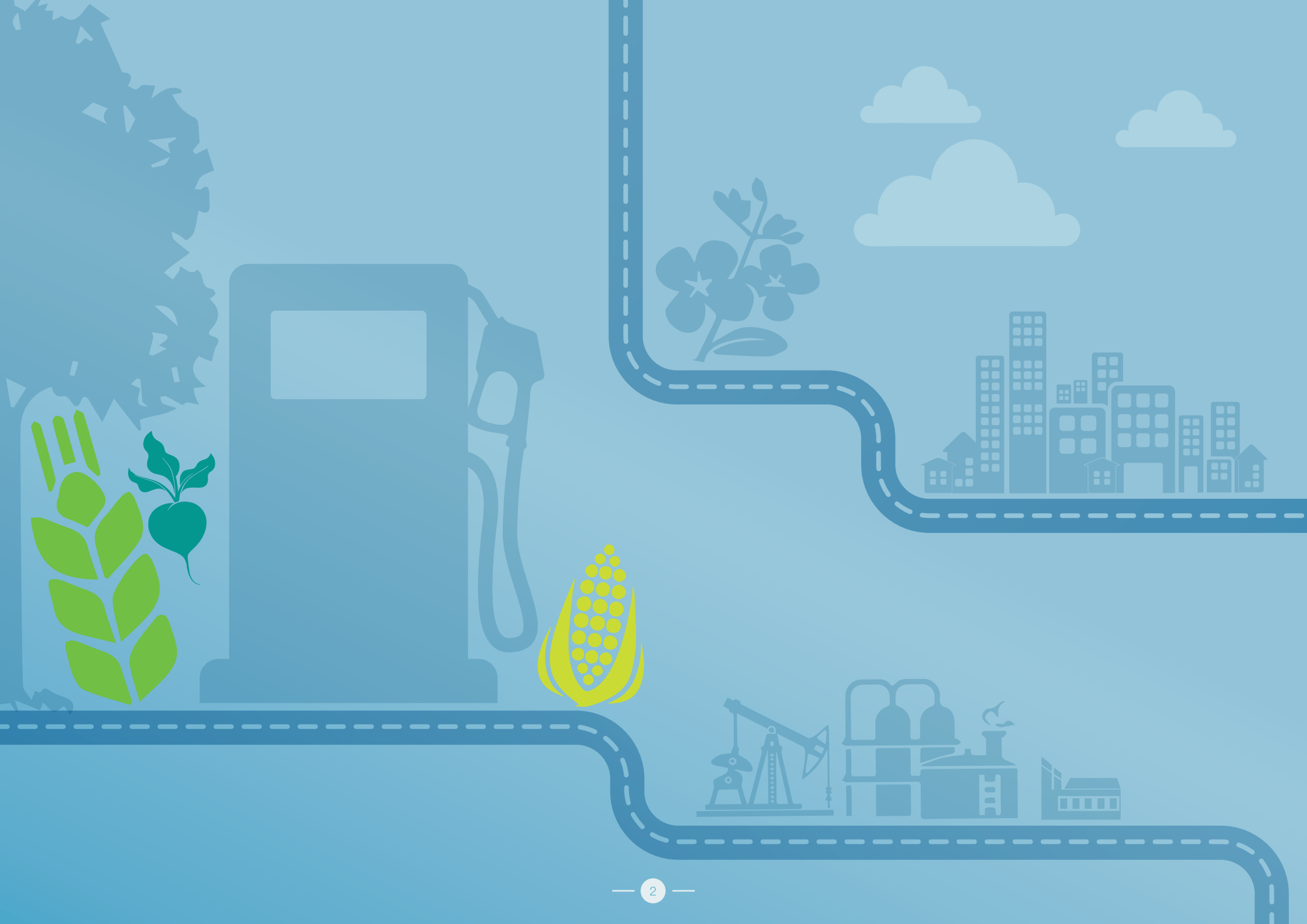






All about
Biofuels








Today's energy landscape is shaped by many major challenges, including the growing importance of climate change and carbon footprint reduction, tighter regulations to support the energy transition and deep-seated changes in the world's energy supply. Tackling these challenges is fully consistent with Total's strategy and our ambition to become the responsible energy major.

“ Even though conventional fuels make up a significant part of the energy mix for transportation and will continue to do so in the medium term, alternatives will clearly play a growing role for new vehicles arriving in the market. Around the world and at numerous Total affiliates, alternative energies such as biofuels, hydrogen, Liquefied Natural Gas (LNG), Compressed Natural Gas (CNG) and electric mobility are being tested and promoted. Accordingly, it is important for us to provide a comprehensive, easy-to-understand and practical look at these energies and markets of the future. ”



“All about Biofuels” is designed to give you the information you need to better understand and explain the biofuels industry and its challenges in the future.

Happy reading!



Research Marketing Strategy
Product Marketing
TOTAL Marketing & Services

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ESSENTIALS

What is a biofuel?

Biofuels are produced from renewable **biobased materials**, primarily plants.

There are different types of biofuel:

		Biosourced feedstock*
GASOLINE	Ethanol	Sugar plants
	ETBE (Ethyl Tert-Butyl Ether)	
	Renewable Naphtha	Oilseed crops Waste**
DIESEL FUEL	FAME (Fatty Acid Methyl Ester)	Oilseed crops Waste**
	HVO (Hydrotreated Vegetable Oil)	

Did You Know?

Biobased feedstocks are usually oxygenated. Which means that they contain oxygen atoms. This oxygens atoms are found in Ethanol, Ethyl Tert-Butyl Ether (ETBE) and Fatty Acid Methyl Esters (FAME). As a result, the incorporation is limited in terms of engine compatibility. Hydrotreated Vegetable Oil (HVO) and renewable Naphtha, on the other hand, are obtained through a hydrogenation process that yields non-oxygenated biofuels. This makes these products, known as drop-in biofuels, easier to use.

*Fossil-based fuels, unlike biofuels, are made essentially from fossilized organic matter that has been extracted from subsurface deposits.

**Waste can be residual, used oils or animal fats.



Note

The word “biofuel” can be used for both **the molecules derived from biosourced feedstock and the finished product at the pump** (blend of biobased molecules with conventional fuel). In this brochure, the word “biofuel” refers exclusively to the biobased molecules.

