

## Helium - Key Facts

- Helium is a chemical element with symbol He and atomic number 2. It is a colourless, odourless, tasteless, and non-toxic gas.
- Helium is the 2nd most abundant element in the universe, after hydrogen. He is relatively rare on Earth, primarily occurring as a byproduct of the natural decay of radioactive elements (e.g. uranium and thorium).
- He is the least dense gas at room temperature and has one of the lowest boiling points of all elements, at  $-268.93^{\circ}\text{C}$  ( $-452.07^{\circ}\text{F}$ ).
- He remains liquid at extremely low temperatures, making it valuable for various applications in cryogenics.
- Helium is considered a finite resource on Earth. Its extraction and storage pose challenges.
- Helium-3 (rare He isotope) has potential applications in nuclear fusion research and as a fuel for future fusion reactors. He-3 is extremely scarce on Earth and mostly found in trace amounts in lunar soil.

## Helium Mining Methods

**Cryogenic Gas Separation:** Natural gas is cooled after extraction, using cryogenic processes, to below  $-269^{\circ}\text{C}$  to undergo liquefaction causing helium to separate.

**Adsorption on Activated Carbon:** In He-rich gas fields, natural gas is passed through beds of activated carbon, which adsorbs helium molecules selectively. Then He is desorbed using temperature or pressure changes.

The separated helium is then collected and further processed to increase its purity level.

## Applications of Helium

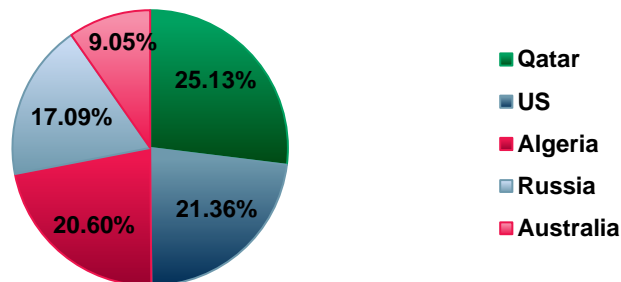
**Scientific Research:** Helium is used in various research applications, such as cryogenics, MRI machines, particle accelerators, and laboratory experiments.

**Medicine:** Helium is utilized in medical imaging technologies like MRI, scanners for diagnostic purposes.

**Industrial Processes:** Helium is used as a shielding gas in welding, as a coolant in nuclear reactors, and in the production of semiconductors and fiber optics.

**Aerospace:** Helium is employed in various aerospace applications, including lifting gas for balloons and airships, pressurizing rocket fuel tanks, and purging systems.

## Top 5 Countries - Helium Reserves (bn cubic meters)

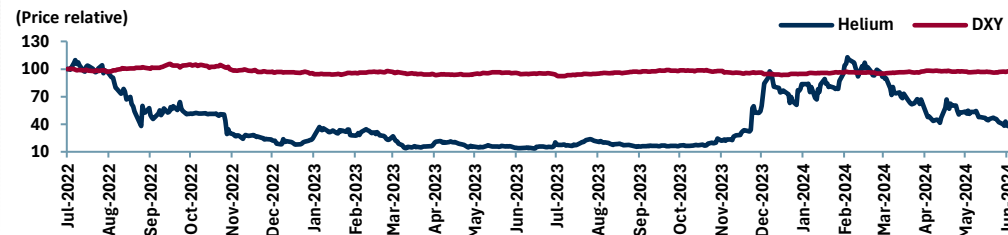


Source: USGS; Insider Monkey, 2023.

