel-Producer-in-the-U-S-Joins-Diesel-Technology-Forum.html
30) https://renewablesnow.com/news/granol-to-boost-biodiesel-production-90301/
31) http://www.granol.com.br/eng/Corporate+governance/pickup_used_frying_oil/
32) http://www.renova.com.ar/compania.php
33) https://www.vicentin.com.ar/biodiesel?lang=en

Impact on forest and peat


Photo: Rich Carey/ Shutterstock.com

Analysis from the EU's Delegated Act on high and low ILUC-risk biofuels (European Commission, 2019a) has been used as a basis to estimate the amount of deforestation and peat loss that can be expected as a result of biofuel led increases in palm oil and soy oil production (see Table 15).

The EU analysis leads to global average rates for deforestation due to expansion, but there are local variations within these averages. For example, soy expansion is not associated with significant deforestation in the U.S., but is in Latin America. Similarly, palm oil expansion in Thailand and Colombia is not as strongly linked to direct deforestation as it is in Indonesia and Malaysia. Global markets for these oils are linked by trade, so soy demand from the U.S. RFS could still indirectly lead to soy oil production increases elsewhere. In the analysis here we have simply used the global average rates for each oil, and have not attempted to analytically distinguish the impact of increased feedstock demand by country.

TABLE 15: ESTIMATED DEFORESTATION AND PEAT LOSS PER TONNE OF PALM OR SOY OIL FROM NEW PLANTATIONS

	Deforestation* (ha/tonne)	Peat loss (ha/tonne)
Palm	0.15	0.08
Soy**	0.03	-

**The assumed area of deforestation is taken to include areas of peat forest – so for palm we anticipate 0.15 hectares of forest lost for every tonne of additional palm oil demand, of which 0.08 hectares are expected to be on peat soils.*

***For soy, we assume for simplicity that the deforestation impact can be allocated equally by mass between the vegetable oil and the meal.*

Soy oil and meal

As the name suggests, the oil palm is primarily an oil crop – while palm kernel meal is produced as a co-product, only about a tenth of a tonne is produced for every tonne of palm oil. It is therefore fair to assume that palm oil production primarily responds to vegetable oil prices and demand. The soybean crop is quite different, in that four and a half tonnes of soybean meal are produced for every tonne of soy oil. Soy oil trades for a higher price per tonne than soy meal, but even so the meal from crushing soybeans is generally worth more than the oil. This is illustrated in Figure 7, which illustrates that for the last five years the value of the soy meal has always been at least 50% more than the value of the soy oil from a tonne of soybeans.[34]

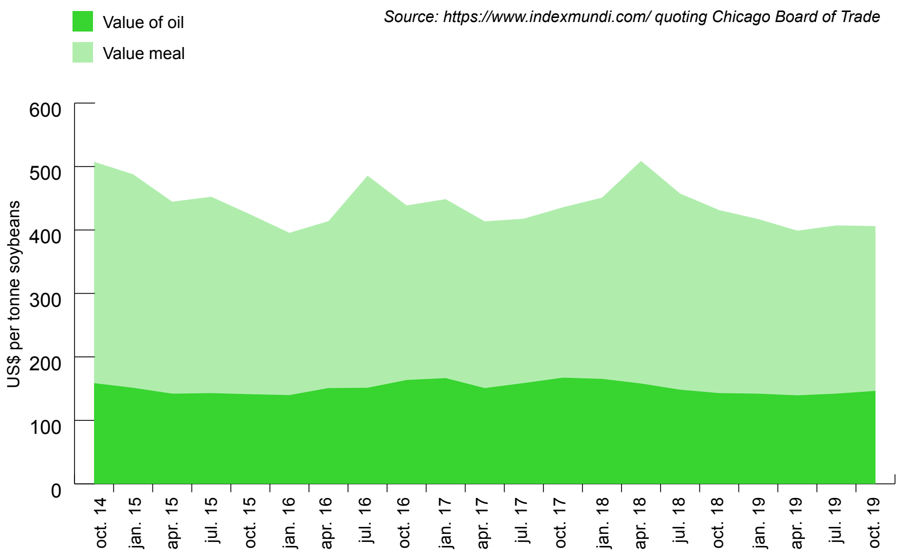
Given that soy meal is worth more than soy oil and that soy oil prices and meal prices are not particularly strongly correlated, it is reasonable to ask how strongly soybean planted areas respond to soy oil demand (if demand for soy meal remains constant). Some commentators argue that soybean production is determined primarily by demand for soy meal (and whole soybeans) for livestock feed, and that the oil should be considered as a by-product. If soy oil production responds only weakly to increases in vegetable oil demand, then one would expect that increased use of soy oil for biofuel production would result in increased production of other oils such as palm oil and rapeseed as well as (or even instead of) increased soy bean production, as discussed above in the section on indirect demand. The overall sustainability of increased soy biodiesel demand therefore depends not only on the relationship between the soy crop and deforestation, but also on the overall environmental sustainability of the oil palm crop.

