

The logo for 'energir' is positioned in the top right corner. It features the word 'energir' in a white, lowercase, sans-serif font. A small white dot is placed above the letter 'e'. The background of the entire page is a dark blue, decorated with several large, abstract, curved shapes in various shades of blue and cyan, creating a dynamic, modern aesthetic.

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# Response Guide

In the presence of liquefied  
natural gas (LNG)

## For additional information

### Energir.com

mesures.urgence@energir.com

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### Other available resources :

Guide 115 GASES – FLAMMABLE  
(Including Refrigerated Liquids) – CANUTEC.

ACNOR/CSA Z276  
Liquefied natural gas (LNG) - Production,  
storage and handling

CSA B108.2:21  
Liquefied natural gas refuelling stations installation code

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### To report an emergency :

Énergir Emergency Dispatch Centre :  
**1 855 598-8111 or 514 598-3152**

Gaz Métro Transport Solutions technical support :  
**1 855 324-4678**

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### For information on available LNG training, or any other training on natural gas :

Etg.energir.com  
Etg@energir.com

Telephone : **450 449-6960**  
Fax: **450 449-0766**

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### Limitations

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It is understood that all relevant laws and regulations as well as all applicable standards and recognized good practices during emergency interventions will take precedence over the content of this document. It remains the responsibility of the emergency response services concerned to ensure that all applicable laws, regulations, and standards, as well as generally recognized and observed good practices, are complied with and enforced.

## Summary

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## Objective

This document provides information on liquefied natural gas (LNG) in order to support emergency response services in the event of an incident.

### Liquefied natural gas

Liquefied natural gas (LNG) refers to natural gas in liquid form. This state is reached when the gas is cooled to around  $-162\text{ }^{\circ}\text{C}$  at atmospheric pressure. LNG is a "cryogenic" liquid.

### Liquefied natural gas (LNG)

(Gaz naturel liquéfiée)

GNI

- Cryogenic liquid:  $-162\text{ }^{\circ}\text{C}$  ( $-260\text{ }^{\circ}\text{F}$ )
- Colourless
- Composed of more than 98% methane
- Stored at a relatively low pressure : less than 230 psi (1585 kPa)
- Odour : our LNG contains mercaptan. When it vaporises, the odour emanating from LNG is the same as natural gas, but may be in lower concentrations
- Heavier than air up to  $-100\text{ }^{\circ}\text{C}$  ( $-148\text{ }^{\circ}\text{F}$ )
- LNG, when released into the environment, flows initially as a liquid and can be contained from spreading before it vaporizes
- Non-toxic, can be suffocating (asphyxiant) due to the displacement of oxygen during its vaporization
- Expansion ratio of 600 : 1 when it vaporizes
- Flammable vapours : Narrow flammable range from 5% to 15%



### Compressed natural gas (GNC)

(Gaz naturel comprimé odorized)

GNC

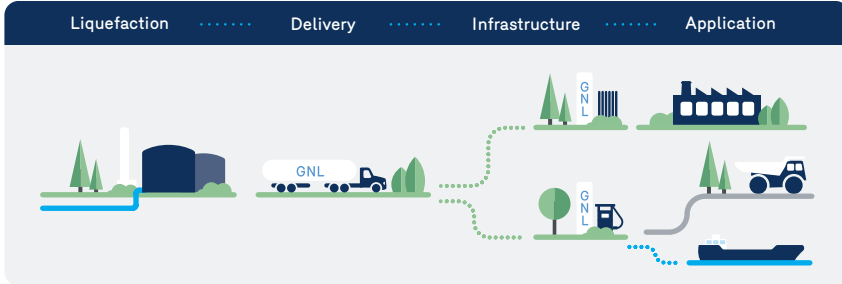
- A gas at ambient temperature
- Colourless
- Composed of more than 95% methane
- Stored at high pressure : 3,000 psi (20684 kPa) and more (ref. : CSA-B108-99)
- Odour: CNG contains mercaptan, a gas that is usually used to odorize natural gas distributed by pipeline
- Lighter than air
- Non-toxic, can be suffocating (asphyxiant) due to the displacement of oxygen during its vaporization
- Flammable vapours : Narrow flammable range from 5% to 15%
- High self-ignition temperature : (Natural gas :  $537\text{ }^{\circ}\text{C}$  ( $998.6\text{ }^{\circ}\text{F}$ )) (Diesel :  $210\text{ }^{\circ}\text{C}$  ( $410\text{ }^{\circ}\text{F}$ ))



## Delivery, infrastructure and applications

LNG has many uses. It is used as a fuel for heavy and maritime transportation and as an energy source for industries in remote areas not served by a gas network.

