TOTAL

All about CNG

Compressed Natural Gas


Do you want to know more about Compressed Natural Gas?
CNG

In the face of climate issues and the evolution of technologies and uses, ground transportation is in a transformation phase, including measures to reduce pollutant emissions and greenhouse gases.

In this context, Total is stepping up their development of Natural Gas for Vehicles, alternative energy to conventional fuels, especially for professional and private mobility.

> **“There is not and will never be one single mobility solution, as each type of energy comes with its own specific advantages and disadvantages, and will be used for the purpose it was built for. NGV will play a crucial role in tomorrow’s mobility, and Total is contributing to developing this energy type. Fossil fuels and alternative energies will be used alongside this.”**

This document should help you gain a better understanding of what CNG is, the challenges it represents and what solutions Total will be developing in this field.

Happy reading!

Research Marketing Strategy
Product Marketing
Total Marketing & Services

Contents

ESSENTIALS

What is CNG?

Natural gas is a blend of light hydrocarbons consisting primarily of methane.
It is naturally present in certain porous rock.

Natural gas, that rings a bell!

The various applications for natural gas

Natural gas is an energy source that has long been used for various purposes:

- RESIDENTIAL (cooking, heating)
- INDUSTRIAL (fuel)
- POWER GENERATION (gas power plant)
- FUEL (boats, trucks)

CNG? CNG is an acronym for **Compressed Natural Gas**, which is natural gas stored at high pressure (between 200 and 250 bars). **As a result, it takes up less room and is easy to transport.**

ESSENTIALS

CNG: a special type of fuel

The states of natural gas

METHANE IN AIR
20°C / 1 bar
1L of diesel fuel = 900L of methane

CNG
20°C / 200 bar
1L of diesel fuel = 5L of CNG

LNG
-120°C / 10 bar
-162°C / 1 bar
1L of diesel fuel = 1.8L of LNG

How is CNG stored?

CNG is stored in one or more cylinders under high pressure (between 200 and 250 bars).

What vehicles run on CNG?

Any type of vehicle can operate on CNG: trucks, light 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.

CNG's false friends

NGV
Natural Gas for Vehicles

CNG
Compressed Natural Gas

LNG
Liquefied Natural Gas (cooled to -162°C)

LPG
Liquefied Petroleum Gas (propane and butane)

ESSENTIALS

Producing CNG

Natural gas is extracted from **geological reserves** all over the world (Russia, United States etc.) and transported via ship or pipeline over a distance of several thousand kilometres.

It then travels through an **underground grid** of pipelines that supply service stations directly.

Once at the station, the gas is compressed and stored, it is then available for filling vehicles, compressed to between 200 and 250 bars.

1. **Extraction and processing of natural gas**
2. **Natural gas liquefaction terminal into LNG and export terminal**
3. **Transportation by sea of LNG**
4. **Regasification terminal**
5. **Natural gas travels through an underground grid**
6. **Compression, storage and distribution of CNG at the service station**

Did you know?

Once cleaned of its impurities, **biomethane (biogas after purification)** can be injected directly at certain points of the pipeline network.

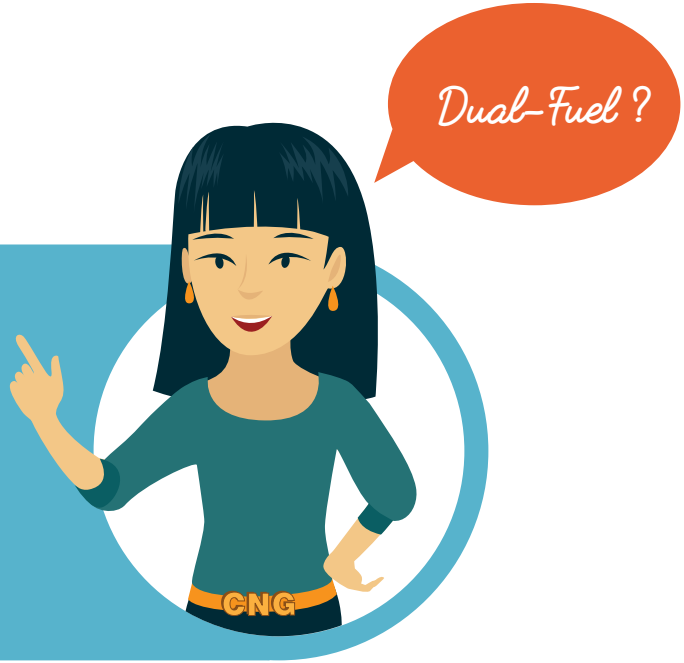
Still little developed today, this renewable gas could be found in your service-station tomorrow!

