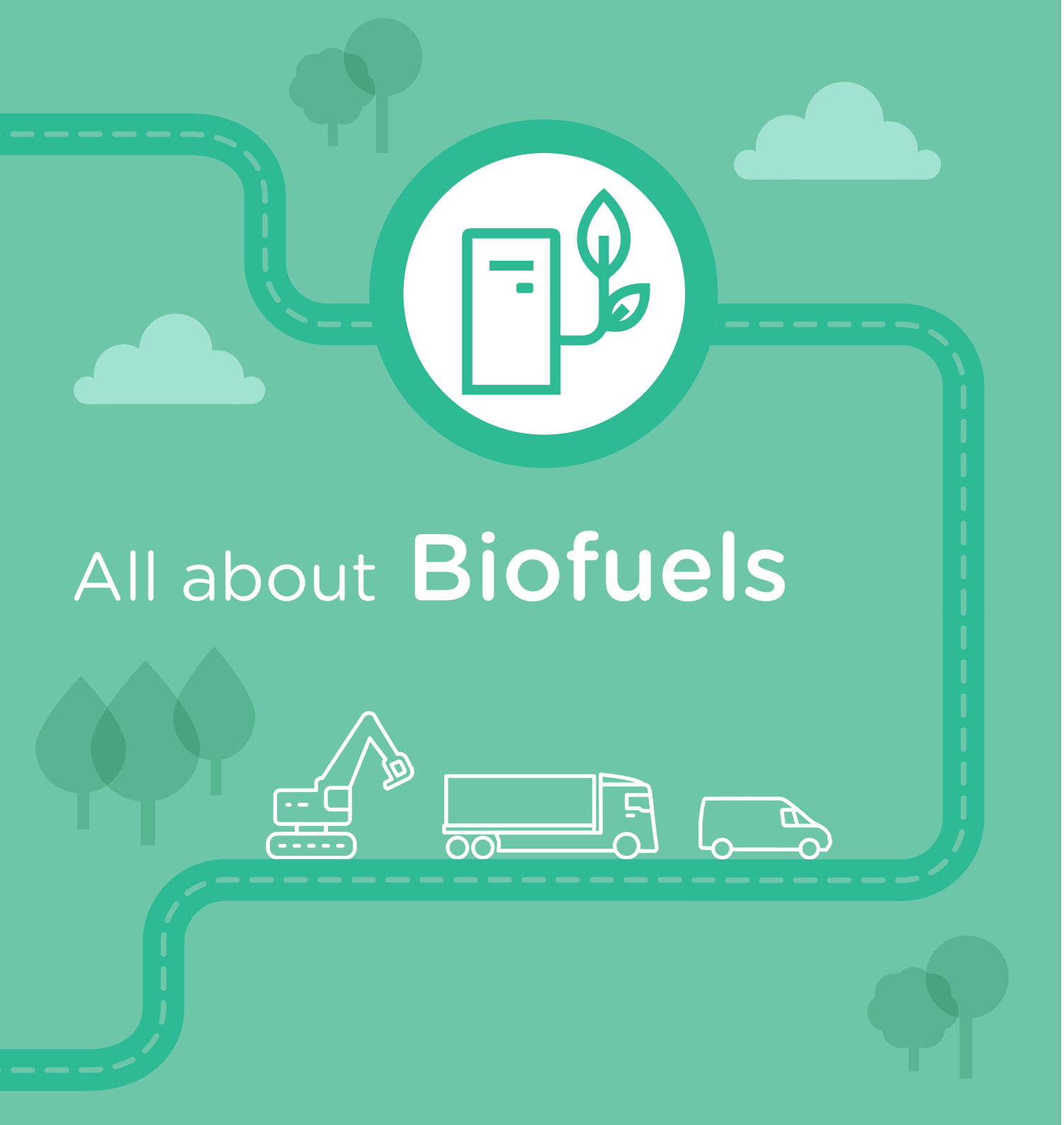
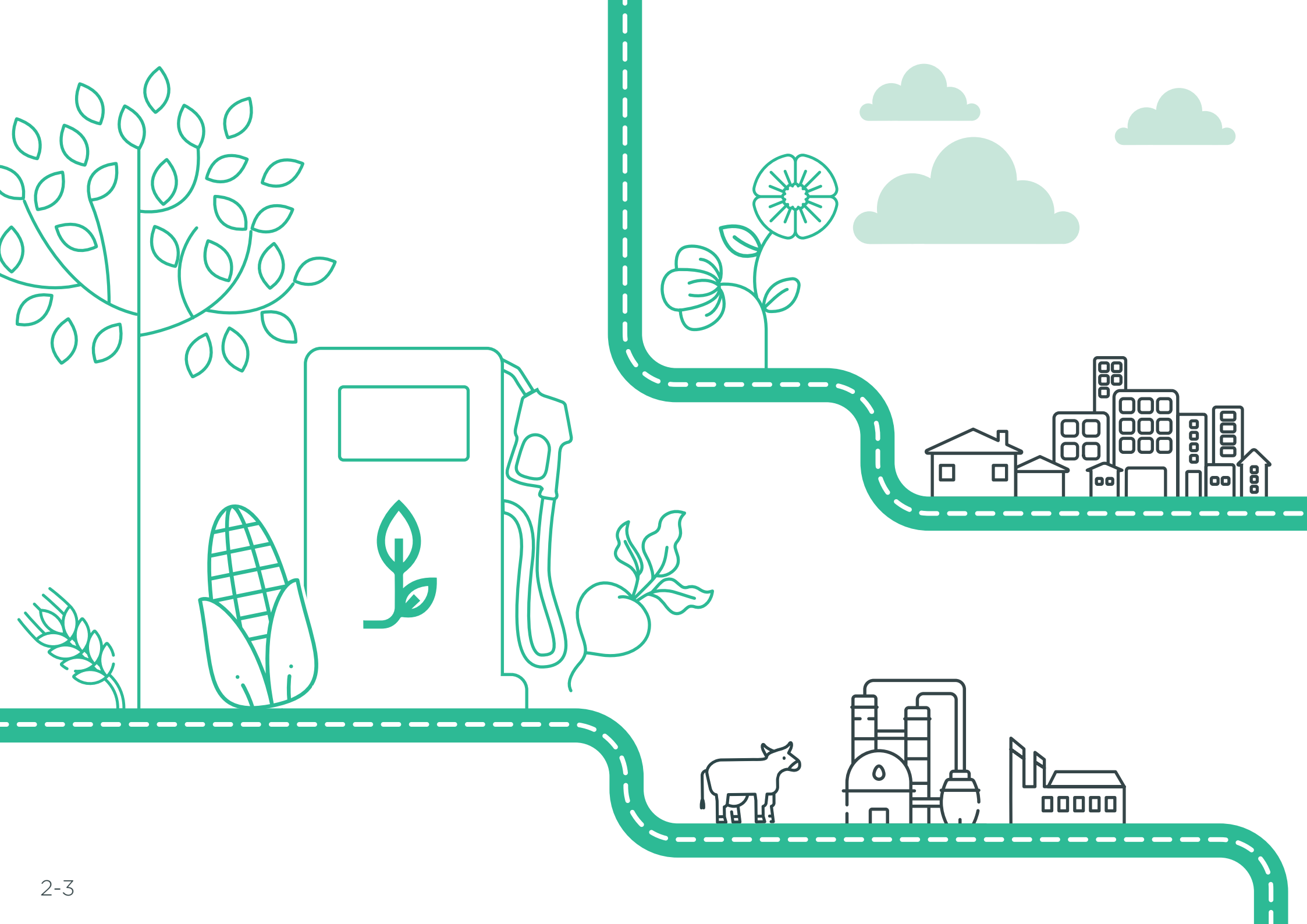


