

Liquid Biofuels Atlas 2021 - 2022

Innovation and Bioeconomy Program

IICA





Liquid Biofuels Atlas 2021-2022

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San Jose, Costa Rica
2022



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Liquid Biofuels Atlas 2021-2022

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San Jose, Costa Rica

2022

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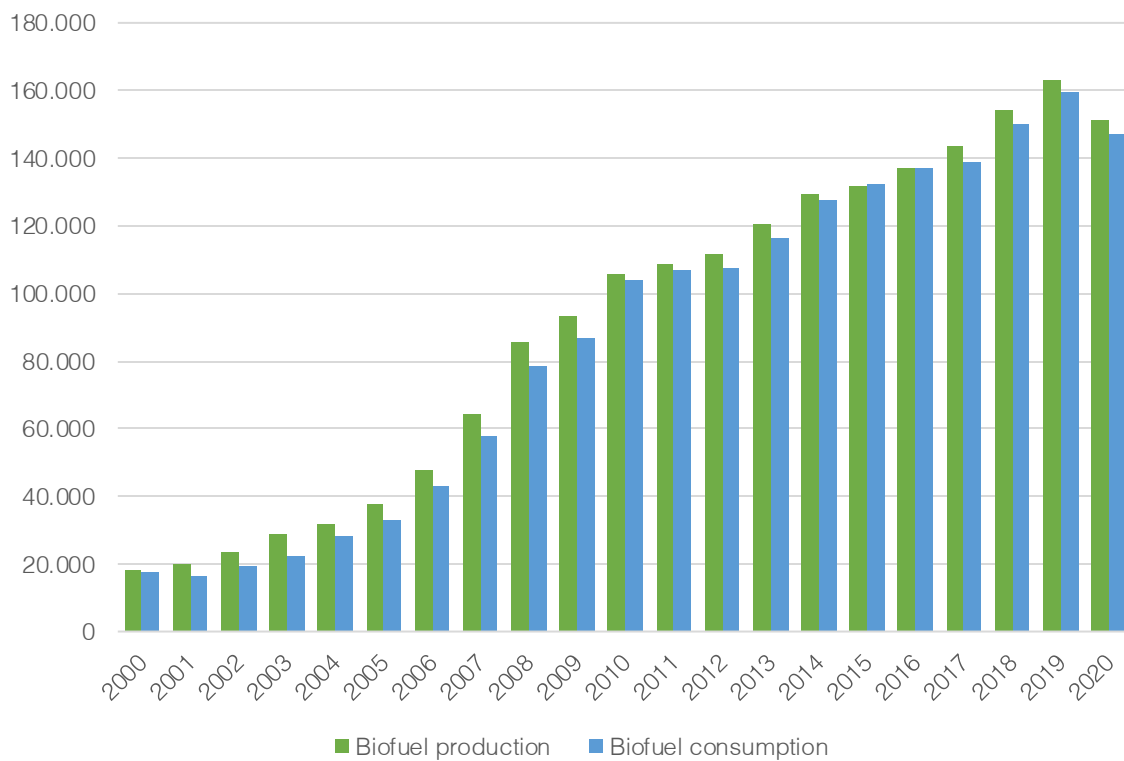


1

INTRODUCTION

Both the production and consumption of liquid biofuels increased vis-à-vis 2020, namely by 4% and 3%, respectively, following a decline during the pandemic. Although production and consumption were still below 2019 levels, this marked a resumption of the upward trend over the last twenty years, during which time these indicators had grown by 568% and 680%, respectively.

Figure 1. Evolution of liquid biofuel production and consumption (in thousands of m³).



Source: Adapted from Torroba (2021a).

By 2021, 60 states had introduced some type of regulation, generally direct or indirect mandates regarding fuel blends, ensuring the consumption of some type of liquid biofuel. Moreover, more than ten subnational states had stipulated mandatory use of bioethanol, biodiesel or both.

In addition to traditional biofuel use mandates, new regulatory schemes are now being implemented, most notably the “low carbon fuel standards” (LCFSs), which are mechanisms that are seeking to decarbonize the transport sector by providing incentives, and which are usually technology-agnostic. California is one outstanding example.

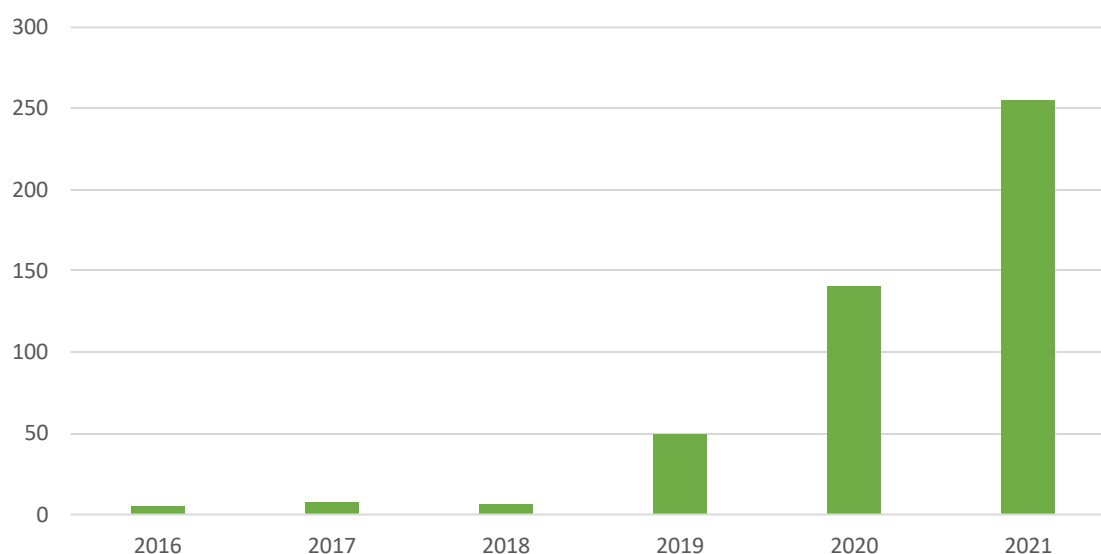
Of the different liquid biofuels, the most widely produced is bioethanol. In the last 15 years, bioethanol production has increasingly used corn as a raw material, in addition to the long-standing tradition of sugarcane-based bioethanol, which Brazil led for several decades.

On the other hand, over the last two decades, the production and consumption of biodiesel—a biofuel made through the process of transesterification using primarily palm, soybean and rapeseed oil with alcohol—is growing more rapidly than bioethanol, despite

starting from a much lower baseline. This product is known as FAME or fatty acid methyl ester. Another more recent development is the production of biodiesel from hydrotreated vegetable oil, commonly known as HVO. Over the last decade, HVO production has grown by 272% to replace diesel and today represents 18% of all biodiesel produced.

Similarly, liquid biofuels for navigation and aviation have become more prevalent, albeit this is still in the incipient stage in the case of the former. In 2007, biojet recorded its first regular level of consumption (IEA 2021a) which, as of 2020, increased significantly due to new installed capacity. Moreover, a number of countries began to implement public policies to promote the use of sustainable aviation fuels.¹

Figure 2. Evolution of sustainable aviation biofuel production (in thousands of m³).



Note: 2021, estimated data.

Source: Prepared by the author, based on IRENA (2021) and IEA (2021a)

Today, liquid biofuels are being refined as part of a cleaner transition in the framework of a mobility paradigm based on internal combustion. While new mobility paradigms are being developed (electromobility, hydrogen propulsion, etc.) that will require considerable time for mass adoption, biofuels afford a more environmentally sustainable alternative to fossil fuels, without calling for major technical changes in existing vehicles.

This document provides information and statistics on the main variables (consumption, production, foreign trade and raw material use) and on the status of public policies regarding liquid biofuel mandates.

¹ The aviation industry uses the term “Sustainable Aviation Fuels” as a generic term for various biofuels, with biojet, also known as aviation biofuel, as the only one that is currently being produced.

