Biodiesel and ethanol put an ever-growing strain on food supply

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Confidential

Key points

In 2022, ethanol and biodiesel accounted for 4.3% of the world's fuel requirements for land transport, or almost 1% of total energy consumption. Produced from edible agricultural resources such as maize, sugar and vegetable oils, these fuels exert direct pressure on food markets: in 2023, their production consumed around 660 million tonnes of food products, some 7% of global volumes. While the share of global maize (15%) and sugar (20%) production allocated to biofuels is fairly stable, that of vegetable oils has jumped from 10% to 17% since 2010, as a result of strong demand for biodiesel and the growing use of palm oil.

This market is dominated by a handful of countries: the United States and Brazil account for 70% of global ethanol production, while the EU, the United States and Indonesia account for 70% of biodiesel production. This concentration is explained by the importance of their agricultural sectors: maize and soya in the United States, sugar cane and soya in Brazil, palm oil in Indonesia.

The International Energy Agency and the FAO are forecasting continued growth in biofuel demand and production. In the short term, however, there could be a demand shock, driven by recent national decisions. The United States plans to increase its biodiesel production considerably to absorb the surplus rapeseed no longer exported to China. This consequence of the tariff war unleashed by Donald Trump would mean, by 2027, additional consumption equivalent to 3.9% of global soya production and 2.2% of rapeseed production. In Indonesia, the transition to the "B40 mandate" - the incorporation of 40% biodiesel into diesel - effective since March, will require 3% of the world's palm oil from 2025; the B50 mandate, envisaged for next year, would require 8.2%. In Brazil, the new legislation will mean an additional requirement of 24 Mt of maize for ethanol (1.9% of world production) and 4.5 Mt of soya beans for biodiesel (1.2%) from 2026. Finally, India is using a growing share of its rice surplus to develop its ethanol industry.

These increases could be partly offset by a stabilisation, or even a decline, in demand for biofuels in the EU, which is refocusing on advanced biofuels and electrification. China is also opting out of conventional biofuels, but is banking on sustainable aviation fuels (SAF) to make better use of its used cooking oil.

Biofuels, which are heavily subsidised, are having an impact on agricultural prices, although the extent of this impact is difficult to quantify, as its contribution varies greatly depending on the context, the crops concerned and the methodologies used.

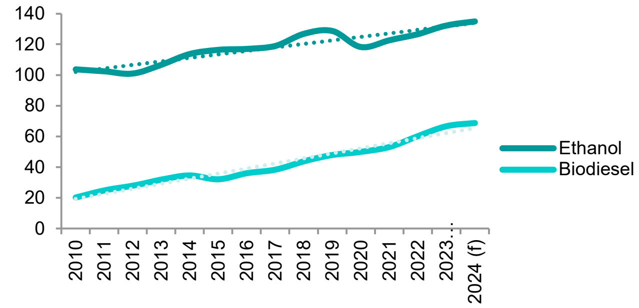
1. Ethanol and biodiesel: 4.3% of transport, 7% of crops

1.1. Massively used fuels, consuming 660 Mt of food per year

Developed as complements or substitutes for petroleum-based petrol and diesel, **ethanol and biodiesel** are currently **the two most widely used biofuels worldwide**. In 2022, they will cover **4.3% of land transport fuel needs** and **almost 1% of total energy consumption**, with 3.94 exajoules (EJ) out of 422 EJ[1] . By way of comparison, the production of gaseous biofuels (biogas and biomethane) was equivalent to just 1.6 EJ[2].

Unlike biogas, liquid biofuels are traditionally and still **overwhelmingly made from agricultural products intended for human consumption** or livestock, although alternative inputs are being developed. In 2023, around **660 million tonnes (Mt) of food products (mainly maize, sugar and vegetable oils) were transformed into ethanol or biodiesel, i.e. 7% of the total**[3] . This has a **considerable impact on food markets**, which is why this study focuses on ethanol and biodiesel.

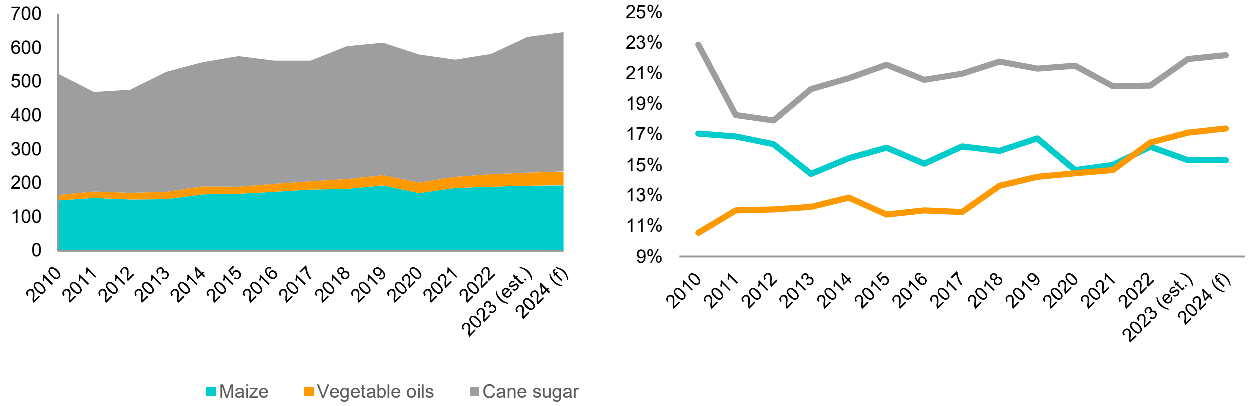
Figure 1: World biodiesel and ethanol production (billion litres)



Source: OECD-FAO Agricultural Outlook 2024-2033

Biodiesel is mainly produced from vegetable oils, mainly **soya**, **rapeseed** and **palm.** These undergo a chemical reaction (transesterification) to convert them into fatty acid methyl esters, or **FAME biodiesel**, which must be mixed with fossil diesel before it can be used. More recently, **renewable diesel** (HVO, *Hydrotreated Vegetable Oil*) has been developed, produced from the same inputs using a separate process, and is 100% substitutable to diesel. For these two varieties, the non-food inputs are mainly **used cooking oil** (UCO) and inedible **animal fats**. Their share remains very low, except in Europe and, to a lesser extent, the United States (see below).

Figure 2: Main agricultural inputs for biofuels, in volume (Mt, left) and as a share of total production (%, right)



Source: OECD-FAO Agricultural Outlook 2024-2033

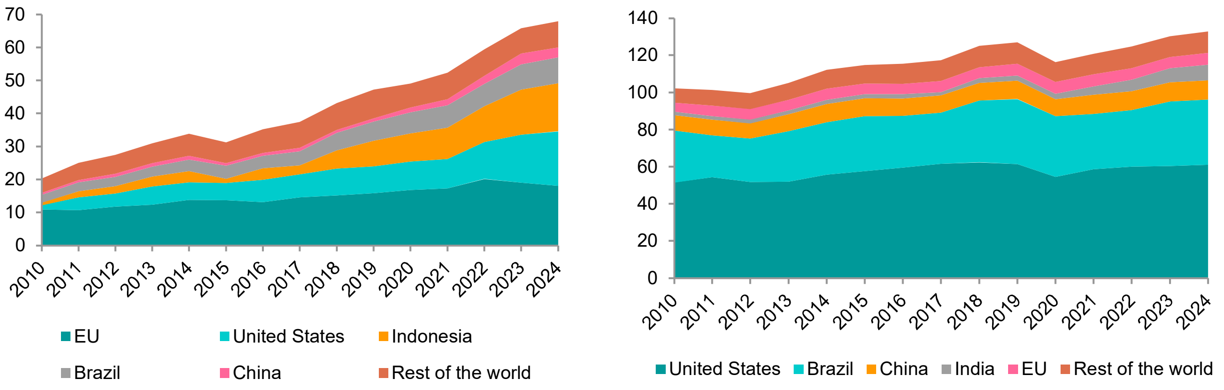
[1] Global Bioenergy Statistics Report 2024, *World Bioenergy Association* , 23/10/2024
[2] Renewables 2023, *International Energy Agency*, 10/01/2024
[3] Global Bioenergy Statistics Report 2024, *World Bioenergy Association* , 23/10/2024

Ethanol is produced mainly from sugar, obtained directly (mainly from **sugar cane**) or by processing the starch present in **cereals**, particularly **maize**. Ethanol must be added to petrol in proportions of up to 15% in standard engines and up to 85% in flex-fuel engines. Some specially-designed vehicles can run on 100% ethanol.

1.2. Production and consumption concentrated in a handful of countries

The production of liquid biofuels is **highly concentrated in a few countries**: between them, the EU, the USA and Indonesia produce 70% of the world's biodiesel; for ethanol, the concentration is even more striking: the USA and Brazil together account for around 70% of production (Figure 3).

Figure 3: Global production of biodiesel (left) and ethanol (right) in billions of litres



Source: OECD-FAO Agricultural Outlook 2024-2033

This concentration is explained by the **agricultural power of the producing countries**: the United States is the world's largest producer of maize and second largest producer of soya, while Brazil is the world leader in soya and sugar cane; Indonesia produces more than half of the world's palm oil.