Recognising that soy oil demand is likely to lead to a combination of soy and palm expansion, in the analysis below it is assumed that half of the response to a tonne of soy oil demand for biodiesel is met by additional soy oil, and half by additional palm oil.

◂◂ The sustainability of increased soy biodiesel demand also depends on the overall environmental sustainability of the oil palm crop ▸▸

FIGURE 7: VALUE OF SOY OIL AND MEAL PER TONNE OF CRUSHED SOYBEANS

Source: https://www.indexmundi.com/ quoting Chicago Board of Trade



34) The value of the oil fraction briefly approached the value of the meal fraction during the food price crisis of 2011, but even then did not exceed it.

Land use change impact and related CO_2 emissions

The potential deforestation and peat loss impacts of the increased biofuel demand scenarios are calculated using a similar methodology to that presented by Malins (2018). It is assumed that a third of vegetable oil demand is delivered through reduced consumption in other sectors (food and cosmetics) and that 10% of demand is delivered through yield increases. For simplicity, these assumptions are used for both palm and soy oil. The assumption that only 10% of additional palm oil demand would be met by improved yields is informed by the relative stability of palm oil yields over time despite large palm oil price variations. There is econometric analysis available suggesting that soy yields do not respond strongly to demand (Huang & Khanna, 2010) and therefore we consider 10% a reasonable assumption for soy as well. Some commentators (e.g. Babcock & Iqbal, 2014) have argued that there may be an increase in double cropping of soybeans in response to demand increases (planting more than one crop in the year). While this is possible, it is noted by Malins (2017b) that these claims are not supported by strong evidence that there is a link between rates of multiple cropping and increases in demand (rather than increases in multiple cropping occurring primarily in response to independent technical advances). In the absence of solid evidence for the strength of this response, we assume that a further 10% of soy oil demand is met by increased multiple cropping.

This approach of making simple assumptions about the fraction of feedstock delivered from additional area lacks the sophistication and detail of full ILUC modelling, but provides an indication of the likely scale of impact based on transparent assumptions. The results presented here are intended to complement rather than replace more sophisticated ILUC modelling approaches.

Table 16 presents the overall expected land use change implications of the palm oil demand scenarios, and Table 17 the soy oil demand scenarios. It should be recognised that delivery of the 'high' or 'low' scenarios need not be correlated between regions, and that therefore global outcomes may be expected to be closer to the sum of the 'medium' cases than to the sum of the extremes.

TABLE 16: SCENARIOS FOR ADDITIONAL DEFORESTATION AND PEAT LOSS DUE TO PALM OIL DEMAND FROM BIOFUEL POLICY, AGAINST A CASE WITH NO BIOFUEL DEMAND

Thousand hectares		2020			2025			2030		
		Low*	Medium	High	Low	Medium	High	Low	Medium	High
Forest loss	Direct demand	1,000	1,150	1,570	890	1,680	2,900	1,020	1,750	5,220
	Indirect demand	50	120	190	50	120	190	50	120	190
	Total	**1,050**	**1,270**	**1,760**	**940**	**1,800**	**3,090**	**1,070**	**1,870**	**5,410**
Peat loss	Direct demand	530	610	830	470	900	1,550	540	930	2,780
	Indirect demand	30	60	100	30	60	100	30	60	100
	Total	**560**	**680**	**940**	**500**	**960**	**1,650**	**570**	**1,000**	**2,880**

Note: Peat loss will overlap to a significant extent with forest loss, so the two areas should not be treated as additive. Rounded to nearest 10 ha.

TABLE 17: SCENARIOS FOR ADDITIONAL DEFORESTATION AND PEAT LOSS DUE TO SOY OIL DEMAND FROM BIOFUEL POLICY, AGAINST A CASE WITH NO BIOFUEL DEMAND

Thousand hectares		2020			2025			2030		
		Low*	Medium	High	Low	Medium	High	Low	Medium	High
Forest loss	Direct demand	460	470	490	440	630	970	360	750	1,730
	Indirect demand	0	10	20	0	10	20	0	10	20
	Total	**460**	**480**	**510**	**440**	**640**	**990**	**360**	**760**	**1,750**
Peat loss	Direct demand	200	210	220	200	280	430	160	330	770
	Indirect demand	0	0	10	0	0	10	0	0	10
	Total	**200**	**210**	**230**	**200**	**280**	**440**	**160**	**330**	**780**

Note: Peat loss will overlap to a significant extent with forest loss, so the two areas should not be treated as additive. Rounded to nearest 10 ha.

