

## Chapter 9. Biofuels

*This chapter describes the market situation and highlights the medium-term projections for world biofuel markets for the period 2019-28. Price, production, consumption and trade developments for ethanol and biodiesel are discussed. The chapter concludes with a discussion of important risks and uncertainties affecting world biofuel markets during the coming ten years.*

## 9.1. Market situation

In 2018, global biofuel production increased in all major producing regions with the exception of Argentina, where biodiesel production decreased to its lowest level in four years mainly because of less favourable export opportunities. While crude oil prices in 2018 increased, ethanol and biodiesel prices decreased due to ample supply. Biofuel feedstock prices remained at levels similar to those in 2017, with the exception of vegetable oil prices, which dropped to historically low levels. The biofuel-to-feedstock price ratios increased in 2018 for biodiesel, thus increasing its profitability, while profits decreased marginally for ethanol producers.

Demand for biofuels was sustained by obligatory blending and by growing global total fuel demand due to continued low energy prices. Decreasing price ratios of biofuels to conventional fuels resulted in additional demand for non-mandated use of biofuels, mainly in Brazil. In some countries, policy decisions were favourable to biofuels in 2018, with developments such as mandate increases and differential taxation systems or subsidies enacted or announced.

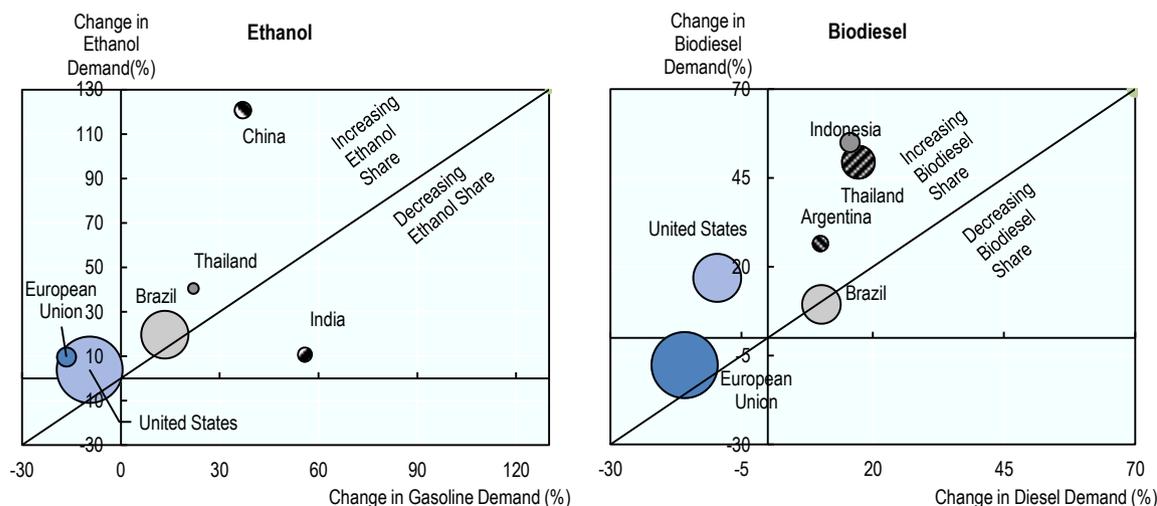
## 9.2. Projection highlights

World prices for biofuels are closely linked to developments in feedstock prices (which are mostly decreasing in real terms) and crude oil prices (constant in real terms). Consequently, international biofuel prices are projected to increase over the outlook period in nominal terms, while they continue to decrease in real terms.

Future developments of biofuel markets will continue to be largely driven by national support policies. Two major producing regions, the European Union and the United States, are increasingly directing their support to advanced biofuels that are not based on traditional agricultural commodities as feedstock (first generation technologies). The IEA *World Energy Outlook* (on which this *Outlook* bases its own projections) foresees decreasing total fuel demand in both regions, suggesting limited growth in biofuel consumption (Figure 9.1). Biodiesel consumption in the European Union is even expected to fall below current levels, driven by an expected decrease in total diesel consumption. In contrast, the United States is expected to experience sustained growth in biodiesel consumption, as biodiesel produced from vegetable oil can qualify as an advanced biofuel in the Renewable Fuel Standard (RFS) rules and both the advanced and biodiesel mandates are increasing in 2019 and 2020.

In Brazil, total fuel consumption is expected to increase, in contrast to the United States and the European Union. Sustained by this development and by the *RenovaBio* law which aims to reduce fuel emissions by 10% by 2028, both ethanol and biodiesel consumption are projected to increase in the coming years. Biodiesel consumption is expected to keep pace with total diesel consumption, while the share of ethanol in gasoline consumption will increase slightly. Ethanol consumption in Brazil is projected to reach 37 bln L in 2028, almost a third higher than today. Only in the People's Republic of China (hereafter "China") is the relative increase expected to be higher. In September 2017, the Chinese government announced that a new nationwide ethanol E10 mandate would be implemented by 2020 and large ethanol production capacities are currently under construction. It is unlikely that the full mandate will be reached by 2020 and this *Outlook* assumes that a blending rate of only about 4% will be reached by this date. Nevertheless, Chinese ethanol consumption will more than double over the coming decade if this is indeed the case.