ESSENTIALS

A heavy-duty CNG engine: how does it 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 (one that runs on CNG or LNG), the blend of air and natural gas is ignited by the spark produced by the spark plug in the combustion chamber... just like in a gasoline engine!



Did you know?

Older generations of so-called Dual-Fuel engines were able to run on 100% diesel or on a diesel/natural gas mixture, but did not meet EURO VI standards.

Recently, a new generation of EURO VI engines has emerged with the HPDI technology in which natural gas and diesel are used. It then takes advantage of the efficiency of diesel engines.

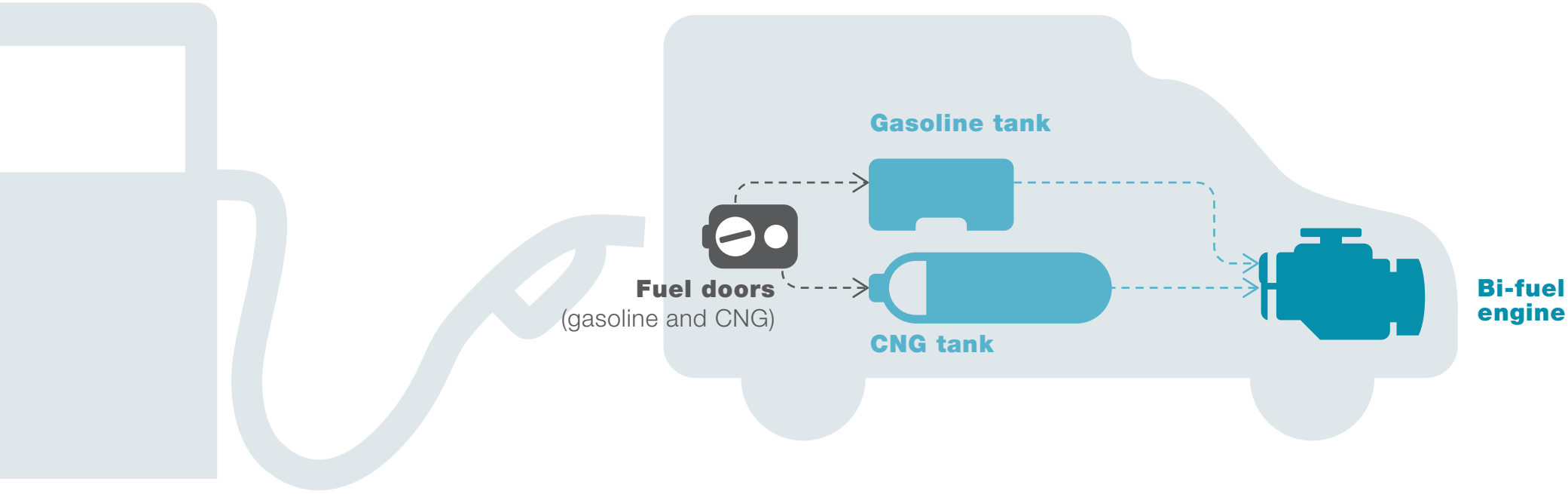
ESSENTIALS

A CNG engine in a light commercial vehicle or passenger car: how does it work?

Under the bonnet, CNG vehicles run just like gasoline-fuelled vehicles, except that they are **equipped with two tanks for just one engine.**

Often referred to as **bi-fuel**, this engine is designed to be able to burn either gasoline or natural gas.

This ensures a **very comfortable driving range** (from 600 km to over 1000 km) and prevents the likelihood of running out of fuel.



IN PRACTICE

Filling up with CNG

The 4 essential steps

1. **Visit a CNG station.** These stations use special equipment, with customised dispensers and couplings.
2. **Unhook the CNG nozzle and connect it** to the vehicle receptacle.
3. **Lock the coupling.** Depending on the system, you need to rotate the handle or set the trigger lock.
4. **Fill your tank.** The pump stops automatically when the tank is full.
   Bear in mind that CNG is dispensed by kilogramme or normal cubic meter (Nm^3).
   Filling a car takes 2 to 3 minutes. Filling a truck will take less than 10 minutes.

...and drive! The remaining mileage and CNG tank level are displayed on the indicator panel or can be obtained from the onboard computer.

Good to know! The connection between the dispenser nozzle and the vehicle is airtight, with no evaporation or projection possible.
Moreover, as long as the nozzle is not placed properly, it is not possible to refuel.

Where can I find a CNG station?