◂◂ If the high scenarios for both palm and soy oil demand were realised, it could drive 7 million hectares of deforestation ▸▸

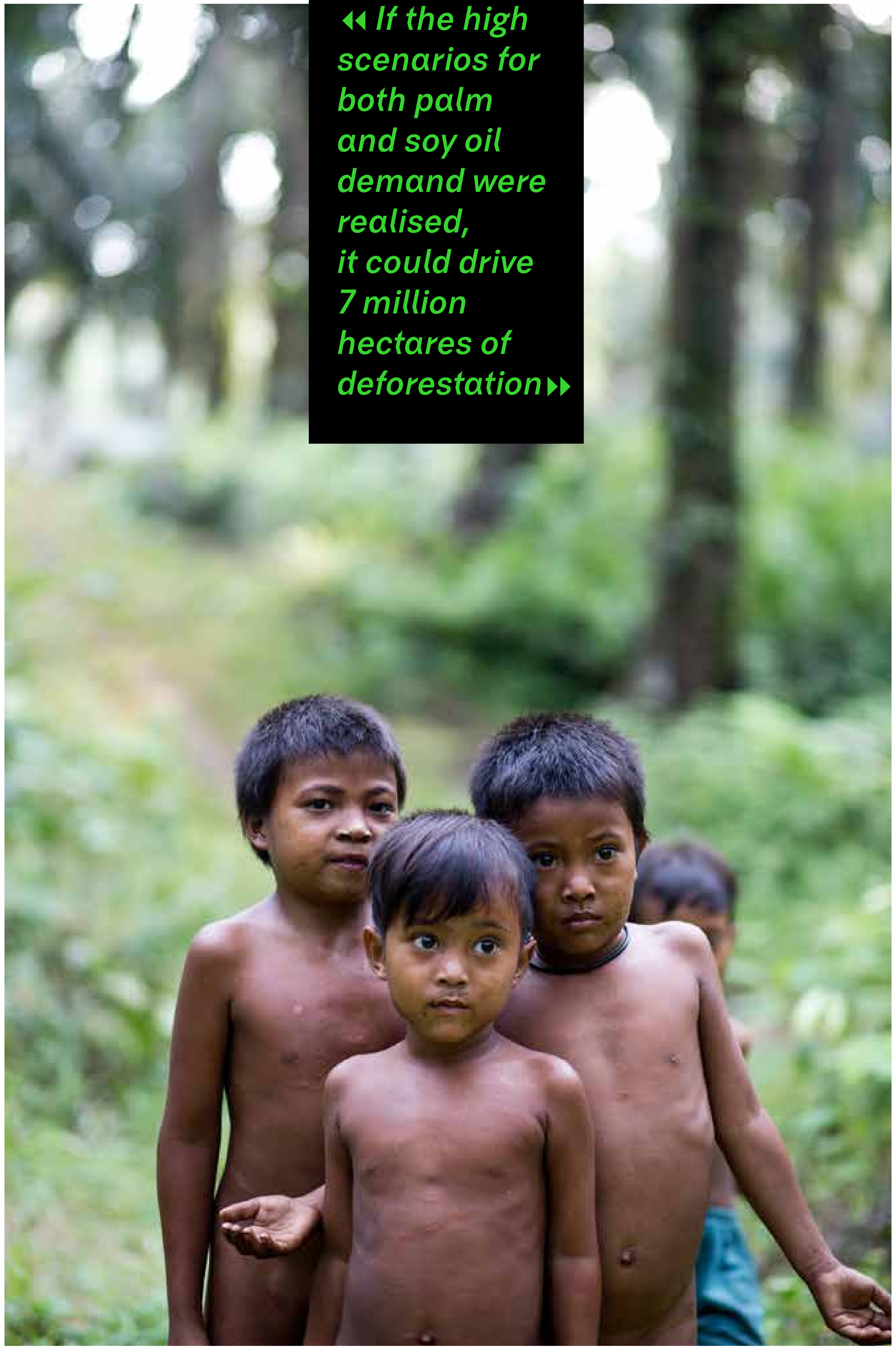


Photo: Per-Ivar Nikolaisen/ Rainforest Foundation Norway

By 2030, the expected additional deforestation due to palm oil use for biofuels is between 1.1 million hectares and 5.4 million hectares – equivalent to somewhere between the size of Cyprus and that of Croatia. The expected additional deforestation due to soy use for biofuels is between 460 thousand hectares and 1.8 million hectares – equivalent to somewhere between the area of Mallorca and that of Wales.[35] The area of peat loss due to palm oil consumption is between 0.4 and 2.5 million hectares, the area of peat loss due to soy oil consumption triggering palm oil expansion is between 0.2 and 0.8 million hectares.

If the high scenarios for both palm and soy oil demand were realised together[36], it could drive total additional deforestation of 7.0 million hectares across Southeast Asia and Latin America, including drainage of up to 3.6 million hectares of peat swamp.