As we shall see, these same countries have also greatly increased their consumption of biofuels, thanks to **mandatory incorporation into locally-distributed fuel**, and therefore **consume most of their production**. Although up sharply on the previous year, US ethanol exports in 2024 - 7.2 billion litres (bn L)[4] - represented just over 11% of its production. Brazil exports around 6% of its production[5]. Trade in biodiesel is even lower: the United States exported around 4% of its production in 2024; Indonesia, 1.43% in 2023; while Brazil's exports are negligible. Some countries, notably in the EU, do import inputs for refining into biofuels, but overall, **world trade in biofuels is relatively limited.**

But this in no way decreases the pressure they exert on world food markets: producer (and consumer) countries are also the main exporters of the agricultural products concerned.

1.3. Varying situations depending on inputs and geography

Rates of use of food inputs for biofuel production vary considerably from one country - and one product - to another. For example :

- 53% of the sugar cane produced in Brazil is processed into ethanol, compared with 22% worldwide
- 37.5% of the maize produced in the United States is processed into ethanol, compared with 15% worldwide
- Indonesia produces all its biodiesel from palm oil

[4] Ethanol Exports Set New Record in 2024, *Growth Energy*, 05/02/2025
[5] Brazil says US ethanol tariff would be unreasonable, calls for sugar talks, *Reuters*, 14/02/2025

- The United States produces more than half its biodiesel from soya oil, compared with just 2% for the EU, which favours rapeseed oil.

These differences can be explained by the local nature of biofuel production and consumption: although some countries import agricultural inputs for processing, **the main producers, who are also the main consumers, have built their strategy around the agricultural sectors they control best**, for reasons of sovereignty and to reduce production costs.

Similarly, the use of the main inputs is not evolving in the same way. While the share of maize and sugar used to produce ethanol is relatively stable, the share of vegetable oils used to make biodiesel has risen from 10% to 17% since 2017 (Figure 2). This figure is mainly due to the **increasingly intensive consumption of palm oil**: an estimated **25% of total production is converted into biodiesel, compared with 10% just a few years ago**[6] ; it is now the **main input for global biodiesel** (36% of the total).[7]

1.4. Consumption set to continue growing

The International Energy Agency (IEA) has listed **more than 80 countries that have introduced mandatory biofuel blends** to reduce their imports of fossil fuels and/or their CO_2 emissions. It therefore anticipates an increase in demand between 2022 and 2028 of between 4.8% (main scenario) and 6.4% (accelerated scenario)[8] . According to the *OECD and FAO Agricultural Outlook for 2024-2033*, the increase in production between these two dates should be even higher: +14% for ethanol and +22% for biodiesel.

These projections are highly uncertain, given the fast-changing environment: low crude oil prices, rapid electrification of the vehicle fleet in some countries, etc. In the shorter term, however, the sector could experience **a major demand shock. In recent months, Indonesia and Brazil have adopted very ambitious consumption targets; they could be followed by the United States, which plans to significantly increase its consumption of biodiesel**. These developments, which come after the IEA and OECD/FAO forecasts, could lead to a significant increase in demand for maize, soya and palm oil.

2. In the United States, record biodiesel demand may rise further

2.1. The world's leading producer and consumer of ethanol

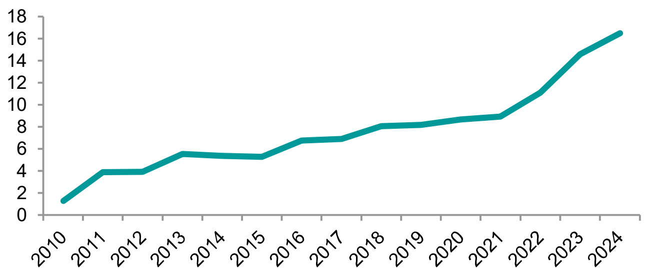
An automotive nation par excellence, the United States developed its ethanol industry **in response to the first oil crisis**, **encouraging the addition of ethanol to petrol as early as 1978** (Energy Tax Act), with the stated aim of **reducing imports of petroleum products**. The Clean Air Act (1990) gave a further boost until 2010, this time in the name of reducing CO_2 emissions. Since then, federal support for ethanol has never wavered. Under pressure from corn growers, Republican and Democratic administrations have maintained and strengthened the main incentives[9] . The United States remains by far the **leading producer and consumer of ethanol**[10] . However, volumes have increased only marginally since 2010 and are likely to remain stable: **the US is slow to embrace electric cars**, and the Environmental Protection Agency (EPA) has no immediate plans to raise the ethanol content of gasoline.

[6] Palm oil production, consumption and trade patterns: The outlook from an EU perspective, *Fern*, 15/06/2022
[7] EBB Statistical Report 2023, *European Biodiesel Board*, 03/2024
[8] Global biofuel demand, historical, main and accelerated case, 2016-2028, *IEA*, 13/12/2023
[9] Understanding US Corn Ethanol and Other Corn-based biofuels subsidies, *Taxpayers for Common sense*, 05/2021
[10] US Ethanol Trade Statistical Summary 2024, *Renewable Fuels Association*, 02/2025

2.2. A new biodiesel giant

The United States, on the other hand, has **sharply increased its biodiesel production**, driven by the introduction of the first diesel blending requirements in 2011: **from 2.1 Mt in the first year, this volume has been gradually increased to 12.6 Mt by 2025.** To meet this demand, **biodiesel production has increased thirteen-fold between 2010 and 2025**, from 1.3 to 16.8 bn L per year (Figure 4), **making the United States the world's second largest producer**, at a level close to that of the EU (Figure 3).

Figure 4: Biodiesel production in the United States (bn L /year)

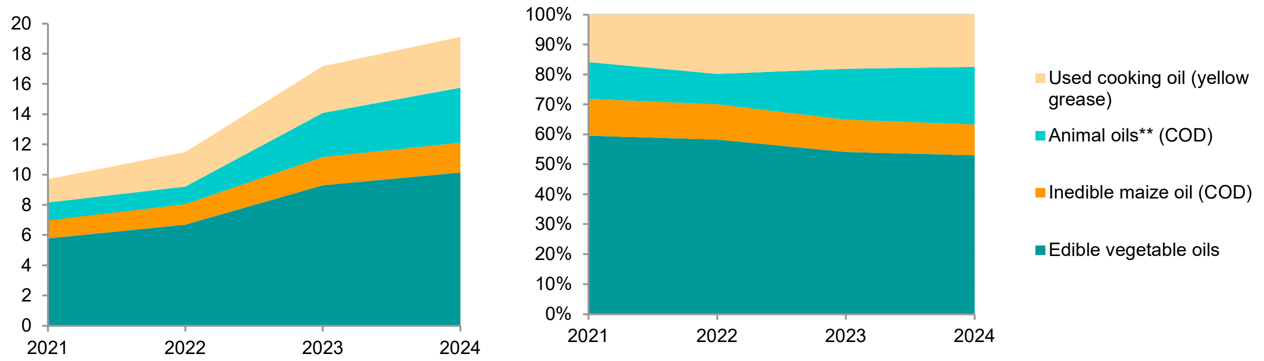


Source: OECD-FAO Agricultural Outook 2024-2033

This increase has been partly driven by the **growing use of inputs that do not compete directly with human food**, such as **distillers' corn oil** (DCO), a by-product of ethanol production that was previously used as a feed supplement for livestock and is now 70% converted into biodiesel. Since the early 2020s, growth has also been driven by **used cooking oil** (UCO) and **animal fats**. The quantity of UCO transformed into biodiesel has more than doubled between 2021 and 2024 (from 1.5 to 3.4 Mt) and now represents 18% of total input tonnage. The use of animal fats has more than tripled, rising from 1.2 Mt to 3.7 Mt over this period, or 19% of inputs (figure 5).

But this **increase in new inputs has not led to a fall in the consumption of edible vegetable oils**: while their relative share has fallen - from 60% in 2021 to 53% in 2024 - **quantities have almost doubled**, from 5.8 Mt to 10.1 Mt. **50% of the edible vegetable oils produced in the United States are now processed into biodiesel, compared with just 5% in 2010**.

Figure 5: Main inputs for biodiesel production, in Mt (left) and % (right)



Source: US Energy Information Administration - Monthly biofuels capacity and feedstocks update
**Mainly soybean and rapeseed oils.*
*** Tallow, lard, poultry fat, etc.*

2.3. Washington is preparing an unprecedented increase in biodiesel production

2.3.1 Trump seeks new outlets for American soya, boycotted by China

The use of edible oils for biodiesel production **slowed sharply in the first few months of 2025**, due to regulatory uncertainties, notably the threat of tariffs on imported rapeseed (a 25% tax has applied since March on Canada, the main supplier) and the expiry on 31 December 2024 of a tax credit supporting biodiesel, the Blenders' Tax Credit[11] . But this respite should only be temporary. On January 1, the Blenders' Tax Credit was

[11] US soybean oil consumption for biodiesel and RD hits 4-year low, www.qcintel.com, 31/03/2025

replaced by a similar scheme, the Clean Fuel Production Credit[12] , which can provide the same amount of aid (USD 1/gallon) depending on the carbon intensity of the biofuel produced.[13]

Above all, **the Trump administration is seeking to trigger a massive increase in biodiesel consumption**: **a proposed new biofuels standard published in June by the EPA will, if adopted, lead to an increase in the quantity of biodiesel incorporated into diesel of 67.5% in 2026 and almost 74.9% in 2027**, compared with 2025.