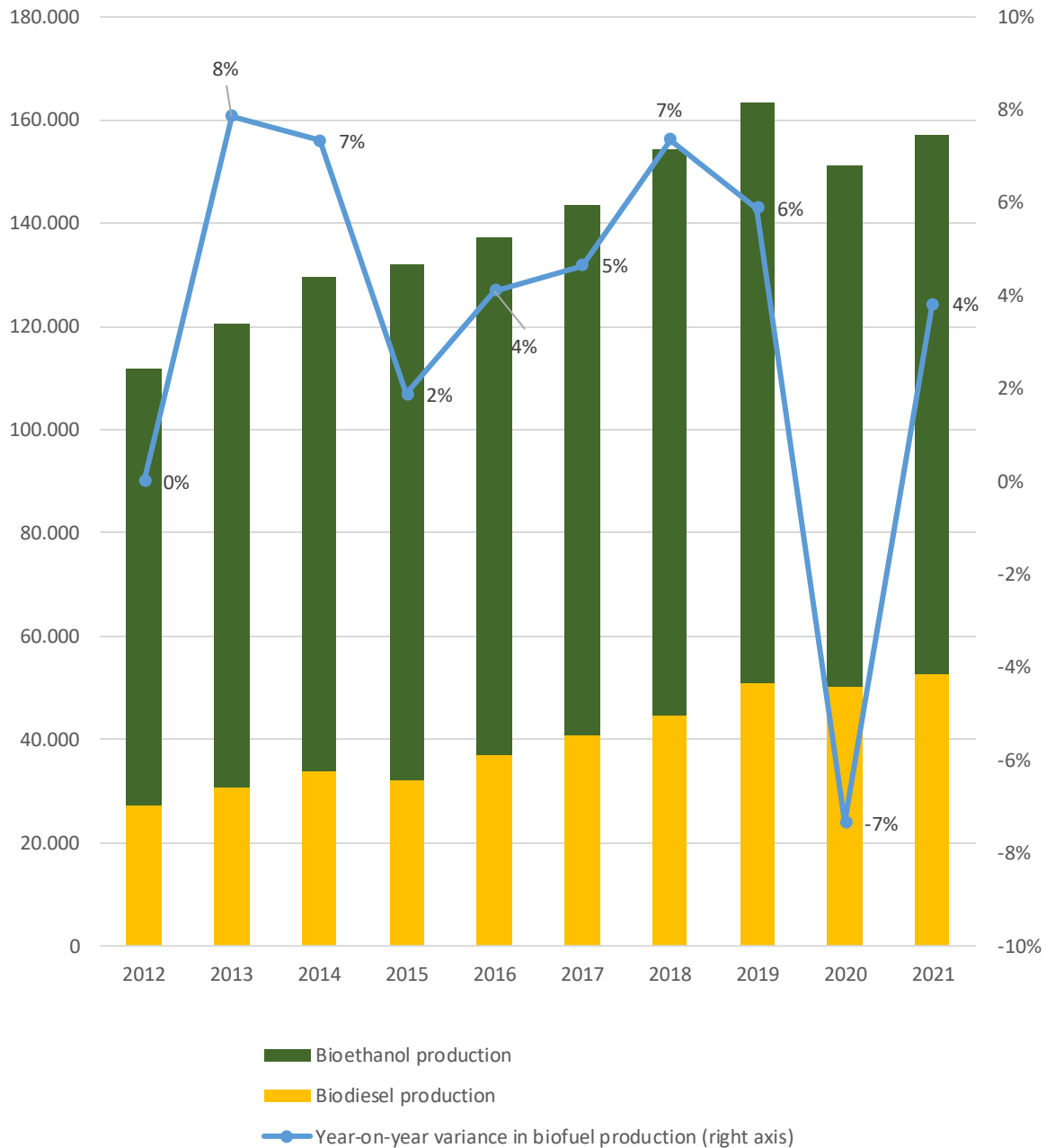


PRODUCTION

2

Over the last decade (2012-2021), global liquid biofuel production increased by 41%. For the same period, the year-over-year variance ranged from -7% to 8%, with a clear upward trend in production, despite a decline to 151,000,000 m³ in 2020, due to the fallout from the pandemic. In 2021, production rose to approximately 157,000,000 m³, representing a year-over-year increase of 4%.

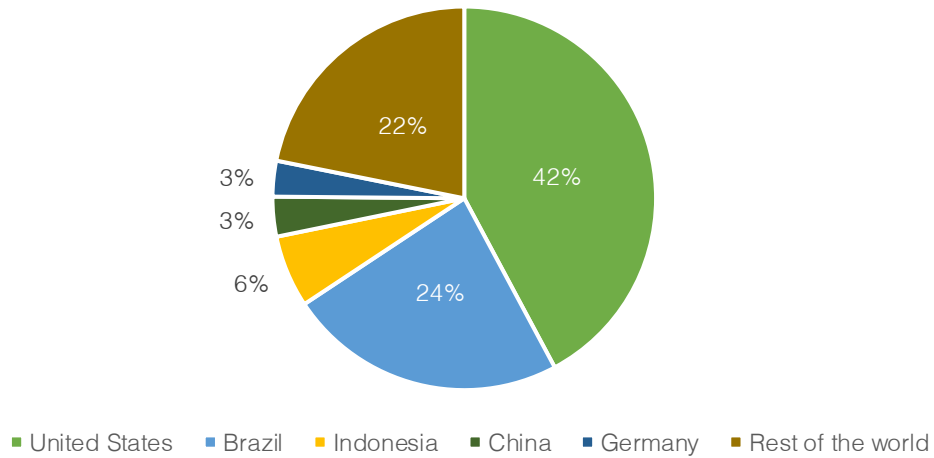
Figure 3. Year-over-year variance, trend and total global liquid biofuel production (in thousands of m³).



Source: Adapted from Torroba 2020a.

The five leading liquid biofuel producers are the United States (42%), Brazil (24%), Indonesia (6%), China (3%) and Germany (3%). The remaining 22% of production is distributed among the rest of the countries in the world, with France, India, Thailand, Argentina, the Netherlands and Spain also holding a notable share of the market.

Figure 4. Percentage distribution of global liquid biofuel production in 2021.

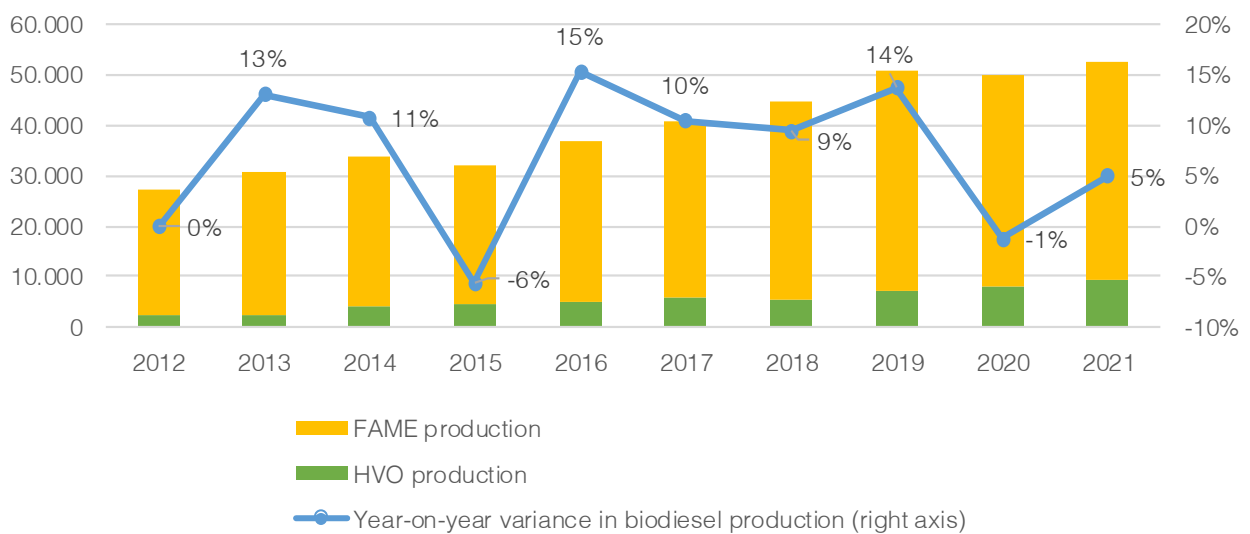


Source: Adapted from Torroba (2021a).

Over the last decade (2012-2021), global biodiesel production increased by 94%. For the same period, the year-over-year variance ranged from -6% to 15%, with a clear upward trend in production, maxing out at 50,000,000 m³ in 2020. In 2021, production showed a year-over-year increase of 5%, surpassing 52,600,000 m³.

Specifically, over the last 10 years, HVO production grew by approximately 272%. The year-over-year variance for last year was 20.5%, amounting to nearly 9,500,000 m³. In the case of FAME, growth over the last decade reached 76%, with production in 2021 surpassing 43,000,000 m³.

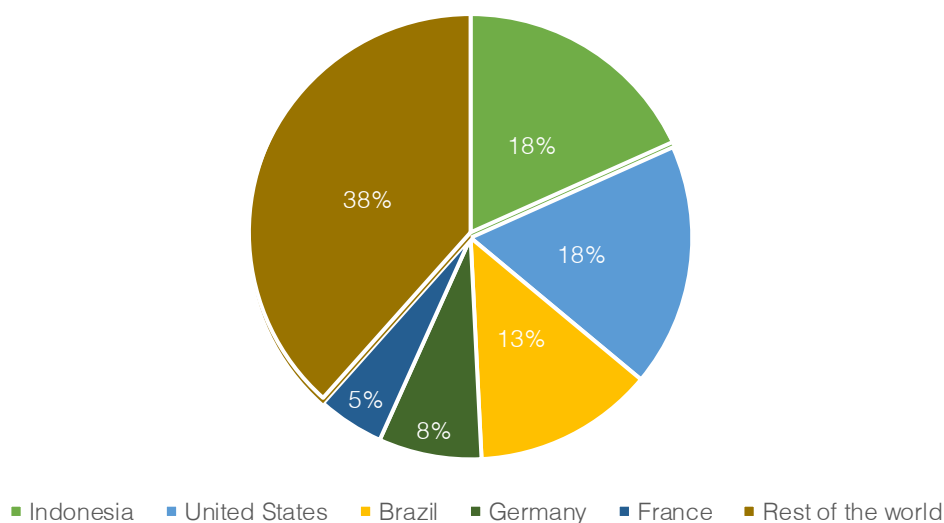
Figure 5. Year-over-year variance, trend and total global biodiesel (FAME and HVO) production (in thousands of m³).



Source: Adapted from Torroba 2020a.

The world's five leading biodiesel producers are Indonesia (18%), the United States (18%), Brazil (13%), Germany (8%) and France (5%). The remaining 38% of production is distributed among the rest of the countries in the world, with the Netherlands, Argentina, Spain, China, Thailand and Singapore also holding a notable share of the market.

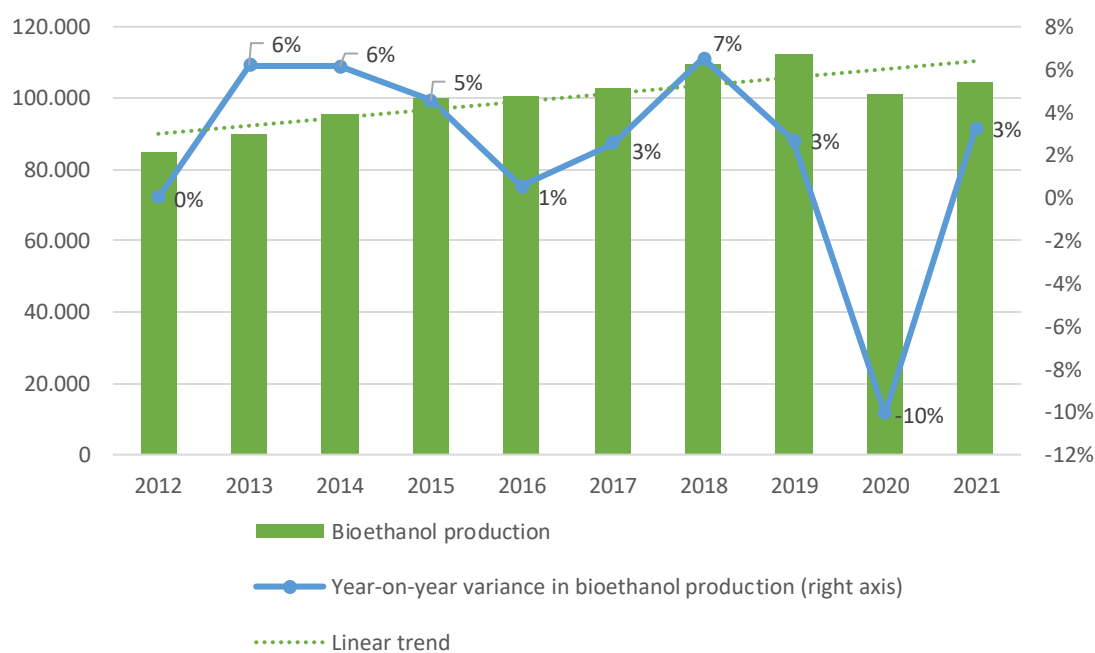
Figure 6. Percentage distribution of global biodiesel production in 2021.