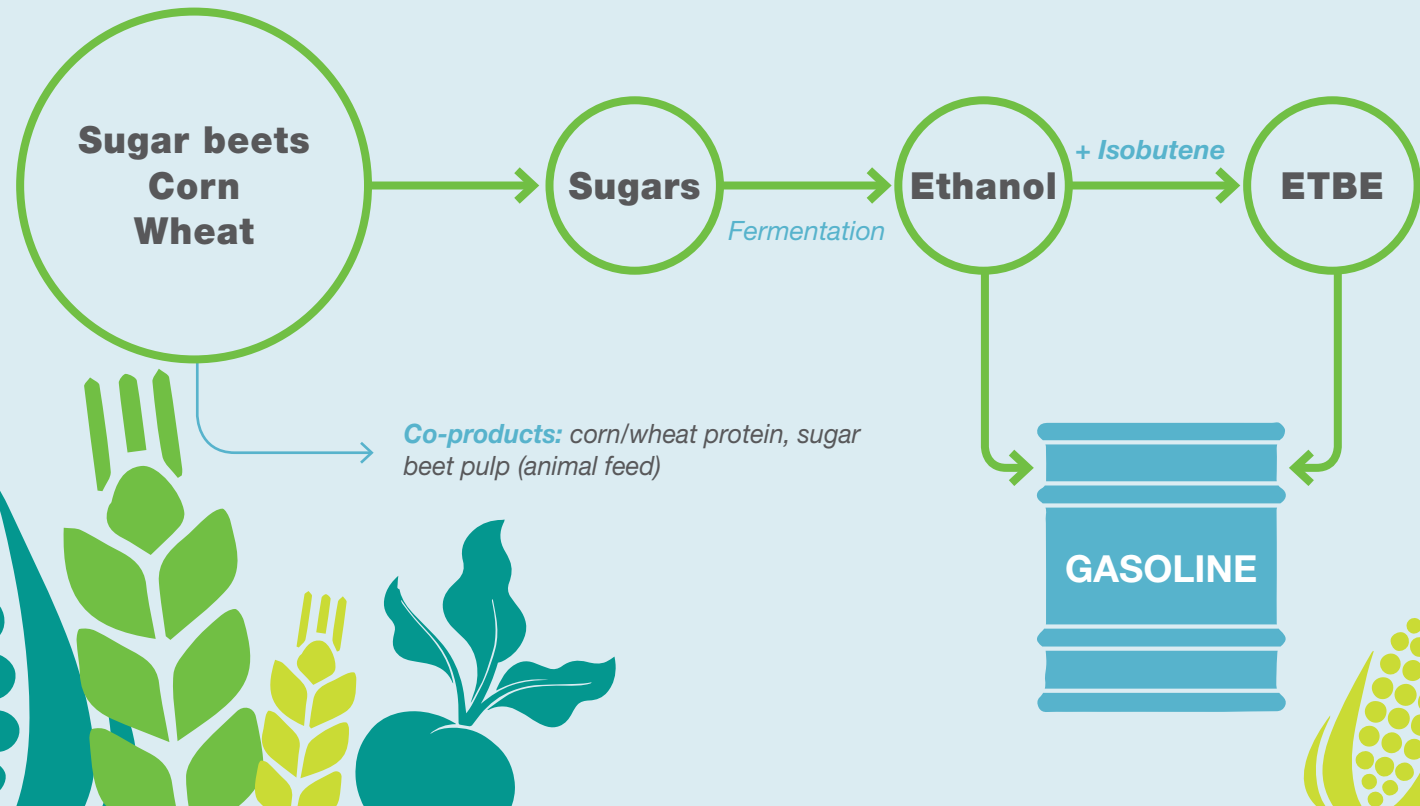


ESSENTIALS

How are biofuels produced?

Traditionally, **there have been two main sectors** for biofuel:

1. GASOLINE SECTOR

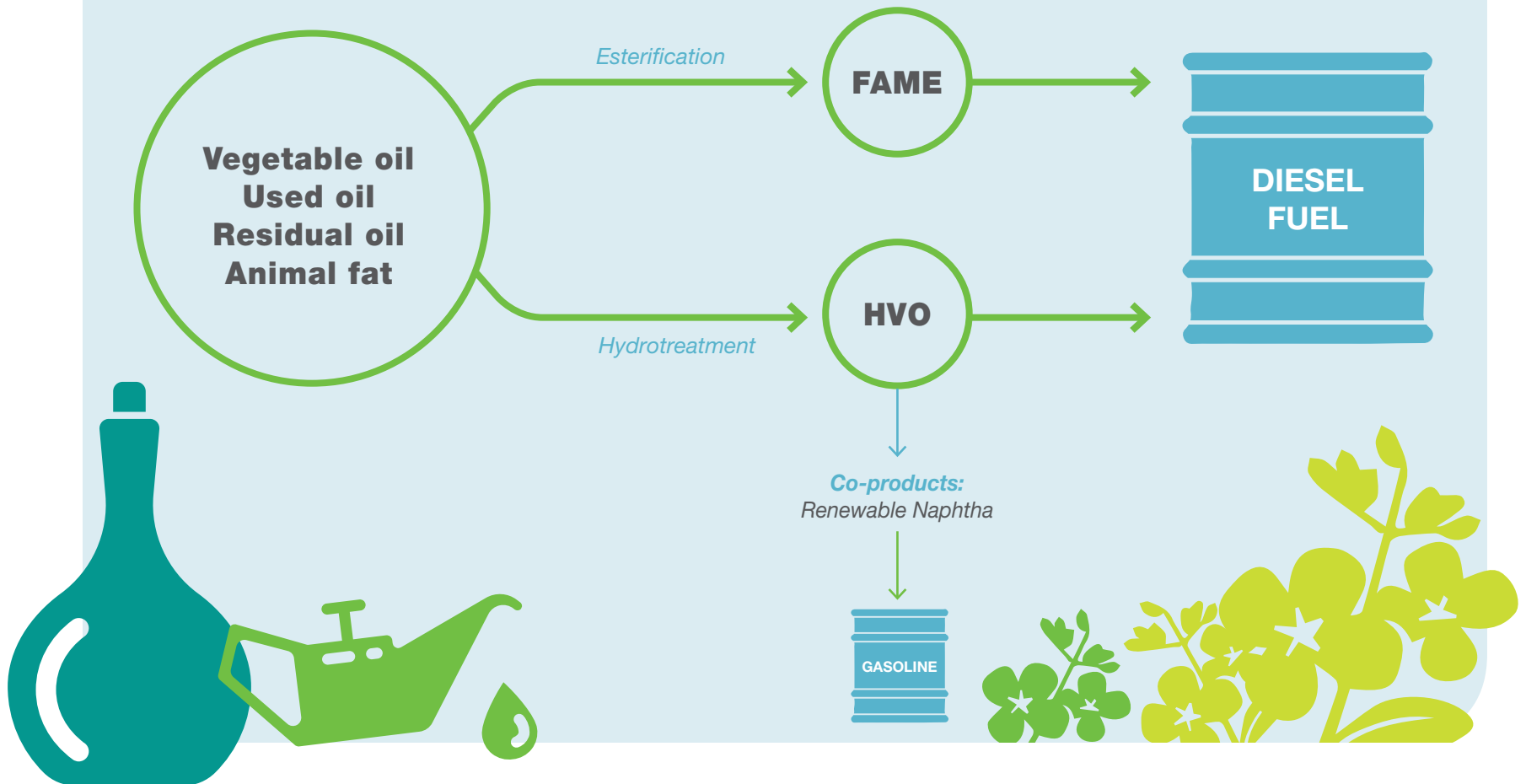




1

ESSENTIALS

2. DIESEL FUEL SECTOR





ESSENTIALS

Why use biofuels?

Today, production costs are higher for biofuels than for conventional fuels. Their use is primarily encouraged through regulations that can have **different objectives depending on the country.**

Objectives vary depending on the country: energy independence, support for agriculture, land use policy or tackling climate change.



Did you know?

In addition, biofuels help reduce greenhouse gas emissions from transportation. They also have attractive technical properties. Ethanol, for example, has a very good octane rating and FAME has very good lubricity properties. More details on page 19.





ESSENTIALS

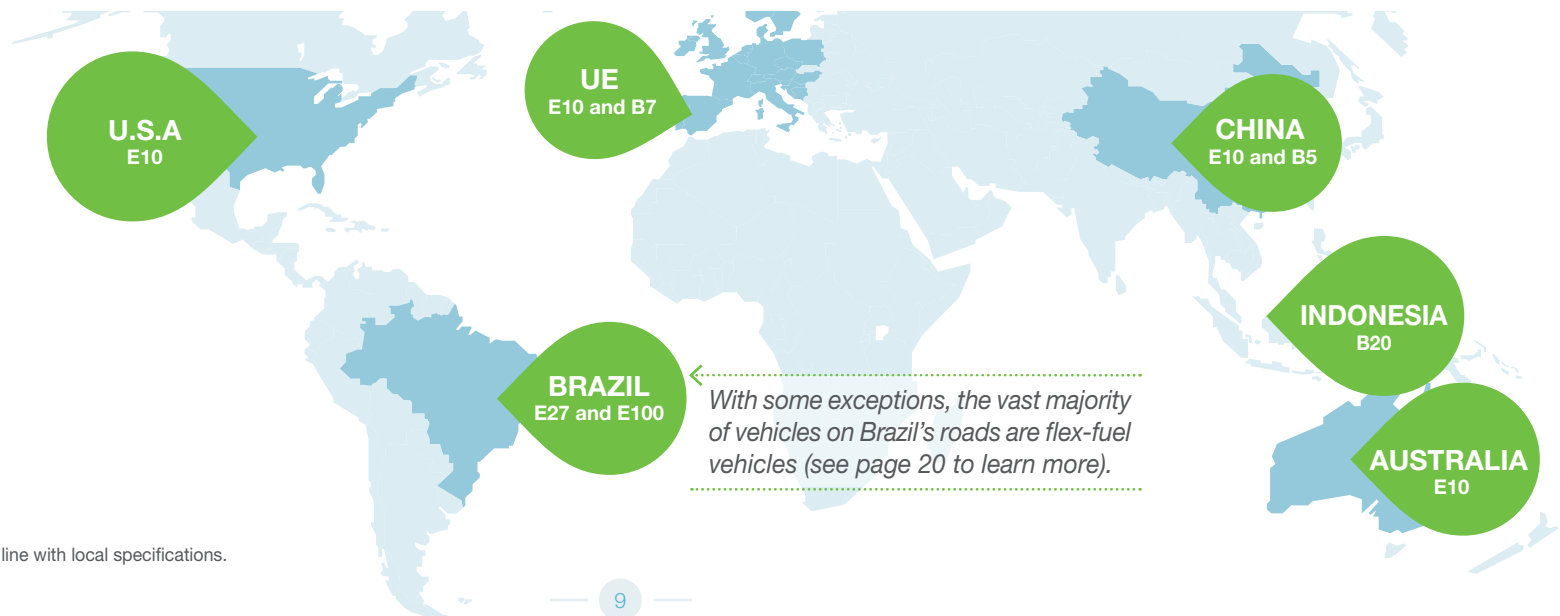
Products with biofuels

Biofuels are mainly found in countries where regulations encourage their use. The percentage of biofuel in a product depends on regulations and fuel specifications. The following nomenclature specifies the percentage of biofuel in a blend:

- > E + % maximum volume of ethanol (pure ethanol or ETBE). For example, E10 would correspond to a maximum ethanol volume of 10%.
- > B + % maximum volume of FAME. For example, B7 would correspond to a maximum FAME volume of 7%.

These denominations reflect the properties required for a fuel in order to be compatible with vehicle engines. Because HVO and renewable Naphtha are non-oxygenated biofuels, they do not have any compatibility issues. Therefore, there is no specific denomination for these drop-in fuels.

Examples of biofuel grades in selected countries and regions



In line with local specifications.