This is **one of the most unexpected consequences of the trade war between the United States and China**: American soya producers lost their main export outlet when Beijing decided to **boycott US soya** in **favour of other suppliers, in particular Brazil,** in response to the tariff increases enacted by Donald Trump[14]. As a result, US soybean exports for the current season had **fallen** by **79%** by the end of May compared to the average for the previous five years[15] . This crisis has prompted Donald Trump to **urgently find a new outlet for farmers**, a key part of his electorate.

More broadly, the EPA's plan is consistent with other policies of the Trump administration, which is **hostile to the electrification of vehicles** and keen to **protect the domestic automotive industry**, which still produces mainly internal combustion vehicles. Diesel is well mastered by American engine manufacturers and is present in the heavy goods vehicle segment, as well as in the very popular pick-up truck segment.

2.3.2 A sharp rise in demand for soya and rapeseed oil

The EPA's draft regulation, if adopted, **will trigger a major demand shock for soybean and rapeseed oil** - the two main inputs for US biodiesel -, especially as **the text provides for a reduction in the value of RIN subsidies**[16] allocated to imported biofuels or biofuels produced from imported inputs. According to the preliminary impact study carried out by the EPA[17], most of the effort will be **made by soya oil and, to a lesser extent, rapeseed oil and** domestic **distillers' corn oil (table 1)**.

Table 1: Changes in demand for biodiesel production inputs in the United States if the draft EPA regulation is adopted (Bn L)

Input	Current volume	Proposed EPA rule		Net increase/decrease from 2024	
	2024	2026	2027	2026	2027
Domestic waste oils	3.218	3.577	3.766	0.36	0.549
Soya oil, domestic	6.397	8.286	9.233	1.89	2.835
Rapeseed oil, domestic	0.000	0.874	0.874	0.87	0.874
Distillers' corn oil, domestic	2.271	3.350	3.350	1.08	1.079
Imported used oils	5.867	5.830	5.830	-0.04	-0.038
Imported soya oil	1.363	1.230	1.340	-0.13	-0.023
Imported rapeseed oil	2.688	2.676	2.676	-0.01	-0.011
Imported distiller's corn oil	0.000	0.015	0.015	0.02	0.015

Data source: Renewable Fuel Standard (RFS) Program - Standards for 2026 and 2027: Draft Regulatory Impact Analysis. Aggregation of tables 3.2-4 (2024) and 3.2-6 (2026 and 2027). GSA calculations

[12] SABR Coalition Welcomes Biodiesel Provisions in Senate Tax Bill, *FOX 4 Kansas City WDAF-TV | News, Weather, Sports*, 01/07/2025
[13] U.S. Department of the Treasury Releases Guidance on Clean Fuels Production Credit, *U.S. Department of the Treasury*, 08/02/2025
[14] China sets June soybean import record | World Grain, *World Grain*, 15/07/2025
[15] *Farmers Press Trump on Biofuels to Counter Tariffs Hit - Bloomberg, Bloomberg.com, 29/05/2025*
[16] *Renewable identification number*, a credit generated for each litre of biofuel incorporated by refiners into the final blend, enabling them to prove their compliance with the Renewable Fuel Standard.
[17] Renewable Fuel Standard (RFS) Program - Standards for 2026 and 2027: Draft Regulatory Impact Analysis, Environment Protection Agency, 12/06/2025

Based on these forecasts, the net additional demand for **soya beans and rapeseed** can be calculated and compared to their global production. According to our calculations (table 2), the EPA's draft regulation, if adopted, would lead, in 2027, to **an additional consumption of 2.4% of the world's soya bean production, and 3.9% of that of rapeseed**.

Table 2: Net additional demand for soybeans and rapeseed resulting from the proposed EPA regulation in 2026 and 2027

	Net additional demand in...	Millions L	In Mt	Beans or seeds required (Mt)*	As a % of US seed production	As % of US oil production	As a % of world oil production	As a % of world seed/bean production
2026	Soya oil	1.76	1.62	9.07	8.0%	13.1%	2.8%	**2.4%**
	Rapeseed oil	0.74	0.68	1.71	90.5%	78.7%	2.6%	**1.9%**
2027	Soya oil	2.81	2.59	14.52	12.8%	21.1%	4.5%	**3.9%**
	Rapeseed oil	0.86	0.79	1.99	105.3%	91.6%	3.0%	**2.2%**

Sources: US production: USDA figures (2023/2024 season), world production FAO 2023 (for beans) and FAO 2022 (for oil); GSA calculations.
**5.61 kg of soya beans are needed to produce 1 kg of soya oil.*
**2.3 kg of rapeseed are needed to produce 1 litre (not 1 kg) of rapeseed oil.*

The pressure on food availability is therefore likely to be significant, particularly in the case of soya: until now, the beans that will be processed into biodiesel were mainly exported to China, where they were used for human consumption, either directly or via livestock feed, and not for biofuel production.

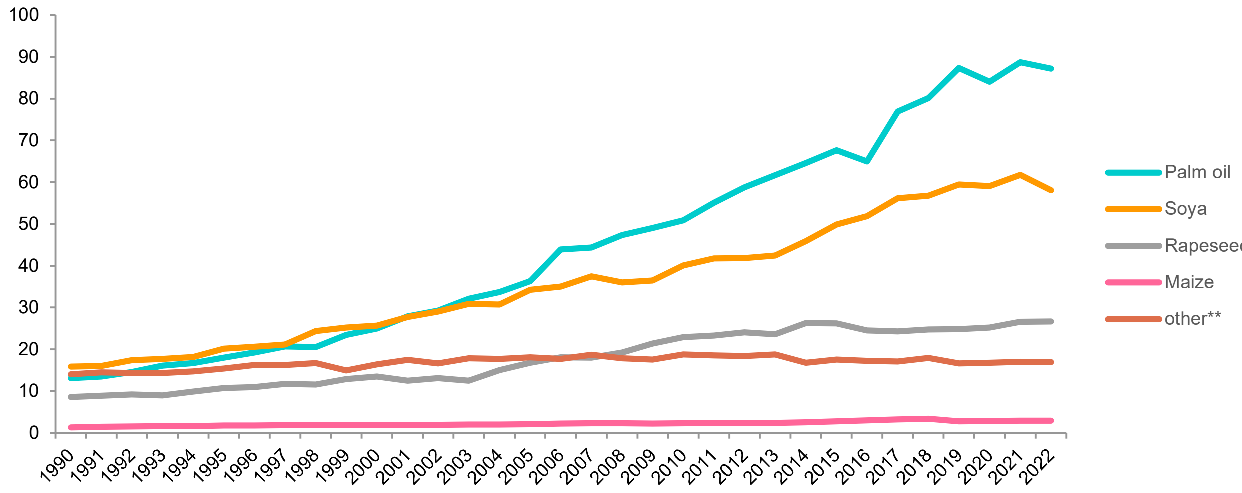
However, the EPA's plan could come up against certain constraints. Even assuming that soya and rapeseed production increases sufficiently, **it is not certain that oil processing capacity can keep pace**. According to the US Soybean Association, total crushing capacity will rise from 69.4 Mt at the end of 2024 to almost 74.5 Mt at the end of 2026 and around 75.5 Mt at the end of 2027[18] , enough to produce, respectively, **1.1 bn L and 1.33 bn L more than in 2024 - a long way, therefore, from the additional volumes needed**. In the case of rapeseed oil, we have not identified any projections for growth in US crushing capacity, but **the US would have to practically double its oil production from 2024 levels** (867,000 tonnes) **as early as 2026**, which seems unlikely. Finally, in both cases, the capacity of biodiesel refiners is a potential additional bottleneck.

3. Biodiesel in Indonesia requires ever more palm oil

Indonesia has seen its biodiesel production soar since 2015, becoming the **world's third largest producer** ahead of Brazil in 2018, and reaching a level close to that of the United States with **9.7 Mt in 2023, i.e. almost a fifth of world production**[19] . This growth is closely linked to the fact that Indonesia is **the undisputed leader in palm oil production**, accounting for around 60% of the world total[20] . Production of this raw material, which is highly prized by the agri-food industry, has itself **grown dramatically since the 1990s**, to become by far the most widely produced vegetable oil in the world (figure 6).