Source: Adapted from Torroba (2021a).

Globally, the accumulated growth of bioethanol production was 23% over the last decade (2012-2021). The year-over-year variance ranged from -10% to 7%, with a clear upward trend in production, until 2020, when it fell to 101,000,000 m³. In 2021, production recorded a year-over-year increase of 3%, amounting to nearly 105,000,000 m³.

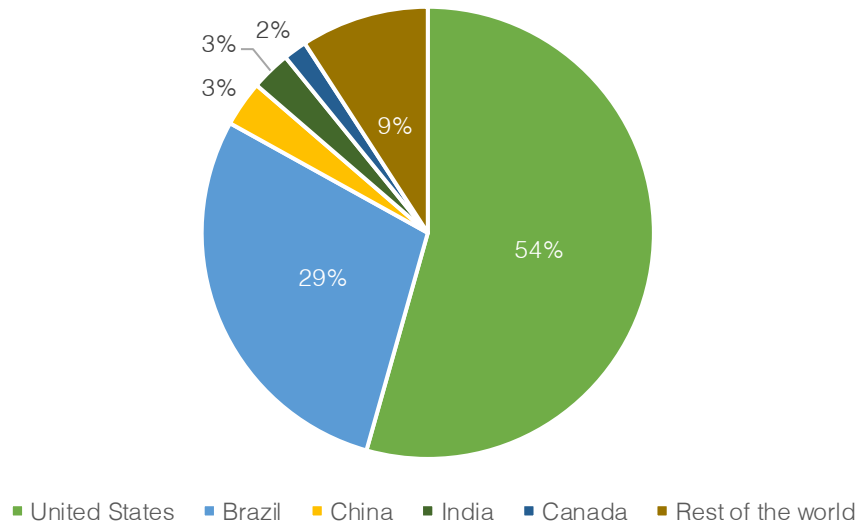
Figure 7. Year-over-year percentage variance, trend and total global bioethanol production (in thousands of m³).



Source: Adapted from Torroba (2021a) and ISO (2022).

The five leading bioethanol producers are the United States (54%), Brazil (29%), China (3%), India (3%) and Canada (2%). The remaining 9% of production is distributed among the rest of the countries in the world, with Thailand, Argentina, Germany and France also holding a notable share of the market.

Figure 8: Percentage distribution of global bioethanol production in 2021.



Source: Adapted from Torroba (2021a) and ISO (2022).

3

CONSUMPTION

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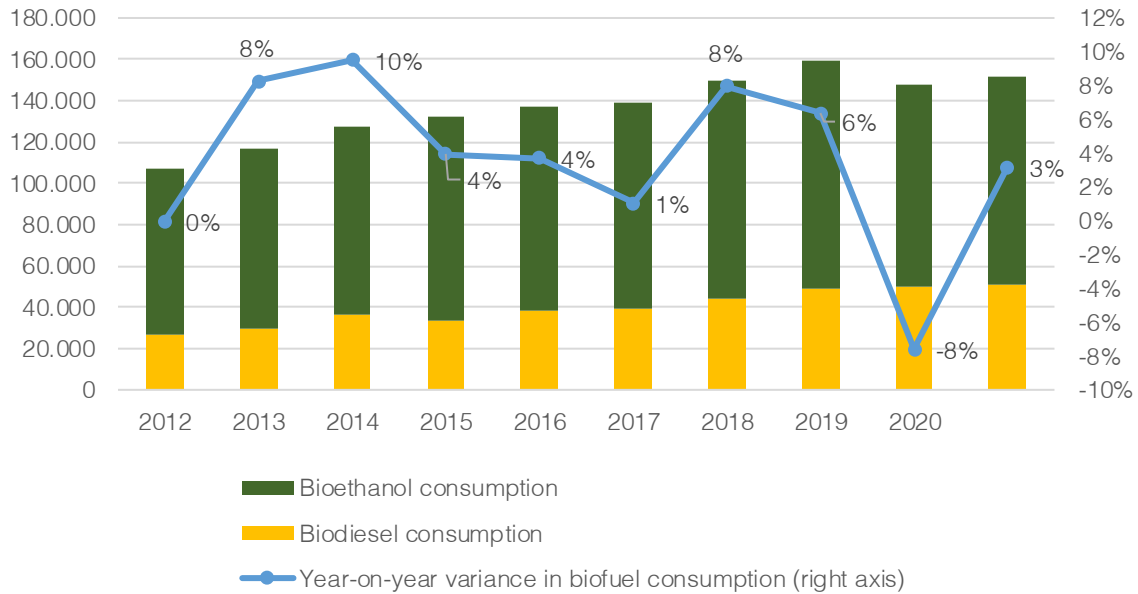
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Over the last decade (2012-2021) global liquid biofuel consumption increased by 41% overall, with a year-over-year variance ranging from -8% to 10%. After a fall-off in 2020, 2021 recorded a year-over-year increase of 3%, climbing to 152,000,000 m³.

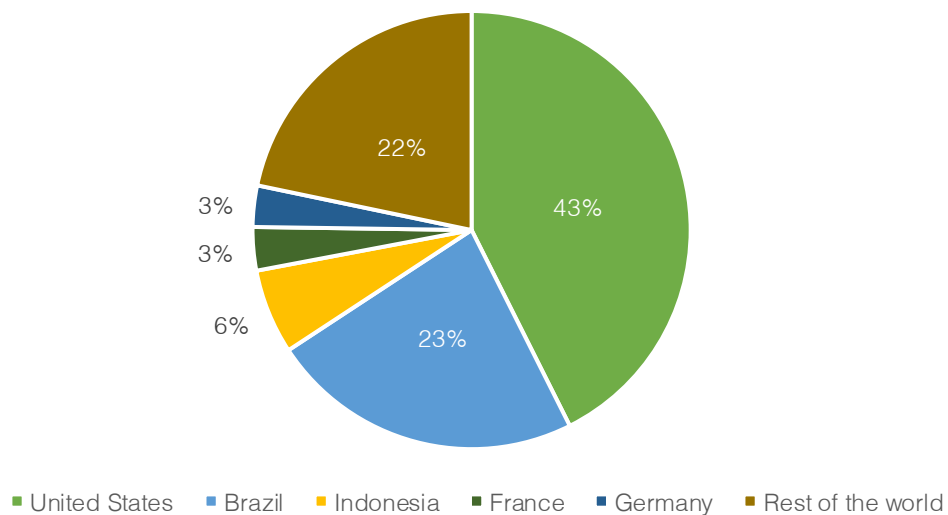
Figure 9. Year-over-year percentage variance, trend and total global liquid biofuel consumption (in thousands of m³).



Source: Adapted from Torroba (2021a).

Liquid biofuel consumption is largely concentrated in two countries: the United States and Brazil, with 43% and 23% of total consumption, respectively. They are followed by Indonesia (6%), France (3%) and Germany (3%). The remaining 22% is distributed among the rest of the countries in the world, with Canada, India, Thailand, China, the United Kingdom, Spain, Argentina and Sweden also holding a notable share of the market.

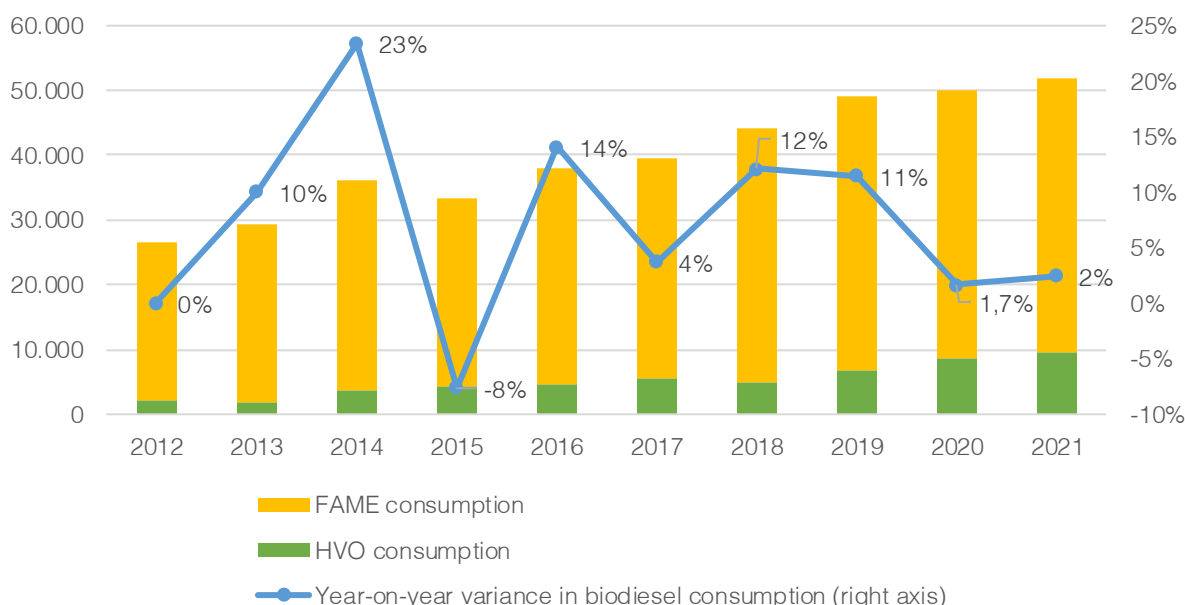
Figure 10. Percentage distribution of global liquid biofuel consumption in 2021.



Source: Adapted from Torroba (2021a).

In terms of biodiesel, over the last decade (2012-2021) global consumption increased 93% overall, with a year-over-year variance ranging from -8% to 23% and surpassing 52,000,000 m³ in 2021. Over the last 10 years, consumption of HVO increased by 325%, with a 10.4% increase in 2021.