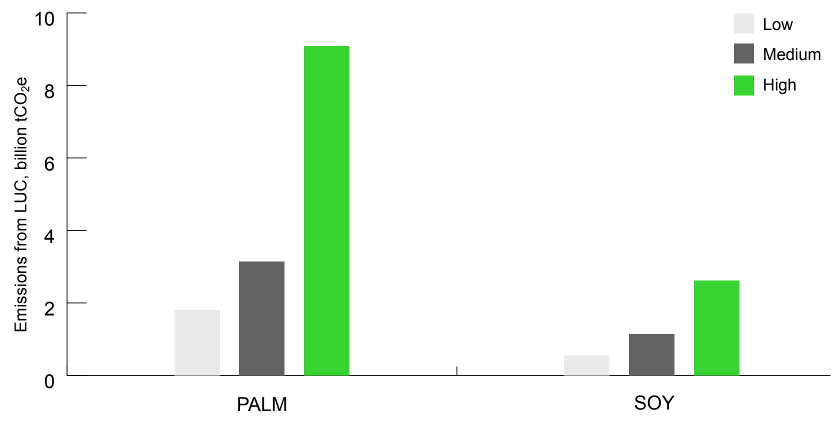
Using the same land use change emission factors as Destination deforestation gives the potential additional land use change emissions by 2030 detailed in Table 18. This includes the emissions from the clearance of the stated area of tropical forest, and twenty years of peat degradation emissions. These are the total CO_2 releases associated with these land use changes, not annual emissions. The high palm scenario would cause 9.1 billion tonnes of CO_2 emissions from deforestation and peat drainage while the high soy scenario would cause 2.6 billion tonnes. The emissions for the medium scenarios are 3.1 billion tonnes and 1.1 billion tonnes of CO_2 respectively. The results are illustrated in Figure 8. If the high scenarios for both palm and soy oil demand were realised together[37], it could result in a total of 11.5 billion tonnes CO_2e of additional land use change emissions[38].

◂◂ If the high scenarios for both palm and soy oil demand were realised, it could cause 11.5 billion tonnes of land use change emissions ▸▸

TABLE 18: POTENTIAL EMISSIONS FROM FOREST LOSS AND PEAT DRAINAGE BY 2030

Billion tonnes CO_2e		Low	Medium	High
Palm	Emissions forest	0.6	1.0	3.0
	Emissions peat	1.2	2.1	6.1
Soy	Emissions forest	0.2	0.4	1.0
	Emissions peat	0.3	0.7	1.7

FIGURE 8: POTENTIAL EMISSIONS FROM FOREST LOSS AND PEAT DRAINAGE BY 2030



35) Land statistics by country taken from https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_area
36) With the exception of the EU, where the high soy oil demand case assumes elimination of palm oil use, and therefore is not double counted.
37) With the exception of the EU, where the high soy oil demand case assumes elimination of palm oil use, and therefore is not double counted.
38) These would be partly offset by reduced emissions from fossil fuel use. Calculating the full net emissions implications of biofuel policy requires assessing agricultural emissions, land use changes, processing emissions and the amounts of fossil fuel use displaced.

Other impacts

As well as driving land use change emissions, deforestation and peat destruction are a driver of biodiversity loss and of increased forest fire risk, and increased use of vegetable oils for energy has implications for food markets. The expansion of agriculture in tropical forests also increases the risk of land-grabbing and violence towards indigenous and other forest-dependent communities.

Impact on biodiversity

Tropical forests are highly biodiverse. IPBES (2018a) identifies palm oil plantations as having been a primary driver of the loss of intact ecosystems in Southeast Asia, and a threat to both terrestrial and freshwater biodiversity. Increases in market demand led by biofuel use are identified as a "key drivers behind this large-scale forest conversion". Replacing either primary or secondary forest with oil palm plantations reduces biodiversity dramatically (Petrenko et al., 2016). Threatened species affected by palm oil expansion include the Sumatran tiger, orangutan, Sumatran rhinoceros and elephant, as well as numerous less well-known species.

Similarly, soybean expansion is a significant threat to biodiversity in Latin America. While IPBES (2018b) considers pasture expansion the main driver of Amazon deforestation, soybean monocultures are also identified as putting pressure on forests, in particular the dry Chaco forest and the Cerrado.

Impact on food markets

Since the food price crisis of 2007/08, the role of biofuel demand in affecting food prices and food consumption has been controversial, but there is a broad consensus that adding large agricultural commodity demand through biofuel mandates tends to push food prices up and to have deleterious overall welfare impacts on poorer communities (Malins, 2017c). While some biofuel lobbyists continue to dispute whether there is any relation between biofuel demand and commodity prices, it is generally taken for granted by market analysts and traders that biofuel mandates raise prices. This can be clearly seen in the case of the Indonesian Government's roll out of B20 and B30 biodiesel blending, which is widely credited with supporting a recovery in palm oil prices[39].

