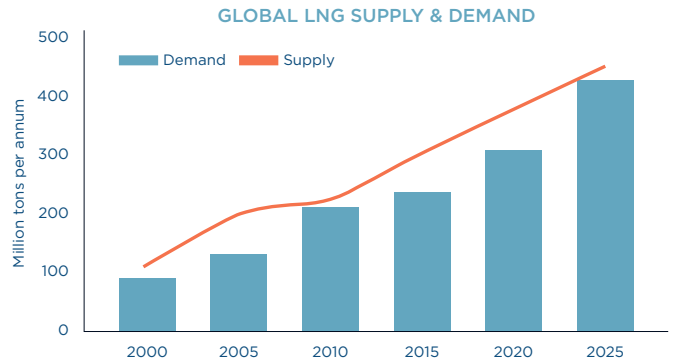


# LNG

Liquefied Natural Gas

## FUTURE ENERGY, TODAY

Demand for cleaner burning fuels increases year-by-year, driven by climate change and lower environmental emissions.



Source: Tetra4

## THE PROPERTIES OF LNG

LNG is simply natural gas that has been cooled down to  $-162^{\circ}\text{C}$  and is in liquid form.

### COMPOSITION

Methane - 94%  
Nitrogen - 6%  
Sulphur - 0%  
(unlike other natural gas sources, no other hydrocarbons are present)



### NON-TOXIC

Odourless  
Non-corrosive  
Boiling point of  $-162^{\circ}\text{C}$   
Density of 0.43 kg/L



### LIGHTER THAN AIR

Unlike LPG where the gas sinks to the ground, LNG will rise upwards and disperse rapidly in the atmosphere.



### SAFE

LNG cannot ignite in its liquid form. When vaporised, the explosive limit in air is between 5-15%. LNG can be stored or transported at very low pressures.

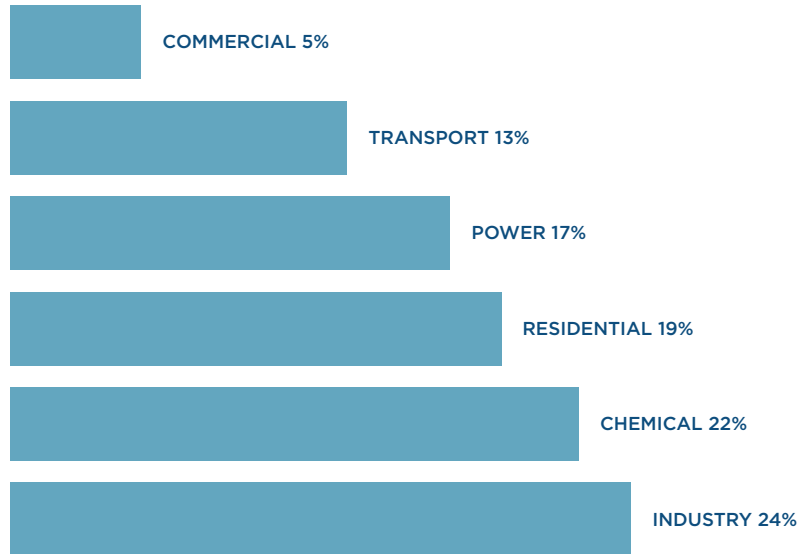


### SMALL VOLUME

LNG compresses to 1/600 of its original volume. This makes LNG easier to transport and store than compressed natural gas (CNG).



## GLOBAL USES OF LNG



LNG, as an alternative fuel to diesel in the transportation sector, is gaining rapid acceptance worldwide. With countries imposing tighter environmental legislation, cleaner burning LNG emits up to 20% less greenhouse gases and particulate matter (fine soot) is reduced by up to 98%.

## FUEL SUBSTITUTION

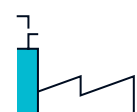


### HEAVY DUTY VEHICLES

There are two methods of introducing natural gas into diesel engines:

**Diesel Dual Fuel (DDF)** - Natural gas is blended with air in a predetermined dynamic ratio before entering the piston cylinder. The energy from the natural gas replaces the diesel energy and thus diesel consumption is significantly reduced while maintaining engine performance.