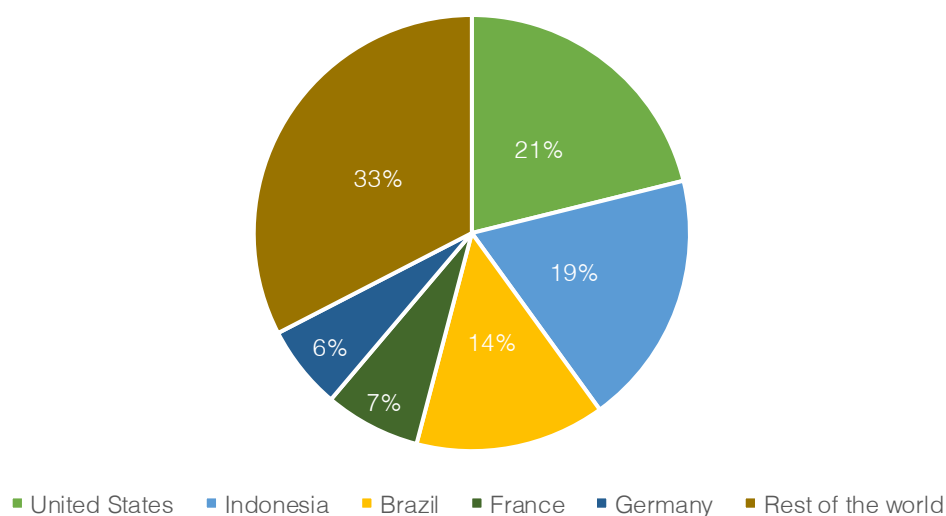
Figure 11. Year-over-year percentage variance, trend and total global biodiesel (FAME & HVO) consumption (in thousands of m³).



Source: Adapted from Torroba (2021a).

Global consumption of biodiesel is more dispersed than bioethanol consumption. The United States, Indonesia, Brazil, France and Germany account for 21%, 19%, 14%, 7% and 6%, respectively. The remaining 33% is distributed among the rest of the countries in the world, with Spain, Sweden, Thailand, the United Kingdom, Italy and Malaysia also accounting for a notable share of the total.

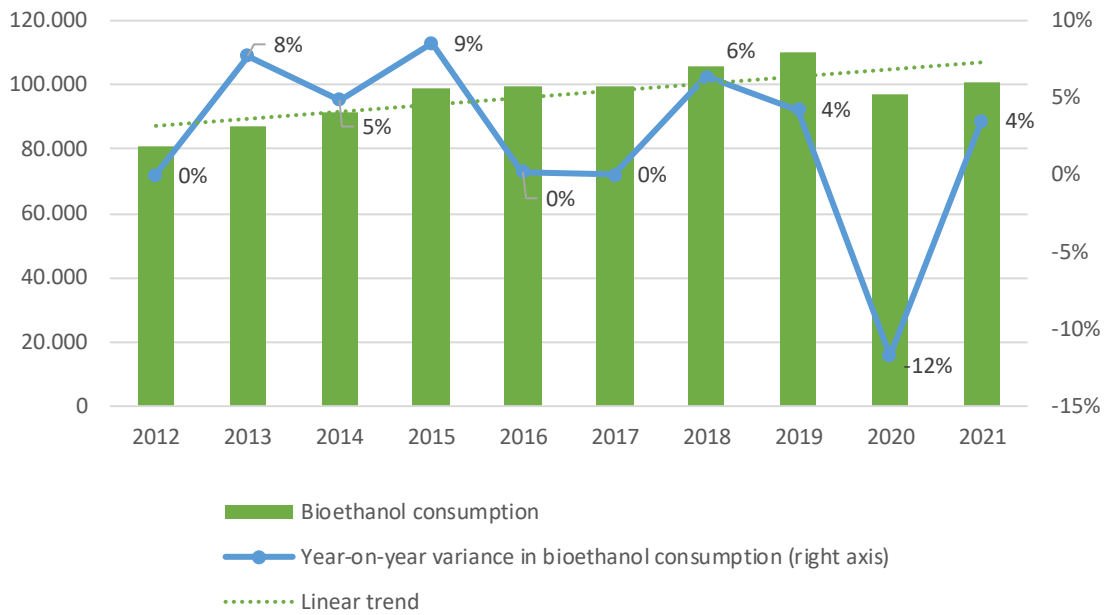
Figure 12. Percentage distribution of global biodiesel consumption in 2021.



Source: Adapted from Torroba (2021a).

Over the last decade (2012-2021), global consumption of bioethanol increased by 24% overall, with a year-over-year variance ranging from -12% to 9%. In 2021, there was a year-over-year variance of 4%, climbing to approximately 101,000,000 m³.

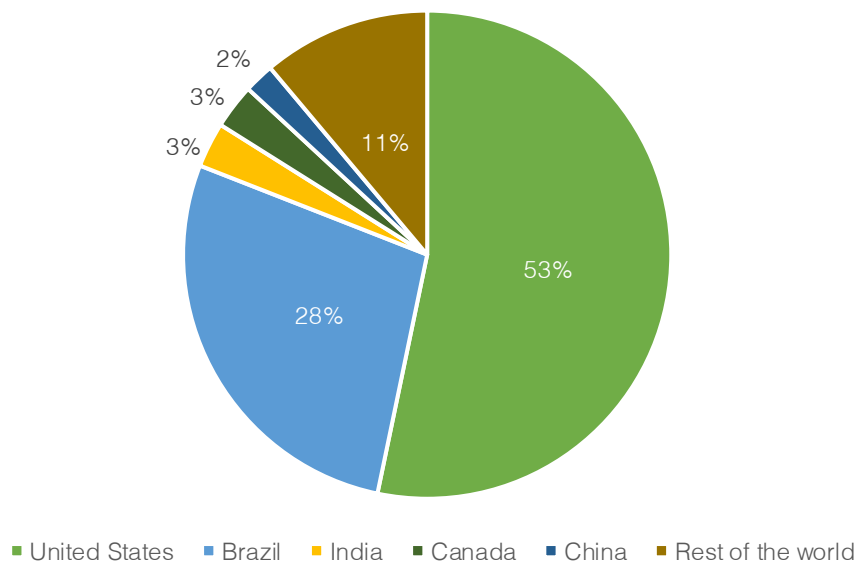
Figure 13. Year-over-year percentage variance, trend and total global bioethanol consumption (in thousands of m³).



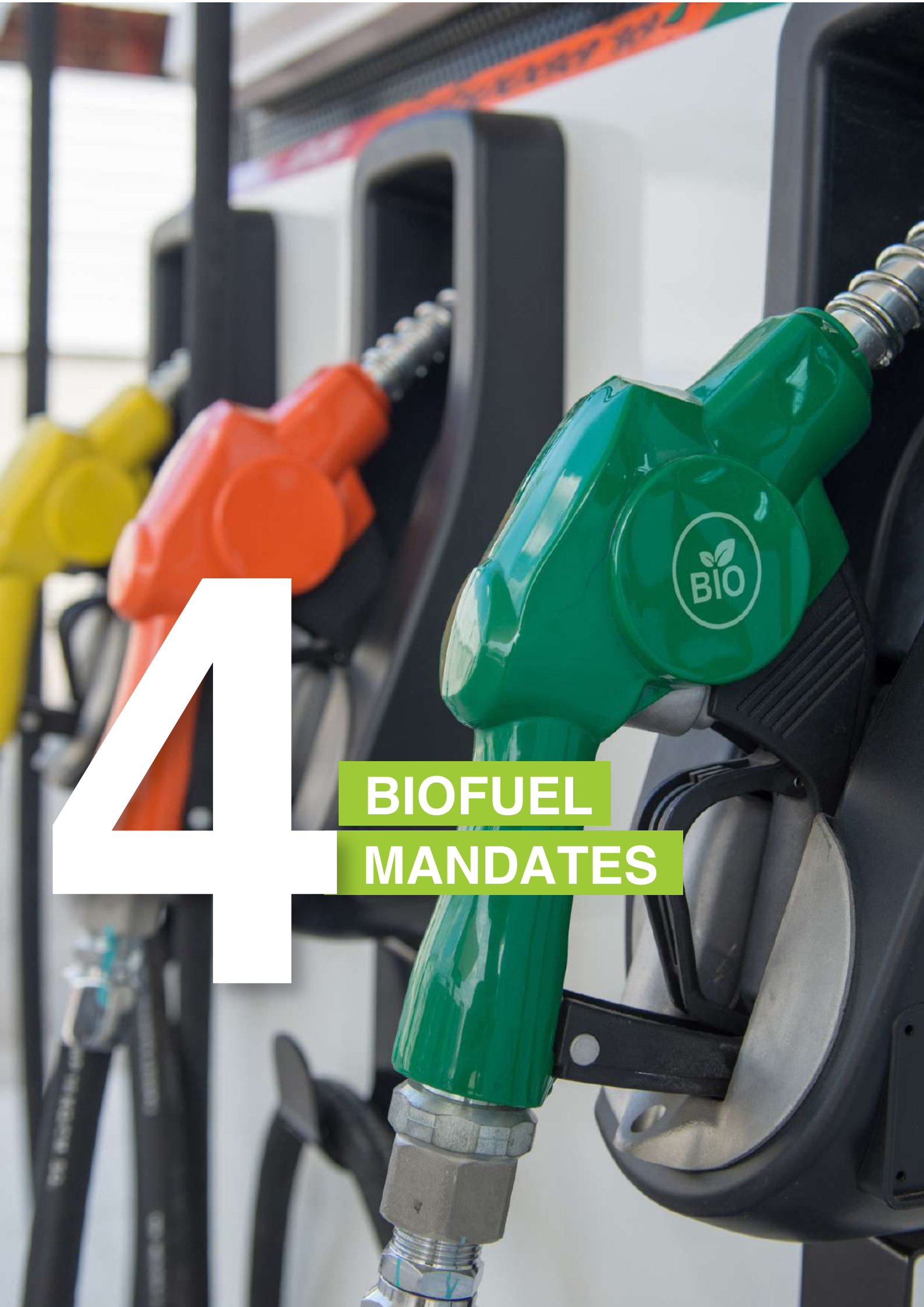
Source: Adapted from Torroba (2021a) and ISO (2022).

Bioethanol consumption is largely concentrated in the United States and Brazil, with 53% and 28% of total consumption, respectively. They are followed by India (3%), Canada (3%) and China (2%). The remaining 11% is distributed among the rest of the countries in the world, with Thailand, Germany, France, the United Kingdom, Japan and Argentina also representing a significant share of the total.

Figure 14. Percentage distribution of global bioethanol consumption in 2021.



Source: Adapted from Torroba (2021a) and ISO (2022).