Figure 9.1. Biofuel demand developments in major regions



Note: Shares calculated on demand quantities expressed in volume and compare 2028 to 2018. The size of each bubble relates to the consumption volume of the respective biofuel in 2018.

Source: OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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In Argentina biodiesel use is assumed to reach the 10% blending mandate. In Indonesia, both total diesel use and biodiesel consumption shares are expected to increase over the outlook period, although it is unlikely that demand will meet the envisaged B20 or B30 targets. This *Outlook* assumes that the biodiesel blending rate will reach about 18% by 2028. In Thailand, the government decided to reduce the ethanol and biodiesel targets from 4.1 bln L to 2.6 bln L based on the assumption that feedstock supply to the domestic biofuel industry would not meet production targets. Ethanol consumption growth in India is not expected to keep pace with total fuel consumption growth (which almost doubles over the coming ten years) because even though ethanol fuel use is projected to increase, ethanol blending is projected to decrease over the projection period.

As biofuel policies in many countries tend to support national markets, international trade volumes are relatively low. Global trade for biodiesel and ethanol as a share of total production (44 bln L biodiesel and 143 bln L ethanol by 2028) has rarely exceeded 10% over the last decade and is dominated by a few countries. World biodiesel trade is projected to decrease from current levels due to faster supply than demand growth in the United States and the European Union, while ethanol trade should remain stable. On the export side, Argentine biodiesel exports are expected to increase and Indonesian ones to decrease.

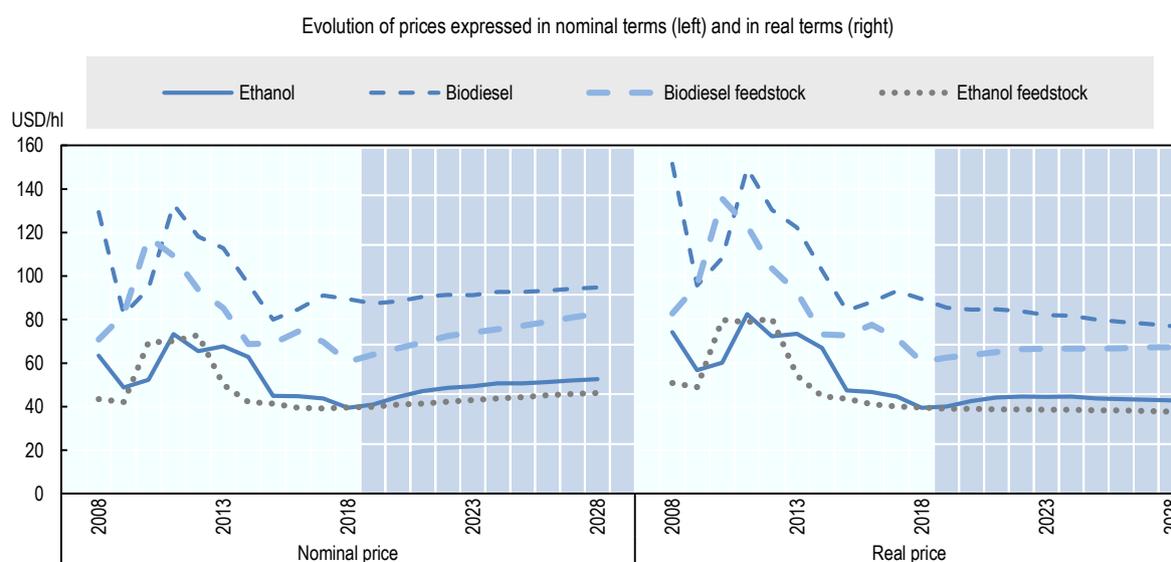
The major risks and uncertainties for the future developments of the biofuel sector are related to the policy environment. This *Outlook* still expects that most of the biofuels produced will be based on agricultural feedstock. Recent policy announcements, however, appear to be favourable to biofuels with a focus on the potential contribution of renewable fuels to greenhouse gas mitigation in the transportation sector (e.g. in the European Union, Brazil or Canada). It is not yet clear whether those announcements will mean stronger investments in research and development for advanced biofuels produced from lignocellulosic biomass, waste or non-food feedstock. However, no substantial increase in

advanced biofuels can be expected before the middle of the outlook period, considering the required investments in production plants.

### 9.3. Prices

Influenced by developments on the vegetable oil markets, nominal biodiesel prices are projected to increase at a slower pace (0.8% p.a.) than ethanol prices (2.4%). Expressed in real terms, biodiesel prices are expected to decrease over the projection period, and ethanol prices return to a decreasing trend after 2023. The main reason for nominal ethanol prices performing more strongly than biodiesel is due to the fact that ethanol prices are currently at historical lows from which a recovery in the first years of the projection period is expected to occur. It should be borne in mind, however, that international and domestic biofuel prices are often disconnected, mainly by policies that include fiscal benefits or supported prices.