[18] Soybean Crush Expansion, 2025 Update - American Soybean Association, *American Soybean Association*, 10/04/2025
[19] Statistical Report 2023, *European Biodiesel Board*, 06/2023
[20] The renewal of palm plantations: a huge challenge for Indonesian agriculture | Cirad, *CIRAD*, 17/04/2025

Figure 6: World production of the main vegetable oils, in Mt



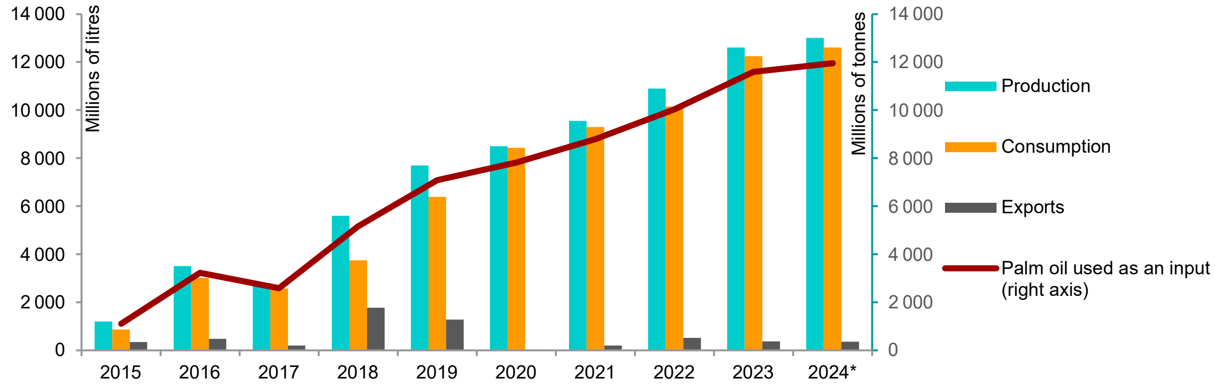
Source: FAO via Our World in Data
**Addition of crude oils extracted from the flesh of the fruit (CPO) and the kernel (KPO).*
***Peanut, sesame, coconut, linseed, olive and safflower oils.*

3.1. Indonesia uses 15% of the world's palm oil for its biodiesel needs.

Indonesia embraced biofuels two decades ago, when the 2006 National Energy Policy mandated that they should account for **5% of the country's total energy mix by 2025**[21]. This impetus led to the obligation to incorporate 2.5% biodiesel from 2008, a ratio that has been progressively increased to **40% since January 1, 2025. This "B40 mandate" is by far the highest in the world.**

To meet this demand, Indonesian refiners **increased their production tenfold** between 2015 and 2024**, from 1.2 bn L to 13 bn L**, almost all of which was consumed locally (12.6 bn L). Palm oil consumption for this purpose has grown in the same proportion, reaching 11.9 Mt (figure 7). Given Indonesia's weight in global palm oil production, the effect on global consumption is significant: in 2024, **25% of Indonesian production, or 15% of global production (78.9 Mt)**[22] **was consumed to meet the country's demand for biodiesel**.

Figure 7: Indonesia - Biodiesel production, consumption and exports



Source: USDA Biofuels Annual Report - Indonesia 2024
**Projection*

[21] National Energy Policy (Presidential Regulation No. 5/2006), 25/06/2006
[22] Palm Oil Explorer, *USDA*, 21/07/2025

3.2. The B40 and B50 mandates will lead to a new demand shock

The effects of the B40 mandate, which was only implemented in March, are expected to be major: **for the same fuel consumption, it should lead to an increase in biodiesel consumption of at least 14.2%**. Indonesian authorities expect actual consumption to be even higher, due to the increase in demand for fuel: they anticipate that **the domestic market will consume 15.6 bn L of biodiesel in 2025**[23] **, compared with around 13 bn L in 2024**. Measured consumption since the start of the year (7.42 bn L at 16 July 2025) is close to this forecast.

Yet Jakarta has no intention of stopping there and is considering **introducing a B50 mandate from 2026**[24] . Although no decision has yet been taken, the Indonesian Ministry of Agriculture already estimates the **palm oil requirements of the B50 mandate at 20 billion litres, or 18.4 Mt, in 2026.**[25]

These developments will have a major impact on the global availability of palm oil: in 2025, **the B40 mandate should lead to additional consumption equivalent to 3% of the world's 2024 production**. The potential **B50 mandate would lead, in 2026, to additional demand** equal to 14% of Indonesian production or **8.2% of world production** (2024), if the forecasts of the Ministry of Agriculture are confirmed (table 3)**.**

Table 3: Projected increase in palm oil consumption due to changes in biodiesel incorporation requirements in Indonesia

	2024	*2025*	*2026*
Mandate (% of biodiesel to be incorporated into diesel)	***B35 (35%)***	***B40 (40%)***	***B50 (50%)***
Biodiesel consumption (billion litres)	*13.00*	*15.60**	*17.33*
Increase compared with 2024	*-*	*20%*	*33%*
Palm oil required (Mt)	*11.96*	*14.35*	*18.40**
Additional palm oil required compared to 2024 (Mt)	*-*	***2.39***	***6.44***
As % of Indonesian production (2024)	*-*	***5.2%***	***14%***
As % of world production (2024)	*-*	***3.0%***	***8.2%***

Source: USDA. GSA calculations
World production 2024 = 78.945 Mt; Indonesian production 2024 = 46 Mt
1t of palm oil can produce around 1086L of biodiesel
** Quantities anticipated by the Indonesian government*

This **increase is much faster than that of palm oil production,** which, after rising sharply until 2019, is tending to stagnate: since that date, **average annualised production growth has been 1.66% worldwide and 1.87% in Indonesia**. Some experts are forecasting global production growth of 4 to 5% for the next agricultural season (2025-2026), but a contraction of -0.5% to -1.5% the following season, due to the cyclical effects of La Niña / El Niño and other factors[26]. The same sources also point out that **demand for palm oil will also continue to grow in the rest of the world**. **Malaysia, the world's second largest producer, plans to double its own biodiesel rate to 20%.**[27]

The pressure on palm oil availability on the world market is likely to be all the greater as **the Indonesian government plans to increase the tax on palm oil exports from 7.5% to 10%**[28] , both to subsidise domestic consumption and to **guarantee the inputs needed by its biodiesel sector**.

[23] Indonesia expects to reach full implementation of B40 biodiesel in March | Reuters, *Reuters*, 14/02/2025
[24] Indonesia's potential B50 mandate could boost domestic palm oil use by 3 million tonnes: CIMB - BioEnergy Times, *BioEnergy Times*, 18/07/2025
[25] Indonesia Requires 20 Million Kiloliters of CPO Annually to Achieve B50 Biodiesel Goals, *Palmoilmagazine.com*, 06/11/2024
[26] Industry Outlook Palm Oil Industry 2025-2027, *krungsri.com*, 21/03/2025
[27] Malaysia expands biodiesel usage of B10 to B20 on ground transport vehicles at main airport, *Reuters*, 29/05/2025
[28] Indonesia expects to reach full implementation of B40 biodiesel in March | Reuters, *Reuters*, 14/02/2025

Indonesian biodiesel producers should be able to keep up, as the utilisation rate of their refineries is estimated at 70.1%[29]. In addition, three units, each with a capacity of one billion litres a year, are currently under construction. However, the authorities estimate that at least two more would be needed if the B50 mandate were to be implemented.[30]

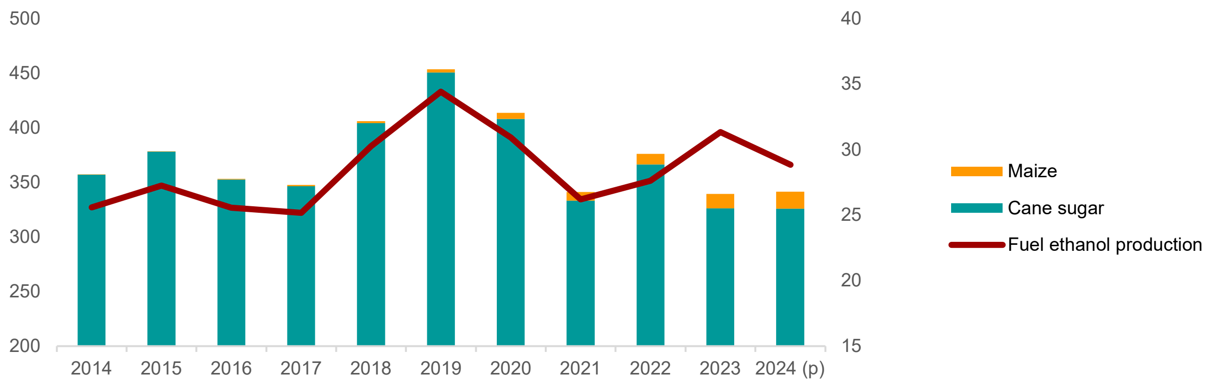
4. A pioneer in ethanol, Brazil is now also banking on biodiesel

4.1. After sugarcane, soya and maize increasingly used for biofuels

Brazil was the first country in the world to impose a 5% ethanol content on imported petrol, back in 1931, and then extended this rule to all petrol consumed in the country in 1938. Already at the time, the official aim was to reduce fuel imports and, unofficially, to find outlets for the surpluses of the large, politically influential sugarcane growers[31] .

Almost a century later, **Brazil remains the world's second largest ethanol producer**, with around 35 bn L produced by 2024, behind the United States but well ahead of China and the EU, and **accounting for more than a quarter of global production**. Sugar remains the predominant input, although maize, available in large quantities and at low cost[32] , is increasingly used. Despite the **low tonnage used compared with cane sugar (figure 8), corn already accounts for around 20% of national ethanol production, thanks to its much higher yield:** around 450 litres of ethanol per tonne used, compared with 85L/t for sugar cane. The vast majority of ethanol produced in the country is consumed locally.