4

**BIOFUEL
MANDATES**

According to Torroba (2021a), biofuel and fossil fuel blending requirements are instituted through a variety of mechanisms, the most widespread of which is the “required blend mandate” to mix bioethanol with gasoline or biodiesel with diesel fuel. These blends are usually expressed as a percentage by volume (volume/volume blends) or by energy (energy/energy blends).

Biofuel use requirements are also established through overall mandates regarding biofuel/fossil fuel blends. These requirements are met in aggregated form, regardless of which is biofuel used.

An additional mechanism is to establish greenhouse gas (GHG) emission reduction targets, while promoting the use of biofuels to achieve them. The Low Carbon Fuel Standard (LCFS) in the state of California in the U.S. is a noteworthy example of this type of mechanism.

A total of 58 countries have established bioethanol use requirements^{2 3} through one of the three aforementioned mechanisms. Brazil is a frontrunner in terms of required blend mandates with a gasoline-bioethanol blend requirement of 27%. In second place is Paraguay, with a mandate of 25%⁴. Argentina comes in third with 12%, followed by a long list of countries with a 10% requirement, the most common in the world.

On the other hand, Norway, Finland⁵ and the Netherlands have overall mandates of 24.5%, 21% and 17.5%, respectively; however, in practice, these are not always met.

² Excludes countries with ranges starting at 0% and that do not use bioethanol, or countries that, despite having mandates, do not comply with them.

³ Includes countries whose mandates were temporarily suspended in 2021 due to the health and geopolitical situation, but that nevertheless continued to utilize bioethanol.

⁴ The following quality specifications for nafta (gasoline)-bioethanol blends are applied in Paraguay:

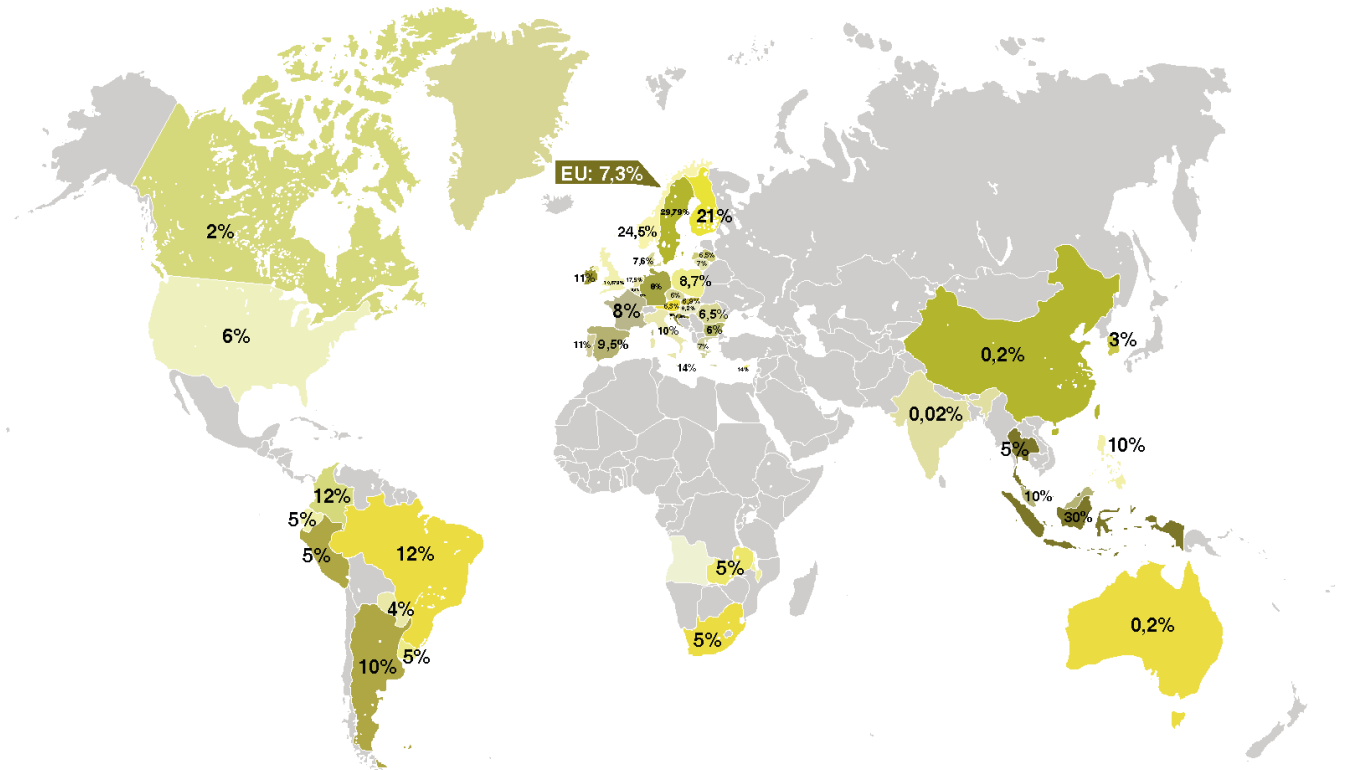
- a) Nafta RON 85, RON 90 and RON 95: 24 to 27% of anhydrous alcohol (pursuant to Resolution No. 385/2018)
- b) Nafta RON 97: 10% of anhydrous alcohol (pursuant to Resolution No. 770/2017)
- c) Nafta E85: 85% of anhydrous alcohol (pursuant to Decree No. 4652/15)
- d) Ethyl alcohol: 100% hydrated alcohol.

⁵ Expressed as an overall percentage of energy content.

Colombia, with a required mandate of 12%⁹. Finally, tied for third are Argentina¹⁰ and Malaysia with 10% mandates.

Countries with biodiesel “overall blend” mandates include Norway (24.5%), Finland (21%¹¹), and the Netherlands (17.5%). Another noteworthy case is Sweden, which has proposed significant GHG emission reduction targets, consequently achieving a renewable diesel (with a high percentage of HVO) penetration rate of 29.79%.

Figure 16. Direct and indirect biodiesel in diesel fuel use mandates¹² in 2021.



Note: Required and overall mandates and average biofuel use in countries with GHG reduction targets. For countries with subnational mandates, the national effective gasoline-bioethanol (v/v) blend is used as a reference. Excludes voluntary blends, mandated ranges starting at 0% and countries with zero bioethanol consumption. See Annex III for more detailed information.

Source: Torroba (2021a), ISO (2022), USDA (2022a), USDA (2022b), REN21 (2022) and Biofuels Digest (2022).

⁹ In Colombia, the mandate was increased to 12% in April of 2021 across most of the country.

¹⁰ In mid-2021, Argentina approved a new biofuel law that reduced the required blend mandate to 5%.

¹¹ Expressed as an overall percentage of energy content.

¹² See Annex III for more information.



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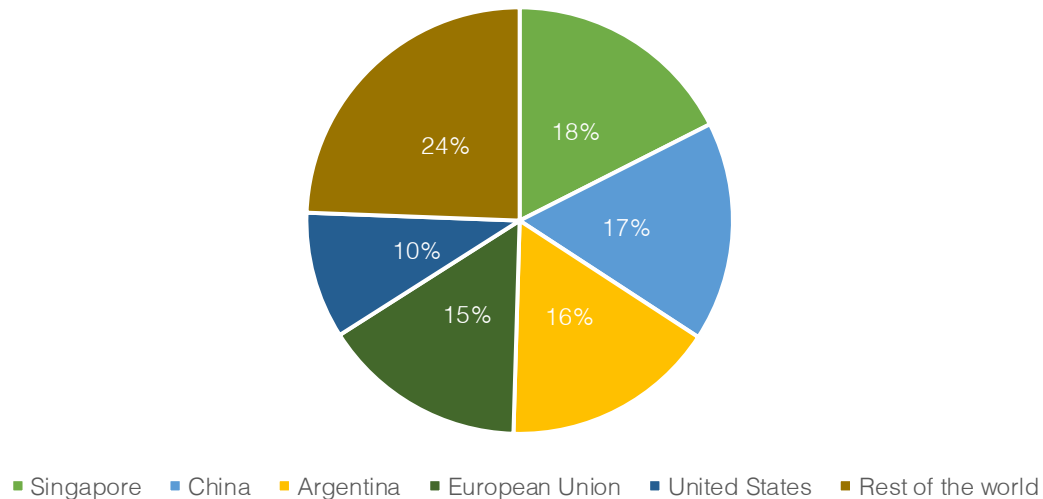
FOREIGN
TRADE



Foreign trade of biodiesel represents 17% of global consumption, with a volume exceeding 8,000,000 m³.

In terms of biodiesel exports, the highest percentage (18%) is concentrated in Singapore, followed by China (17%), Argentina (16%), the European Union (EU) (15%) and the United States (10%). The remaining 24% is distributed among the rest of the countries in the world, with Malaysia, the United Kingdom and Canada also holding a notable share.

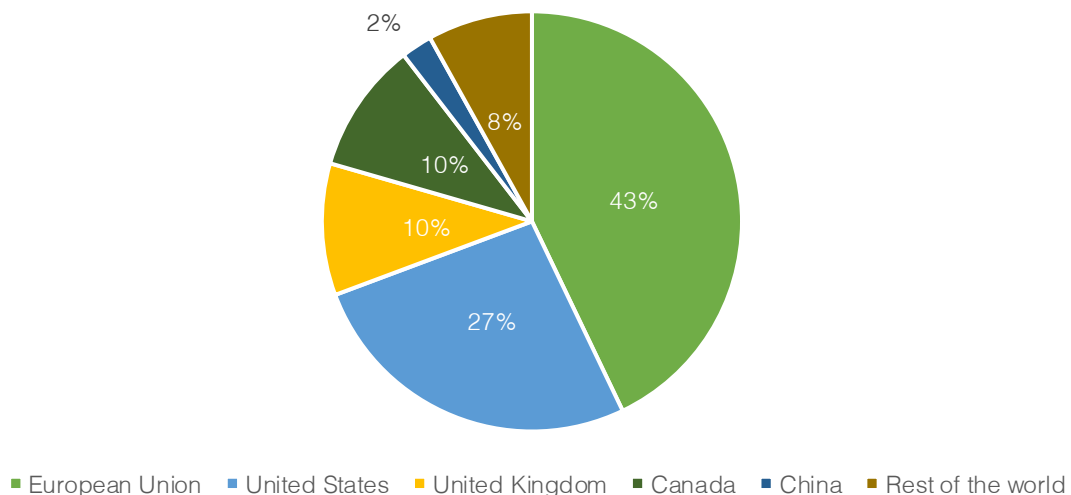
Figure 17. Market share of global biodiesel exports in 2021.