**Figure 9.2. The evolution of biofuel and biofuel feedstock prices**



*Note:* Ethanol: wholesale price, United States, Omaha; Biodiesel: Producer price, Germany, net of biodiesel tariff and energy tax. Real prices are calculated based on the GDP deflator in the United States. As proxy for the biodiesel feedstock price, the world vegetable oil price is used and for Ethanol a weighted average between raw sugar and maize is applied.

*Source:* OECD/FAO (2019), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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### 9.4. Production and use

A major driver for global biofuel production and use are developments in the global transportation sector. External projections taken from the *IEA World Energy Outlook* anticipate global gasoline demand to remain at about 1 120 bln L over the projection period, while diesel demand is expected to decrease about 8%, from 762 bln L to 703 bln L. This despite that many countries are expected to continue to face increasing total fuel demand (Figure 9.1).

### Box 9.1. Biofuels at a glance

Biofuels (bioethanol and biodiesel<sup>11</sup>) are fuels produced from biomass. Today about 60% of ethanol is produced from maize, 25% from sugar cane, 7% from molasses, 4% from wheat, and the remainder from other grains, cassava or sugar beets. About 77% of biodiesel is based on vegetable oils (30% soybean oil, 25% pal oil, 18% rapeseed oil) or waste cooking oils (22%). More advanced technologies based on cellulosic feedstocks (e.g. crop residues, wood, or dedicated energy crops) do not account for large shares of total biofuel production. Nevertheless, they are often seen as relevant technologies for the future as they are supposed to cause less competition with food products and emit safer levels of greenhouse gas emissions.<sup>2</sup> The international biofuel sectors are strongly influenced by national policies with three major goals: farmer support, reduced greenhouse gas emissions, and/or reduced energy independency.

**Table 9.1. Biofuel production ranking and key feedstocks**

	Production ranking (base period)		Major feedstocks	
	Ethanol	Biodiesel	Ethanol	Biodiesel
United States	1 (50%)	2 (19%)	Maize	Soybean oil / diverse other oils
European Union	4 (5%)	1 (36%)	Maize / wheat / sugar beet	Rapeseed oil / waste oils
Brazil	2 (24%)	3 (12%)	Sugar cane	Soybean oil
China	3 (8%)	8 (3%)	Maize	Waste oils
India	5 (2%)	15 (0.5%)	Molasses	Palm oil
Canada	6 (1.6%)	10 (1.4%)	Maize	Waste oils
Indonesia	23 (0.2%)	4 (10%)	Molasses	Palm oil
Argentina	9 (1%)	5 (7%)	Maize / sugar cane	Soybean oil
Thailand	7 (1.5%)	6 (4%)	Molasses / cassava	Palm oil
Colombia	13 (0.4%)	9 (1.5%)	Sugar cane	Palm oil
Paraguay	15 (0.3%)	19 (0.03%)	Maize / sugar cane	Soybean oils

*Note:* Percentage numbers refer to the production share of countries in the base period.

*Source:* OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

1. Biodiesel includes renewable diesel (also known as Hydrotreated Vegetable Oil or HVO) in the accounting of this *Outlook* although both are different products.

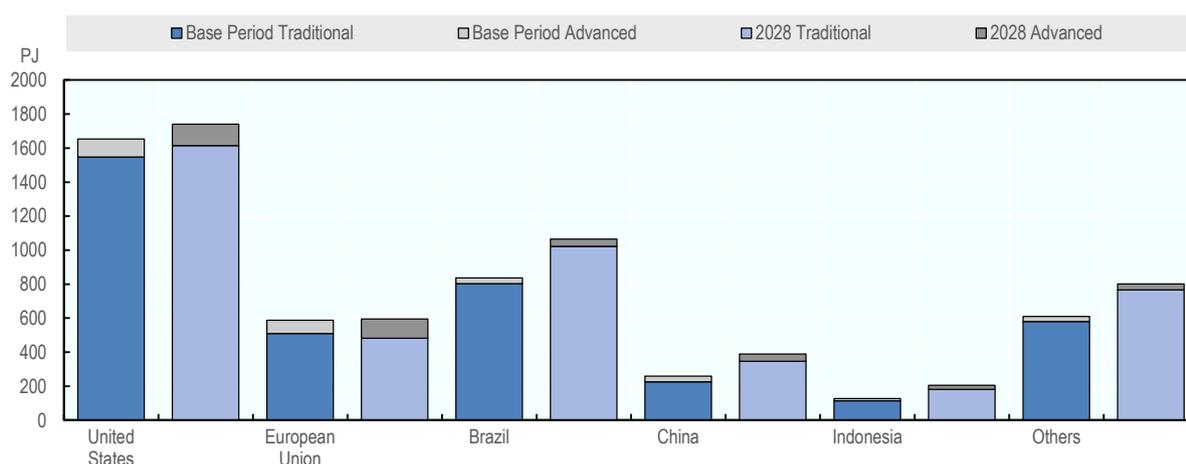
2. An analysis of the potential contribution of biofuels to climate change mitigation in the transport sector (COM/TAD/CA/ENV/EPOC(2018)19/FINAL) that uses the Aglink-Cosimo model finds, however, that a substantially increased role for biofuels in decarbonisation of the transport sector would require a different set of policy incentives that would also need to be cost-effective and take into account effects on food security and the sustainability of resource use.

