

## All about Gas Mobility

# TotalEnergies

#### Gas mobility,

using a bridge energy that's helping to create zero-carbon transportation.

Faced with climate issues and the evolution of technologies and uses, transportation is in a transformation phase. The energy transition starts with actions and measures that are aimed at reducing pollutant emissions and greenhouse gases.

TotalEnergies operates a network of stations for road transportation as well as bunkering facilities for shipping to meet the demand for mobility powered by gas – an alternative energy we're offering to our customers, especially transportation professionals.

There is not and will never be one single mobility solution, as each type of energy comes with its own advantages and disadvantages and will be used for the purpose it is best suited for. Among all energy types available today, gas mobility will play a crucial role in tomorrow's mobility, and TotalEnergies is contributing to its development.

This document will help you gain a better understanding of what gas mobility is, the challenges it poses for users and the offers TotalEnergies is developing in this area.

We hope you enjoy your reading!

**New Mobilities and Marketing Division** TotalEnergies Marketing Services







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Natural gas is a fuel that can be extracted from the depths of the Earth or produced from natural materials or waste. It is mainly composed of methane (CH<sub>4</sub>). Natural gas is colorless and odorless and the simplest naturally occurring hydrocarbon.

#### The different applications of natural gas

Natural gas is an energy source that has been used for a long time for many applications:





INDUSTRIAL (fuel)



PRODUCTION

OF ELECTRICITY (gas power plant)



FUEL (truck, ship)





## What is gas mobility?

Gas mobility is the use of methane as energy for transportation. When we talk about gas mobility, we mean the storage and use of gas in two forms:



#### Gas engines: how do they work?

Whether they run on diesel or natural gas, combustion engines operate by burning a mixture of air and fuel. For a diesel engine, the air/diesel mix ignites by itself (auto-ignition) when the temperature and pressure are sufficiently high within the combustion chamber. In a natural gas engine, the blend of air and natural gas is ignited in the engine via the spark produced by the spark plug in the center of the combustion chamber... just as in a gasoline engine!



#### Did you know?

For power generation, natural gas can power an engine as well as a turbine that drives an alternator to generate electricity. In addition, the combustion gases are captured to heat water and power a steam turbine connected to the alternator. The result is a controllable means of production with an efficiency rate of up to 60%.



#### Natural gas in all its forms

For reasons of energy density, natural gas is stored in vehicles in one of two forms: compressed (CNG) or liquefied (LNG).







#### CNG

**How is CNG stored?** CNG is stored in one or more cylinders under high pressure (200 bar at 15°C).

**What vehicles run on CNG?** Every type of vehicle can run on CNG, including trucks, commercial vehicles and passenger cars.

#### Are there different grades of CNG?

Its ingredients may vary slightly depending on the region and the time of year, but it must always comply with the EU's EN16726 standard to guarantee its quality.

Pressurized gas: CNG

Thick-walled

high-pressure reservoir

#### LNG

How is LNG stored at service stations? LNG is stored in cryogenic tanks that reduce its potential to heat up and change into a gas (-162°C/1 bar).

What vehicles can run on LNG? On roads, LNG is used solely for heavy vehicles, such as trucks and buses. It offers range of up to 1,500 kilometers. As a result, it's primarily used for longhaul transportation. But LNG is also used in certain vessels.

#### Are there different types of LNG?

The fuel's composition may vary depending on the source, but the LNG dispensed at pumps always meets quality standards.

> Gas portion: boil-off

Liquid portion: LNG

Double-walled vacuum cryogenic tank

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The gas produced by the fermentation of organic animal and plant matter without oxygen is known as biogas. Its main components are methane and carbon dioxide, but it may also contain 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. A Guarantee of Origin (GO) – an electronic document that traces renewable gases in the natural gas network – provides proof that the biomethane is renewable. When used as a fuel, it's known as BioNGV (renewable natural gas vehicle fuel).



#### What is **BioLNG**?

?!