Source: Adapted from Torroba (2021a).

In terms of biodiesel imports, the EU is the top net importer (43%), followed by the United States (27%), the United Kingdom (10%), Canada (10%) and China (2%). The remaining 8% is distributed among the rest of the countries in the world, with Peru, Switzerland, Malaysia and Norway also holding a notable share.

Figure 18. Market share of global biodiesel imports in 2021.

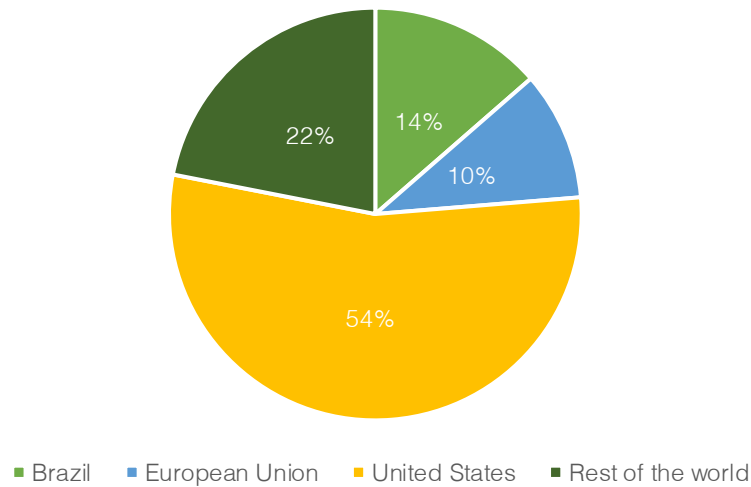


Source: Adapted from Torroba (2021a).

Foreign trade of bioethanol represents 8.6% of global consumption, with a volume of approximately 8,600,000 m³.

In terms of exports, the United States was responsible for 54%, followed by Brazil (14%) and the EU (10%). The remaining 22% is distributed among the rest of the countries in the world, with India, Paraguay and Peru also holding a notable share.

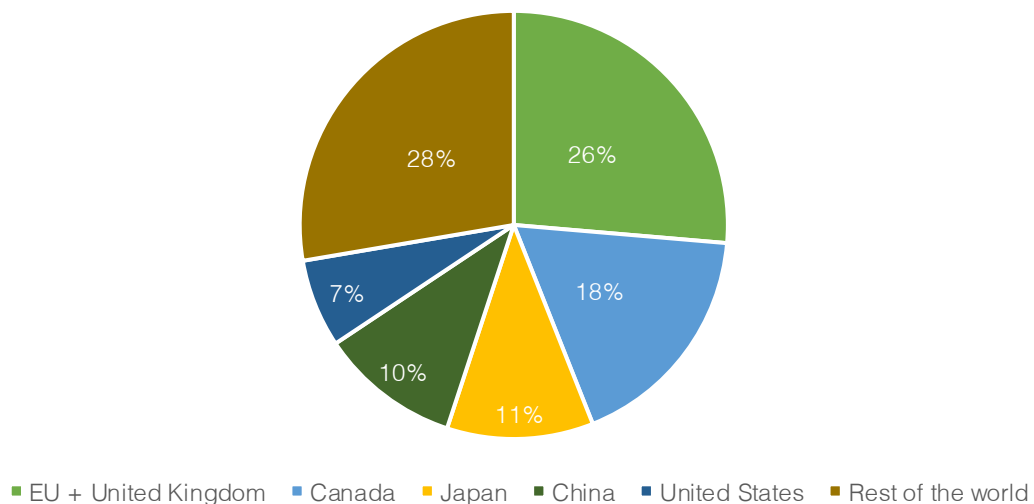
Figure 19. Market share of global bioethanol exports in 2021.



Source: ISO (2022).

With respect to bioethanol imports, the EU and the United Kingdom as a whole represent 26%, followed by Canada (18%), Japan (11%), China (10%) and the United States (7%). The remaining 28% of imports are distributed among the rest of the countries in the world, with India, Brazil, the Philippines and Jamaica also holding a notable share.

Figure 20. Market share of global bioethanol imports in 2021.



Source: ISO (2022).

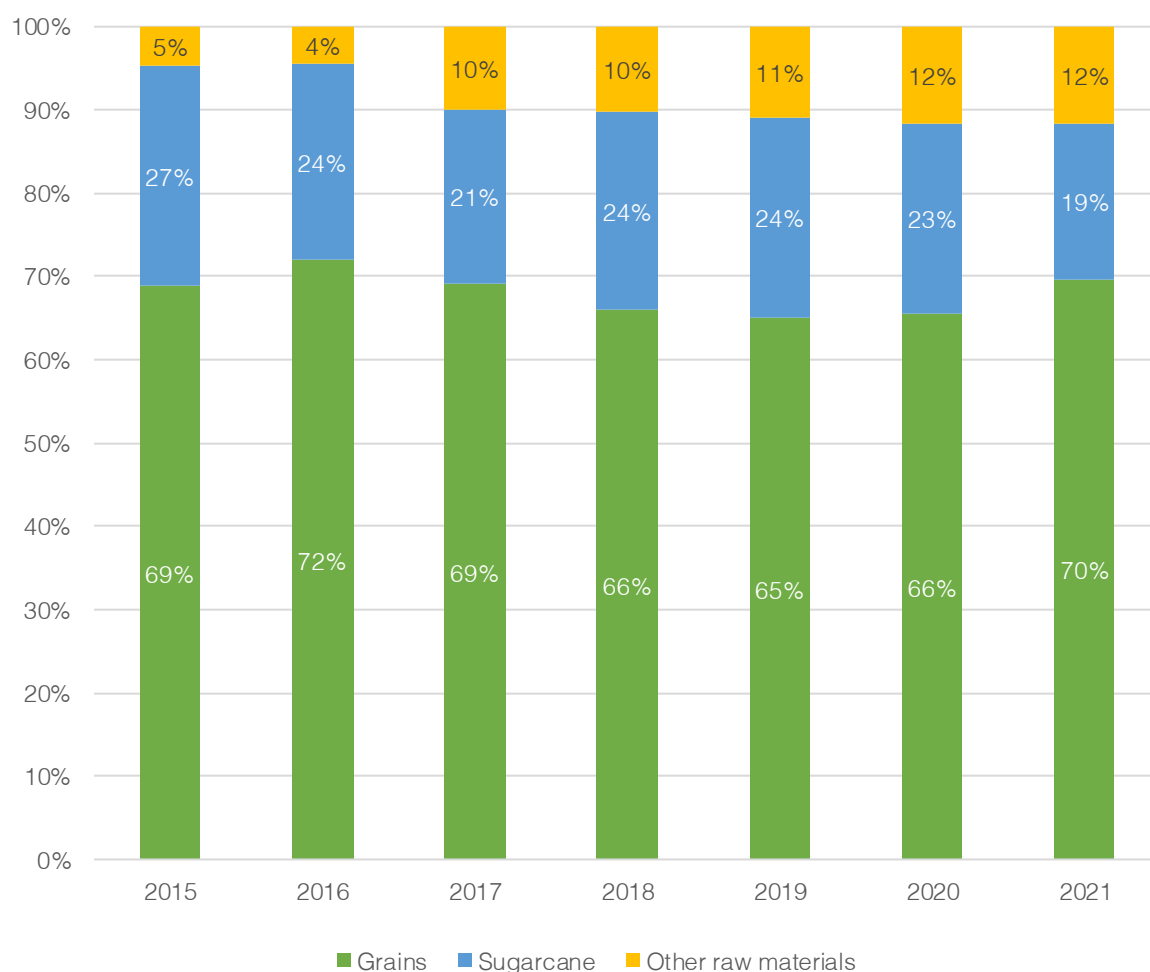


**RAW
MATERIALS**

6

In 2021, corn and sugarcane were the most utilized raw materials for bioethanol production, representing 68% and 19%, respectively. In the case of corn, over 169,058,000 tons were used to produce bioethanol. In the United States, China, Canada, Argentina and several EU nations, corn is used in mass quantities, whereas in Brazil, where sugarcane is the traditional input, the use of corn is just starting to gain ground. In the case of sugarcane, more than 279,000,000 tons were allocated to bioethanol production¹³ in Brazil, Colombia, Paraguay, Argentina and India. The remaining 13% is produced from other raw materials, such as sugar beet, molasses, and cereals such as wheat and cassava, among others.

Figure 21. Bioethanol production by type of raw material used in 2021.



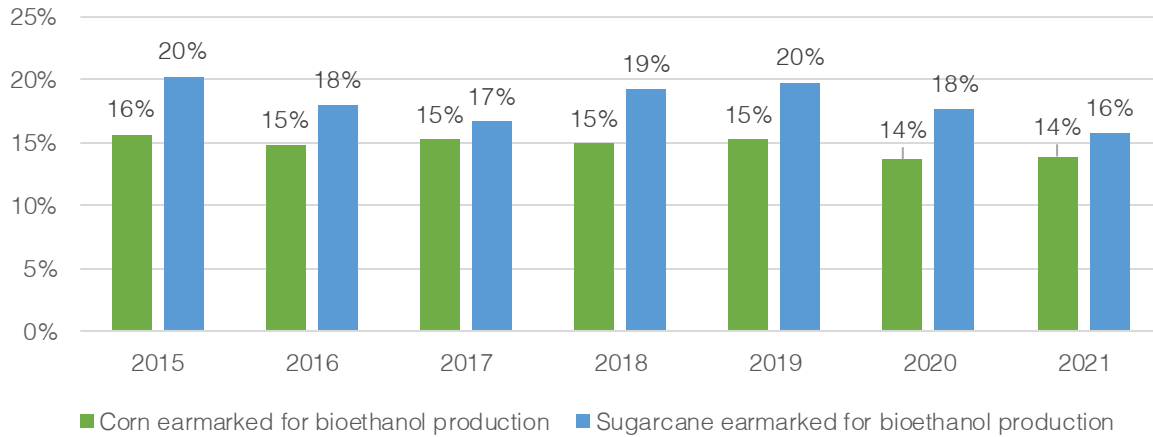
Note: Sugarcane-based bioethanol production excludes molasses, which is included under other raw materials.

Source: Adapted from Torroba (2021a) and ISO (2022).