Figure 8: Brazil's ethanol production (left axis, billion litres) and consumption of main inputs (Mt, right axis)

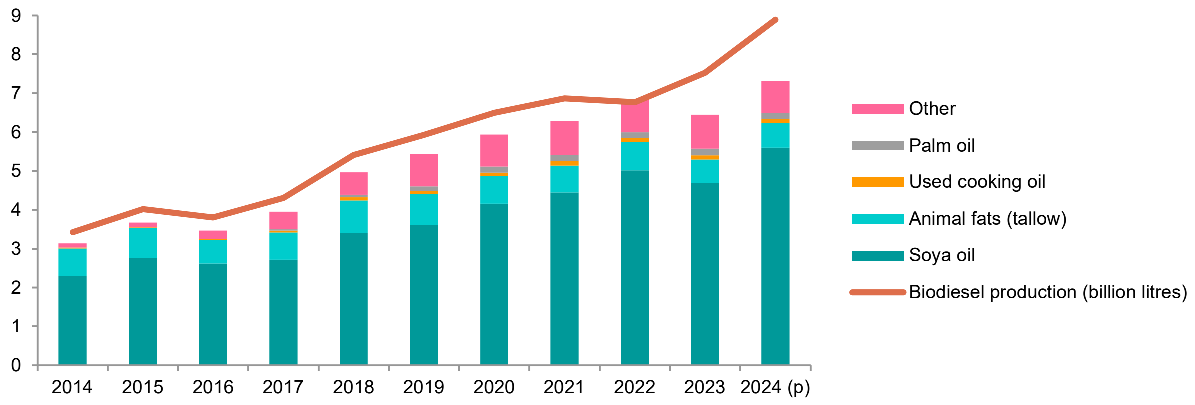


Source: USDA

Brazil is now also developing the biodiesel industry, with 7.4 bn L in 2024, the fourth largest in the world. **Biodiesel production has developed in parallel with soya cultivation, of which Brazil is the world leader** after overtaking the United States in 2017-2018. Over 80% of Brazilian biodiesel is produced from soya oil - although other inputs now play a significant role (Figure 9) - and **almost all of it is consumed on the domestic market.**

[29] *Indonesia: Biofuels Annual - 2024, USDA*, 29/09/2023
[30] Indonesia needs 5 new biodiesel plants to meet B50 target: report, www.qcintel.com, 18/07/2025
[31] The re-emergence of ethanol fuel in Brazil, Eduardo Luiz Correia, Oxford Energy Forum, 2007
[32] Biofuels Annual - Brazil 2024, *USDA*, 31/08/2024

Figure 9: Brazil - biodiesel production (billion litres) and main inputs (Mt)



Source: USDA

4.2. Lula, a biofuels advocate, hikes ethanol and biodiesel rates

The development of biofuels has been one of the priorities of the Lula administration since its return to power in January 2023. The key measure was **the adoption, in September 2024, of the "Fuels of the Future" law** (*Combustíveis do Futuro*), which had been tabled in Parliament four years earlier but blocked by the Bolsonaro administration, which had prioritised the production of conventional hydrocarbons.

At the end of 2024, this new law increased the rate of ethanol incorporated into petrol from 22% to 27%, which the National Energy Policy Council has raised to **30% from 1 August 2025**[33]. It may be increased to a maximum of 35%, although no date has yet been set. For biodiesel, the progression will be more linear: the rate of incorporation, from 14% in 2024, has been raised to 15% in 2025, and **will be increased by one percentage point per year until it reaches 20% in 2030**.

The arguments put forward by the Lula administration partly echo those put forward in 1931: the main aim is to reduce petrol and diesel imports, as Brazil is not yet self-sufficient despite rising oil production. Brasilia also intends to **position Brazil as a leader in the energy transition** and highlight its efforts to combat CO_2 emissions. The government is also seeking to **protect the country's automotive industry**: carmakers based in the country mainly produce vehicles powered by internal combustion engines, and the government has taken numerous measures to encourage the production of "flex fuel" vehicles (up to 85% ethanol), vehicles running on 100% ethanol fuel (E100), as well as ethanol-electric hybrids.

4.3. A significant impact on the global availability of soya and maize

The impact of the new biofuel incorporation requirements set out in the new law should mainly affect soya and maize. For biodiesel, the share of inputs other than soya oil has stabilised in recent years, so that **soya continues to account for more than 80% of production** (figure 9). **The increase in ethanol production that is needed should be based almost entirely on maize: production from cane sugar has stagnated for several years**[34] , and the last few years of production growth have been driven by corn. Most analysts therefore agree that the Brazilian government is betting mainly on corn to meet the objectives of the new legislation[35] . The measure could have a political dimension: the Lula administration would be seeking to make gestures to the traditionally hostile corn-growing regions of the south-west.

With unchanged demand for fuel, **Brazil will process an additional 4.5 Mt of soya beans into biodiesel from 2026, or 1.2% of world production** in 2023**, as a result of the new legislation**. In 2030, when the biodiesel mandate reaches 20%, **the additional quantity required will be 13.5 Mt, or 3.6% of world**

[33] Brazil raises biofuel blending levels, *Biofuels International*, 07/07/2025
[34] Brazil corn ethanol boom covers demand as country hikes biofuel mandate, *Reuters*, 27/06/2025
[35] Brazil raises biofuel levels, sees gasoline self-sufficiency, *Reuters*, 25/06/2025

production. For ethanol**, an additional 24 Mt of maize will be needed in 2026, or 1.9% of world production**. The effect of a possible E35 mandate, for which no date has been set, would be much greater: 39 Mt, or 3.1% of world corn production (tables 4 and 5).

In reality, however, the impact is likely to be even greater, as Brazil's consumption of biodiesel and ethanol is on the rise. Brazil is encouraging the adoption of 'flex-fuel' vehicles, and even those running on 100% ethanol (E100). However, this increase could be slowed by the growing adoption of electric vehicles, particularly from China.[36]

Table 4: Projected increase in soya consumption as a result of changes in biodiesel incorporation requirements in Brazil

	2024	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Mandate (% of biodiesel to be incorporated)	14%	15%	16%	17%	18%	19%	20%
Biodiesel consumption (billion litres)	8.9	9.5	10.1	10.7	11.4	12.0	12.6
Increase compared to 2024	-	7.1%	14.3%	21.4%	28.6%	35.7%	42.9%
Soybean oil required (Mt)	5.6	6.0	6.4	6.8	7.2	7.6	8.0
Soya beans required (Mt)	31.4	33.7	35.9	38.1	40.4	42.6	44.9
Additional beans needed (p/r to 2024) (Mt)	**-**	**2.2**	**4.5**	**6.7**	**9.0**	**11.2**	**13.5**
% of world production (2023)	**-**	**0.6%**	**1.2%**	**1.8%**	**2.4%**	**3.0%**	**3.6%**

Sources : USDA, FAO
5.61 kg of soya beans are needed to produce 1 kg of soya oil
This calculation assumes that the share of inputs other than soya remains stable.
World soya bean production (2023): 371.2 Mt

Table 5: Projected increase in maize consumption as a result of changes in ethanol incorporation requirements in Brazil

	2024	**2025**	**2026**	**?**
Mandate (% of ethanol to be incorporated)	22%	27%	30%	35%
Fuel ethanol consumption (billion litres)	29.71	36.46	40.51	47.26
Increase compared to 2024 (billion litres)	-	6.75	10.80	17.56
Additional maize required (compared with 2024) (Mt)	**-**	**15.00**	**24.01**	**39.01**
% of world production (2024)	**-**	**1.2%**	**1.9%**	**3.1%**

Sources: USDA, FAO
1kg of maize produces 0.45L of ethanol
This calculation assumes that all the increase in Brazilian ethanol production is accounted for by corn.
World maize production (2023): 1241 Mt

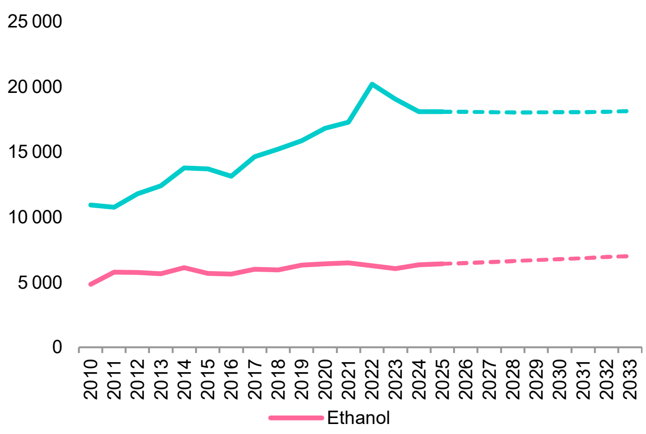
[36] Electric vehicles: emerging countries already a major growth driver for Chinese manufacturers, *Global Sovereign Advisory*, 24/11/2024

5. A major market, the EU is now looking for alternatives

5.1. The world leader in biodiesel, the EU now wants to limit its use

As the world's leading producer of biodiesel, the EU has been encouraging its member states to incorporate biofuels into the transport energy mix since the 2000s, both to reduce their dependence on fossil fuels and to meet the climate objectives set at community level. In particular, the RED directive of 2009 introduced a target of 10% renewable energy in transport by 2020. **This dynamic has particularly favoured biodiesel, which is supplied mainly by EU-produced vegetable oils (rapeseed and soya)**, **supplemented by palm oil imports**. Biodiesel production reached 20 billion litres in 2022, but has since fallen, and forecasts show that production will stabilise at around 18 bn L by 2033 (figure 10).