All about **Biofuels**

Biofuels,
towards sustainable mobility

TotalEnergies



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 the TotalEnergies 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 Company affiliates, alternative energies such as biofuels, hydrogen, liquefied natural gas (LNG), compressed natural gas (CNG) and electric mobility are being tested and promoted. With this in mind, we felt that it was important to provide a comprehensive, easy-to-understand and practical look at these energies and markets of the future."**

This, document, **All About Biofuels**, is designed to give you the information you need to get a clearer picture of the situation and to better understand and explain the biofuels industry and the challenges in its future.

We hope you enjoy your reading!

New Mobilities and Marketing Division
TotalEnergies Marketing Services

Contents

ESSENTIALS

What is a biofuel?

Biofuels are made from **renewable biobased materials**, including vegetable oils, used oils and animal fat. **There are different types of biofuels depending on the production channel:**

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

**Fossil-based fuels, unlike biofuels, are made essentially from fossil resources (derived from fossilized organic matter) that have been extracted from subsurface deposits.*
***Residues, used oils or animal fats.*

Did You Know?

Biobased feedstock most often contains oxygen. This oxygen is present in ethanol, ethyl tert-butyl ether (ETBE) and fatty acid methyl esters (FAME). As a result, these fuels have compatibility issues with conventional vehicle engines.
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.

Note

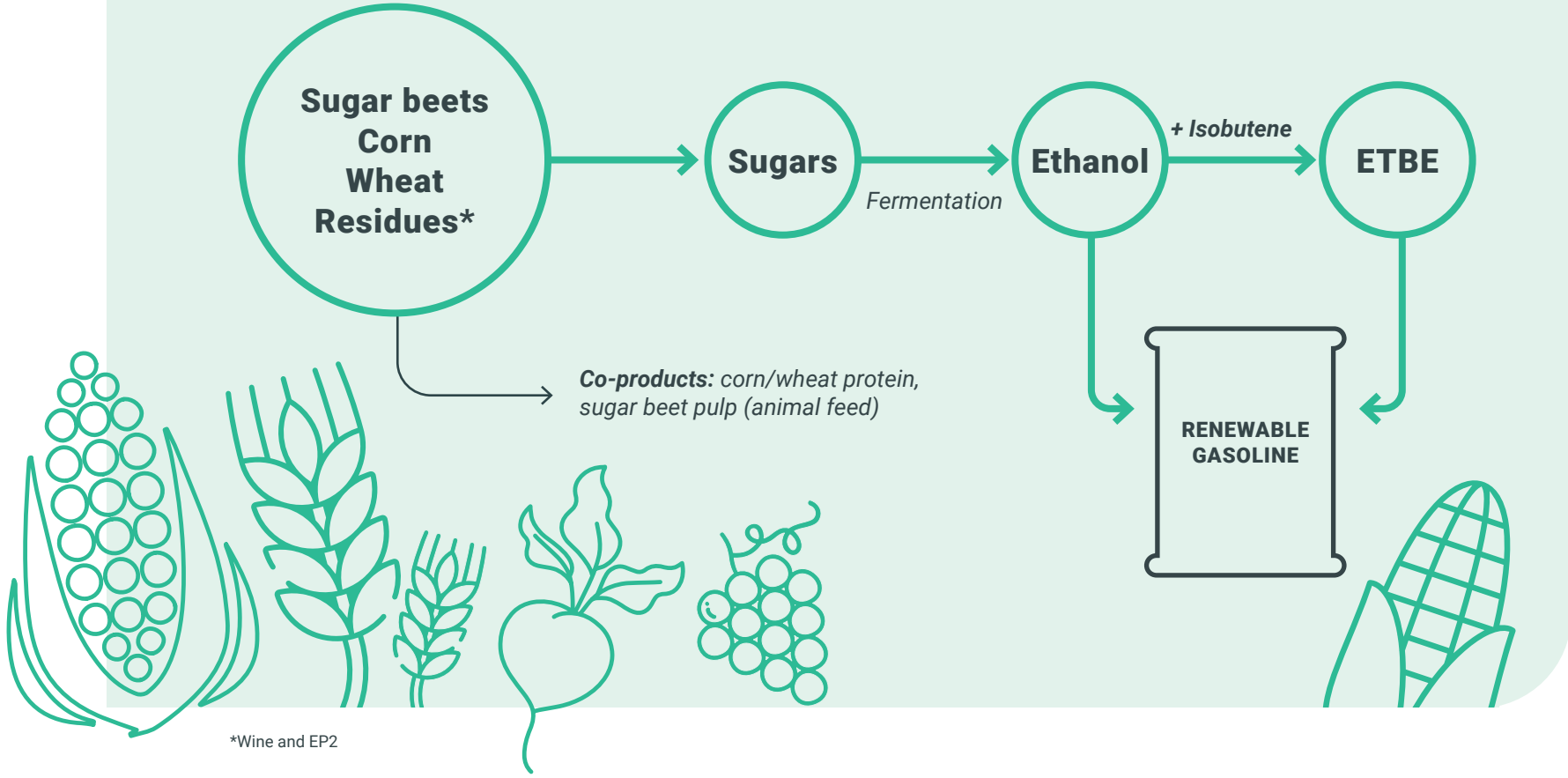
The word “biofuel” can be used for both **the molecules derived from biosourced feedstock and the finished product at the pump** (blend of biobased molecules with conventional fuel). In this brochure, it refers exclusively to the biobased molecules.