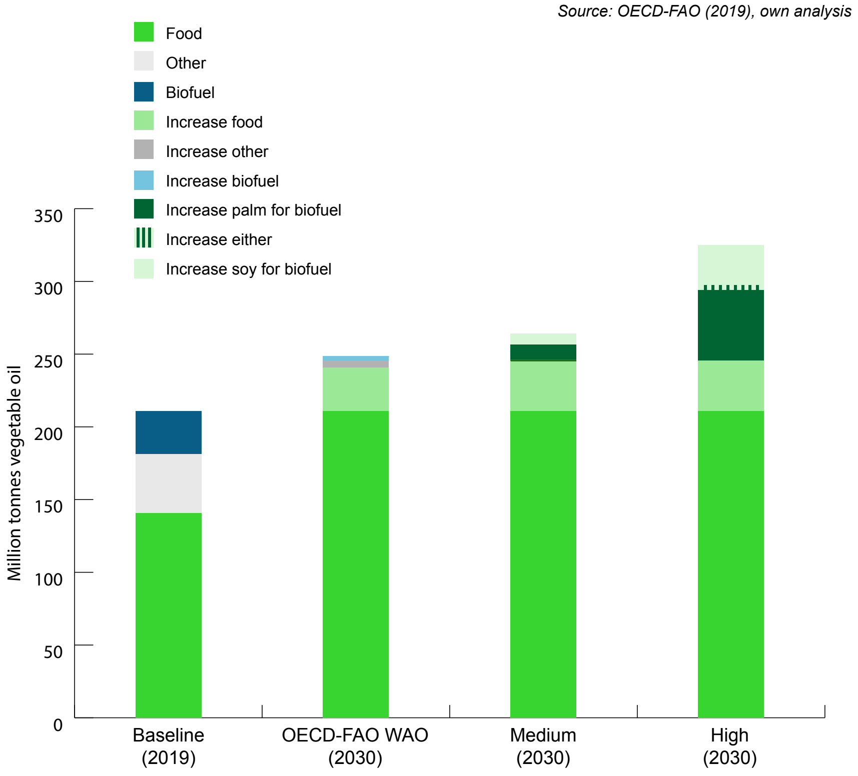
The increases in palm and soy oil consumption for biofuel identified in the high scenarios are large compared to expected increases in vegetable oil demand for food. Figure 9 compares the increases in demand for palm and soy oils in the medium and high scenarios to OECD-FAO World Agricultural Outlook data and projections[40] for global vegetable oil use. If the high demand scenarios were delivered in all jurisdictions[41], the overall demand increase for vegetable oils would be trebled (if there was no resultant reduction in food consumption). Even in the medium case, the implied growth in vegetable oil demand for biofuels is six and a half times larger than the OECD-FAO forecast.

Even in the OECD-FAO projections (without the aggressive growth in demand for palm oil for biofuels production identified in this report) significant palm oil production growth is projected for Indonesia and Malaysia (adding 7 million tonnes of annual capacity). Expanding demand for palm oil for biofuel is not about finding markets for existing production or about avoiding market shrinkage, it is about accelerating the growth of the industry. OECD-FAO anticipates vegetable oil price increases over the coming decade even with relatively modest growth in demand from biofuels, "Prices are set to recover as the ongoing global expansion of food and oleochemical demand for vegetable oil coupled with new domestic demand for vegetable oil as a biodiesel feedstock in selected countries, notably Indonesia." OECD-FAO anticipate that, "production constraints in major palm oil-producing countries will hamper any major expansion of supplies over the next decade," which is based on an assumption that, "The scope to increase palm oil output in Indonesia and Malaysia will increasingly depend on replanting activities and accompanying yield improvements (as opposed to area expansion)." If the ambitious biofuel targets detailed in this report are to be met, this suggests that either palm oil area will need to expand faster than OECD-FAO anticipate (likely meaning deforestation) or that demand will be curtailed in the food sector.

In the medium or high scenarios there would be significant upwards pressure on vegetable oil prices for food. OECD-FAO already project a 30% increase from 2019 to 2028 if overall vegetable oil demand increases by 37 million tonnes. If demand followed the high case for both oil in all jurisdictions (without reduction in the food sector) this would be trebled to 107 million tonnes, and would imply significant price rises. Based on the methodology in Malins (2017c) for estimating medium term impacts on vegetable oil prices, we would expect that if the high scenario for increased palm and soy oil demand in 2030 was realised alongside projected increases in vegetable oil consumption for food it would *increase world vegetable oil prices by a further third.* This would have major welfare impacts. In practice, the price increase would likely be moderated by reductions in food consumption.

