



LNG 液化天然氣



(1) 產品簡介

Liquefied natural gas (LNG) is natural gas that has been cooled down to liquid form for ease and safety of non-pressurized storage or transport. It takes up about 1/600th the volume of natural gas in the gaseous state at standard conditions for temperature and pressure.

The liquefaction process involves removal of certain components, such as dust, acid gases, helium, water, and heavy hydrocarbons, which could cause difficulty downstream. The natural gas is then condensed into a liquid at close to atmospheric pressure by cooling it to approximately -162°C (-260°F). The gas extracted from underground hydrocarbon deposits contains a varying mix of components, which usually includes mostly methane (CH_4), along with ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). The acidic elements such as H_2S and CO_2 , together with oil, mud, water, and mercury, are removed from the gas to deliver a clean sweetened stream of gas. The density of LNG is roughly 0.41 kg/liter to 0.5 kg/liter, depending on temperature, pressure, and composition, compared to water at 1.0 kg/liter.



LNG is odorless, colorless, non-toxic, and non-corrosive. It typically contains more than 90% methane. The heating value depends on the source of gas that is used and the process that is used to liquefy the gas. The higher heating value of LNG is approximately 50 MJ/kg or 21,500 BTU/lb; the lower heating value of LNG is 45 MJ/kg or 19,350 BTU/lb.

The volumetric energy density of LNG is approximately 2.4 times that of compressed natural gas (CNG), which makes it economical to transport natural gas by ship in the form of LNG. The LNG is stored in a specialized double-walled insulated tank at atmospheric pressure ready to be transported to its final destination. International LNG transport travels by special tanker ships. Once on site, the LNG must be stored in vacuum insulated or flat bottom storage tanks. When ready for distribution, the LNG enters a regasification facility where it is pumped into a vaporizer and heated back into gaseous form. The gas then enters the gas pipeline distribution system and is delivered to the end-user.

液化天然氣 (簡稱 LNG) 主要將天然氣轉化為液態在海上運輸，供給技術和經濟上不允許架設管道的情況。氣田生產的天然氣經淨化處理，去除有價值的成份和高分子碳氫化合物，以及對下游產業不利的硫、氮、水等，再經過超低溫液化，得到在常壓下為液體的天然氣。一般液化天然氣處在 1 大氣壓 (1atm) 下，須透過降溫到約攝氏零下 163 度來液化，其體積約為同量氣態天然氣體積的 1/600，重量僅為同體積水的 45% 左右，熱值為 52 MMBtu/t (1 MMBtu = 2.52×10^8 cal)。

LNG 無色、無味、無毒且無腐蝕性，主要含甲烷 (CH_4)，具有熱值大、性能高、安全環保及不易爆炸等特點。與壓縮天然氣 (簡稱 CNG) 相比，等體積 LNG 的能量密度是 CNG (250 bar) 的 2.4 倍或 60% 柴油燃料，因此遠距離的船舶運輸具成本效益。LNG 儲存在低溫和接近常壓下，運輸過程配有專用的低溫 LNG 船舶和 LNG 槽車，運輸至市場再氣化為 CNG 分配給最終用戶，也可直接用於 LNG 汽車或者氣化後用於 CNG 汽車。



(2) 產品用途

Fuel; the primary use of LNG is to simply transport of natural gas from the source to a destination.

燃料 (發電用、工業用、家庭用、交通工具用) 及工業用原料

(3) 產品規格

Quality:

Items	LNG	Test Methods	
		CNS	ASTM
Methane Content (mol.%)	Min. 85	13275	D1945 GPA2261
Butane and Heavier (mol.%)	Max. 2.0	13275	D1945 GPA2261
Sulfur Content (mg/Nm ³)	Max. 35	14476 14665	D3246 D5504
Gross Heating Value (kcal/Sm ³)	Min. 9,000 Max. 10,000	14765	D3588 GPA2172

品質：

項目	數值	試驗方法	
		CNS	ASTM
甲烷含量 (mol.%)	Min. 85	13275	D1945 GPA2261
丁烷以上含量 (mol.%)	Max. 2.0	13275	D1945 GPA2261
總硫含量 (mg/Nm ³)	Max. 35	14476 14665	D3246 D5504
總熱值 (kcal/Sm ³)	Min. 9,000 Max. 10,000	14765	D3588 GPA2172

註：參考 CNS 3719 天然氣標準

(4) 危害辨識資料



Composition listed as follows:

Component Name	CAS Number	Concentration (% Volume)
Methane	7-82-8	88~93
Ethane	74-84-0	< 9
Propane	74-98-6	1~5
n-Butane	106-97-8	0.1~1
Isobutane	75-28-5	0.1~1
Nitrogen	7727-37-9	0.1~1
n-Pentane	109-66-0	0.01~1
Isopentane	78-78-4	0.01~1
Hexane	110-54-3	0.01~0.1
Carbon dioxide	00124-38-9	< 1
Oxygen	7782-44-7	≤0.1

混合物：

化學性質：烷烴類

危害成分	化學文摘社登記號碼	濃度或濃度範圍 (%)
甲烷	7-82-8	88~93
乙烷	74-84-0	< 9
丙烷	74-98-6	1~5
正丁烷	106-97-8	0.1~1
異丁烷	75-28-5	0.1~1
氮氣	7727-37-9	0.1~1
正戊烷	109-66-0	0.01~1
異戊烷	78-78-4	0.01~1
己烷	110-54-3	0.01~0.1
二氧化碳	00124-38-9	< 1
氧氣	7782-44-7	≤0.1

(5) 物理及化學性質

- Appearance: Colorless liquid (refrigerated gas)
- Odor: LNG is odorless; it does not exhibit the characteristic odor of



natural gas.

- Odor Threshold: N/A*; LNG is odorless.
- Melting Point/Freezing Point: No data available
- pH: N/A
- Boiling Point: -259°F (-162°C)
- Flammability: Liquid LNG is not flammable, but its vapors are flammable.
- Decomposition Temperature: Not applicable
- Flash Point: < -306°F (< -188°C)
- Auto-Ignition Temperature: 999°F (537°C)
- Lower Explosive Limit (volume % in air): As low as 4.0% depending upon LNG composition; the higher the ethane content, the lower the lower explosive limit.
- Upper Explosive Limit (volume % in air): As high as 15.0% depending upon LNG composition; the higher the methane content, the higher the upper explosive limit.
- Vapor Pressure: Approximately 700 psia at -110°F
- Vapor Density: 0.0435–0.0481 lb/ft³ at 14.7 psia and 60°F
- Liquid Density: 3.5–4.0 lbs/gallon at -260°F (H₂O = 8.33 lbs/gallon at 60°F)
- Solubility in Water: Negligible, below 0.1%
- Partition Coefficient (n-octanol/water): No data available
- Evaporation Rate (n-butyl acetate = 1): >1

外觀(物質狀態、顏色等)：液化氣體	氣味：無味
嗅覺閾值：-	熔點：-182°C (-296°F)
pH 值：-	沸點/沸點範圍：-161°C ~ -88°C (-258°F ~ -126 °F)
易燃性(固體、氣體)：易燃性氣體	閃火點：-180°C (-292°F)
分解溫度：-	測試方法：開杯
自燃溫度：540°C	爆炸界限：5% ~ 15%
蒸氣壓：-	蒸氣密度 (Air=1)：0.55



密度：420kg/m ³ ~499kg/m ³ @15 °C(59°F)	溶解度：水溶解度：< 0.1% 溶解於無水酒精、苯
辛醇/水分配係數 (log Kow)：—	揮發速率：- (乙酸丁酯 = 1)

(6) 產品包裝

UN Number: UN1972

UN Proper Shipping Name: Natural gas, refrigerated liquid

Transport Hazard Class: 2.1

Packing Group: N/A*

Environmental Hazards:

Special Precautions:

*N/A indicates not applicable; LNG is not authorized to be transported in non-bulk packages under DOT regulations.