ESSENTIALS

How are biofuels made?

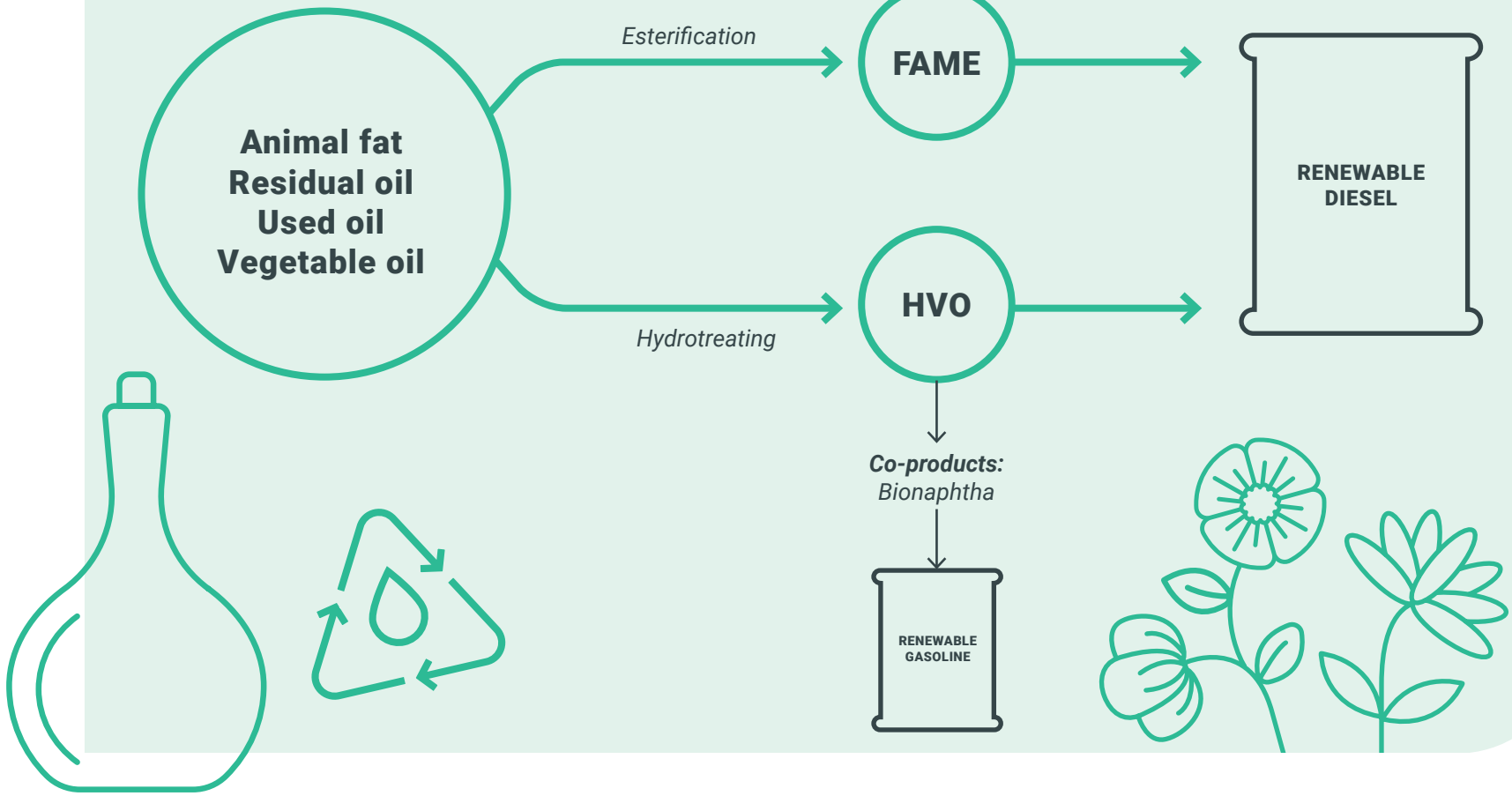
Traditionally, there have been **two main sources** for biofuel:

1. GASOLINE



*Wine and EP2

2. DIESEL


Animal fat
Residual oil
Used oil
Vegetable oil
Esterification
FAME
Hydrotreating
HVO
RENEWABLE DIESEL
Co-products:
Bionaphtha
RENEWABLE GASOLINE

ESSENTIALS

Why use biofuels?

Production costs are higher for biofuels than for conventional fuels, so their use is primarily encouraged through regulations.

These regulations can have **different objectives depending on the country**, ranging from fighting climate change and securing energy independence to support for farmers and land planning.

Did You Know?

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. HVO has a high cetane index as well as excellent oxidation stability.

See page 19 to learn more.