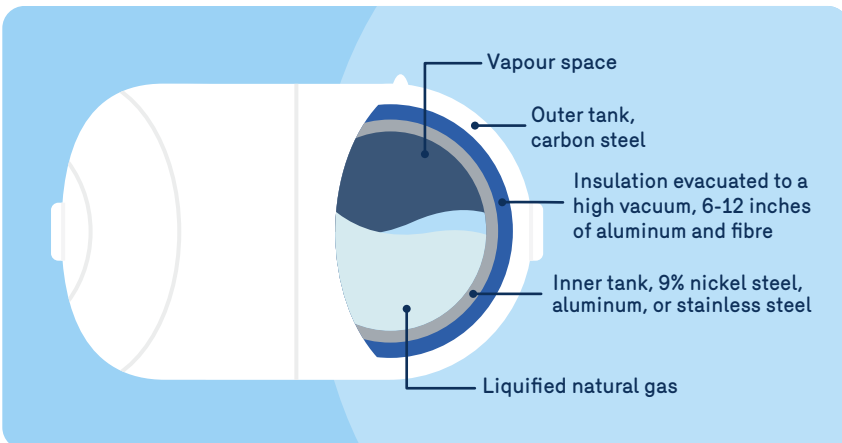
### Énergir distribution system :



### a Delivery

In Québec, LNG is currently delivered in bulk by cryogenic tank (cryotank). LNG can be transported in large amounts inside a tanker truck or thermally insulated double-walled tanker trailer. A guide has been developed specifically for the transport of LNG by Énergir. It can be obtained on request.

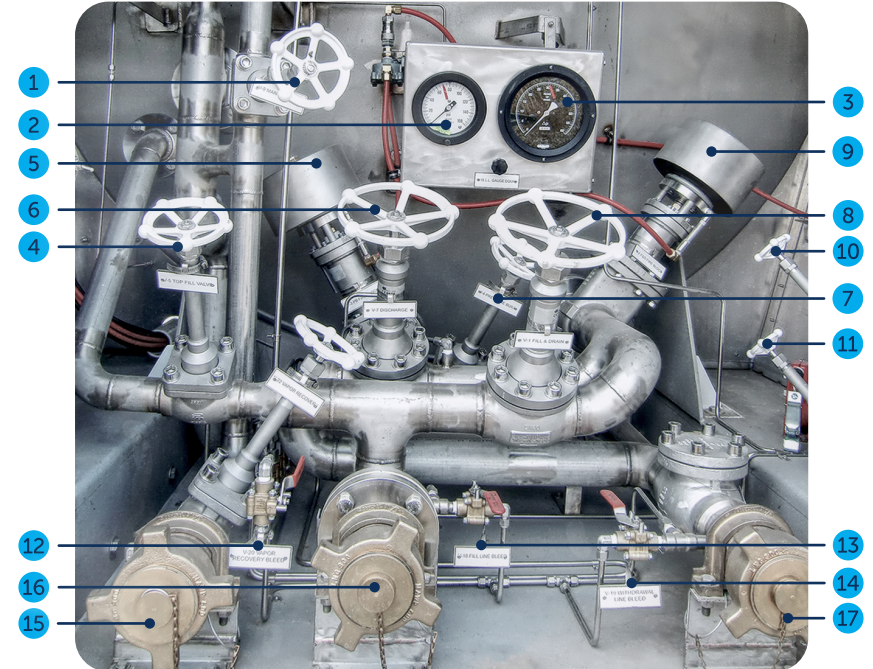
### Composition of a LNG tank :



### b Infrastructure

If it is not directly delivered to a customer, the fuel is then stored in a fuelling station. LNG may be stored in an insulated tank inside a pool or dike holding up to 110% of the tank volume.