Globally, the *Outlook* projects increases in biofuel production at a much slower pace when compared to previous decades. The primary reason is that policies of the United States and the European Union are injecting less additional support into the biofuel sector. Demand for biofuels is expected to grow in major developing countries given expected developments in the transportation fleet and domestic policies that favour demand at the consumer level and higher blends.

Global ethanol production is projected to increase from about 122 bln L during the base period to 143 bln L by 2028, while global biodiesel is projected to reach almost 44 bln L,

driven principally by the mandate increase in the United States over the initial projection years. Global biofuel production will continue to be dominated by traditional feedstocks, despite the fact that increasing sensibility to the sustainability dimension of biofuel production is observed in many countries (Figure 9.3). Coarse grains, especially maize, and sugarcane will continue to dominate ethanol feedstock. Ethanol production is projected to use 14% and 24% of global maize and sugarcane production respectively by 2028. Vegetable oil is expected to continue as the feedstock of choice in biodiesel production. Biodiesel production based on waste oil and tallow will continue to play an important role in the European Union, Canada, and the United States.

**Figure 9.3. World biofuel production from traditional and advanced feedstocks**



*Note:* Traditional feedstocks are here defined as food and feed crop based biofuels. Values in Petajoule = 1015 Joule.

*Source:* OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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The share of energy that enters the transport sector through biofuels exceeds 10% in only a single country, Brazil. However, a goal of many biofuel policies, especially in developing countries, is to reduce energy dependency from fossil sources. A goal that is far from being achieved in many countries.

### *United States*

In the United States, the 2007 Energy Independence and Security Act (EISA) defined the Renewable Fuel Standard programme (RFS2). It established four quantitative annual mandates up to 2022: the total and advanced mandates that require fuels to reduce GHG by at least 20% and 50% respectively, and the biodiesel and cellulosic mandates nested within the advanced mandate. The Environmental Protection Agency (EPA) establishes annual minimum quantities for each of the four classes of biofuels required.<sup>2</sup>

In 2018, the EPA decided to increase the advanced biofuel mandate in 2019 (+2.3 bln L) and the biodiesel sub-mandate in 2020 (+1.3 bln L). Similar to previous rulings, an important part of the initial final levels proposed in the EISA were waived for the total advanced and cellulosic mandates on the basis that the production capacity for cellulosic ethanol was not developed; the conventional gap,<sup>3</sup> often referred to as an implied maize mandate, was maintained at 56.8 bln L.

This *Outlook* assumes that all mandates will remain at recently announced levels in volume terms despite the projected decrease in the use of transportation fuel. The exception is the cellulosic mandate, which is assumed to more than double over the projection period, even though it is projected to attain only 4.6% of the level specified in EISA for 2028. It is assumed that the cellulosic mandate will be filled, mostly with renewable compressed natural gas and renewable liquefied natural gas. The ethanol blend wall<sup>4</sup> is projected to increase only moderately to 11.2% by 2028, as current discussions about developing E15 pumps nationwide have not been taken into account.

Due to the aforementioned mandate increases, the production of biodiesel, which is eligible for both mandates, is projected to increase to 8.7 bln L (Figure 9.5). Growth in ethanol production is projected to be limited to 0.1% annually, almost entirely driven by the assumed increase in the cellulosic mandate; this *Outlook* does not project a large biofuel export potential for the United States. Although it is projected to maintain its position as the world's largest ethanol producer, US global production shares are projected to decrease from 50% to 43%.

### *The European Union*

Since 2010, EU legislation related to biofuel support is based on the 2009 Renewable Energy Directive (RED), which requires from EU Member States that at least 10% of transport energy use be based on renewables by 2020. In June 2018, agreement was reached to increase the biofuel target to 14% by 2030, with national caps to food and feed crop-based biofuels at 1 percentage point above 2020 levels but not exceeding 7%. The new framework was adopted under Directive 2018/2001 on 11 December 2018 and will be fully implemented by 2030<sup>5</sup>. The major metrics of this framework, on which the *Outlook* projections are based, are illustrated in Table 9.2.

**Table 9.2. EU policy framework for biofuels**

	2010-2020 Framework	2020-2030 Framework
	RED / ILUC	ILUC RED II agreement
Renewables in transport	10%	14%
Cap on crop-based biofuels	7%	2020 Member States level +1 p.p., max 7 %
Target for advanced	No target, with double-counting	3.5 %, with double-counting
Contribution of waste oils and fats		Max 1.7 % with double-counting

*Source:* EU agricultural outlook for markets and income, 2018-2030. European Commission, DG Agriculture and Rural Development, Brussels.