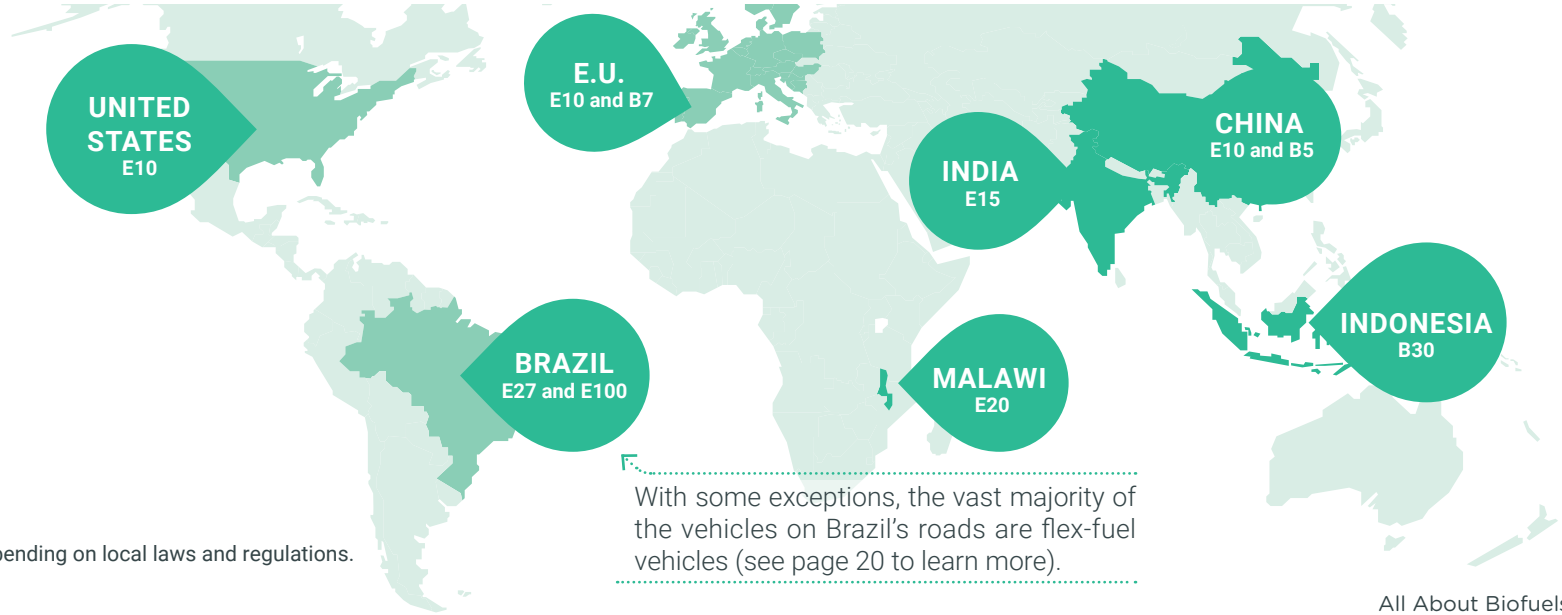
ESSENTIALS

What products contain biofuels?

Biofuels are mainly available in countries where regulations encourage their use. The percentage of biofuel in a product can vary depending 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% in gasoline.
- B + % maximum volume of FAME. For example, B7 would correspond to a maximum FAME volume of 7% in diesel. This blend percentage can be higher with the use of drop-in non-oxygenated biofuels, such as HVO and renewable naphtha, since they do not have any compatibility issues. That type of biofuel can be blended in any proportion, subject only to the technical specification for the fuel standard.

Examples of biofuel grades in selected countries and regions



With some exceptions, the vast majority of the vehicles on Brazil's roads are flex-fuel vehicles (see page 20 to learn more).

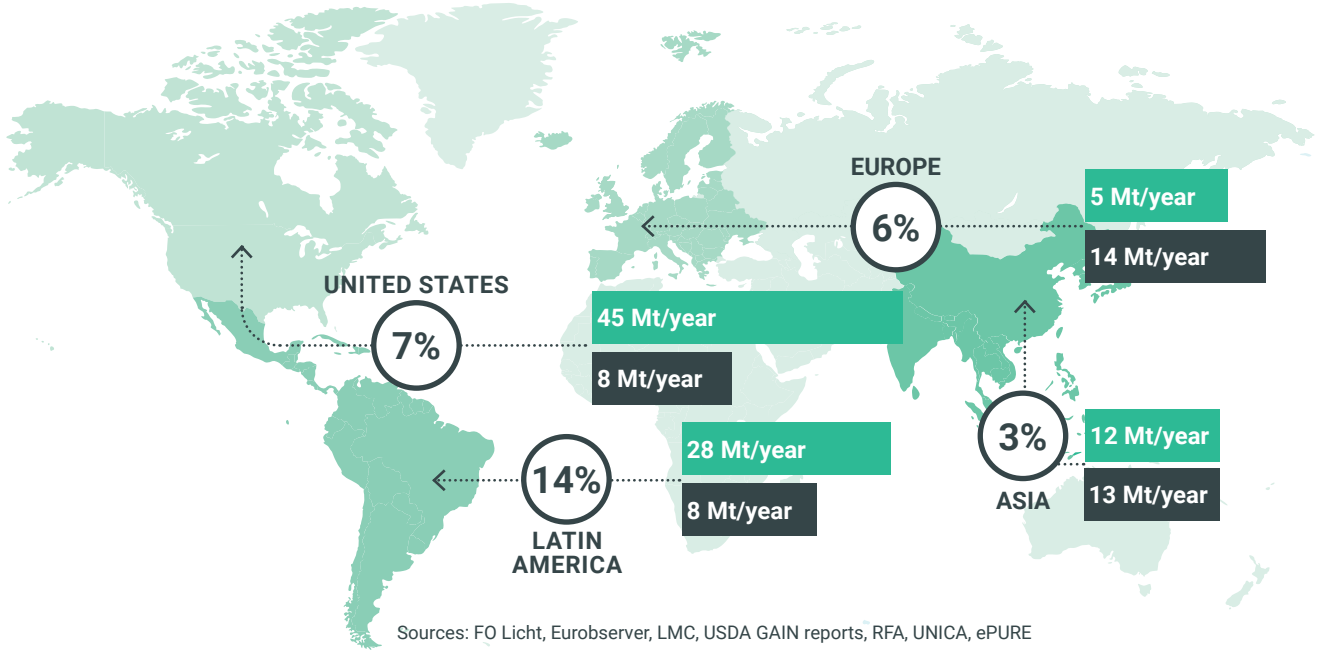
Depending on local laws and regulations.