### LNG transfer control valves :



#### Legend

- |                                                    |                                        |
|----------------------------------------------------|----------------------------------------|
| 1. Manual vent valve (V-9)                         | 10. Full trycock valve (V-13)          |
| 2. Pressure gauge (PL-1)                           | 11. Liquid sample valve (V-12)         |
| 3. Liquid level gauge (LL-1)                       | 12. Vapour recovery bleed valve (V-20) |
| 4. Top fill valve (V-5)                            | 13. Fill line bleed valve (V-18)       |
| 5. Fire block valve (pressure building coil) (V-3) | 14. Withdrawal line bleed valve (V-19) |
| 6. Discharge line valve (V-7)                      | 15. Vapour recovery connection (DC-3)  |
| 7. Pressure build valve (V-4)                      | 16. Fill connection (DC-2)             |
| 8. Fill and drain valve (V-1)                      | 17. Discharge connection (DC-1)        |
| 9. Fire block valve (fill and drain) (V-2)         |                                        |



## C Application

### Road transport

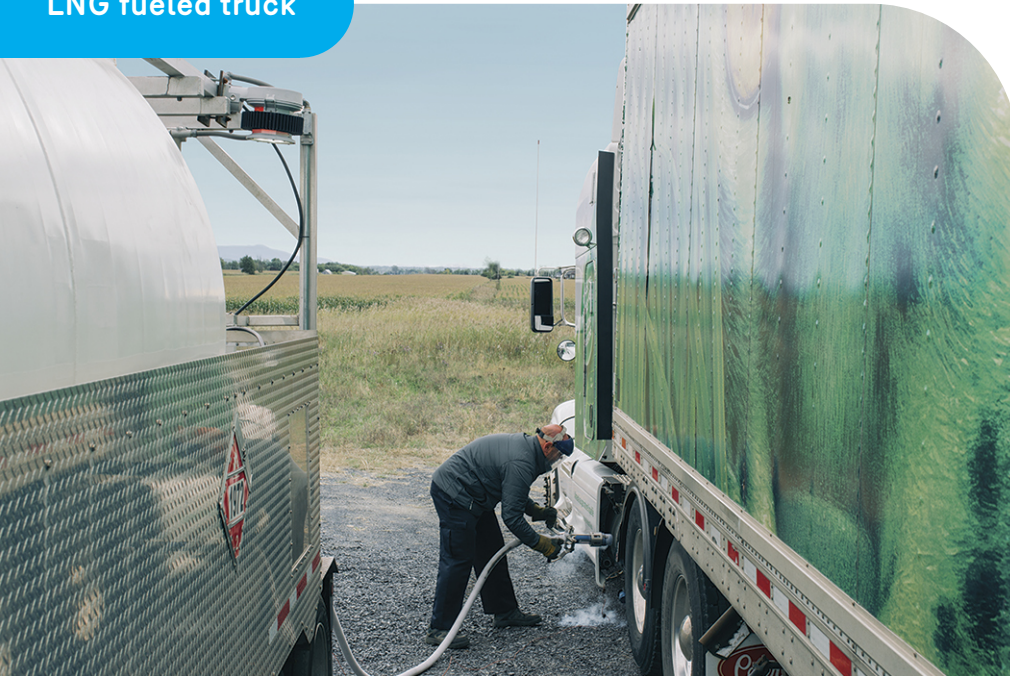
The LNG used as fuel for road vehicles is stored in tanks with similar shapes to diesel tanks. These cylindrical tanks are located at the same spot on the vehicle,

on either side, between the front and rear wheels of the truck or tractor trailer. The tanks have a capacity of 265 to 455 litres (70 to 120 US gallons).

LNG tanks are very robust; tests have shown that it is virtually impossible to deform or pierce them. Weak spots where a leak could occur are at the connection point and control valves. During a major leak, the LNG flows out, producing a cryogenic liquid pool covered with white vapour containing a high concentration of natural gas. This natural gas vapour can ignite, if in contact with a sufficiently hot heat source. The valves on the fuel tanks should never be used in an emergency situation.

There is also a CNG tank on the vehicle. This tank has a small capacity and is used to supply the liquefied natural gas engine's combustion chamber. The location of the tank may vary depending on the truck model.

### LNG fueled truck



### Maritime transportation

Liquefied natural gas is also used as fuel for maritime transportation thanks to a proven, high-performance and cleaner technology than marine diesel. The LNG fuelling of vessel is done from a tank truck which acts as a pump for other tanks connected in parallel.

### Industrial sector

The use of natural gas in Quebec's industries and the mining sector is one of the solutions to combat climate change. Regions such as Gaspésie, Côte-Nord, and Northern Quebec, not served by the gas network, can now also consider having access to natural gas by being supplied with LNG. When a plant uses natural gas instead of fuel oil, it reduces its GHG emissions by up to 32%. It should also be noted that, in several types of industrial processes, electricity cannot replace thermal energy such as fuel oil or natural gas.