FIGURE 9: GLOBAL VEGETABLE OIL CONSUMPTION IN 2019 AND POTENTIAL INCREASE TO 2030

Source: OECD-FAO (2019), own analysis



The high scenario could increase world vegetable oil prices by a third

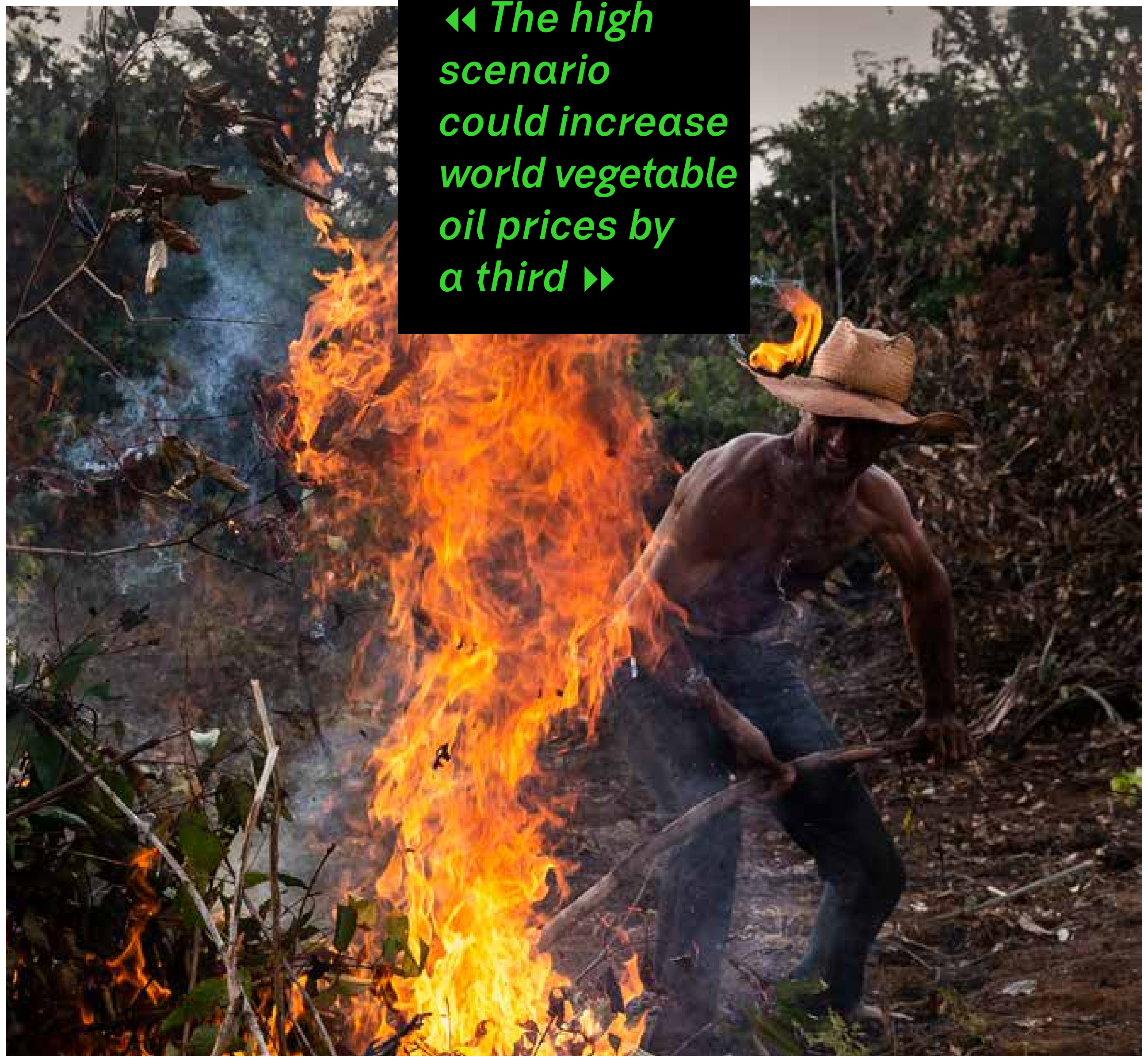


Photo: Araquém Alcântara/Rainforest Foundation Norway

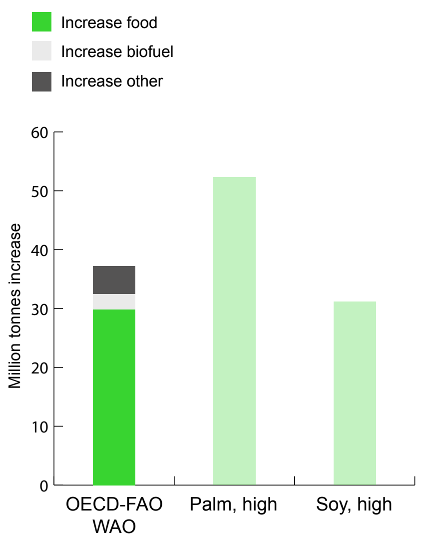
39) See for instance https://www.reuters.com/article/indonesia-palmoil-fry/update-1-palm-prices-outlook-revised-up-as-output-disappoints-b30-sparks-buying-idUSL3N27H262
40) (OECD-FAO, 2019) projects only to 2028, we extrapolate linearly to 2030.
41) Recognising that the high scenarios for EU palm and soy oil demand are mutually exclusive – the overlap between those cases is marked by the hatched area on Figure 9.

Conclusions

Since 2018, important steps have been taken in Europe to recognise and react to the environmental risks of increasing palm oil demand through biofuel mandates. Palm oil biofuel has been identified as 'high ILUC-risk' by the European Union, requiring a gradual removal of support by 2030. Given this policy change and the continued lack of progress in expanding the use of HEFA biofuel in aviation the central 'medium' scenario for direct biofuel-led palm oil demand by 2030 has improved somewhat, reduced by seven million tonnes compared to the previous report.