ESSENTIALS

Which countries use biofuels?

Worldwide, biofuels account for 5% of total road fuel consumption.

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



Sources: FO Licht, Eurobserver, LMC, USDA GAIN reports, RFA, UNICA, ePURE

BIOGASOLINE
Americas market
Growing demand in the United States and Brazil

GLOBAL DEMAND:
UP 3%/YEAR
between 2010 and 2019

FAME & BD*
European market
Growth in BD in Europe

GLOBAL DEMAND:
FAME UP10%/YEAR
BD UP 35%/YEAR
between 2010 and 2019

WORLD 5% = 2 Mboe/day in 2020 (77 Mt/year of ethanol fuel and 44 Mt/year of FAME and BD)

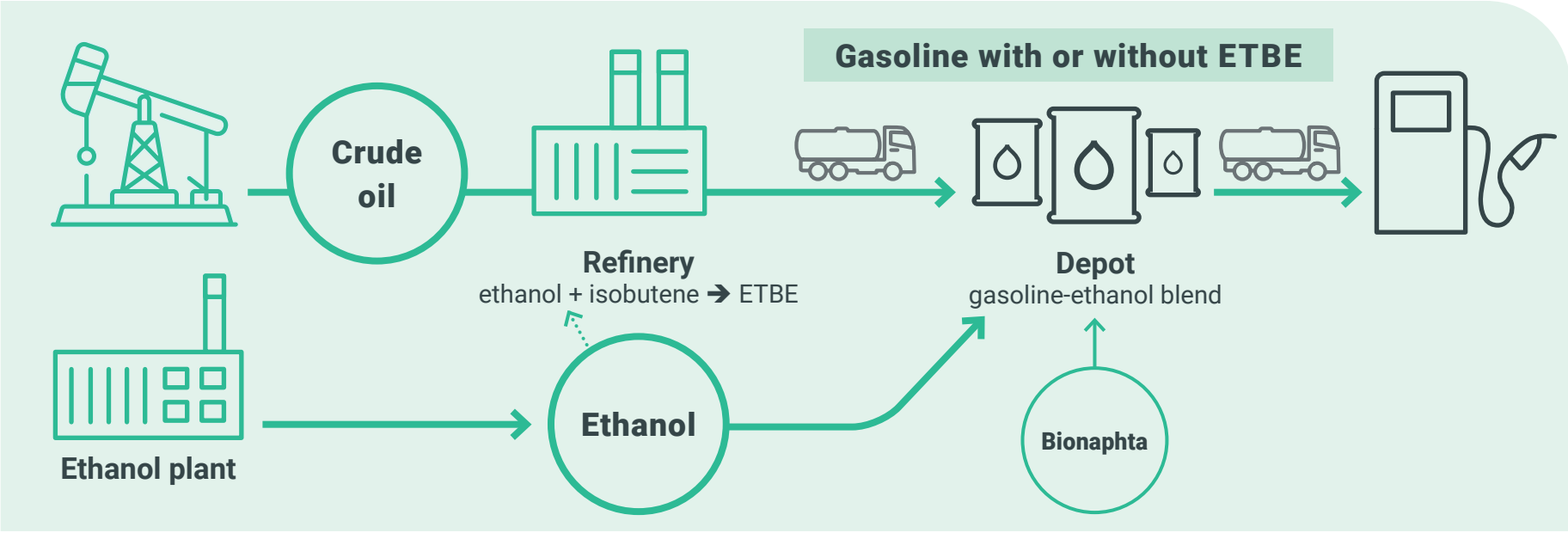
*BD: Biodiesel (HVO)

Biogasoline consumption, 2020 | FAME and BD consumption, 2020 | (%) Volumes blended into road fuel in 2020.

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**.