Figure 10: EU biofuel production, in million L



Source: OECD, FAO

This downturn is the result of heated debates at EU and national level about the relevance of using food inputs for fuel production, as well as the indirect effects on changes in land use (ILUC)[37] , and while the benefits in terms of CO_2 emissions are being questioned. **Palm oil in particular has been the focus of criticism**: it is associated with significant environmental impacts, notably through tropical deforestation. The Commission has therefore classified biodiesel made from palm oil as "high ILUC", i.e. leading to deforestation or conversion of use resulting in additional carbon emissions. From 2023, EU legislation provides for a gradual phase-out **of palm oil in biofuel production, with a total ban by 2030, which several Member States have already anticipated.[38]**

5.2. The EU focuses on electric vehicles and 2nd generation biofuels

The RED III directive, adopted in 2023, marks a turning point. It imposes a binding target of 29% renewable energy in transport by 2030, of which **5.5% must come from "advanced"** biofuels derived from non-food inputs. At the same time, **it maintains a strict 7% ceiling for first-generation biofuels made from food and feed crops**[39] . Above all, electric vehicles (EVs) powered by renewable electricity are included in these targets, while the Commission has set 2035 as the target date for banning the sale of combustion-powered vehicles. **Unless the situation is reversed, EVs will therefore account for the bulk of the RED III target, with biofuels playing an increasingly marginal role**.

In response to these regulatory changes, several member countries, notably Germany, the Netherlands and France, have also invested in **the recovery of agricultural residues, municipal waste and used oils**, the share of which has risen sharply, According to the European Biodiesel Board (EBB), used cooking oil and animal fats accounted for **28% of Europe's biodiesel production** in 2024**, while agricultural, industrial and municipal waste (known as "Annex IX (A)") accounted for 27%** (Figure 11).

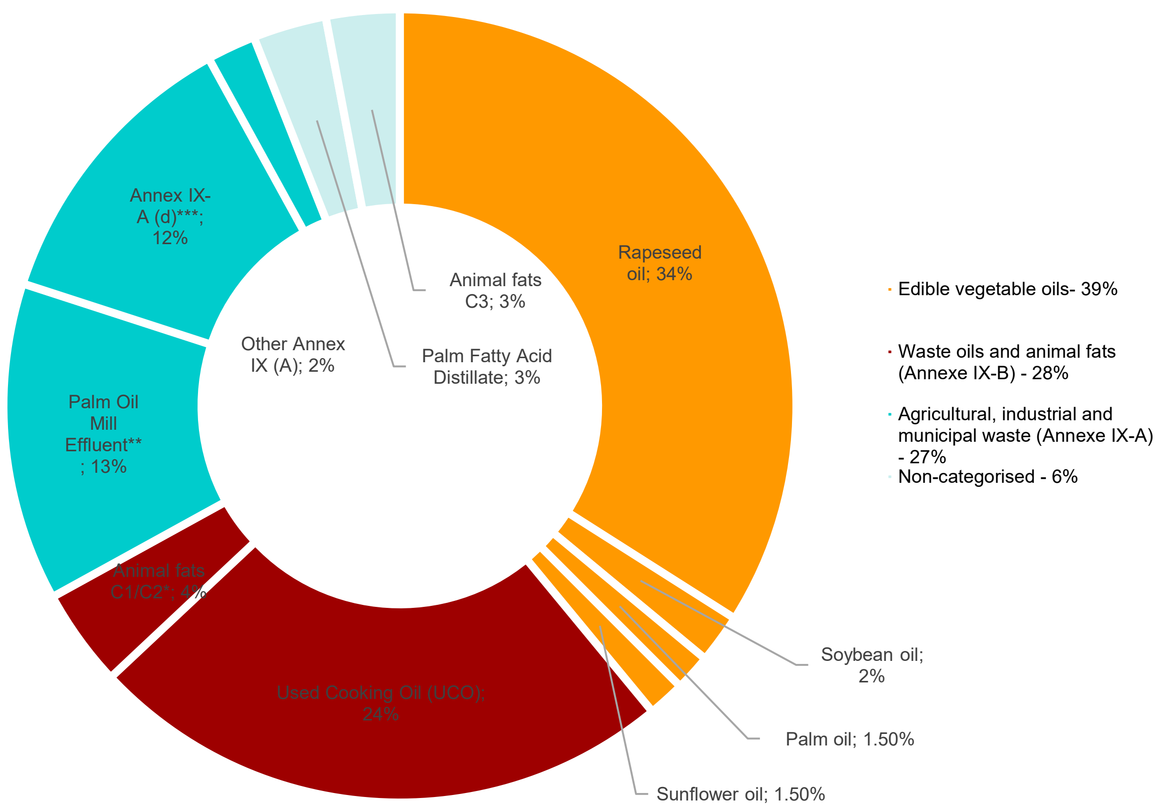
According to the EBB, imported palm oil now accounts for just 1.5% of the total, six years before its planned ban. However, EU refiners still use palm oil by-products, which are exempt from RED regulations and imported mainly from Asia. But some sources, such as the NGOs Transport & Environment[40] and the Environmental

[37] Wessels et al, "Rethinking the Food Vs Fuel Debate in Scaling up Biomass Feedstocks Sustainably."
[38] *Ibid.*
[39] High EU biofuel standards will hamper supply - Euractiv FR, *Euractiv FR*, 09/11/2021
[40] Palm oil in disguise ?, Transport & Environment, 03/2025

Investigation Agency[41] point out that **the volumes of these residues imported by the EU and the UK are twice as high as their total world production, suggesting massive fraud: a large proportion would in fact be palm oil deliberately misdeclared** to avoid import bans.

However, the development of second-generation biofuels is coming up against major structural constraints. On the one hand, exploitable waste deposits are still unevenly distributed between Member States. Secondly, the production costs associated with these sectors remain higher than those of conventional biofuels, making them less competitive without direct public support[42].

Figure 11: EU biodiesel production inputs, 2024



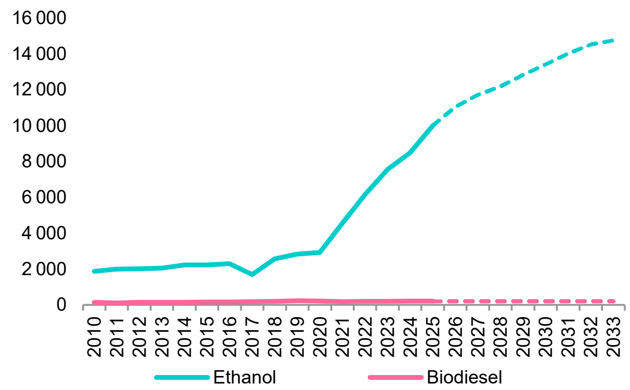
Source: European Biodiesel Board
**For human consumption*
***Non-edible liquid effluent generated during palm oil extraction.*
****Biomass extraction from industrial waste that cannot be used in the food or feed chain, including: commercial waste, organic waste from the agri-food industry, aquaculture and fisheries waste.*

[41] 'Alarming' rise in palm oil products being imported into the EU to make biofuels due to loophole, *eia-international.org*, 07/03/2025
[42] Biofuels: why Europe is losing the competitiveness battle, Les Echos, 02/05/2024

6. India relies on ethanol to dispose of its sugar and rice surpluses

6.1. A sugarcane crisis has enabled the ethanol industry to take off

Figure 12: Biofuel production in India, in million L



Source: FAO, OECD

India experimented with the incorporation of ethanol into petrol via the *Ethanol Blended* Programme (EBP) pilot scheme back in 2003[43] , but consumption was held back by the priority given to food use of inputs and the absence of strong public incentives. What's more, only C molasses, a by-product of sugar cane alongside refined sugar that is unfit for human consumption, was authorised as an input for ethanol production . **Production remained relatively low, due to a lack of public incentives and the priority given to human consumption in a country with a fast-growing population**. However, a major turning point was reached in 2018. The fall in the price of sugar cane, linked to a record harvest and an excessively high administered price, triggered a **crisis of overproduction**[44] . The government then reviewed its policy of administered prices and, above all, **subsidised the production of ethanol from raw sugar cane, sugar, syrups and B molasses**[45] . This strategy was aimed at selling off stocks while **reducing dependence on imported hydrocarbons**.