According to the IEA baseline used for this *Outlook*, total energy use in the transport sector is projected to decrease for diesel and gasoline. The decrease for diesel-type fuels is that strong that, although the RED II proposal promotes some growth in biofuel consumption shares, only ethanol consumption is projected to increase (+0.8 bln L), while biodiesel consumption is projected to decrease in absolute terms (-0.4 bln L). Palm oil-based biodiesel constitutes a large share of this decrease in view of the EU sustainability concerns associated with palm oil production. Biodiesel produced from other vegetable oils is expected to decrease as well, but less significantly, while production from waste oils is projected to remain stable. Given these projected demands for the biodiesel sector, the European Union is expected to continue being the world's largest biodiesel-producing region in 2028, but global production shares are expected to decrease from 36% to 30%.

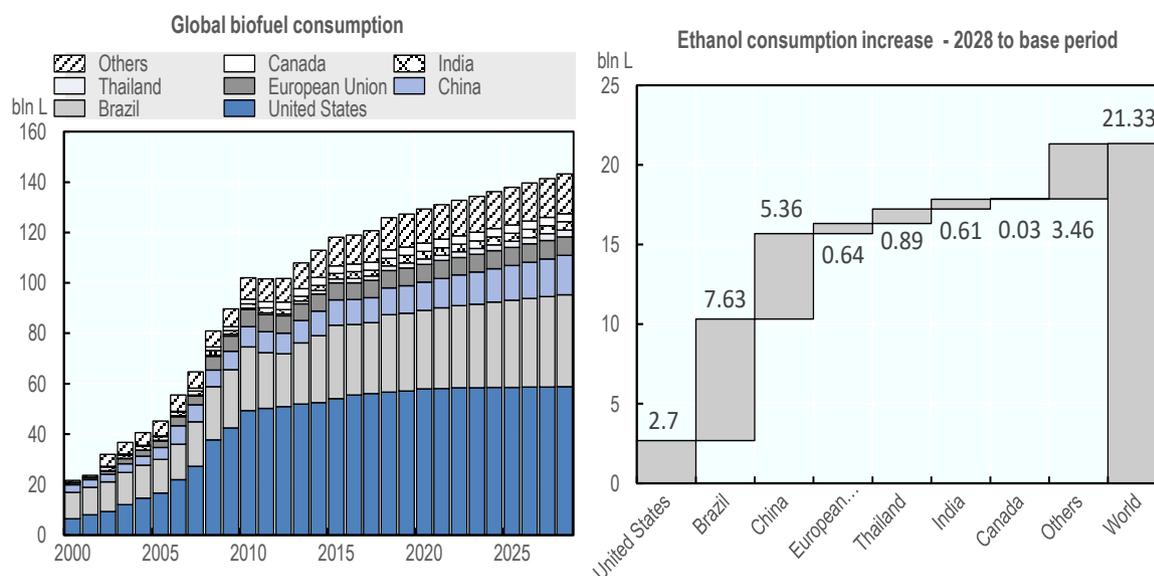
Total biofuel consumption in 2028 in terms of energy is projected to increase slightly (+14 PJ), but the share of advanced biofuel sources is projected to increase from 15% today to 22% in 2028 (Figure 9.3).

### Brazil

Brazil is one of the few countries with a large fleet of flex-fuel vehicles that can run on either gasohol (a mix of gasoline and anhydrous ethanol) or on E100 (hydrous ethanol). For gasohol, the mandatory blending requirement for ethanol is legislated at 27%. There is also a differentiated taxation system that favours hydrous ethanol over blended gasohol in key Brazilian states. For biodiesel, a 10% mandate exists.

The largest share of ethanol consumption and production increases in this *Outlook* is expected to come from Brazil (Figure 9.4), due mainly to the RenovaBio programme<sup>6</sup> which will come into effect over the next two years. The RenovaBio programme was officially signed in January 2018; it defines a minimum blending target for anhydrous fuel ethanol that should reach 40% by 2030, as expressed in volume terms. It is intended to reduce the emissions intensity of the Brazilian transport sector in line with the country's commitments under COP 21. To create the necessary incentive structure, RenovaBio will introduce a system of tradeable carbon savings credits similar to those in California's Low Carbon Intensity Program. It might take a few years until this programme changes current production trends, but strong increases in production should be expected once this is the case. Brazil is assumed to contribute 37 bln L to global production and use growth (+8 bln L). In 2028, more than half of the total Brazilian ethanol production is projected to be consumed by high blend flex-fuel vehicles, implying an increase of this fleet.

Figure 9.4. Development of the world ethanol market



Source: OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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In contrast to the United States and the European Union, total fuel consumption of diesel and gasoline in Brazil is projected to increase over the coming decade (Figure 9.1),

underpinning the potential for growth of these two renewable fuel types. As a consequence, this *Outlook* projects that not only ethanol market volumes in Brazil will increase, but also biodiesel consumption. This increase is projected to occur at the same pace as that of total diesel consumption because the 10% biodiesel blending mandate was reached in 2018 and no further change to this mandate is assumed.

### *China*

The second largest contribution to the global increase in ethanol production is expected to come from China. In September 2017, the Chinese government announced a new nationwide ethanol E10 mandate to be implemented by 2020. Mechanisms for its implementation and enforcement had not been announced as of March 2019. Although this *Outlook* assumes that the ambitious E10 mandate will not be reached by 2028, it does assume that gasoline-type fuels will be blended with 4% of ethanol. This corresponds to a production increase of 5 bln L as the *Outlook* assumes most of the ethanol demand will be produced from domestic feedstocks. Biodiesel production in China will continue to be used more for cooking oil, which has limited growth potential.