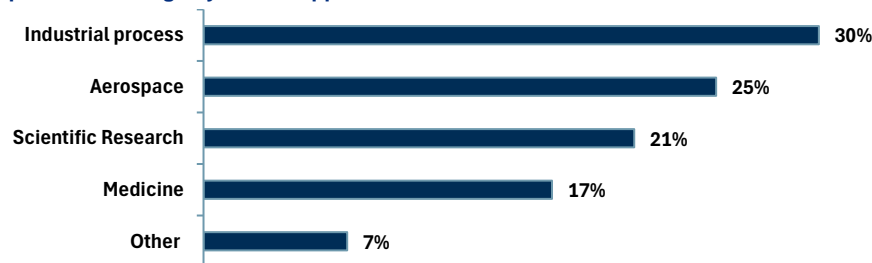
## Helium - Value Chain

- Mining & Extraction:** Helium is primarily extracted as a byproduct of natural gas production. Process = cryogenic separation.
- Processing & Refining:** Once extracted, helium undergoes further purification and refining to remove impurities. Refining processes incl. additional cryogenic distillation or membrane separation to achieve the desired purity.
- Logistics & Transportation:** Helium is transported as a compressed gas or in liquid form under cryogenic conditions in specialised containers to storage facilities, distribution centres, and end users.
- Trading & Distribution:** Helium is traded globally through various channels (e.g. gas suppliers, industrial gas cos., and Helium wholesalers).
- End Users:** Helium is delivered to diverse end users (e.g. research labs, medical facilities, semiconductor manufacturers, and aerospace industries).

## US Dollar Index vs. Helium Jul 2022 – Jun 2024

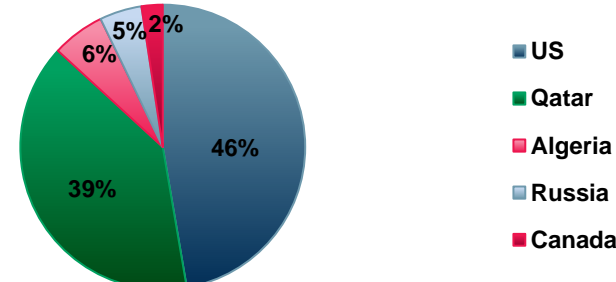


## Top 5 Helium Usage by Sector Application



Source: USGS, 2024.

## Top 5 Countries - Helium Production (m cubic meters)



Source: Global energy prize; US Geological Survey, 2023.

# HELIUM VALUE CHAIN

## Top 5 Helium Trading & Distribution co.s

Air Products (NYSE: APD)  
Linde Plc (NYSE: LIN)  
Air Liquide S.A. (EPA: AI)  
Nippon Sanso Holdings Corp. (4091.T)  
Iwatani Corporation (IWA.MU)

## Top 5 Helium Users

NASA (US govt agency)  
Siemens Healthineers AG (OTCPK: SMMNY)  
GE HealthCare Technologies (Nasdaq: GEHC)  
NVIDIA Corporation (Nasdaq: NVDA)  
Taiwan Semiconductor Manufacturing Co. (NYSE: TSM)

## Top 5 Countries - Helium Reserves

Qatar (25.13%)  
US (21.36%)  
Algeria (20.60%)  
Russia (17.09%)  
Australia (9.05%)



Sources: ACF Equity Research Graphics; Image generated by OpenAI's DALL-E.

## Top 5 Helium Logistics & Transportation co.s

Air Products (NYSE: APD)  
Linde Plc (NYSE: LIN)  
Exxon Mobil Corporation (NYSE: XOM)  
Air Liquide S.A. (EPA: AI)  
Iwatani Corporation (IWA.MU)

## Top 5 Helium Processing & Refining co.s

Air Products (NYSE: APD)  
Linde Plc (NYSE: LIN)  
Exxon Mobil Corporation (NYSE: XOM)  
Air Liquide S.A. (EPA: AI)  
Iwatani Corporation (IWA.MU)

## Top 5 Helium Mining Mid-cap co.s

Royal Helium (TSXV: RHC)  
Avanti Helium (TSXV: AVN)  
Desert Mountain Energy (TSXV: DME)  
Total Helium (TSXV: TOH)  
Global Helium (CSE: HECO)