While these policy developments are positive and may lead to a more general reassessment of whether palm-oil-based biofuels can play a useful role in climate policy, we also note that palm oil demand for biofuel has actually grown faster in some regions than anticipated by our previous assessment (Malins, 2018). In the EU this uptick in palm oil consumption is likely to be temporary, but in Indonesia and Malaysia 'success' in deploying higher biodiesel blends represents a serious threat to forest habitats. The prospect of rapid expansion of HEFA production for aviation is similarly concerning. Palm oil is not the only forest-risk commodity supported by the biofuel industry - we have also explicitly identified biofuel-driven demand for soy oil. While most commentators agree that soy oil demand does not lead to deforestation as strongly as palm oil demand, there is still a clear link, both directly through expansion of the soy crop, and indirectly through transmission of soy oil consumption to palm oil production. Global soy oil consumption as biofuel feedstock looks set to be comparable to palm oil consumption in our medium scenario. Given the ongoing weakening of anti-deforestation policy in Brazil, there could not be a worse moment to add demand to the soy market.

FIGURE 10: OECD-FAO PROJECTION (OECD-FAO, 2019) FOR GLOBAL VEGETABLE OIL CONSUMPTION INCREASE (2018-2030)[42] COMPARED TO HIGH SCENARIOS FOR INCREASED PALM OIL AND SOY OIL DEMAND FOR BIOFUELS



These high consumption scenarios do not only have grim implications for land use change, they also imply significant disruption to global vegetable oil markets. Figure 10 compares the additional demand identified in the high scenarios with projection for total global increases in vegetable oil consumption given by (OECD-FAO, 2019). These high scenarios imply many times more expansion of the biofuel market for vegetable oils than is foreseen by OECD_FAO – indeed, as much additional demand as is expected for food use in the same period from a growing global population. Even without this enormous additional demand the OECD-FAO project vegetable oil prices increasing by 40%. It is almost inconceivable that such a large diversion of food resources to the energy sector could be achieved without significant negative welfare impacts for poorer food consumers. It must also be recognised that using vegetable oils for biofuels implies a persistent additional cost to drivers and/or taxpayers. Whereas cellulosic fuel cost could in the long-term to be cheaper than fossil fuels, vegetable oils have high value in their own right and there is no prospect that vegetable oil based fuels will ever be cost competitive with diesel or jet fuel.

42) OECD-FAO projection only goes to 2028, linearly extrapolated to 2030 for comparison.

Given the contrast between the expectations of the OECD-FAO and the high or even medium scenarios presented here, it is reasonable to ask whether targets will be deliverable in practice. If vegetable oil prices grow under the stress of biodiesel and HEFA mandates, it would not be surprising to see ambition rolled back. While a reduction of ambition for vegetable oil use as biofuel feedstock would be good news for food markets, biodiversity and the climate, it should be noted that these policies are understood by the implementing governments as part of climate change mitigation efforts. Alternative policies that are both more sustainable and more achievable are urgently needed to deliver real emissions reductions in the transport sector.

For the aviation industry in particular, a sober look at the implications of meeting proposed alternative fuel trajectories using HEFA suggests that it's time to explicitly focus on other options. That should involve looking actively to commercialise more sustainable advanced biofuels from cellulosic material, but also requires recognising that the volumes of biofuel consumption implied by stated 2050 goals are simply unlikely to be either achievable or advisable, and that alternative approaches to reduce climate impact will be necessary. That could include power to liquids technologies and novel airframes, but should also include consideration of demand management measures.