NGVA Europe regularly updates existing stations in Europe: www.ngvaeurope.eu

For more information on TOTAL and AS 24 CNG stations in France, visit: https://gnv-mobilite.total.com

IN PRACTICE

Precautions to take

When filling the tank

CNG is no more hazardous than gasoline or diesel fuel. All of the connections are airtight, with no risk of fumes or projection.

At the service station, you should follow the same safety guidelines as you would for gasoline or diesel fuel:

- **Do not smoke** and do not bring a heat source near the vehicle
- **Do not use your phone**

When parking

Driving on CNG does not entail any restrictions on parking, including underground parking.

It is also worth noting that natural gas is no more explosive than LPG or gasoline.

If you detect a leak

Leaks of CNG can be identified by the accompanying sulphur smell, similar to that of mains gas.

The first thing you need to do is define a safety perimeter around the leak (because of the risk of inflammation from a heat source).

Next, notify the fire brigade and onsite safety personnel.

In most cases, the tank should be allowed to empty completely.

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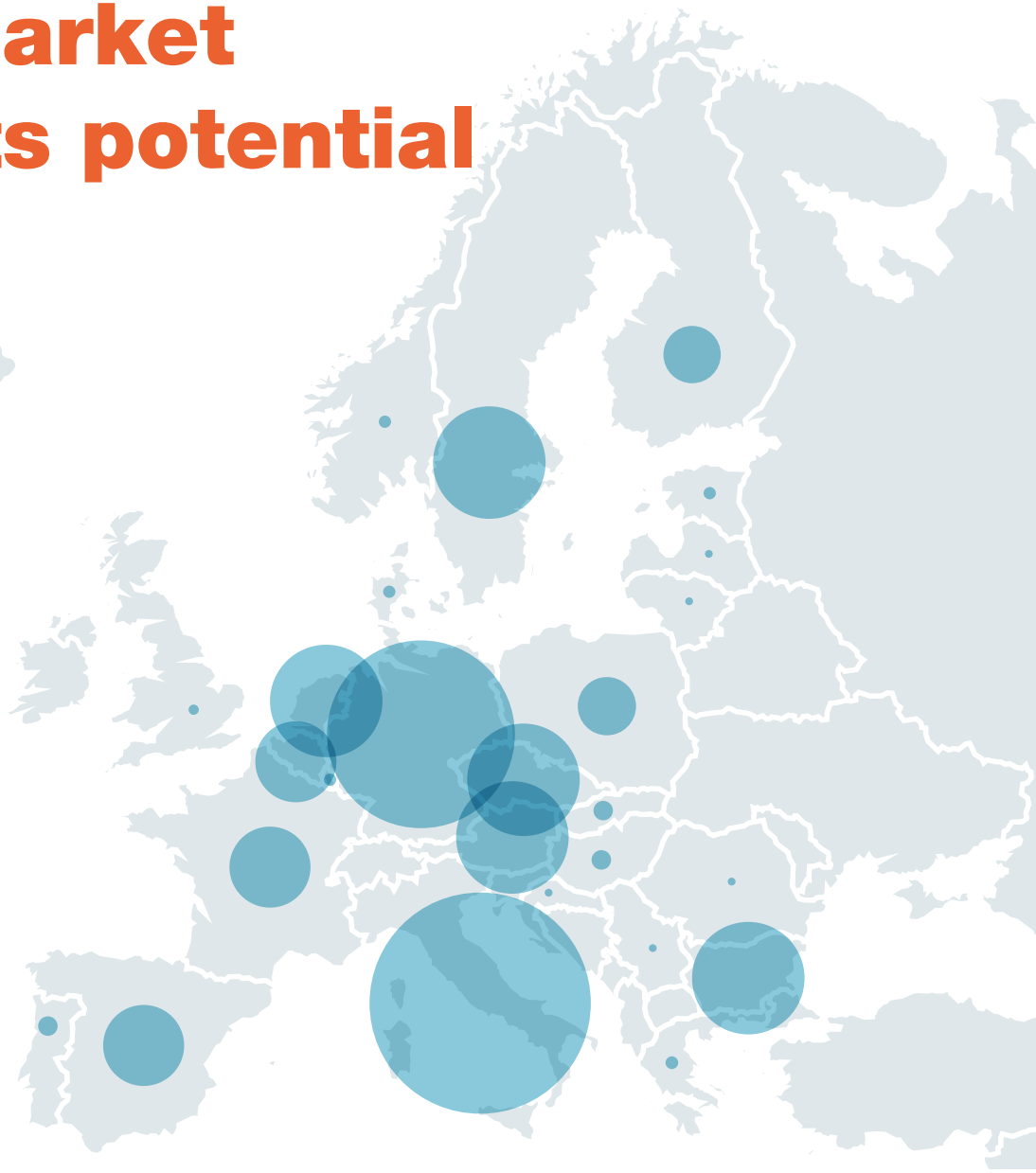
IN PRACTICE

The current market for CNG and its potential

CNG is gradually being rolled out in Europe, led by **Italy and Germany**. Professionals (passenger cars and urban or regional transportation trucks) are accelerating their conversion to CNG, especially in France, Belgium and the Netherlands.