¹³ In this case, bioethanol is produced through a process of juice extraction. This excludes molasses.

During the 2021-2022 harvest, 14% of harvested corn¹⁴ and 16% of processed sugarcane were earmarked for bioethanol production.

Figure 22. Percentage of global corn and sugarcane production earmarked for bioethanol production.

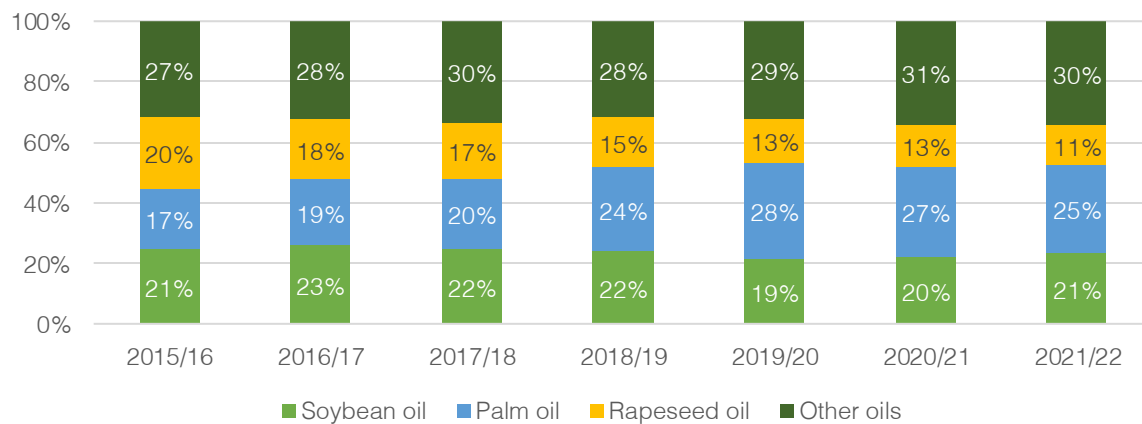


Note: The full amount of corn utilized in the bioethanol production process is attributed to bioethanol, without consideration for the byproducts.

Source: Adapted from Torroba (2021a) and USDA (2022c).

In 2021, the most used raw materials in biodiesel production were vegetable oils, the most notable of which are palm (25%), soybean (21%) and rapeseed (11%). The remaining 30% is attributed to other raw materials, such as recycled vegetable oils, animal fats and other virgin vegetable oils.

Figure 23. Biodiesel production by type of raw material in 2021.



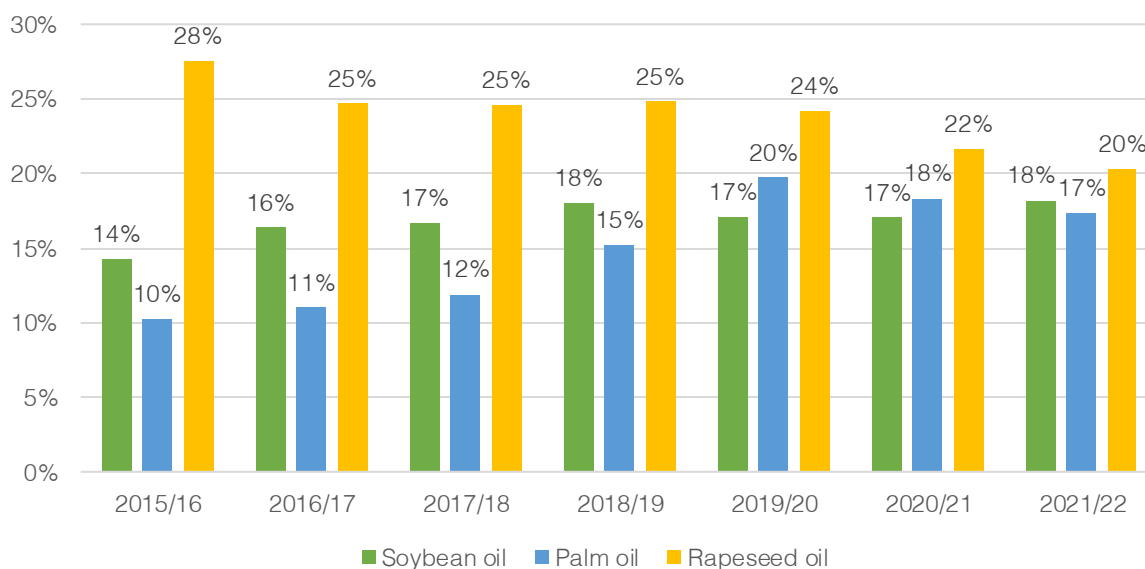
Source: Adapted from Torroba (2021a) and USDA (2022c).

¹⁴ For every 1,000 kg of corn processed to produce bioethanol, the following approximate amounts of byproducts are also obtained: a) 900 kg of wet distillers grains or 320 kg of dry distillers grains, also known globally as DDGS/WDGS8; b) 0.3 tons of vinasse (water included); and c) 300 kg of CO₂. That is why a large part of the corn allocated for bioethanol production produces a multiplicity of food products. In terms of volume, less than half of the corn produced generates bioethanol.

The United States, Argentina, Brazil and Paraguay produce biodiesel mainly from soybean oil. The use of rapeseed oil as an input for production is widespread in the EU, while palm oil is the most used input in Colombia, Indonesia and the rest of Southeast Asia.

In 2021, 20% of global rapeseed oil production, 18% of soybean oil production and 17% of palm oil production were earmarked for biodiesel production.

Figure 24. Percentage of global palm, soybean and rapeseed oil production earmarked for biodiesel production.



Source: Adapted from Torroba (2021a) and USDA (2022c).

Annex I. Biofuel consumption (in thousands of m³).

Year	Biodiesel production	Bioethanol production	Biofuel production
2012	27,083	84,770	111,852
2013	30,623	90,019	120,641
2014	33,927	95,558	129,485
2015	32,020	99,896	131,916
2016	36,920	100,404	137,324
2017	40,764	102,954	143,718
2018	44,617	109,677	154,294
2019	50,751	112,619	163,371
2020	50,128	101,249	151,377
2021	52,628	104,530	157,158

Annex II. Biofuel consumption (in thousands of m³).

Year	Biodiesel consumption	Bioethanol consumption	Biofuel consumption
2012	26,556	80,915	107,471
2013	29,220	87,147	116,367
2014	36,055	91,371	127,426
2015	33,296	99,174	132,470
2016	37,987	99,366	137,353
2017	39,396	99,398	138,794
2018	44,182	105,710	149,892
2019	49,247	110,200	159,447
2020	50,070	97,277	147,347
2021	51,315	100,697	152,013

Annex III. Biodiesel and bioethanol mandates by country, volume by volume (except clarifications) in 2021.

State	Bioethanol mandate	Biodiesel mandate	Observations
Angola	10%	0%	
Argentina	12%	5%	The new bioeconomy law, <i>Ley de Biocombustibles 27640</i> , approved in mid-2021, established a mandatory bioethanol blend rate of 12%, with half of it (6%) to be derived from sugarcane and the remaining 6% from the corn industry. However, if it considers it necessary, the government may reduce the percentage of corn-based ethanol by up to half, to a minimum of 3%. On the other hand, the law establishes a mandatory blend of at least 5% biodiesel with fossil-based diesel, which may be reduced to 3% if price increases of the raw material are distorting the price of fuels.
Australia	1.4%	0.2%	There is no national mandate; however, two states have mandates for both biofuels.
Australia (New South Wales)	6%	5%	There are a number of exceptions and so the effective blend is less. In 2020, the figure was 2.1% for both biofuels.
Australia (Queensland)	4%	0.5%	In 2020, the effective blend was 1.5 % for bioethanol and 0.1 % for biodiesel.
Austria	3.4%	6.3%	Expressed as a percentage of energy content, with an overall target of 5.75% plus 0.5% advanced biofuels and a 6% reduction in fuel greenhouse gas (GHG) emission intensity.
Belgium	6.5%	6.5%	Expressed as a percentage of energy content, with an overall target of 9.55 %. The advanced biofuel target is 0.11%. Double counting permitted up to a maximum of 0.6%.
Bolivia	8%	0%	Although E12 and E8 gasoline blends are sold in Bolivia, there is no ethanol mandate. Various measures have been introduced to promote the production and sale of ethanol fuel. In 2017, the Bolivian government highlighted the benefits of a national ethanol policy, which would spur economic growth, a reduction in the importation of gasoline, a potential 15% blend with gasoline and the reduction of greenhouse gas (GHG) emissions.
Brazil	27%	10%	At the end of 2021, the biodiesel blend mandate was 10%, established as of

			November. The mandate was subject to as many as 5 modifications throughout the year, fluctuating between 10% and 13%.
Bulgaria	9%	6%	Expressed as a percent by volume. There is a 6% biodiesel mandate, which stipulates that 5% must be first-generation biodiesel and 1% advanced biodiesel. There is also a 7% limit on conventional biofuels and a 0.05% advanced biofuels mandate.
Canada	5%	2%	Five provinces have biofuel mandates ranging from 5% to 10% for bioethanol and 2% to 4% for biodiesel.
Canada (Alberta)	5%	2%	
Canada (British Columbia)	5%	4%	
Canada (Manitoba)	9.3%	3.5%	
Canada (Ontario)	10%	4%	
Canada (Saskatchewan)	7.5%	2%	
China	1.9%	0.2%	The national E10 implementation goal has been suspended. In 2019, seven provinces and cities had fully implemented the E10 blend, with partial implementation in five others to varying degrees. Three other provinces launched pilot programs in some cities, but they have been reduced or suspended. In the case of biodiesel, only Shanghai implements a B5 program. The estimated national blend ratio for 2021 is shown.
Colombia	6%	12%	On 31 March 2021, the Colombian government issued an emergency resolution to reduce the ethanol blend mandate from E10 to E4, starting on 1 April 2021 and up to June 2021. After June 2021, the blend mandate was to gradually increase to E10 by the end of 2021. However, the Ministry of Mines and Energy (MME for its acronym in Spanish) has continued to issue new resolutions to reduce the ethanol blend mandate, which has not reverted to E10 since March 2021, having closed the year at E6. On the other hand, a 12% biodiesel mandate was established, starting in April, decreasing to 11% three days before the end of the year.
Costa Rica	8%	5%	The mandate stipulates from 0% to 8% for bioethanol and from 0% to 5% for biodiesel. In 2020, consumption of both biofuels included 0% fossil fuels.