Industries using liquefied natural gas in their process receive LNG by truck or iso tank. The LNG is then stored in horizontal or vertical double-walled tanks until it is vaporized and used in the process in its gaseous form.

## Risks

An intervention in the presence of LNG is a specialized operation requiring knowledge of the product's physical and chemical properties in order to reduce the risk. LNG has significant risks that are not the same as natural gas or propane gas. LNG entails major risks.

**When there is an LNG leak, wearing the full protection suit is mandatory, although this type of suit does not provide sufficient thermal protection for a cryogenic product.**

## Spills

An LNG spill produces a cloud of gas that stays at ground level until its temperature warms up to above  $-100\text{ }^{\circ}\text{C}$ , at which point it then floats up. The spilled liquid pools on the ground and flows toward lower points.

### Control measures

- Eliminate all ignition sources ;
- Approach the spill from an upwind direction ;
- Avoid all contact with the product ;
- Find the source of the spill and, if available and safe to do so, apply a leak plugging or control mechanism (i.e. emergency stop button) ;
- Confine the LNG spill to a specific sector using a temporary or permanent physical barrier to minimize the scope and spread of the spill ;
- For an LNG leak outside a building, use a mist spray or install a water curtain to promote the dispersion of LNG in the atmosphere, while avoiding contact between the runoff water and the LNG pool ;
- For an inside leak, evacuate the LNG vapour in the building using recognized natural gas evacuation techniques;
- Risk should not be underestimated if the characteristic rotten egg smell of mercaptan is not highly perceptible.

## Frostbite and freeze burn

LNG running from a tank, free in the environment or inside a transfilling pipe, circulates at an extremely cold temperature, i.e.  $-162\text{ }^{\circ}\text{C}$  ( $-260\text{ }^{\circ}\text{F}$ ). LNG or equipment coming into contact with skin will immediately lead to frostbite. The regular full protection suit worn by firefighters does not provide sufficient thermal protection for direct contact with LNG.

### Control measures

- Avoid all contact with the product ;
- Do not walk in the LNG ;
- Stay a safe distance away from the white vapour cloud produced by the LNG vaporization (upstream of the wind) ;
- Wear cryogenic gloves to handle transfilling equipment ;
- Wear a self-contained breathing apparatus (SCBA).

## Fire and explosion

Vaporized LNG presents a high ignition hazard, but only under certain conditions (when the vapour is in a confined space or a zone with a high level of obstruction). The flammability range of natural gas is from 5% to 15%. At this concentration, LNG could ignite if it comes into contact with an ignition source. An LNG leak in a confined space increases the chances of catching fire and burning. When on fire, LNG generates very intense radiating heat.

### Control measures

- Eliminate all ignition sources ;
- Approach the spill from an upwind direction ;
- Contain the LNG freely flowing from an undiked tank ;
- **Stay a safe distance away from the cloud of white vapour generated by the LNG vaporization ;**
- **Use a chemical extinguisher to put out the fire ;**
- **Don't put out the fire with water. Spraying water on the flames may speed up LNG vaporization and increase flame volume ;**
- Avoid agitating the LNG (by spraying water on it, for example) since this will increase its rate of vaporization.
- Control the runoff water from the water sprays to prevent contact with the LNG ;
- In a confined space, safely ventilate the space to lower the natural gas concentration in the air to less than the lower flammability limit (5% in the air). Act prudently at all times when the natural gas concentration in the air approaches flammability limits .





## Explosion of an LNG tank (BLEVE)

LNG is a flammable gas liquefied by refrigeration contained inside an insulated double-wall tank. While tests have shown that the explosion hazard (BLEVE) of an LNG double-walled tank is virtually nil, precautions must be taken when the outside wall of the tank is damaged or pierced, if the tank is heated for a long period of time, or if there is an impact on the tank at the junction between the tank and the connection point or between the tank and the control valve. BLEVE consequences include the projection of tank fragments, intense thermal radiation, and the creation of a fireball and a shock wave.