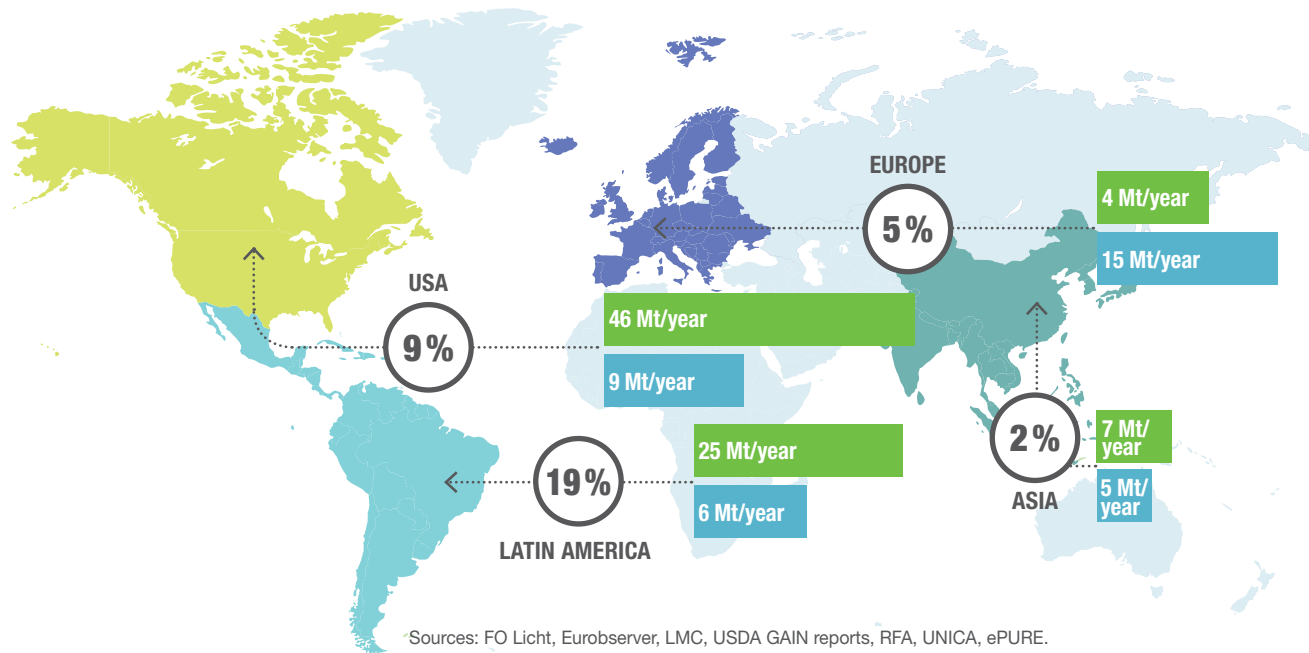


ESSENTIALS

The biofuels in the world

Worldwide biofuels represents 4.3% of total road fuel consumption.

Biofuels are used in the countries where they are produced, with some exports.



BIOGASOLINE

An **American** market.
Growing demand in the United States and Brazil

GLOBAL DEMAND :

UP 9% / YEAR
Between 2015 and 2018

FAME & HVO

An **European** market.
Growth in HVO in Europe

GLOBAL DEMAND :

UP 35% / YEAR
Between 2015 and 2018

WORLDWIDE

4,3%

= 1.8 Mboe/d in 2018
(82 Mt/year of ethanol fuel and
38 Mt/year of FAME and HVO)

■ Biogasoline consumption, 2018 ■ FAME and HVO consumption, 2018 ○ share of road fuel in 2018

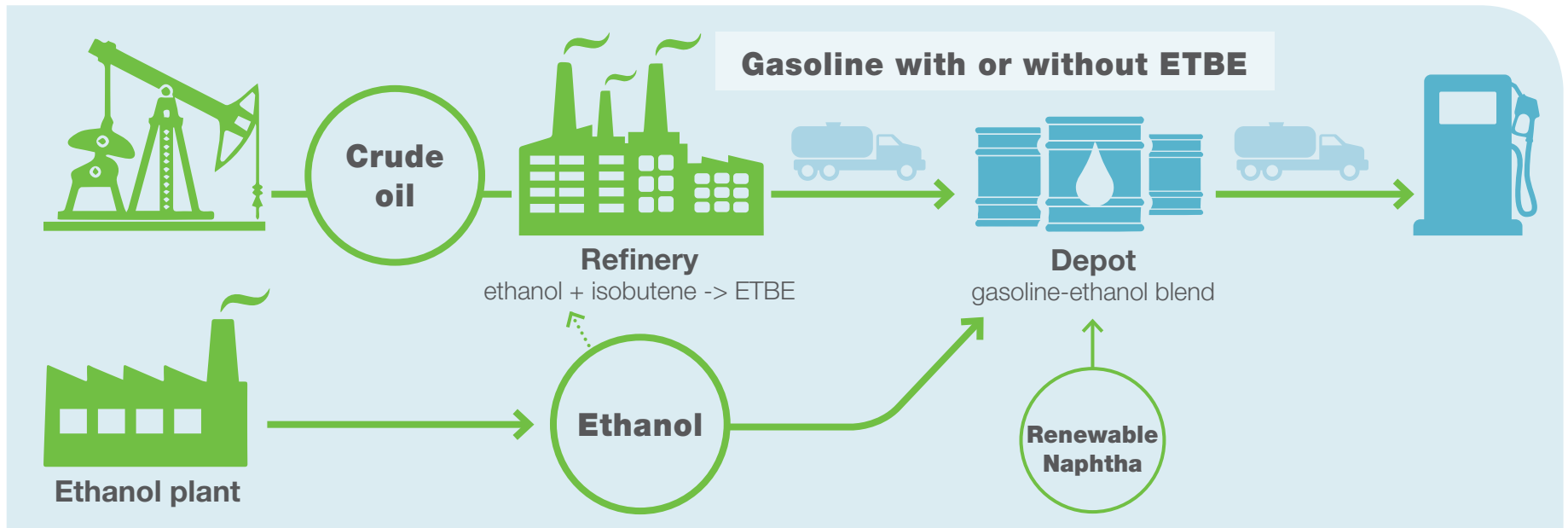


2

IN PRACTICE

Blending Ethanol/ETBE/Renewable Naphtha into gasoline

The physical and chemical properties of biofuels are different from those of conventional fuels. For this reason, blending must be done under **special conditions**.