Croatia	1%	7.5%	Expressed as a percentage of energy content. The country has established an overall biofuel percentage of 8.81%, 0.1% advanced biofuels target and a 6% target reduction in fuel GHG emission intensity. Advanced and waste-based biofuels are double counted.
Cyprus	14%	14%	The country has established overall percentages, expressed in energy content. The advanced biofuel target is 0.2% and there is a 6% target reduction in fuel GHG emission intensity.
Czech Republic	4.1%	6%	Expressed as percent by volume. 6% required reduction in GHG emissions. Double counting system of biofuels made from the recycled cooking oils and animal fats classified in Categories 1 and 2, in accordance with Regulation (EC) No. 1069/2009, which are considered low risk in terms of land use change.
Denmark	7.6%	7.6%	Expressed as a percentage of energy content. The country has a 0.9% advanced fuels target, which excludes vegetable oils and animal fats, and a 6% target reduction in fuel GHG emission intensity.
Ecuador	5%	5%	There is no specific ethanol mandate in Ecuador, only a permit to mix with gasoline. The distribution and sale of an ethanol-gasoline blend is based on the supply of anhydrous ethanol, which is produced nationally. In this case, the most popular blend sold is the E5 mix in the gasoline known as Eco-país.
Estonia	10%	10%	These are overall percentages. Is exempt from blending obligations. Utilizes 98 RON gasoline. There is a 0.5% advanced fuel target and a 6% target reduction in fuel GHG emission intensity.
Ethiopia	10%	0%	
European Union	5.9%	7.3%	Final estimated blend for 2021 is shown. The target for 2021 was 13% of the final energy demand of the transport sector, with a 7% limit on conventional biofuels. New targets of up to 2.2% were also proposed for the use of advanced biofuels.
Finland	21%	21%	Utilizes overall percentages of energy content.

France	8.6%	8%	Targets are expressed as percentages of energy content. Double counting is applied for cellulosic and waste-based biofuels, and those produced from the raw materials listed in Annex IX of Directive 2009/28/EC, except for pine oil and pine tar. The advanced biofuels target is 0.7%, with a 10% target reduction in fuel GHG emission intensity.
Germany	5.3%	8%	The country has set a greenhouse gas (GHG) emission reduction target of 6% and a 6.5% limit on the use of conventional fuels, with 0.1% advanced biofuels.
Greece	3.3%	7%	Expressed as a percentage of energy content in the case of bioethanol and as a percent by volume in the case of biodiesel. There is 0.2% advanced biofuels target and 6% target reduction in fuel GHG emission intensity.
Guatemala	5%	0%	The mandate is not met. The government recently announced that it will implement a bioethanol mandate of 10% starting in 2024.
Hungary	6.1%	8.2%	Expressed as a percentage of energy content. Double counting of biofuels from recycled trash, cooking oil or animal fat. 6% target reduction in fuel GHG emission intensity.
India	8.1%	0.02%	The Biofuels Policy sets an E20 target in the Ethanol Blended Petrol Program for 2030. At present, India has established an E10 target that it has been unable to meet thus far, but expects to meet in 2022; the estimated blend in 2021 was 8.1%. In the case of biodiesel, there is a 5% target for 2030; however, the final blend in 2021 was just 0.02%.
Indonesia	0%	30%	With respect to biodiesel, in 2021 the blend percentage increased to 30%. The country has a 5% bioethanol mandate for Public Service Obligation (PSO) transport and a 10% mandate for non-PSO transport, but they have yet to be implemented.
Ireland	12.4%	12.4%	Overall percentages expressed as a percent volume of total fuel used. Double counting of biofuels made from recycled vegetable oil and animal fat. The advanced biofuels target is 0.25%, while the target reduction in fuel GHG emission intensity is 6%.

Italy	10%	10%	Overall percentages expressed in energy content, of which 3.1% (2.5 biomethane + 0.6 other advanced biofuels) is advanced biofuels. Double counting of advanced biofuels. 6% target reduction in fuel GHG emission intensity.
Jamaica	10%	0%	
Japan	1.8%	0%	Japan's only commitment with respect to biofuels for transport, which is in effect until the 2022 fiscal year, is a de facto mandate of 500 million liters of oil equivalent (LOE) for road transport. To meet this objective, Japan utilizes ethyl tertiary-butyl ether (ETBE) derived from bioethanol, which Japanese oil refineries blend with gasoline. Gasoline blended with bio-ETBE is much more common than E3 gasoline and is widely distributed. There are two methods for blending bioethanol with gasoline: "direct blending" and "ETBE". The Japanese oil industry promotes the use of the ETBE method. The final estimated blend for 2021 is shown.
Kenya	10%	0%	The province of Kisumu has implemented an E10 mandate.
Latvia	9.5 and 5%	6.5%	Expressed in volumetric percentages. There is a 9.5% mandate for 95 RON gasoline, and a 5% mandate for 98 RON. In the case of biodiesel, there is a 6.5% mandate, except during winter, when it is increased to 7%. The target fuel GHG emission intensity is 6%.
Lithuania	10%	7%	Expressed in volumetric percentages. 0.5% advanced fuels target and 6% reduction in fuel GHG emission intensity.
Luxembourg	7.7%	7.7%	Overall percentages expressed in energy content. 7.7% before double counting and 9.7% after. 6% target reduction in fuel GHG emission intensity.
Malaysia	10%	10%	The country had planned to extend the biodiesel mandate to achieve a 20% blend in the first quarter of 2020; however, the plan was delayed due to the pandemic. The Government modified the implementation date to mid-2021 but, according to several analysts, this target will not be achieved until 2022.
Malawi	10%	0%	Implementation of the mandate depends on availability.
Malta	10%	10%	These are overall percentages of energy content. The advanced biofuels target is

			0.1%, while the target reduction in fuel GHG emission intensity is 6%.
Mexico	5.8%	0%	Not mandatory.
Mozambique	10%	0%	
Norway	24.5%	24.5%	These are overall percentages of energy content, which is 9% in the case of advanced biofuels. Double counting for advanced biofuels, resulting in an effective blend rate of 12.25-15.5%.
New Zealand	10%	7%	Not mandatory. In the case of biodiesel, it ranges from 5% to 7%.
The Netherlands	17.5%	17.5%	Overall percentages of energy content, which is 1.2% in the case of advanced biofuels. 5% limit on conventional biofuels. Double counting system for biofuel from waste and residues. 6% target reduction in fuel GHG emission intensity.
Paraguay	25%	4%	In the case of biodiesel, Paraguay established a gradual annual increase target of 1% starting in 2020. In 2021, the biodiesel blend percentage was 4%.
Peru	7.8%	5%	
Philippines	10%	2%	
Poland	8.7%	8.7%	Overall percentages of energy content. Double counting system. 0.1% advanced biofuels target and 6% reduction in fuel GHG emission intensity.
Portugal	11%	11%	Overall percentages of energy content. 0.5% advanced biofuels target with double counting. Limit for conventional biofuels set at 3.1%. -10% reduction in fuel GHG emission intensity.
Romania	8%	6.5%	10% overall percentage. Expressed as percentage of energy content. Double counting system. 6% target reduction in fuel GHG emission intensity.
Slovakia	9%	6.9%	Established as minimum blends for both biofuels, with an overall percentage of 8%. Expressed as percentages of energy content. The percentage of second-generation biofuels is 0.3% with double counting. 6% target reduction in fuel GHG emission intensity.
Slovenia	10%	10%	Mandates are expressed as a general percentage of energy content. Double counting is undertaken for biofuels produced from waste, residue, non-food cellulosic material and lignocellulosic material. There is a 7% limit on conventional fuels, with a 6% target reduction in fuel GHG emission intensity.

Spain	9.5%	9.5%	Overall percentages expressed in energy content. Double-counting system. 0.1% target for advanced biofuels.
South Africa	10%	5%	Bioethanol ranges from 2% to 10%.
South Korea	0%	3%	
Sudan	5%	0%	
Sweden	6.3%	29.8%	4.2% minimum required reduction of GHG emissions for gas and 21% for diesel. The final blend for 2021 is shown.
Thailand	10%	10%	There is no mandatory blend for bioethanol, but rather a consumption target of 2.7 billion liters by 2037. Three blend rates are used: E10, E20 and E85. In the case of biodiesel, diesel used in industry and agriculture is excluded from the mandate. For most of 2021, the mandate remained at 10%; however, in October, a government mandate decreased the rate to 5%. In 2021 the estimated bioethanol blend was 12.5% and the biodiesel blend was 7.3%.
Turkey	3%	0%	A mandate of 3% was in place up to 2020. However, it was suspended in 2021 due to the impact of the COVID-19 pandemic on consumption.
Ukraine	7%	0%	The Alternative Fuel Types Act of 2000, amended in 2014, sets targets for the transport sector (mandatory bioethanol blend of 7% as of 2016). These provisions do not currently apply. Ukraine has started to use the Euro-5 fuel standard, which provides for the addition of 5% biofuel. This standard includes a range from 0% to 5%. At present, this fuel is sold almost without bio-additives.
United Kingdom	10.7%	10.7%	Expressed as a percent by volume. Double counting of biofuels made from certain waste, energy crops and renewable fuels of non-biological origin. 6% target reduction in fuel GHG emission intensity.
United States	10%	6%	The figure for the overall national blend is based on individual state blends and E85.
USA (Hawaii)	10%	0%	
USA (Louisiana)	2%	2%	
USA (Massachusetts)	0%	15%	The mandate stipulating a minimum of 15% biodiesel will be applicable, if the Commonwealth of Massachusetts Office of Vehicle Management and other specialized agencies determine that the blend target is appropriate. Agencies may request exemptions in certain cases, such as when the alternative fuel cannot be

			sourced within an appropriate distance, when the price is prohibitive, etc.
USA (Minnesota)	10%	20%	The biodiesel mandate ranges from 5% to 20%, depending on the season of the year.
USA (Missouri)	10%	0%	
USA (Montana)	10%	0%	
United States (New Mexico)	0%	5%	
USA (Oregon)	10%	5%	
USA (Washington)	2%	2%	
Uruguay	5%	5%	Minimum blends.
Vietnam	5%	0%	In keeping with regulations, E5 blends have been marketed in 7 provinces since 2015. A target of E10 was initially planned for 2017, but has not been implemented.
Zambia	10%	5%	
Zimbabwe	10%	0%	Ranges from 5% to 20%, based on local production levels.

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