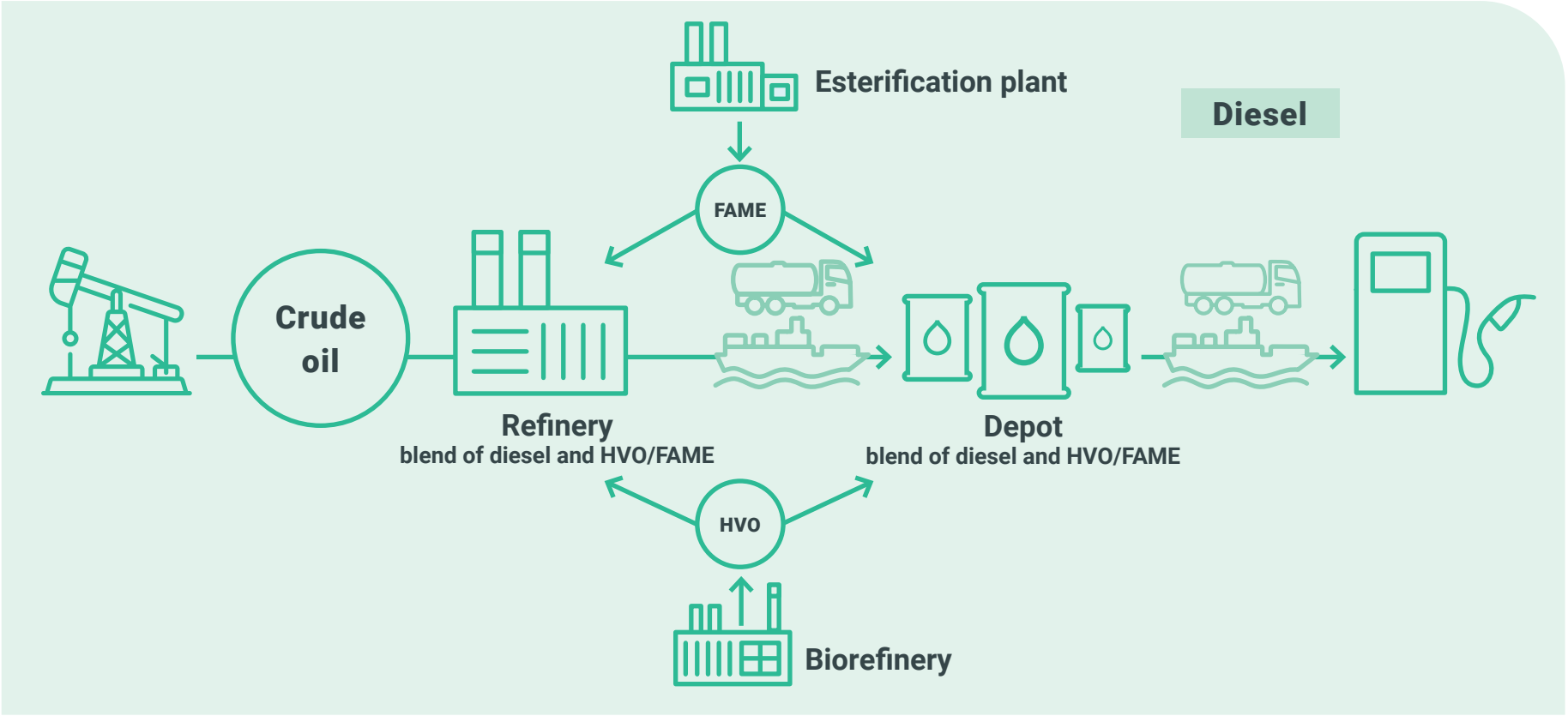


Blending prerequisites

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.

IN PRACTICE

Blending HVO/FAME into diesel



Blending prerequisites

To comply with local specifications, blends of diesel with HVO and/or FAME must meet two prerequisites.

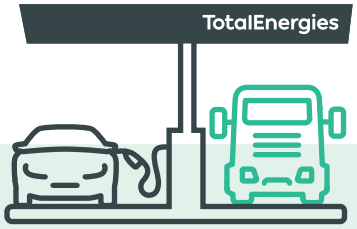
1 HVO can be easily blended into diesel without exceeding the maximum density under the current specification.

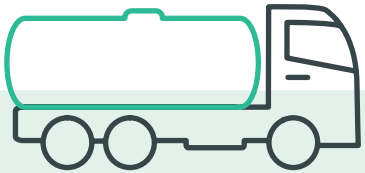
2 The FAME must have very specific characteristics in order to meet the specifications of the final fuel. Adding antioxidants is recommended to ensure the stability of the esterification.

2

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: 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 blend, 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 blends 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 and that pipes are dry and treated with a corrosion inhibitor.

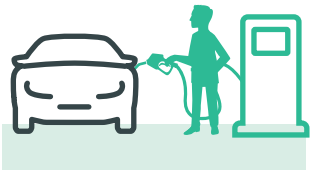
IN PRACTICE

Safety measures for customers

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

Not sure 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 compatible vehicles on their websites.



Filling up

At the pump, follow the same safety measures as for gasoline or diesel, 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 www.legifrance.gouv.fr
**List prepared by the ACEA (European Automobile Manufacturers' Association): www.acea.auto

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 vehicule with 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.

CO_2 emissions

Biofuels help reduce greenhouse gas emissions. For example, using HVO100 renewable diesel reduces greenhouse gas emissions by at least half and in some cases up to 90%* compared to conventional fuel.

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, is consumed 25% faster than a conventional fuel.

Diesel **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.

*Depending on the source of the feedstock used in production and measured across the well-to-wheel cycle.

IN PRACTICE

Biofuels, an integral part of the Company's strategy

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

Transportation accounts for more than 25% of global carbon 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 TotalEnergies uses as a baseline.

The Company 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 TotalEnergies

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

Blending generally takes place in Europe, but depending on national regulations, we can also incorporate biofuels in Asia, the Americas and Africa.

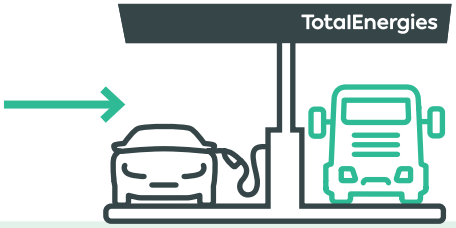
Ethanol/ ETBE

TotalEnergies added nearly

1.3 MILLION

TONS OF ETHANOL

(either pure ethanol or ETBE) to gasoline in its depots in 2019.



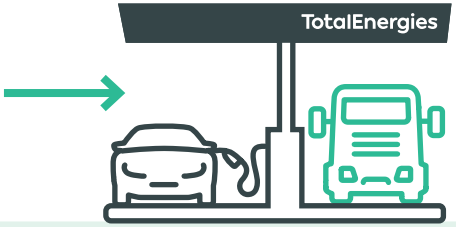
FAME/HVO

TotalEnergies added more than

2.2 MILLION

TONS OF FAME AND HVO

to diesel in its refineries in 2019.



IN PRACTICE

Biofuel production at TotalEnergies

TotalEnergies began producing biofuels in the early 1990s, starting with ETBE. The Company has been co-processing ETBE and HVO since 2009.