The blending gasoline and biofuel: a mix under conditions

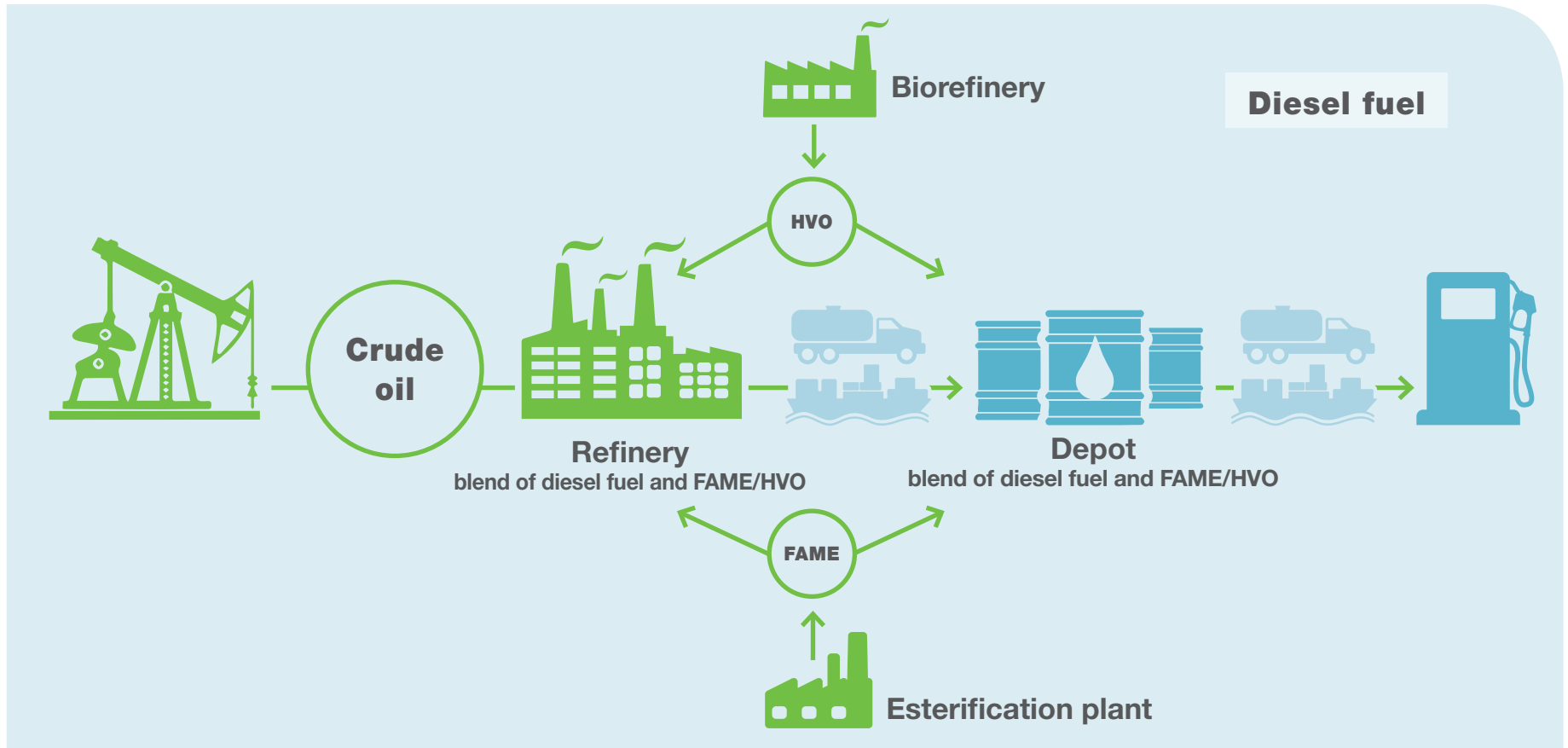
To obtain a gasoline-ethanol blend that complies with local specifications, the gasoline must have the right properties in terms of vapor pressure, oxygen content, distillation characteristics, octane rating, etc.



2

IN PRACTICE

Blending FAME/HVO into diesel fuel



The blending diesel fuel and biofuel: a mix under conditions

To comply with local specifications, blends of diesel fuel with FAME and/or HVO must respect two essential requirements.



1

The FAME must have very specific characteristics in order to meet the specifications of the final fuel. Adding antioxidants is recommended to ensure the stability of the esterification.

2

HVO can be easily blended into diesel fuel without exceeding the maximum density value under the current specification.



IN PRACTICE

Safety measures, from storage to distribution

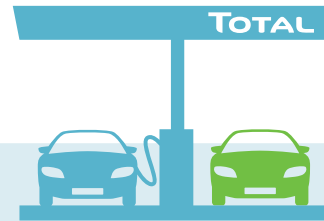


In depots

Operators must wear appropriate personal protective equipment when handling biofuels, just as they do with petroleum products.

Specific recommendations for oxygenated biofuels:

- Ethanol - Storage tanks must be clean and any sediment or water must be removed before use to avoid contamination and prevent corrosion.
- FAME: In order to limit oxidation, storage should not exceed six months.



In service stations

Depending on the percentage of oxygenated product (ethanol, ETBE or FAME) in the mixture, the conventional fuel-biofuel blend may cause some damage to service station equipment such as pipes, seals and elastomers.

All materials used must be compatible.



During transportation

Operators should always wear appropriate personal protective equipment when handling biofuels.

To preserve the quality of blend containing oxygenated products (ethanol, ETBE or FAME), it is crucial to avoid contamination with water, residues or rust.

In particular, it is important to make sure that equipment is clean, that there are no leftover deposits, that pipes are dry and treated with a corrosion inhibitor...



IN PRACTICE

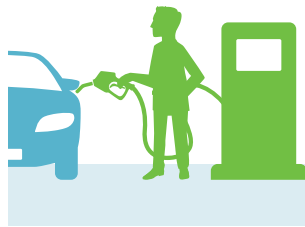
Safety measures for customers

The conventional fuel-oxygenated biofuel blends sold in service stations are compatible with most vehicles on the road. However, there may be a few exceptions, such as oldest automobiles.



Not sure if the fuel is compatible with your engine?

- Start by checking the **owner's manual**.
- Information is also available from recognized sources such as **the Transportation Ministry*** and automobile manufacturers' associations like **ACEA**** in Europe, which list on their websites the compatibility of the vehicles with the different fuels.



Filling Up

At the pump, follow the same safety measures as for gasoline or diesel fuel, regardless of the biofuel content:

- **Do not smoke** or bring a source of heat near the vehicle.
- **Do not use your cellphone.**

*To consult the list compiled by the French Environment Ministry, go to https://www.legifrance.gouv.fr/jo_pdf.do?numJO=0&dateJO=20121106&numTexte=36&pageDebut=17333&pageFin=17336

**List prepared by the European Automobile Manufacturers' Association (ACEA): https://www.acea.be/uploads/publications/130329_revised_ALL_ACEA_SAAB_JAMA_E10_COMPATIBILITY.pdf and https://www.acea.be/uploads/publications/ACEA_B10_compatibility.pdf

Did you know?

Flex-fuel vehicles are compatible with all types of gasoline (E85, SP95-E10, SP98 and SP95). The fuels are stored in the same common tank. More details on page 20.





IN PRACTICE

Driving a vehicle with a biofuel



Driving

If they are compatible with the vehicle, biofuels have no impact on acceleration, braking or smooth driving. Car care is the same as with conventional fuel.



CO₂ emissions

Biofuels help reduce greenhouse gas emissions.

For example, using B7 diesel fuel reduces CO₂ emissions by at least 3.5%.



Driving range

Biofuels do not necessarily have the same energy content as conventional fuels, and this can impact driving range. High biofuel content can affect consumption: E85, for example, has an overconsumption of 25% compared to a conventional fuel.