Professionals can also build a private station, if their operation warrants it.



Density of CNG stations in Europe

Source: NGVA 2018

IN PRACTICE

Total's ambition for NGV

Total is expanding rapidly in the NGV sector, aiming to become the European leader. To help achieve that, it acquired **PITPOINT**, Europe's third-largest clean fuel operator.

More recently, Total has made an equity investment in Clean Energy Fuels, a leading NGV supplier in the North American market.

2022 target: 350 NGV stations in our European networks

TOTAL AS24 PITPOINT CLEAN FUELS

Did you know?

Total already has NGV stations in Europe, but also in Egypt and Pakistan.

FIND OUT MORE

A vehicle running on gasoline, diesel or CNG: which one should I choose?

Each technology has its advantages and drawbacks in terms of cost, noise, pollutant emissions and so on. Choose depending on your needs and preferences.

Cost

A vehicle that runs on CNG can prove more cost-efficient than its diesel or gasoline equivalent, depending on the price of fuel, the number of kilometres covered annually, and prevailing tax laws. Even if a CNG vehicle is more expensive to purchase.

Noise

The engine technology for natural gas reduces noise levels in CNG vehicles quite substantially compared to Diesel vehicles. This is a real advantage for urban or night transport.

Autonomy

CNG trucks have a range of up to 570 km, so they are mainly used in urban and regional areas. Passenger cars are always equipped with a second fuel tank, which gives them very comfortable autonomies (between 600 km and 1,000 km).

FIND OUT MORE

CO_2 emissions

It is difficult to separate CNG vehicles from other vehicles, as CO_2 emissions vary greatly between vehicles and their uses. Remember, however, that like biodiesel or bioethanol, any incorporation of biomethane into the CNG lowers the vehicle's environmental impact.

Pollutant emissions

Both Diesel and CNG trucks comply with the European Union's EURO VI standard. That standard, which took effect on 1st January 2014, defines permissible pollutant emission levels for heavy-duty vehicles. Light vehicles comply with the EURO 6 standards, whether they run on gasoline, Diesel or CNG.

Did you know? When applied to trucks, the EU standard is written as EURO VI. When applied to light passenger vehicles, it is written as EURO 6.

FIND OUT MORE

Summary of maintenance tasks

I drive a truck

EURO VI CNG

- Replace spark plugs
- Regularly inspect the special parts in the CNG engine
- Verify that the gas circuit and CNG tank are airtight

Did you know?

Oil change intervals may need to be shorter than those observed in diesel, particularly for certain applications (e.g. urban routes). Make sure to check with the vehicle manufacturer.

I drive a passenger car or light commercial vehicle

Apart from special inspections of the gas circuit and CNG tank, maintenance for your vehicle is very similar to that of a conventional-fuel vehicle. Your dealer will point you to authorised garages.

! Important

Maintenance must be performed by an authorized shop approved by the manufacturer of your CNG vehicle.

FIND OUT MORE

Driving a Gasoline/CNG bi-fuel vehicle

Does your vehicle have a gasoline tank and a CNG tank?

- The engine uses gasoline to start up
- It automatically switches to CNG in less than a minute, as soon as the optimal conditions are reached
- If the supply of CNG runs out, the engine automatically switches to gasoline mode
- The supply levels in the gasoline tank and CNG tank can be monitored from the driver's seat
- A button is available to tell the engine to switch to gasoline mode, even while driving
- Bi-fuel systems are completely transparent for the driver, and the fuel source can be changed seamlessly
- No space is lost in the boot: the gas tanks are located in the vehicle floor

And what about trucks? Is driving any different?