India's strategy is set out in *the* 2018 *National Policy on Biofuels*, which targets a 20% ethanol incorporation rate in petrol (E20) and 5% biodiesel incorporation rate in diesel (B5) by 2030[46] . Between 2018 and 2024, ethanol production tripled, reaching an **incorporation rate of 19.8% in June 2025**[47] , according to figures from the Indian Ministry of Energy. India, the world's third largest importer of oil, is justifying this transition by the desire to reduce its imports, while at the same time offering a stabilising agricultural outlet for its agricultural sectors. **This success led the Indian government, in 2022, to bring forward its E20 to 2025/2026**, a milestone it is virtually certain to achieve[48] . It has not announced a new target for the incorporation of ethanol, but is seeking to increase consumption by other means, such as promoting 100% ethanol fuel, by encouraging car manufacturers to market compatible vehicles and service stations to install dedicated pumps[49]. For biodiesel, the 5% target still seems a long way off: the government is aiming for 1 to 1.5% incorporation by 2027.[50]

6.2. Gradual diversification of inputs

Historically focused on C molasses, supplies to the ethanol industry have gradually broadened, particularly to ensure that the E20 targets are met. In addition to the sugar and sugarcane already mentioned, the authorities have authorised maize and **more recently rice**[51]. **This diversification is based on a differentiated pricing system and support for the construction of new distilleries, particularly in cereal-producing areas** (figure 13).[52]

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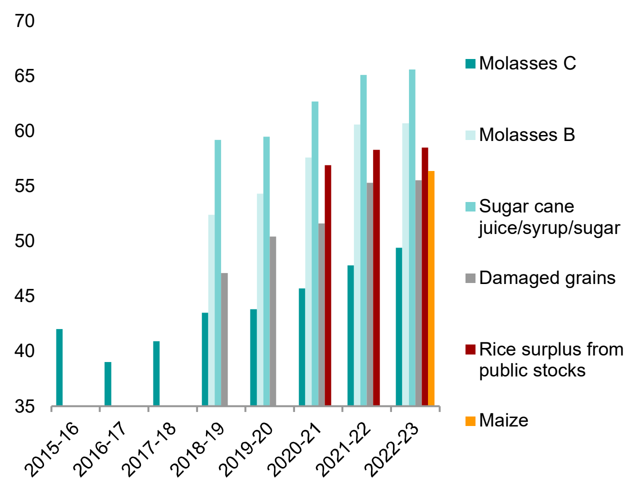
[43] (PDF) Ethanol Blending of Petrol in India, *ResearchGate*, 24/05/2023
[44] Before the elections, India gives a boost to its sugar sector | Les Echos, *Les Echos*, 23/05/2018
[45] (PDF) Ethanol Blending of Petrol in India, *ResearchGate*, 24/05/2023
[46] Roadmap for Ethanol Blending in India 2020-25 - Policies - IEA, *IEA*, 09/07/2024
[47] IEW 2025: India achieves 19% ethanol blending, on track for 2025 target: Modi | S&P Global, *S&P Global Commodity Insights*, 11/02/2025
[48] Government changes biofuels policy, brings forward target of 20% ethanol blending in petrol - Team France Export, *Team France Export*, 06/07/2022
[49] Press Release: ETHANOL 100 fuel launched by Petroleum Minister Hardeep S Puri, *Government of India Press Information Bureau*, 15/03/2024
[50] India could triple its biofuel use and accelerate global deployment - Analysis - IEA, *IEA*, 07/02/2024
[51] "India's Ethanol Public Policy." *March 2023*, 2023. https://www.artb-france.com/images/syntheses/1-politiques-agricoles-gestion-des-risques/Politique_thanolire_Inde_-_Mars_2023_-_FINAL.pdf.
[52] Das, Shilpita, and Joanna Brown. "Biofuels Annual." Biofuels. USDA, 2025.

The rise of maize is partly the result of irregular sugar harvests. Requiring less water, it is presented as a more resilient option. But this trend is not without consequences: demand from the ethanol industry has led to **upward pressure on maize prices**, **in direct conflict with the needs of livestock farming**.

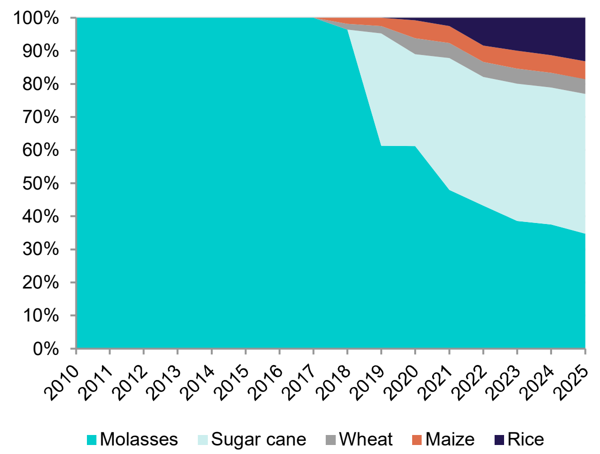
Conversely, the use of rice to produce ethanol is - officially - a response to cyclical constraints. In 2024, the *Food Corporation of India* (FCI) reallocated a **record 5.2 Mt of surplus rice for ethanol production, representing around 9% of world rice trade for that season**. This reorientation was aimed at disposing of stocks in excess of food security requirements, estimated at 13.5 Mt while total reserves exceeded 59 Mt[53] . The government emphasised that priority was still given to human consumption, and that these volumes would only be allocated in the event of a clear surplus. However, the share of rice has risen steadily since 2020 (figure 14).

Figure 13 - Ethanol purchase price according to input, INR/litre



Source: BPCL, GDP and NITI Aayog

Figure 14 - Share of inputs in Indian ethanol production



Source: FAO, OECD

7. China shies away from biofuels

7.1. A secondary market for ethanol, and an embryonic one for biodiesel

With 4.9 bn L of ethanol produced in 2024 and a similar quantity consumed as fuel, China appears to be a relatively modest market in relation to its demographic and economic weight, clearly behind the United States and even the EU. Cereals - maize, wheat and rice - account for more than 80% of its production, with a marginal share of sugar-based varieties[54] (cassava, molasses). **The rate of incorporation of ethanol into petrol is low: 1.8% nationally in 2022**. The ambitious target of achieving a national ethanol incorporation rate of 10% (E10), set in 2017, has therefore been suspended in 2020 due to insufficient stocks of maize[55]. The country is therefore dependent on imports to satisfy its domestic demand for ethanol (13.9 bn L in total, including fuel use), which is also driven by the chemical industry. In 2022, most of these imports came from France and the United States.

The biodiesel sector is still in its infancy, **with an incorporation rate** that **has never exceeded 0.2 to 0.3%**. Domestic consumption therefore remains very limited and heavily dependent on imports**, mainly palm oil**

[53] From shortage to glut: India directs record rice crop to ethanol production | Zonebourse, *Zonebourse*, 26/06/2025
[54] Ekbom et al, "Biofuels Production and Development in China."
[55] Biofuels Annual - China,*USDA,* 29/08/2024

biodiesel from Indonesia and Malaysia[56]. Chinese refiners import biodiesel when the price is competitive with conventional diesel.

There are several reasons for the limited development of biofuels in China. Firstly, for both ethanol and biodiesel, China does not have a national blending mandate: obligations only exist in certain provinces, and public incentives are modest[57]. **Furthermore, China does not have an expandable agricultural land base comparable to Brazil or India**: only 10% of the country is arable, and expansion on marginal land remains limited (a few million hectares)[58]. It continues to rely on imports for the main inputs (soya, maize, sugar, edible oils, etc.). China has therefore chosen to forego biofuels in order to prioritise its food security and limit imports. This strategy is also consistent with the **massive electrification of the car fleet** and the accelerated deployment of solar and wind energy.

7.2. SAF aerial biofuels to recover used cooking oil

China is taking a more aggressive stance on sustainable aviation fuels (SAF). With domestic and global air traffic booming, Beijing sees SAF as a strategic opportunity. **In 2013, Sinopec inaugurated a pilot project to produce SAF from** domestic **used cooking oil** (UCO). **By 2024, several Chinese companies have announced projects with a combined capacity of more than 1 Mt per year, fuelled by UCOs and totalling more than USD 1 billion in investment**[59] . Sinopec is also developing, in partnership with TotalEnergies, a SAF unit with a capacity of 230,000 t/year[60] , integrated into an existing site. Certification from the Chinese civil aviation authority CAAC has already been obtained, enabling a first commercial flight to be powered by SAF.[61]

This strategy aims to reduce kerosene imports and **make better use of UCOs, exports of which have exploded in recent years**, rising from 730,000 t in 2019 to 2.9 Mt in 2024, mainly to the United States and the EU, where they are processed into biodiesel or SAF.

However, SAF production is still in its infancy: 200,000 t/year, most of which is exported[62]. Local consumption remains marginal (less than 0.1% of the paraffin consumed in 2022). As elsewhere, high costs, a lack of suitable logistics infrastructure and the absence of binding regulations are slowing down large-scale deployment. However a number of analysts believe that China could catch up quickly, on the strength of its capacity to mobilise industry and its stated climate objectives. **For 2030, the country is envisaging an SAF incorporation rate of between 2 and 5%, for a total kerosene market expected to reach 50 Mt/year.**[63]

8. Biofuels, crude oil prices and food prices: a complex relationship

8.1. More expensive, massively subsidised fuels

The production cost of biofuels is generally much higher than the cost of fossil fuels. This difference can be explained by the price of agricultural inputs, processing costs and the specific logistics involved in distribution. In the absence of public support, few biofuels are truly competitive with diesel or petrol.