### *India*

The National Policy on Biofuels came into effect in May 2018. The main objectives are to achieve 20% ethanol and 5% biodiesel blending, substantially above the current 1.4% and 0.1% blending levels. A new characteristic is that it opens the possibility to use grains as feedstocks if these are not suitable for human consumption. Ethanol would continue to be produced primarily from molasses. This new policy includes the use of non-edible crops, restrictions on imports, price regulations, fiscal incentives, and research and development, especially in second generation biofuels.

Although India is the world's fifth largest ethanol producer, most of it is used for industrial and food purposes, whereas biofuels represents about 44% of total demand. Biodiesel production in India is marginal given that it is a net importer of vegetable oils. While this *Outlook* assumes ethanol and biodiesel fuel use to reach 1.6 bln L and 0.24 bln L by 2028, blending is expected to decrease marginally from current levels as demand for conventional fuels expands faster.

The main limitation to biofuel production growth assumed over the outlook period is the availability of feedstocks. Projected molasses production in India would not be sufficient to meet the increasing demand from the biofuels industry. While sugarcane would be an alternative, the current use of sugar cane in ethanol is marginal. There is no clear indication on how the new policy would support increases in processing capacity for sugar cane; this *Outlook* assumes no relevant growth. Although non-edible grains would be eligible for producing ethanol, projected decreases in stocks to use ratio of feed grains (maize and other coarse grains) indicate tight markets and no increase of grain-based ethanol is expected.

### *Canada*

The federal Renewable Fuels Regulations mandates 5% renewable content in gasoline (some provinces have their own provincial mandate which is higher) and 2% in diesel fuel. This regulation is supposed to be replaced by the Canadian Clean Fuels Standard (CFS) to be implemented in 2022 for the liquid fuel stream.<sup>7</sup> The Clean Fuel Standard (CFS) policy, currently under negotiation, aims to reduce greenhouse gas emissions from the fuels consumed by introducing Carbon Savings Credits. The current Renewable Fuel Regulations (biofuel mandates) at the federal level (5% renewable content in gasoline and

2% renewable content in diesel) will most likely not be suppressed, but could act as a backstop to the CFS by providing minimum blending rates. The expectation is, however, that the CFS will add value to biofuels through compliance credits and that it would create further incentives to increase blending and use in Canada. This *Outlook* does not include the effects that the CFS might have on biofuel markets, thus biodiesel and ethanol blending rates are expected to stay at current levels.

### *Indonesia*

The implementation of B30 aims to reduce the country's dependency on imported fossil fuels. In recent years, biodiesel production was increased due to the Biodiesel Program, which provides support to biodiesel producers and is financed by the crude palm oil (CPO) fund. In the years 2016-2017, based on media reports, it is estimated that the CPO fund was about USD 1.9 bln, of which 1.5 bln were used for the Biodiesel Program. Sustaining the growth of biodiesel production relies entirely on palm oil exports and competitive prices.

Sustained by the collection of export levies through the CPO fund over the last three years, biodiesel production in Indonesia reached an historical peak of 5 bln L in 2018. This *Outlook* assumes an additional increase in production in 2019, reaching 5.5 bln L. Thereafter, and given the projected increases in palm oil exports, the CPO fund would need to be replenished to allow production to continue to expand. As a result, this *Outlook* assumes a two-year transition period during which biodiesel production is expected to decrease, although not below 5 bln L, to then resume an upward trend, reaching 6 bln L by 2028. The policy to support biodiesel producers relies on international prices, specifically the price wedge between domestic and international palm oil prices that defines the amount of the levy to be collected. Although Indonesia aims to fulfil a B30 target, the blending rate is expected to increase from 8% in the base period to 13% by 2028 (5.8 bln L). Nonetheless, the projected biodiesel production increase is the highest among all countries in this *Outlook* (Figure 9.5).