**Dedicated Natural Gas Truck** - Unlike diesel engines, natural gas engines require spark plug ignition to combust the fuel and thus diesel cannot be used as a fuel source. The only exemption is the Volvo FH LNG truck where 5% diesel is added with the natural gas to produce a 'liquid' spark plug. Most major truck manufacturers are turning to LNG in place of CNG as travel distances can be doubled for the same tank volume.



### INDUSTRIAL HEATING APPLICATIONS

Methane, the major constituent of natural gas, is one of the cleanest burning fuels available. Fuels such as LPG on the other hand, consists of varying amounts of higher hydrocarbons and this can lead to combustion issues where product quality in direct fired furnaces or ovens is paramount. With inconsistent fuel composition, setting the correct air to fuel ratio is extremely difficult and this could lead to sooting or oxidation problems. Renergen's LNG only contains methane and thus once the burner system has been set up it requires no further adjustment for perfect combustion.

## HOW IS LNG STORED?

LNG storage tanks consist of two parts, or two tanks to be more precise. Liquefied natural gas whose temperature is  $-162^{\circ}\text{C}$  is stored in the inside tank, made of cryogenic resistant steel. The outer shell of the tank is made of standard steel and between the walls of the two tanks, a vacuum (an insulator) exists that helps maintain the LNG in the inner tank at very low temperatures - the same principle as a vacuum flask.

If the LNG is not used over a long period of time (Up to 90 days), the LNG starts to boil off and the static pressure of the inner tanks will slowly increase and may eventually lead to the escape of some LNG to the atmosphere via pressure relieve valves. To reduce the probability of this happening, systems such as re-liquefaction units can be employed to contain potential losses from the tank.

## SAFETY

Natural gas is odourless, colourless and tasteless and under normal circumstances this makes it very difficult to detect if a leak occurs. However, a stenching agent is added to natural gas giving it a "rotten egg" smell that makes it easy to detect. It is also lighter than air and thus any gas leak dissipates very quickly up into the atmosphere. It explodes only when air and gas meet in just the right proportions (between 5-15% in air by volume). According to the American Gas Association, safety related incidents have decreased 29 percent since 1988 - even though natural gas usage has risen by over 20 percent.

## CARBON TAX

From June 2019 the South African Government introduced carbon tax on greenhouse gases emitted from fuel combustion and industrial processes. The tax is set to rise at two percent above inflation, currently at 4.5 percent, until 2022 and in line with inflation thereafter. This has directly affected fuel prices and more increases are in the pipeline. LNG from Renergen is currently exempt from Carbon Tax thus making LNG more economically attractive in the future.

## WHERE DOES LNG COME FROM

Natural gas extracted by Renergen from the Vredefort Basin in the Free State is different to conventional natural gas in that it consist of only one hydrocarbon - methane. In its raw form Renergen's natural gas contains 94% methane, 4% nitrogen and 2% helium. The primary reason why only methane is found in the gas can be put down to its source. Deep down in the Vredefort basin a plethora of microbes feed on a strata of carbon rich shale and excrete only methane gas. The gas rises through faults and fissures in the geology of the basin and is eventually trapped under a dolomite layer approximately 400-500m below the surface. A borehole type drilling machine is used to extract the gas and the well is then capped. Currently, gas from one well is conveyed via pipeline to Renergen's compressor station where it is compressed to 200 bar (Compressed Natural Gas) in large transportable cylinders that supplies ten dedicated natural gas buses for Megabus in Virginia. In the near future, Renergen will erect a specialised cryogenic plant where the methane is liquefied at  $-162^{\circ}\text{C}$ . This form of gas is known as Liquefied Natural Gas (LNG) and has many advantages over Compressed Natural Gas (CNG):

- Easier and more economical to transport
- It expands 600 times to reach its gaseous state (1 unit of LNG= 600 units of natural gas)
- A large amount of natural gas can be stored and transported at low pressure

LNG production will come on stream in Q2 2021.

## USEFUL CONVERSIONS

1 GJ = 20kg LNG

1 GJ = 26.75 Nm<sup>3</sup> LNG

1 GJ LNG = 27.7 L Diesel (net calorific value)

1 kg LNG = 1kg LPG

1 L Paraffin = 0.774 kg LNG

1 L Polyfuel = 0.728 kg LNG

1 mmBtu = 1.055056 GJ