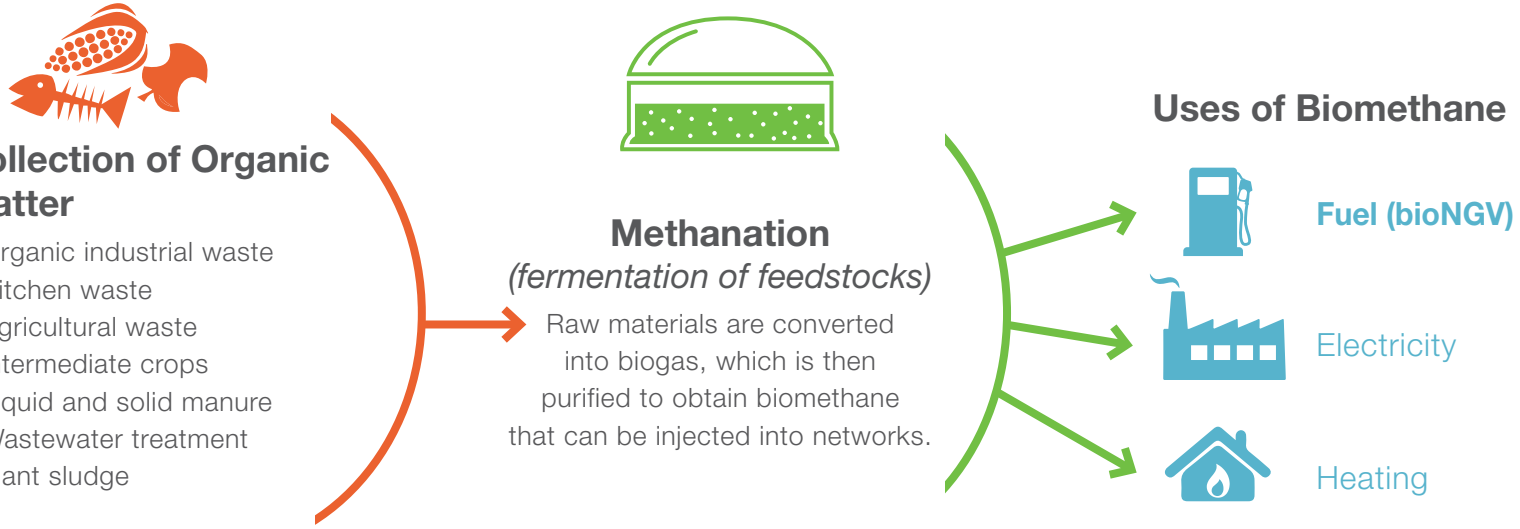
Given the same size engine, driving a vehicle that's running on CNG is no different from driving a diesel vehicle.

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.

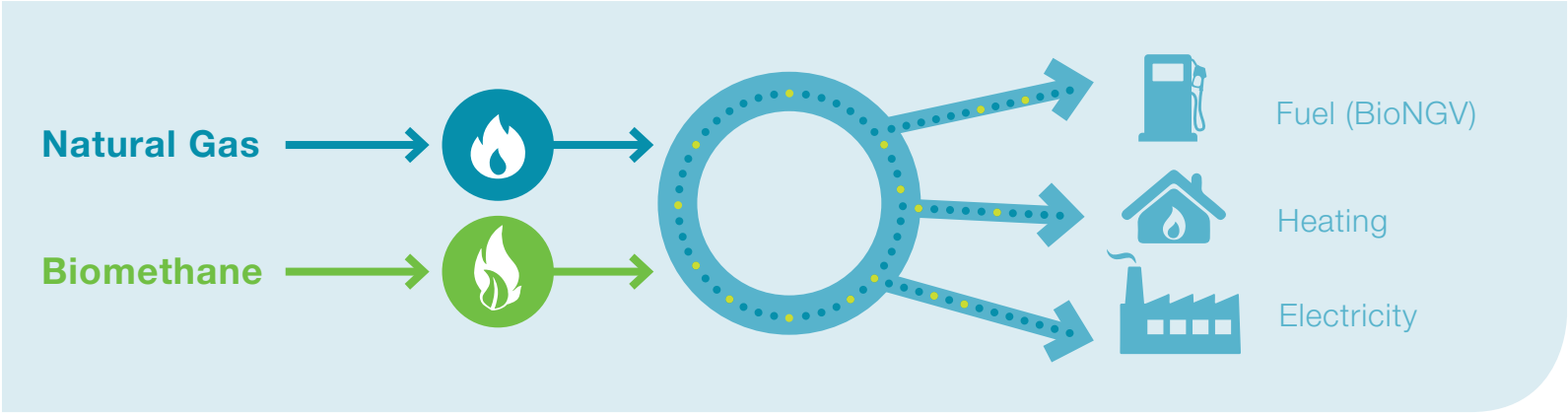
FIND OUT MORE

The benefits for combating greenhouse gases

- BioNGV is produced from organic, renewable resources.
  As a result, it helps to reduce vehicle CO_2 emissions.
- Blending at least 15% BioNGV into NGV reduces CO_2 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.



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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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