### *Argentina*

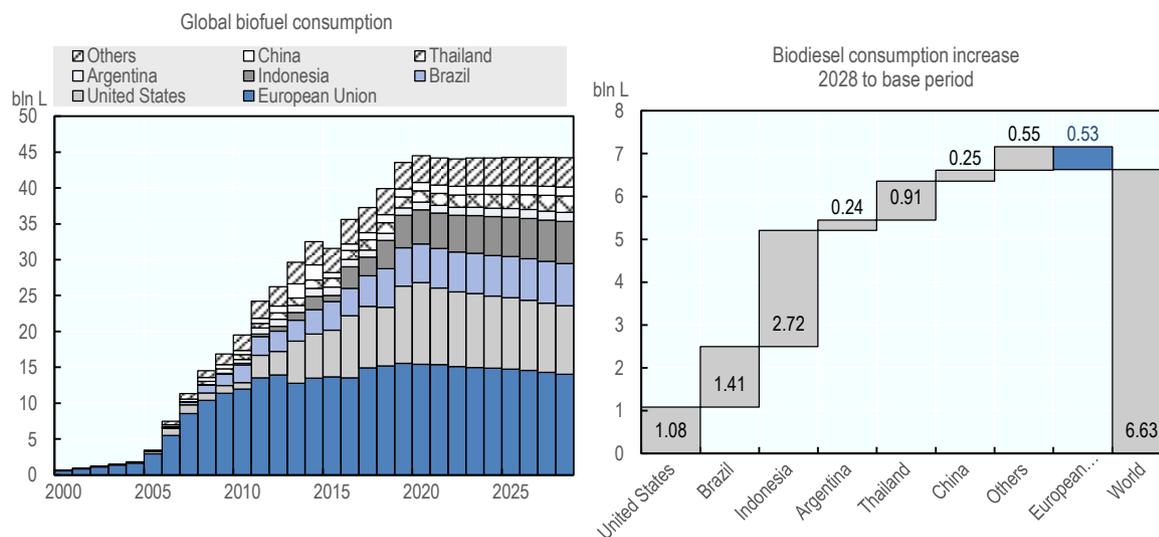
Argentina has blending mandates of 10% biodiesel and 12% ethanol. Increases to the biodiesel mandates are under discussion especially given that the two major export markets, the United States and the European Union, have filed anti-dumping import duties on Argentina. Argentina's mandates are expected to be filled by 2021. Tax exemptions should continue to boost the development of the Argentinean biodiesel industry, which exports more than half of the production. However, trade barriers set by the United States on Argentinean biodiesel will likely limit export demand for this country's biodiesel. Thus, although production is expected to recover from current low levels, Argentina is not expected to reach the production peaks of 2014 or 2017 again.

### *Thailand*

Thailand is seeking to reduce CO<sub>2</sub> emissions and its dependency on imported fossil fuels. To achieve these goals, it has set an ambitious target of producing 4.1 bln L of ethanol and biodiesel; this target, however, was revised downwards to 2.6 bln L due to problems of feedstock availability – domestic production constraints of molasses, cassava, and palm oil. While the projected domestic cassava production would be sufficient to meet the initial target, cassava production is heavily focussed on export markets because international prices are higher than those offered by the local biofuels industry. As a result, domestic supply to the biofuels industry will remain limited over the outlook period. While sugarcane

would be an alternative, investment in sugarcane mills that can process ethanol is limited and no policy changes to allow for this are envisaged.

**Figure 9.5. Development of the world biodiesel market**



Note: Blue shaded number means reduction

Source: OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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## Columbia

The government has announced its intentions to implement the E10 at the national level. The existing Biodiesel B10 mandate has proved difficult to be fulfilled, as it would require palm oil production to increase significantly. Other policies include tax exemptions to promote blending and regulated prices for domestic producers.

This *Outlook* assumes that the E10 mandate will be reached by 2028, leading to a fuel demand of 1.5 bln L. The main feedstock is currently sugarcane and projections assume this will continue over the outlook period. In line with historical developments, ethanol is projected to increase in importance as an alternative source of income for the sugarcane industry. By 2028, it is projected that about 38% of the sugarcane production will be used for ethanol production. Such an ambitious target can only be met by doubling production capacity over the projection period. Biodiesel demand is projected to increase marginally 1.1 p.a. over the projection period, to reach 0.7 bln L in 2028, with the blending rate constant at about 6%. Although biodiesel will benefit from tax exemptions, blending obligations and mandate prices, production is assumed to remain limited. As of 2018, Colombia began importing a small amount of biodiesel; this raised concerns amongst producers about the sustainability of the domestic industry if more imports were allowed.

## Paraguay

The average blending rate in Paraguay is about E18. Based on past growth and on automobile fleets largely made up of flex cars, the national blending rate could increase in the future. Ethanol production is projected to remain largely based on sugar; however,

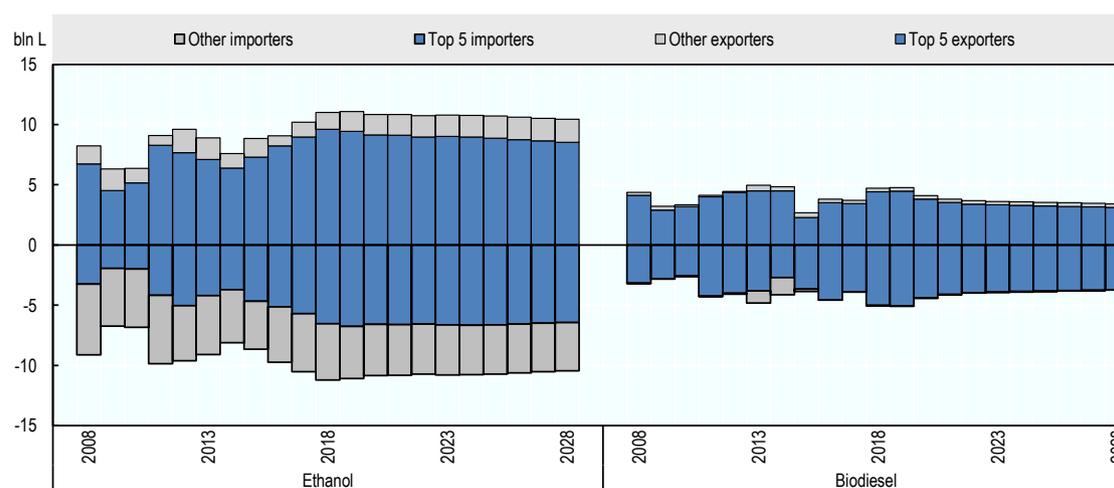
maize would increase its share as the sugarcane industry is not expected to be able to meet the demand for both food and biofuels, even with declining sugar per-capita intake. The production of both biofuels is projected to more than double over the outlook period.