### Control measures

- Set up security perimeters with debris projection distances, LNG and possible fireball sizes in mind ;
- **For a tank directly exposed to fire and whose external thermal insulation panel is damaged :**
  - Stay a safe distance away, because an explosion could occur at any time ;
- **For a tank exposed to fire radiation :**
  - Cool the tank with water, if water is available continuously and in sufficient quantity. **If the source of radiant heat is ignited LNG, the flames may be put out with chemical extinguishers.** If water is the only cooling or extinguishing agent available, containment measures may be considered to reduce the contact of water with the LNG, which would increase the fire's intensity.

Do not approach the tank, even if the fire is out, without first having the tank assessed by a specialist. There continues to be an explosion hazard as long as the internal pressure has not been completely evacuated. Using an infrared camera will be a good way to assess the temperature of the tank.

## Asphyxia

While LNG is not a toxic gas, its vaporization promotes the displacement of oxygen, possibly causing asphyxiation. A leak inside an unventilated confined space may therefore represent a hazard for anyone in this same space.

### Control measures

- Wear a self-contained breathing apparatus (SCBA) ;
- Evacuate people inside the security perimeter ;
- Safely ventilate the area to decrease the natural gas concentration in the air ;
- Act prudently at all times when the natural gas concentration in the air approaches flammability limits.

## Tactics

During an intervention in the presence of LNG, the head of operations must determine which tactics to implement based on the priorities and strategy selected. These recognized tactics, in conjunction with safe work methods, enable the situation to be controlled and the integrity of staff and the public to be protected, as applicable.

**The firefighting team needs to keep in mind that an LNG intervention is not handled the same way as an intervention involving a common flammable gas, such as compressed natural gas or propane.**



Use of a fire extinguisher

## Tactics chart

<b>Site control</b>	Set up security perimeters and work zones for operations <b>Goal:</b> Manage the intervention safely and efficiently
<b>Detection and measurement</b>	Detect and measure the concentration of natural gas in the air and assess the ignition and explosion hazard. <b>Goal:</b> Know which are the risky areas and ensure the safety of personnel and the neighbouring population.
<b>Controlling the leak and stabilizing the container</b>	Activate the safety mechanisms on the tank or the fixed installation (red emergency button) <b>Goal:</b> Eliminate or reduce the direct cause of LNG spill.
<b>Containement</b>	Contain the LNG spill to a specific sector using a temporary or permanent physical barrier to minimize the scope and spread of the spill. Control the runoff water from the water sprays to prevent its contact with the LNG. <b>Goal:</b> Reduce the LNG vaporization speed, and ensure the safety of personnel and the population.
<b>Evacuation and rescue</b>	Evacuate and assist anyone who may be affected or threatened by the incident. <b>Goal:</b> Protect the lives of people at risk.
<b>Ventilation</b>	Evacuate the LNG vapour in a building using approved natural gas evacuation techniques. <b>Goal:</b> Eliminate or reduce LNG concentrations and prevent the vapour from igniting.
<b>Controlling the dispersion of LNG vapour</b>	For an LNG leak outside a building, use a mist spray or install a water curtain between LNG and sector to protect to disperse the LNG in the atmosphere, while avoiding contact between the runoff water and the LNG pool. Note : <b>The water curtain does not completely block the movement of LNG vapour.</b> <b>Goal:</b> Promote the dispersion of vapour into the atmosphere and reduce the spread of the hazardous LNG vapour ignition zone.
<b>Water spray system</b>	Install the number of sprays required to prevent the fire from spreading to the neighboring buildings and facilities, taking care not to spray the LNG pool directly <b>Goal:</b> Protect intervention personnel, allow evacuation and rescue, if applicable, and reduce the spread of the fire.

## Tactics chart

<b>Contain the fire</b>	<b>If it is necessary to extinguish the flames to limit the risk of spreading and aggravating the situation, apply a large quantity of chemical extinguishing powder (e.g. type BC or K) to the surface of the LNG, sweeping quickly from left to right to cover the entire surface.</b>  NOTE: Avoid the use of water or conventional foam which would only increase the volume of flames and radiant heat" <b>Goal:</b> Control the spread of the fire and the risk of aggravating the situation if the vapour is left to burn itself off.
<b>Product recovery</b>	The LNG spill will vaporize into the air and dissipate in the atmosphere. The LNG in a tank may be transfilled using the required material, observing recognized procedures and using qualified personnel who will be dispatched to the scene by the manufacturer's or carrier's emergency response plan.  <b>Goal:</b> Control the risk of natural gas emissions into the atmosphere





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