Diesel fuel

35 GJ/cu. m



HVO

34 GJ/cu. m



FAME

33 GJ/cu. m



Gasoline

35 GJ/cu. m



Ethanol

21 GJ/cu. m



Cost

Currently, biofuels are more expensive to produce than conventional fuels.

The price paid by the end user depends on numerous factors, including local taxes.



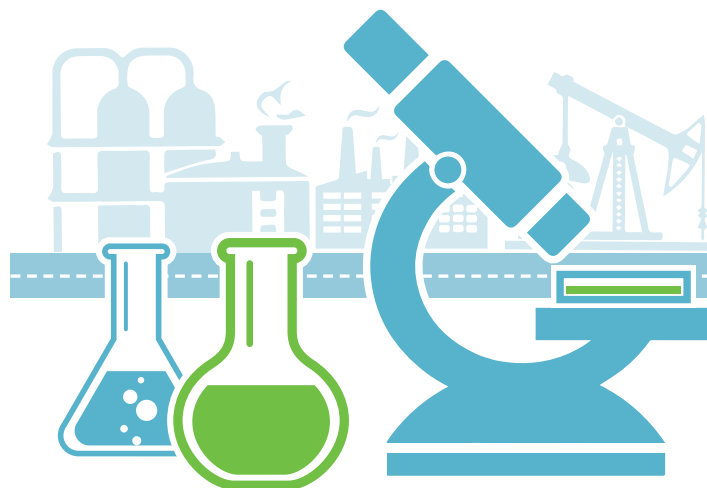
IN PRACTICE

Biofuels, an integral part of Total's strategy

Total integrates the climate into our strategy and has set the ambition of becoming **the responsible energy major**. To achieve this, Total is continuing to expand in renewable energies and is building low-carbon businesses, including biofuels, into a significant proportion of our portfolio.

Transportation are responsible of more than 25% of global CO₂ emissions and remains heavily dependent on fossil fuels.

Biofuels are one identified solution to meeting the challenges of the International Energy Agency's Sustainable Development Scenario, which Total uses as a baseline.



Total is actively participating in various programs to develop solutions to convert all available types of biomass. We are working in our own laboratories and via **R&D partnerships** with manufacturers, start-ups, universities and private laboratories.

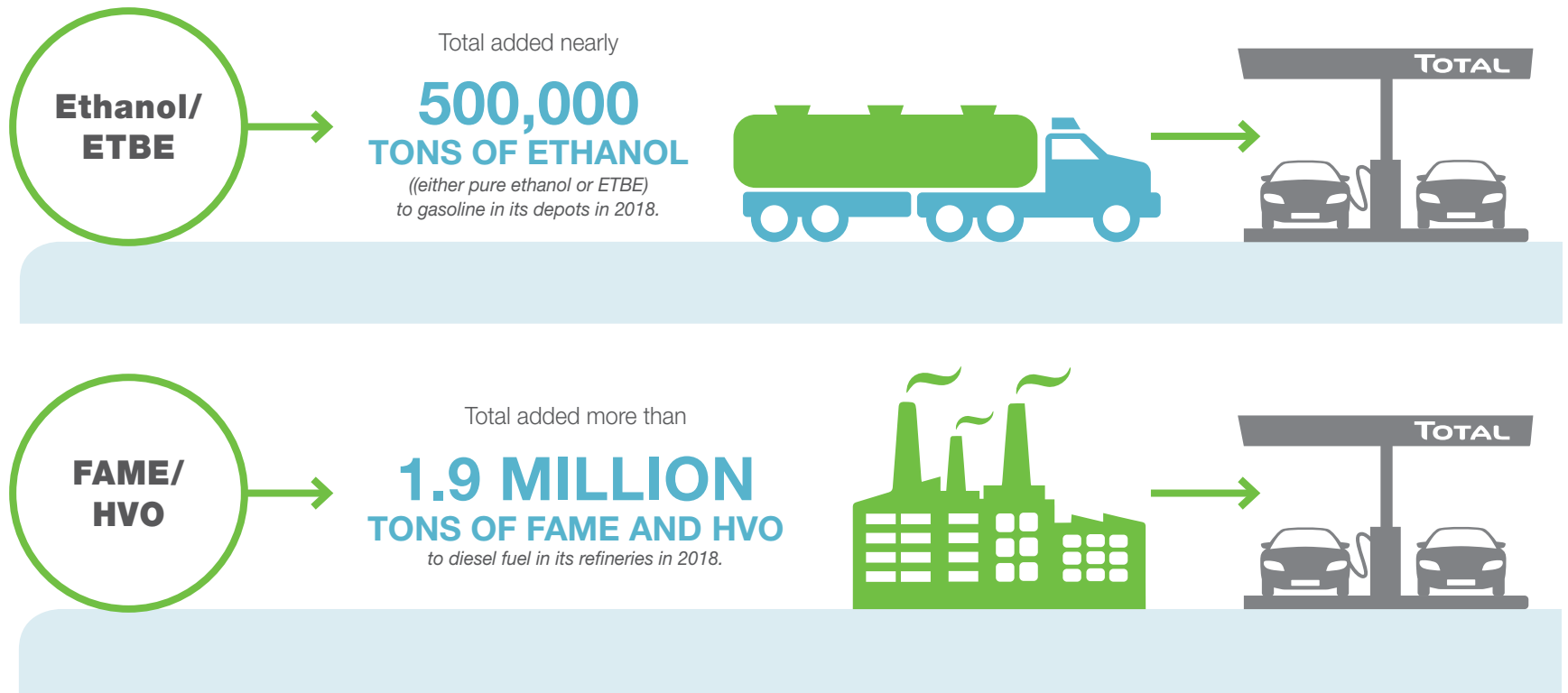


IN PRACTICE

Biofuel blending at Total

Total has been blending biofuels since 1994 and is a major player in this industry.

Blending is generally done in Europe, but depending on national regulations, we can also incorporate biofuels in Asia, America and Africa.





IN PRACTICE

Biofuel production at Total



Total began producing biofuels in the early 1990s, starting with ETBE.

From 2009, Total produces ETBE and HVO in co-processing.