聯合國編號：UN 1972

聯合國運輸名稱：冷凍液態甲烷或甲烷含量高的冷凍液態天然氣

運輸危害分類：第 2.1 類易燃氣體

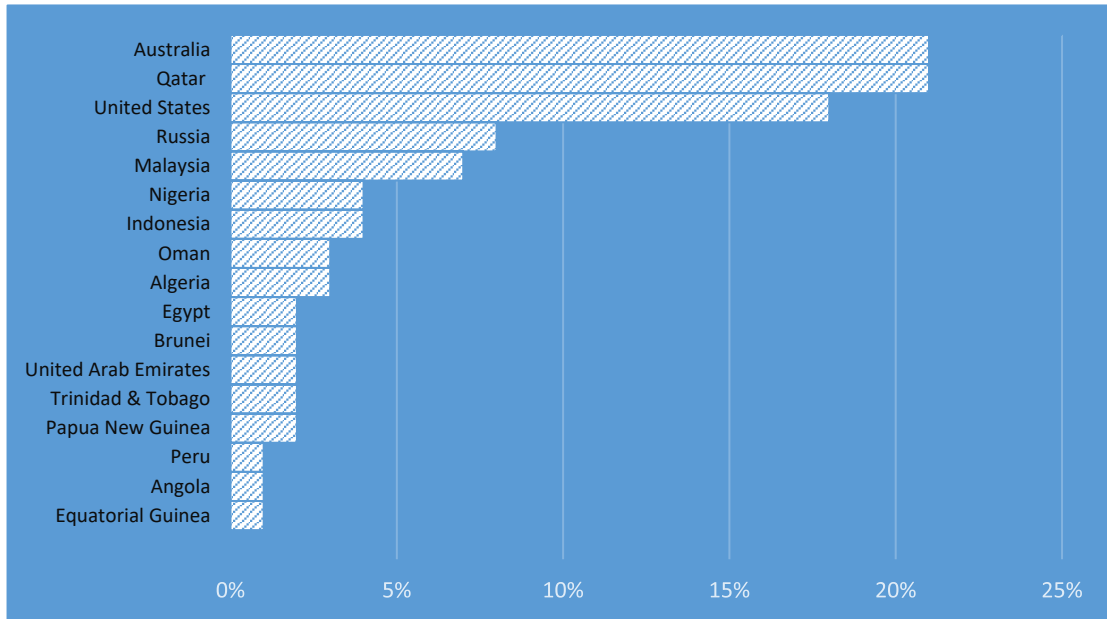
包裝類別：—

海洋污染物 (是 / 否)：否

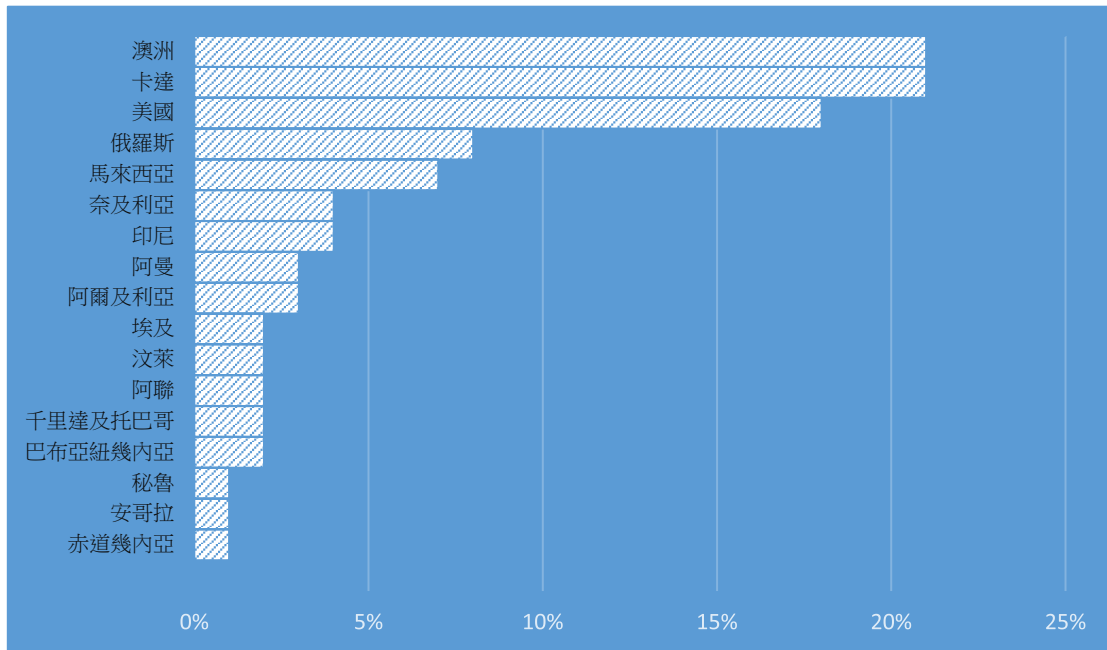
特殊運送方法及注意事項：—

(7) 主要出口國

The LNG export market share worldwide in 2021 is in the diagram shown below: Qatar and Australia were the world's largest exporters of LNG in 2021. Both countries each accounted for 21 percent of global LNG exports. The United States followed, after having grown its liquefaction capacities and is on the way to becoming the largest export market in the coming year.



2021 年 LNG 主要出口國（下圖）為澳洲、卡達、美國、俄羅斯、馬來西亞、阿爾及利亞等，主要進口國為日本、中國、韓國、印度等。亞洲地區目前使用的液化天然氣，主要是開採自澳洲西北部大陸架上的天然氣田。



資料來源：維基百科、中油、Philadelphia Gas Works (PGW)、Statista