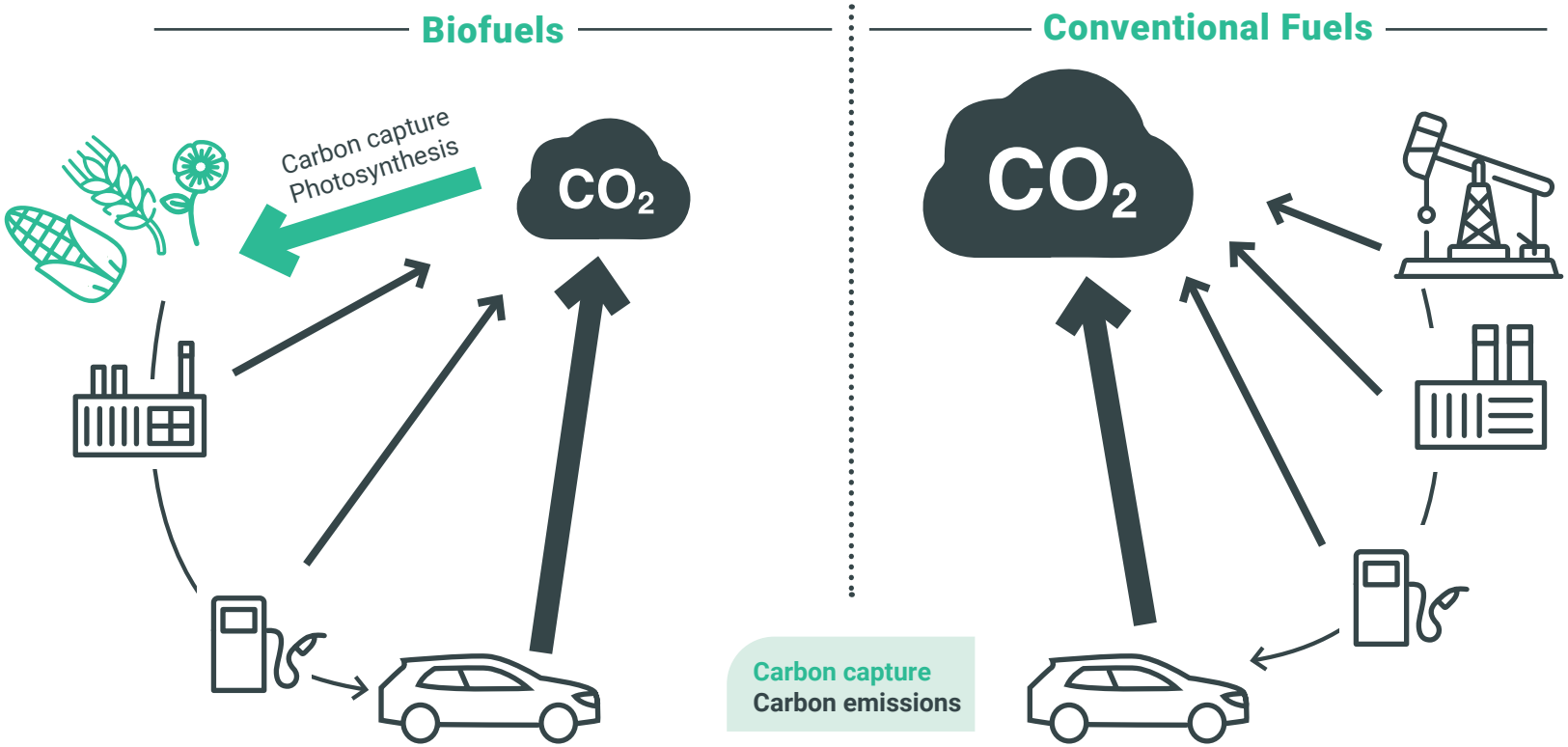
La Mède

France's first world-class biorefinery. Designed to process a wide range of feedstocks, including both vegetable oils (such as rapeseed and sunflower) and waste from the circular economy (used cooking oil, animal fat), the biorefinery can produce 500,000 tons of renewable diesel annually.

FIND OUT MORE

Impacts on carbon emissions

Unlike conventional fuels, the carbon emissions released when a biofuel is burned are offset beforehand by the carbon dioxide captured during the growing plant's photosynthesis.
Biofuel can also be produced from wastes and residues from the circular economy, as an alternative to using agricultural resources.



FIND OUT MORE

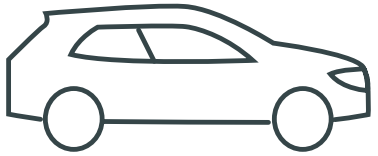
Growth drivers for fuels with high biofuel content (such as E85)

Modified vehicles

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

Favorable tax rules

- **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 higher consumption

- Although biofuel is consumed 25% faster than conventional fuel, it costs less at the pump (average price: €0.79 per liter for E85, €1.77 per liter for SP95-E10, €1.88 per liter for SP98-5 and €1.50 per liter for diesel**).

Did You Know?

Consumers interested in using E85 superethanol have two options: they can acquire a flex-fuel vehicle, or they can modify conventional vehicles to be SP95-E10 compatible. To do that, they simply 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.

*Sample of carmakers offering these vehicles as of November 2021. **Source: www.prix-carburants.gouv.fr (November 2021).

FIND OUT MORE

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

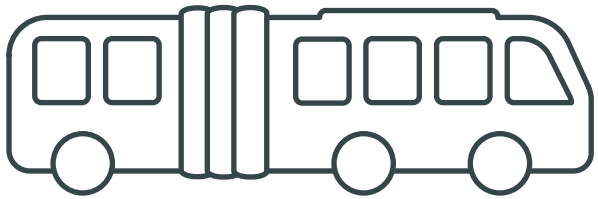
A non-oxygenated biofuel

Hydrotreated Vegetable Oil (HVO) is made up of paraffins, the same molecules present in conventional diesel. For this reason, a regular internal combustion engine can use HVO pure or blended into diesel.

TotalEnergies sells EN 15940-compliant HVO100 in order to provide a fully renewable alternative to diesel that is compatible with existing diesel 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 (50%-90%) in carbon emissions measured over a well-to-wheel cycle.
- Reduction in local polluting emissions such as particulates and NOx.



Did You Know?