La Mède

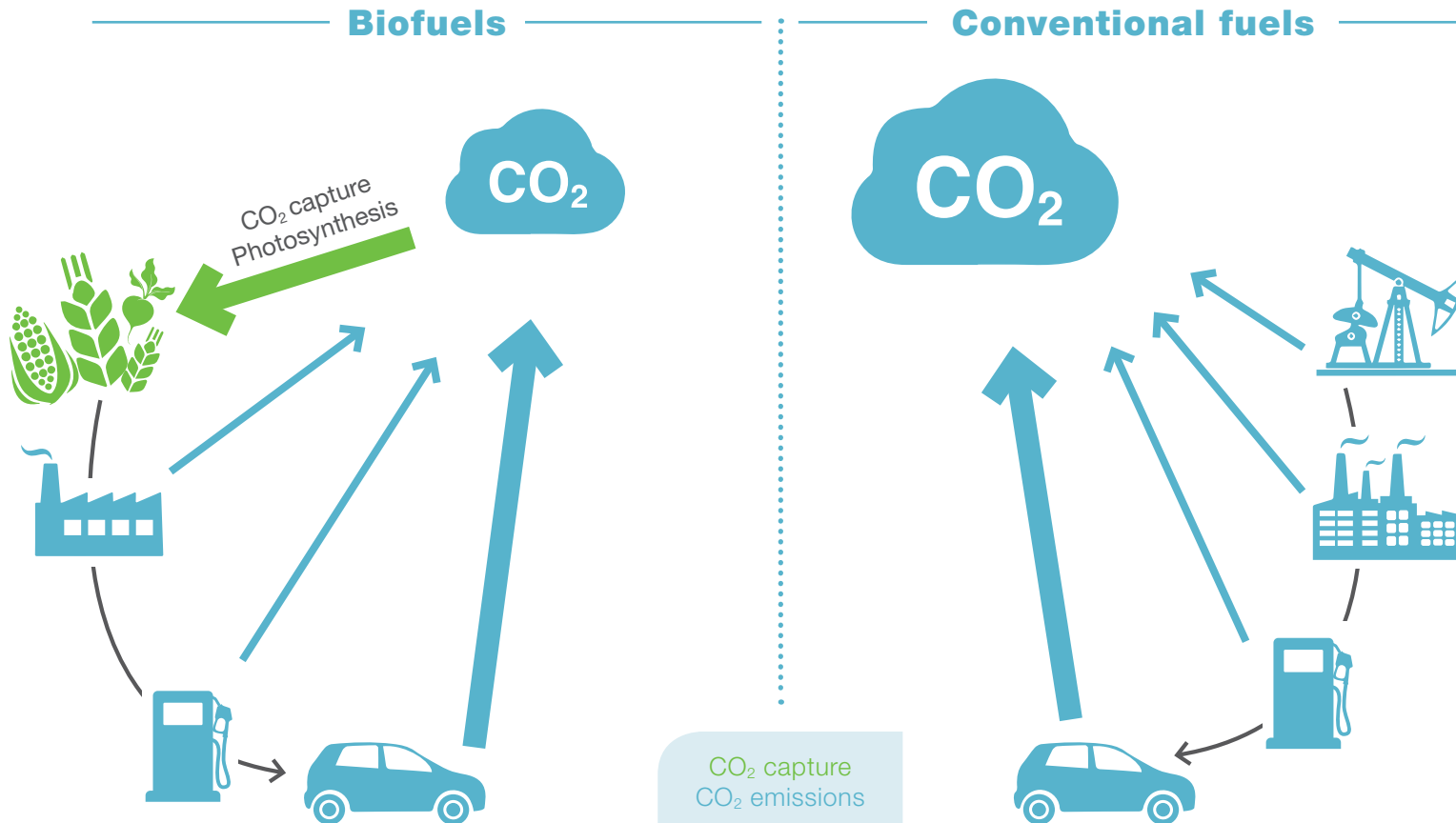
Total is making an initial investment of €275 million **to convert the La Mède facility into a world-class biorefinery**, one of the largest in Europe in order to meet market requirements. Designed to process all types of oils, the biorefinery will have an annual production capacity of 500,000 tons of HVO.



FIND OUT MORE

Impacts on CO₂ emissions

Contrary to conventional fuels, the carbon dioxide emitted during biofuel combustion is offset by the carbon dioxide captured as part of the photosynthesis process in plants.





FIND OUT MORE

Growth drivers for fuels with high biofuel content (such as E85)

Suitable vehicles:

Flex-fuel vehicles can run on all types of gasoline, **with an ethanol content varying from zero to 100%**. Citroën, Ford, Peugeot and Volvo* are among the automakers selling flex-fuel vehicles.

Favorable tax policies:

- **Car registration costs can be waived.**
- **Buyers can avoid the eco-tax** when they purchase a new flex-fuel vehicle.
- **The carbon surtax on car registrations can be reduced** for the purchase of a used flex-fuel vehicle.

Pump prices that offset overconsumption:

- Although biofuel has an overconsumption of 25% compared to conventional fuel, it costs less at the pump (average price of €0.68 per liter versus €1.54 per liter for E95 and €1.50 per liter for diesel fuel**).



Did you know?

Consumers interested in using superethanol E85 have two options: they can acquire a flex-fuel vehicle, or they can modify conventional vehicles compatible with SP95-E10. To do that, they can purchase an approved electronic control unit and have it installed by an accredited mechanic. The unit, which costs approximately €500, will quickly pay for itself with the cost savings from using E85.

*As of March 2019. **Source: www.prix-carburants.gouv.fr, September 2018 (French only).



FIND OUT MORE

HVO, the biofuel that can be blended into diesel fuel in any amount

A Non-Oxygenated Biofuel

Hydrotreated Vegetable Oil (HVO) is composed mainly by paraffins, the same molecules founded in conventional diesel fuel. For this reason, a regular internal combustion engine can use HVO pure or blended into diesel fuel. Total sells TOTAL HVO100, EN15940-compliant in a commitment to provide a fully renewable alternative to diesel fuel that is compatible with existing customer logistics.

HVO's Strengths

- No changes needed compared with conventional diesel fuel: same vehicles, same fuel delivery and same maintenance.
- Better cold start operability and storage stability than conventional diesel fuel.
- Very significant reduction of at least 50% in CO₂ emissions across the product life cycle.
- Reduction in local polluting emissions such as particulates and NOx.



Did you know?

We offer TOTAL HVO100 in France for our business customers' captive fleets only, since its sale at service stations is prohibited under French law.