In the United States, producing a gallon of biodiesel in 2023 cost around USD 4.7, of which almost USD 3.6 was spent on purchasing the raw material (soya oil). Including the costs of transport, blending and the margins of blenders and resellers, the final cost at the pump was over 5.5 USD/gallon, **while the selling price of diesel was 3.88 USD/gallon**[64] . This extra cost is offset by a series of subsidies, including a federal tax

[56] Ekbom et al, "Biofuels Production and Development in China.
[57] Ekbom et al, "Biofuels Production and Development in China."
[58] Open Knowledge Repository, *openknowledge.worldbank.org*, 15/07/2025
[59] Focus: Chinese firms invest in 'green' jet fuel, anticipating blending rule | Reuters, *Reuters*, 17/05/2024
[60] China: TotalEnergies and SINOPEC join forces to produce sustainable jet fuel at a SINOPEC refinery | TotalEnergies.com, *TotalEnergies.com*, 26/03/2024
[61] China's commercial aircraft complete demo flights with Sinopec SAF - Green Car Congress, *Green Car Congress*, 10/06/2024
[62] China 'green' jet fuel plants push back start-up amid lack of policy | Reuters, *Reuters*, 27/02/2025
[63] Focus: Chinese firms invest in 'green' jet fuel, anticipating blending rule | Reuters, *Reuters*, 17/05/2024
[64] Pyziur, Max and Energy Policy Research Foundation, Inc. 2023. *Estimating U.S. Biodiesel Costs*. Energy Policy Research Foundation, Inc.

credit of USD 0.98/gallon[65] , plus RIN credits of up to USD1.55/gallon. **Only this massive public support makes it possible to compensate for up to USD 3/gallon, making it possible to incorporate biodiesel without excessive increases at the pump**.

Biodiesel production costs are also very high in Europe. In 2022, the wholesale price of biodiesel was 70% to 130% higher than that of conventional diesel, depending on the raw material used[66]. Member states are mobilising a variety of policies to maintain incorporation. Some, like France, are proposing tax exemptions, while others are letting consumers absorb the extra costs.

In Indonesia, an export tax on palm oil is used to subsidise local consumption of biodiesel**[67]**. **In India, the government intervenes via a system of administered purchase prices for ethanol**, calculated to cover production costs, and supplements this with tax reductions on fuels incorporating ethanol.

Biofuels can, in some cases, be naturally competitive. In Brazil, high agricultural yields from sugarcane, integrated logistics and a favourable tax policy have resulted in a very low price for ethanol: it cost 70% of the price of petrol in 2023, the threshold considered to be the tipping point for competitiveness for consumers equipped with flex-fuel vehicles[68]. In some regions, parity has even fallen to 60%. The average price of ethanol in São Paulo could fall to R$2.60/litre in the coming months, compared with around R$4/litre for petrol. Added to this is a fall in the price of agricultural inputs (fertilisers, diesel), enabling producers to reduce their production costs.

8.2. The price of biofuels and crude oil are closely correlated

The pricing of biofuels cannot be dissociated from that of fossil fuels, particularly oil: when the price of crude oil, and therefore of petrol or diesel, rises, the economic incentive to incorporate more ethanol or biodiesel increases, raising their market price. Conversely, cheap oil tends to limit their attractiveness, especially if they are poorly subsidised[69] . A rise in crude oil prices therefore boosts the profitability of biofuels, **increasing demand for their inputs, which in turn drives up food prices**. This relationship is particularly apparent in the case of maize and soya (graphs 15 and 16). **Mandatory incorporation thresholds** reinforce this link: when oil prices rise, distributors can exceed their incorporation obligations if biofuels become competitive. But when oil prices fall, biofuel consumption is maintained.

Figure 15 - Brent, maize and ethanol prices

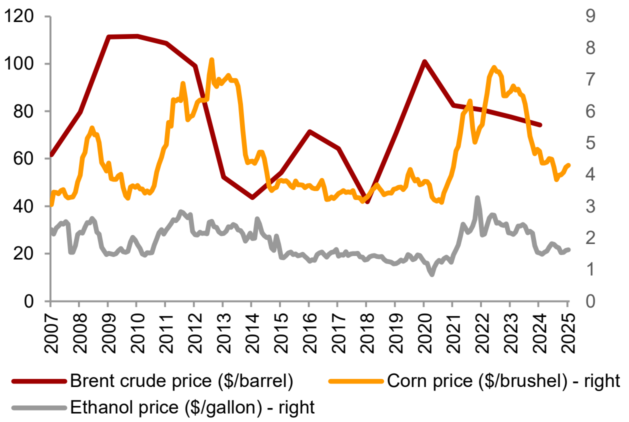
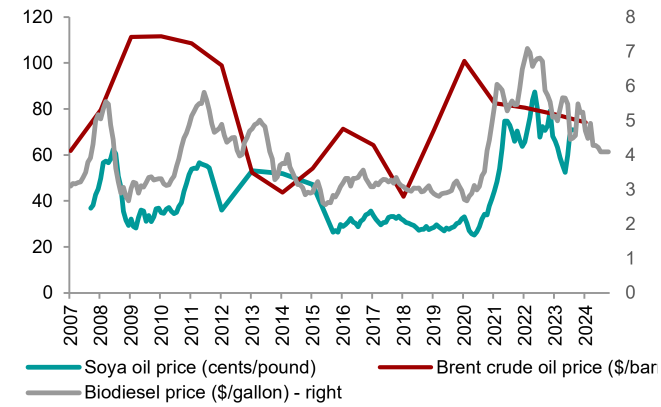


Figure 16 - Prices of Brent, soya oil and biodiesel



Source: IEA, USDA

[65] Transport biofuels - Renewables 2023 - Analysis - IEA, *IEA*, 2023
[66] Biofuels twice as expensive as petrol and diesel in most cases | T&E, *T&E*, 30/06/2022
[67] Transport biofuels - Renewables 2023 - Analysis - IEA, *IEA*, 2023
[68] Ethanol costs 60% of petrol in some places, says Jalles director, www.novacana.com, Date not found
[69] Cerulogy, "How Does Biofuel Demand Affect Food Markets?", 2023

Another indirect transmission channel is the price of agricultural inputs: a rise in the price of oil increases the cost of agricultural production (fuel for agricultural machinery, transport), which in turn increases the cost of agricultural inputs used to produce biofuels.

Conversely, biofuels can keep pump prices down by increasing the supply of fuels on the end market[70]. In 2007, without ethanol, petrol prices would have been between 1.4% and 2.4% higher for US households, according to some studies[71]. **This moderating effect is mainly seen when fossil fuels soar**. **However, this effect is illusory: while the price at the pump may be lower, the production cost of biofuels is, in the vast majority of cases, higher than that of petroleum-based fuels, the difference being made up by subsidies** or other public aid to farmers or refiners.

8.3. A definite, yet difficult to measure, impact on food inflation

The rise of biofuels has been accompanied by an intense debate, summed up by the expression **"food vs fuel", on the pressure they exert on food prices**. The first link is direct: consumption of inputs **reduces the amount of food available**. This mechanism is amplified when demand is rigid - as is the case for basic foodstuffs - or when stocks are low.

But there are also indirect links[72]. **The expansion of crops dedicated to biofuels can generate a change in land use**, increasing the pressure on available resources[73]. More broadly**, the increased use of labour, capital, fertilisers, water, etc., adds to agricultural production costs**.

Numerous studies have attempted to quantify the effect on food prices, with mixed results. Some macroeconomic modelling estimates that the surge in agricultural prices in 2007-2008 was amplified by policies to support biofuels[74] . A study[75] **suggests that almost 75% of the rise in food prices that year could be attributed to these policies**. Other, more cautious assessments, such as that by the US Department of Agriculture[76]**, put the impact at a more moderate 10%**. These differences can be explained by different methodologies, and by the difficulty of isolating the effect of biofuels from other factors: demographic growth, oil volatility, weather conditions, depreciation of the dollar, etc. According to these studies**,** the **effects vary according to the crop**. Biofuel production in the United States in 2007 is estimated to have increased the cost of maize by 15-28%, but only 10-20% for soya. The previous year, when production was lower, the increases were more limited: 2 to 7% for soya, 5 to 13% for maize. **These results demonstrate a positive link between biofuel production and agricultural prices, without establishing a single or linear causality**.

Finally, price effects can also be mitigated by specific national policies. For example, the use of co-products (distillers' grains, used oils) can cushion the impact on food markets. Similarly, the structuring of supply chains, the diversification of inputs or the use of marginal land can help to contain tensions between energy and food uses.

[70] Interdependencies in the energy-bioenergy-food price systems: A cointegration analysis, *ideas.repec.org*, 01/08/2010
[71] Model estimates food-versus-biofuel trade-off*, California Agriculture,* 10/2009
[72] Biofuels versus food: Understanding the trade-offs between climate friendly crop and food security, www.sciencedirect.com, March 2019
[73] Implications of land use change on the life cycle greenhouse gas emissions from palm biodiesel production in Thailand, www.sciencedirect.com, 03/2011
[74] (PDF) Model estimates food-versus-biofuel trade-off, *ResearchGate*, 02/05/2014
[75] Malins, Chris, "How Does Biofuel Demand Affect Food Markets?", *Cerulogy*, 2023.
[76] Model estimates food-versus-biofuel trade-off*, California Agriculture,* 10/2009