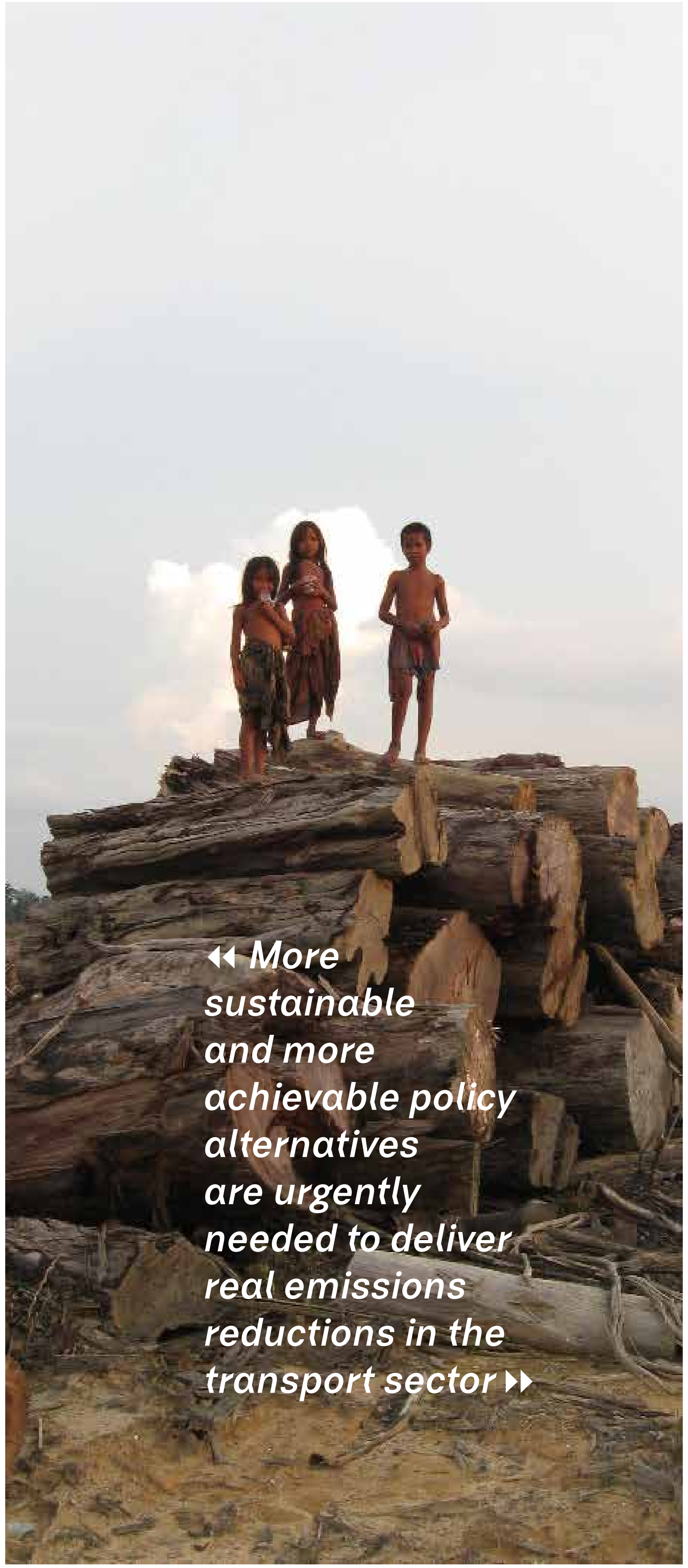


Photo: Heri Doni /Rainforest Foundation Norway

Photo: Araquém Alcântara/Rainforest Foundation Norway

Recommendations

- Palm oil, PFAD and soy are unsuitable as biofuel feedstocks. Due to land use change associated with expanding palm oil and soy production, biofuels based on these feedstocks increase GHG emissions and drive biodiversity loss. The use of palm oil- and soy-based biofuels should be phased out as soon as possible.

- Under the RED II, EU Member States should adopt policies to phase out support for both palm oil- and soy oil-based biofuels, referencing the available evidence on ILUC risk.

- In the 2021 review of the delegated act on high and low ILUC-risk fuels, the European Commission should lower the level at which the threshold for "significant expansion into land with high carbon stock" is set, recognising the extensive evidence that the expansion of crops such as soy cause CO_2 emissions from grassland conversion as well as from deforestation.

- In Europe, the use of biodiesel other than that produced from approved waste or by-product feedstocks should be reduced. The categorisation of palm oil as high ILUC-risk is welcome, but EU policy makers should recognise that vegetable oil markets are linked, and that there is evidence that biofuels from other crop-oils deliver no or limited climate benefit. Member States are explicitly empowered in the RED II to favour biofuels with lower expected ILUC emissions, irrespective of the high ILUC-risk designation.

- In the United States, palm oil biodiesel should continue to be restricted from generating advanced RINs under the Renewable Fuel Standard, due to its poor GHG performance.

- Indonesia should reassess the relationship between its rapidly increasing biofuel mandate, expansion in its palm oil industry and its international climate commitments, and refocus its biofuel programme on advanced biofuels from wastes and residues, including those produced by the palm oil industry (Paltseva, Searle, & Malins, 2016).

- Other countries such as China and Japan should avoid creating new renewable fuel incentives without strong environmental safeguards to ensure that genuine emissions savings are delivered, and should in particular limit support for high deforestation risk biofuels such as those based on palm oil, PFAD and soy oil.

- The aviation industry should focus on the development of advanced aviation biofuels from wastes and residues, rather than hydrotreated fats and oils. These advanced fuels from wastes have dramatically better environmental performance, and have the potential to be cheaper than hydrotreated biofuels in the longer term (Peters, Alberici, Passmore, & Malins, 2016).

- Any national targets or incentives for aviation biofuel use should not support HEFA production from vegetable oils, instead focusing on advanced biofuel pathways.

- More generally, policy makers and the aviation industry should recognise that the volumes of advanced biofuel necessary to meet suggested industry targets are unlikely to be sustainably available in 2050, and prioritise investment in other technologies such as electrical planes and electrofuels, and consider demand management approaches.

- The shipping industry should seek to avoid widespread use of biofuels and instead focus on alternatives such as hydrogen, ammonia and electrification. If biofuels are used, this should be limited to advanced biofuels based on cellulosic material.

- Sustainability initiatives for oil palm agriculture should be supported for food and oleochemical applications, but must not be used as an excuse for driving further demand growth in the biofuel sector.

- Tropical countries that produce palm oil and/or soy, in particular Indonesia, Malaysia and South American countries, should be supported to overhaul forest governance and break the link between vegetable oil production and environmental destruction.

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