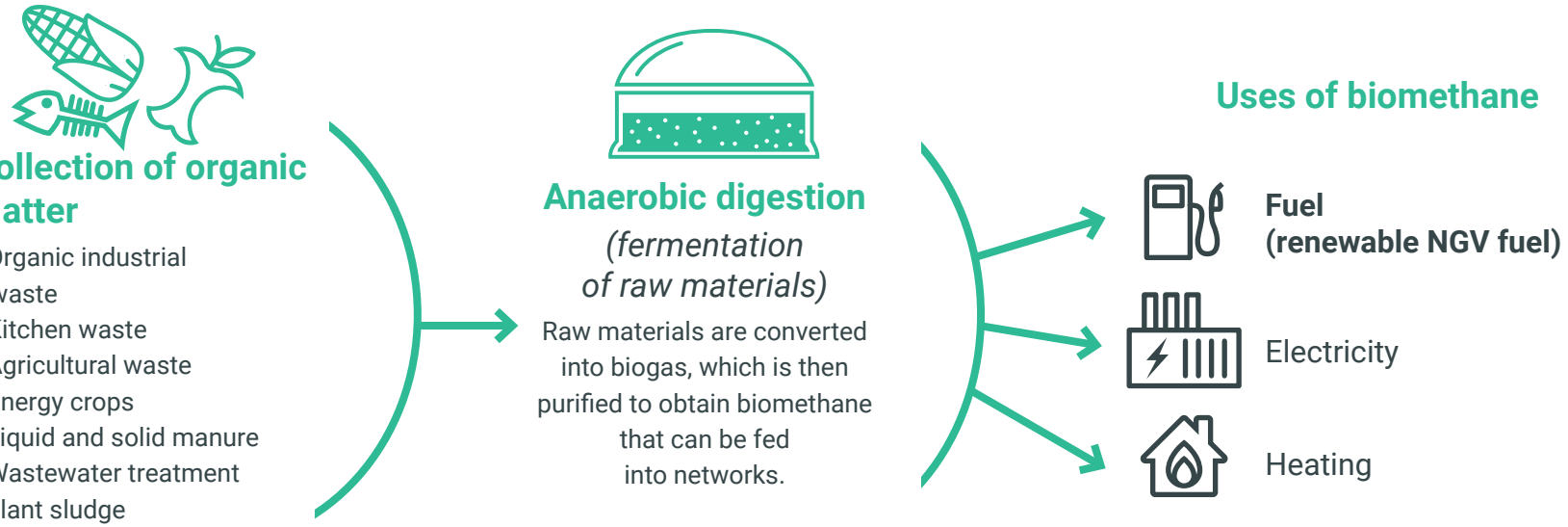
We currently offer HVO100 in France for our business customers' captive fleets only, since its sale at service stations is prohibited under French law. HVO100 is, however, sold at service stations in Belgium and Luxembourg.

FIND OUT MORE

Renewable natural gas vehicle fuel

The natural gas produced from the fermentation of organic animal and plant 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 fed into an underground gas network, the biogas has to be purified. The end product is known as biomethane, and it has the same composition as natural gas vehicle fuel—essentially methane.

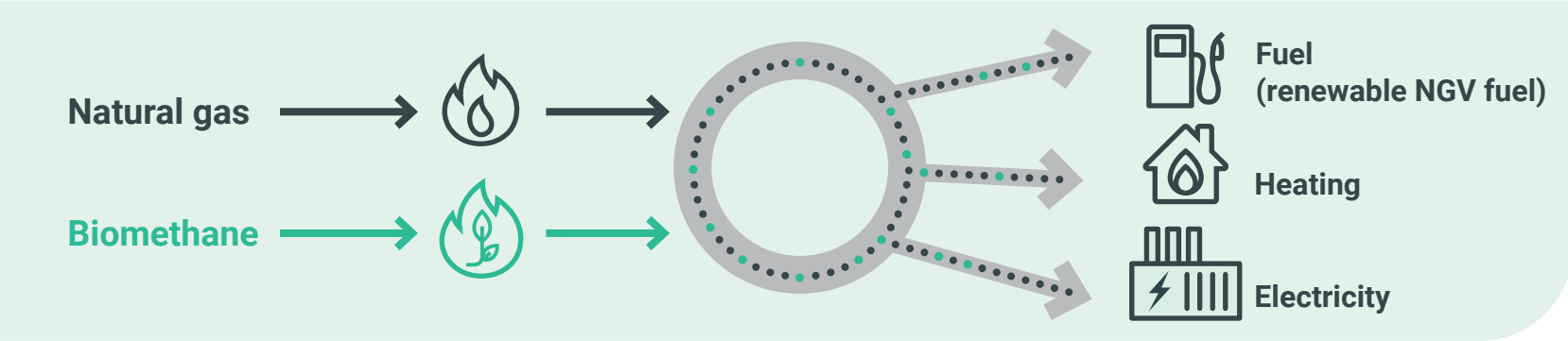
Biomethane can be used for the same applications as natural gas. When used as a fuel, it's known as renewable natural gas vehicle (NGV) fuel.



Did You Know?
Renewable NGV fuel, like NGV fuel, is made up primarily of methane and meets the same specifications.

FIND OUT MORE

Renewable natural gas vehicle fuel is made from organic, renewable resources. As a result, it helps to reduce vehicle carbon emissions substantially.
Biomethane can be fed into the natural gas network, creating a single physical product (a blend of natural gas and biomethane).



In France, production can be certified in one of two ways:

Guarantees of origin

Guarantees of origin are electronic certificates used to certify the injection of biomethane into the natural gas network, so consumers have an assurance of using ecofriendly natural gas.

- A guarantee of origin is issued for each MWh of biomethane injected into the grid by a producer.
- A guarantee of origin is valid for one year.

Biogas certificates (CPB)

These certificates are issued solely for renewable gas produced in France without a subsidized purchase agreement. Energy suppliers that sell gas are required to incorporate a percentage* of renewable gas. For that purpose, they can either purchase biogas certificates from biomethane producers or generate their own certificates.

- A biogas certificate is issued for roughly each MWh of biomethane injected into the network by a producer.
- Unlike guarantees of origin, biomethane certificates are valid for five years.

*The mandatory percentage of biogas is set by the government and increases over time.

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