Physical bioLNG derived from 100% organic feedstocks is obtained from direct liquefaction of the biomethane exiting the production unit. However, there are other ways of offering bioLNG that use a material balance system, such as liquefying gas extracted from the network or selling LNG that comes with Guarantees of Origin (GOs). The aim is to ensure that a portion of the LNG consumed helps to create a greener network, because a corresponding amount of biomethane is injected into the network.









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600 8 Shipping

The shipping industry emits more than 1 billion tons of greenhouse gases each year\*. If it were a country, the industry would be the sixth largest emitter of greenhouse gases worldwide. Today, LNG is the most commercially viable alternative fuel available on a large scale. LNG also serves as a gateway to biomethane.

#### Growing demand, mature solutions

The world's LNG-powered fleet is expanding rapidly. There are more than **300 LNG-powered vessels currently in operation, with the potential for nearly 900 LNG vessels by the end of the decade\*\*.** In the LNG bunkering market, TotalEnergies anticipates nominal demand of 22 million tons annually by 2030. There is also a growing number of LNG bunkering (i.e., refueling) facilities, for easier deployment of marine LNG fuel. **Marine LNG is now available in 185 ports and will be available at an additional 50 ports by 2025.** 

#### A pioneer in LNG bunkering

Since 2020, TotalEnergies has conducted more than **140 LNG bunkering operations** in Europe\*\*\*. Our operations are backed by **three LNG bunker vessels** in our major bunkering hubs:

- Gas Agility based in Rotterdam in the Netherlands, with capacity of 18,600 m<sup>3</sup>.
- Gas Vitality based in Marseille, France, with capacity of 18,600 m<sup>3</sup>.
- Brassavola to be based in Singapore, with capacity of 12,000 m<sup>3</sup>.

These assets are designed to supply a wide variety of vessels of all sizes, which gives us the ability to develop customized solutions for a range of shipping segments.

#### Did you know?

In addition to reducing greenhouse gas emissions (by 23%, depending on the engine, and by up to 69% when biomethane is used, according to <u>sea-Ing.org</u>), LNG improves air quality, cutting nitrous oxide emissions by up to 85% and sulfur oxide emissions and fine particulate matter by 99%).

## Gas mobility's carbon impact and total cost of ownership (TCO)

Vehicles equipped with natural gas engines offer an alternative to the diesel engines that are standard in the market.

#### **Carbon impact\***

A tractor-trailer can generate fewer greenhouse gas emissions over its entire lifecycle than a diesel vehicle:

- > up to 10% or 15% fewer emissions with CNG or LNG
- > up to 80% fewer emissions with biomethane (in bioCNG)



#### Total cost of ownership\*

The TCO takes both capital expenditure (capex) and operating expenditure (opex) into account.

#### Capital expenditure:

A gas-powered truck can cost 40-45% more to purchase than a diesel truck. The actual difference depends on the type of truck (tractor-trailer, rigid truck, etc.) and the tank (CNG or LNG, capacity, etc.).

#### **Operating expenditure:**

Historically, the energy cost per 100 kilometers of a natural gas-powered truck has been less than that of a diesel vehicle, so operating expenditures with gas were lower than with diesel. 90,000 80,000 70,000 60,000 50,000 40,000 20,000 0 Diesel NGV fuel CAPEX (vehicle cost - resale value) OPEX (energy + maintenance + insurance)

€/year

Therefore, depending on the use scenarios, the added capital expenditure for natural gas vehicles can be offset by more attractive operating expenditures coupled with tax incentives (purchase incentives, accelerated depreciation, etc.).

\*TotalEnergies estimates



As a major player in the energy transition, TotalEnergies is committed to profoundly transforming our production and sales to provide zero-carbon solutions while continuing to meet the energy needs of a growing population. Here are our objectives for 2030:



#### For road transportation

- More than 2,600 natural gas fueling stations in our networks worldwide\*
- 100% biomethane in Europe



#### For shipping

The Company's goal is to serve at least 10% of the LNG bunkering market (representing about 2 million tons).







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