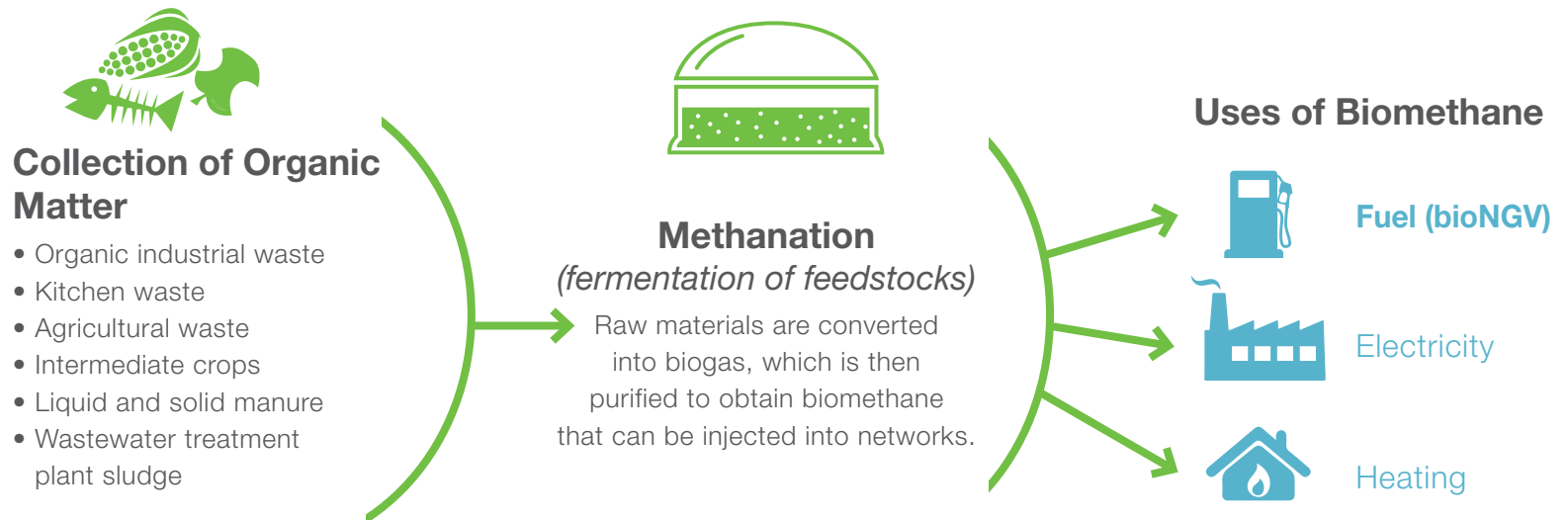
FIND OUT MORE

BioNGV

The Gas produced by the fermentation of organic, animal or vegetal matter without oxygen is known as biogas. Its main components are methane and carbon dioxide, but it also contains other gases, such as nitrogen and hydrogen sulfide, that are considered impurities.

Before it can be injected into the underground gas network, the biogas has to be purified (all the other gases must be removed). The end product is known as biomethane.

Biomethane can be used for the same applications as natural gas. When used as a fuel, it's known as BioNGV (Natural Gas for Vehicle).



Composition

- BioNGV, like Natural Gas for Vehicle, are composed by methane and meets the same specifications.



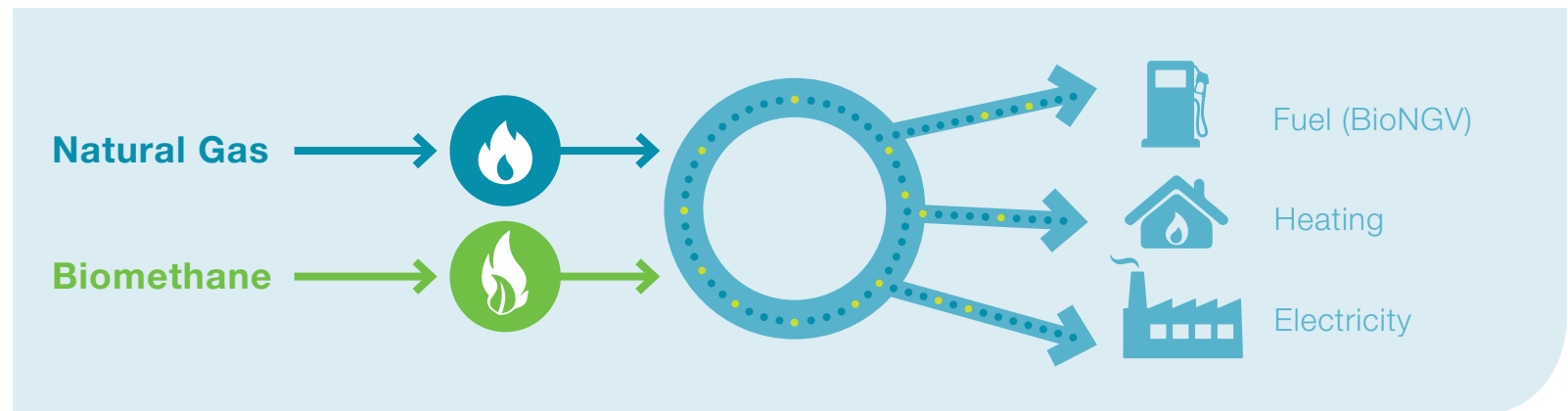
FIND OUT MORE

The benefits for combating greenhouse gases

- BioNGV is produced from organic, renewable resources. As a result, it helps to reduce vehicle CO₂ emissions.
- Blending at least 15% BioNGV into NGV reduces CO₂ emissions compared to fossil fuel-based diesel regardless of the vehicle's purpose, whether it's an urban waste collection vehicle or a long-haul truck.

Guarantees of origin

- Biomethane can be injected into the natural gas network, creating a single physical product (a blend of natural gas and biomethane). Guarantees of origin are used to certify the injection of biomethane into the natural gas grid, so consumers have an assurance of using ecofriendly natural gas.
- One guarantee of origin corresponds to one MWh of biomethane injected into the grid by a producer.
- France's national Guarantees of Origin Registry, which is operated by GRDF under authority granted until 2023, ensures that all biomethane and related transactions can be traced.



[total.com](https://www.total.com)



Total is a major energy player committed to supplying affordable energy to a growing population, addressing climate change and meeting new customer expectations.

Those commitments guide what we do. With operations in more than 130 countries, we are a global integrated energy producer and provider, a leading international oil and gas company, and a major player in low-carbon energies. We explore for, produce, transform, market and distribute energy in a variety of forms, to serve the end customer.

Our 98,000 employees are committed to better energy that is safer, cleaner, more efficient, more innovative and accessible to as many people as possible. As a responsible corporate citizen, we focus on ensuring that our operations worldwide consistently deliver economic, social and environmental benefits.

Our ambition is to become the responsible energy major.



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