## 9.5. Trade

Global ethanol trade is projected to remain as a low share of global production, decreasing from 9% over the base period to 8% by 2028. The United States is expected to remain a net exporter of maize-based ethanol and a modest importer of sugarcane-based ethanol. The need for sugarcane-based ethanol imports is related to the Low Carbon Fuel Standard in place in California and to the limited filling of the advanced mandate. US ethanol exports should decrease over the projection period because of a combination of strong domestic demand and weak international demand. Brazilian ethanol exports are not expected to expand over the projection period given that the Brazilian ethanol industry will mostly fill sustained domestic demand and that domestic ethanol prices are expected to remain slightly above international ones.

Biodiesel trade is subject to uncertainties concerning the future of current trade tensions. In this *Outlook*, biodiesel trade is projected to decrease over the next ten years as most countries with biodiesel mandates or targets will fill these domestically, and import demand from developed countries, in particular the United States and the European Union, should decrease.

**Figure 9.6. Biofuel trade dominated by a few global players**



*Note:* Top five ethanol exporters in 2028: United States, Brazil, Pakistan, European Union, United Kingdom. Top five ethanol importers in 2028: Brazil, United States, Japan, Canada, China. Top five biodiesel exporters in 2028: Argentina, European Union, Canada, United States, Indonesia. Top five biodiesel importers in 2028: European Union, United States, United Kingdom, Peru, Canada.

*Source:* OECD/FAO (2019), “OECD-FAO Agricultural Outlook”, OECD Agriculture statistics (database), <http://dx.doi.org/10.1787/agr-outl-data-en>.

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Argentina should remain the lead biodiesel net exporter, followed by the European Union (mainly exports to the United Kingdom) and Canada. Argentinian exports are expected to increase from current lows over the projection period. Exports from Indonesia and

Malaysia are expected to decline due primarily to diminishing export markets, notably the European Union.

## 9.6. Main issues and uncertainties

The major risks and uncertainties for future development of the biofuel sector are related to the policy environment. This includes uncertainties about mandate level changes, mandate enforcement mechanisms, investments in non-traditional biofuel feedstocks, and changes to tax exemptions for biofuels.

This *Outlook* makes many assumptions on the expected fill rates of mandates and in many cases these are considerably lower than 100%. Stronger investments in biofuel production capacities or stronger support to the sector would increase the potential of biofuels.

Another uncertainty is related to the capacity of the agricultural sector to produce feedstock for the increasing demand for biofuels in many countries if mandates were to be fulfilled. Biodiesel production is constrained by the limited supply of vegetable oil as it competes directly with food demand. Ethanol production is subject to disruptions in the sugarcane sector inherent to the cyclical production nature of this crop. While such challenges could be addressed by diversifying feedstocks, increasing processing capacity remains uncertain.

Sustainability criteria, agreed upon in early 2019 require European Union Member States to reduce “high ILUC risk” biofuels as of 2024, reaching zero by 2030. “High ILUC-risk” biofuels are produced from food and feed crops that require significant global expansion into land with high carbon stock such as forests, wetlands and peatlands. It remains uncertain how this criteria will affect the biofuel market, especially the use of palm oil as “low ILUC risk” biodiesel feedstock requires certification.

A major determinant in the use of biofuels would be related to the development of national transport fleets. The automobile industry is currently investing in electric cars and, depending on the uptake of this technology (which might depend on the policies enacted), total fuel demand projections could be lower than assumed in this *Outlook*, thereby decreasing the potential of biofuel.

## Notes

<sup>1</sup> Biodiesel includes renewable diesel (also known as Hydrotreated Vegetable Oil or HVO) in the accounting of this *Outlook* although both are different products.

<sup>2</sup> <https://www.epa.gov/renewable-fuel-standard-program/final-renewable-fuel-standards-2019-and-biomass-based-diesel-volume>.

<sup>3</sup> The conventional gap is the difference between the total and advanced mandates as defined by the Renewable Fuel Standard (RFS2).

<sup>4</sup> The blend wall in this context is the maximal achievable national average blending rate, given that most pumps in the United States offer only E10. This assumes that several E15 pumps will be developed over the coming years.

<sup>5</sup> <https://ec.europa.eu/jrc/en/jec/renewable-energy-recast-2030-red-ii>

<sup>6</sup> [http://www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2017/lei/L13576.htm](http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/lei/L13576.htm).

<sup>7</sup> <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-standard/regulatory-design.html>.