Helium, Helium-3 & CO₂

Downstream end-uses
& example uses

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Think of "downstream" as where the gas shows up in the real world:

• equipment that *needs* it
• industries that *consume* it
• buyers who pay for it

Up to ~325,000 Minnesota jobs are embedded in advanced manufacturing and helium-dependent industries

Helium (He)

Helium: big volumes, many industries

MRI & medical
Labs (NMR)
Semiconductors
Aerospace
Leak detection

Helium-3 (^{3}He)

Helium-3: niche, security + cryogenics

Neutron detection
Ultra-low temperature
research / quantum R&D

Carbon dioxide (CO_2)

CO_2: big volumes, everyday uses

Carbonation
Dry ice / cold chain
Water & wastewater
Industrial pH control
Food Packaging
Welding

What helium does here

- Keeps superconducting magnets cold enough to work

- Enables stable, high-field imaging for diagnostics

- Losses show up as "helium top-offs" / maintenance

Example users / buyers

- Hospitals & health systems (e.g., Mayo Clinic, Cleveland Clinic, Kaiser Permanente)
- Imaging centers (regional radiology networks)
- OEMs and service providers (GE HealthCare, Siemens Healthineers, Philips)
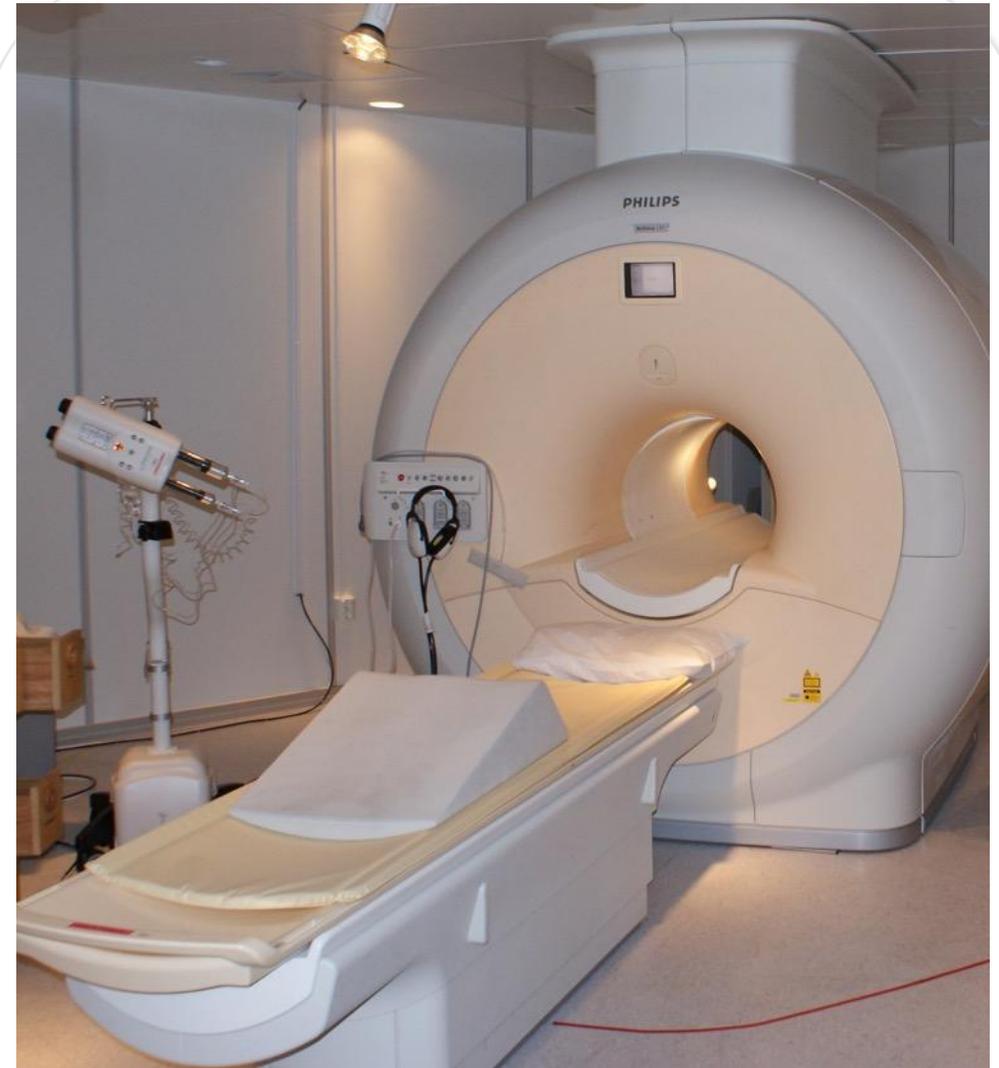
MRI scanners rely on very cold superconducting magnets (often cooled with helium).

What helium does here

- Cools superconducting magnets for NMR spectroscopy

- Supports materials, chemistry, and pharma analysis

- Demand tied to lab uptime and instrument fleet size

Example users / buyers

- Pharma & biotech R&D (e.g., Pfizer, Merck, Novartis, Roche)
- Universities and national labs (chemistry & materials labs)
- Contract research labs (analytical testing providers)

NMR systems use superconducting magnets (helium helps keep them cold).

Where helium shows up

- Inert purge / controlled atmospheres in manufacturing

- Leak checking and high-purity environments

- Demand often tracks fab utilization and tool installs

Example users / buyers

- Chipmakers (e.g., TSMC, Samsung, Intel, Micron, Polar Semiconductors)
- Electronics manufacturers with high-purity processes
- Hospitals
- Universities
- Fiber Optic
- Ship Building
- Aerospace
- Defense

Helium is used across electronics manufacturing (purge, inerting, process support).

What helium does here

- Pressurizes propellant tanks and lines

- Purges systems to reduce contamination and risk

- Used during ground test, fueling, and operations

Example users / buyers (illustrative)

- Launch providers (e.g., SpaceX, ULA, Blue Origin)
- Space agencies (e.g., NASA, ESA)
- Defense & aerospace programs (government and prime contractors)

Helium is widely used for pressurization and purging in rocket systems.

Why helium works for leak testing

- Small atoms: finds tiny leaks other gases miss
- Inert and non-flammable (easy to handle)
- Used with mass-spectrometer leak detectors
- Batteries! Batteries! Batteries! Drone Fleets & EVs

Example users / buyers (illustrative)

- HVAC & refrigeration manufacturers (e.g., Carrier, Trane)
- Automotive & EV supply chain (fuel systems, batteries)
- Medical devices & pharma packaging (quality assurance)
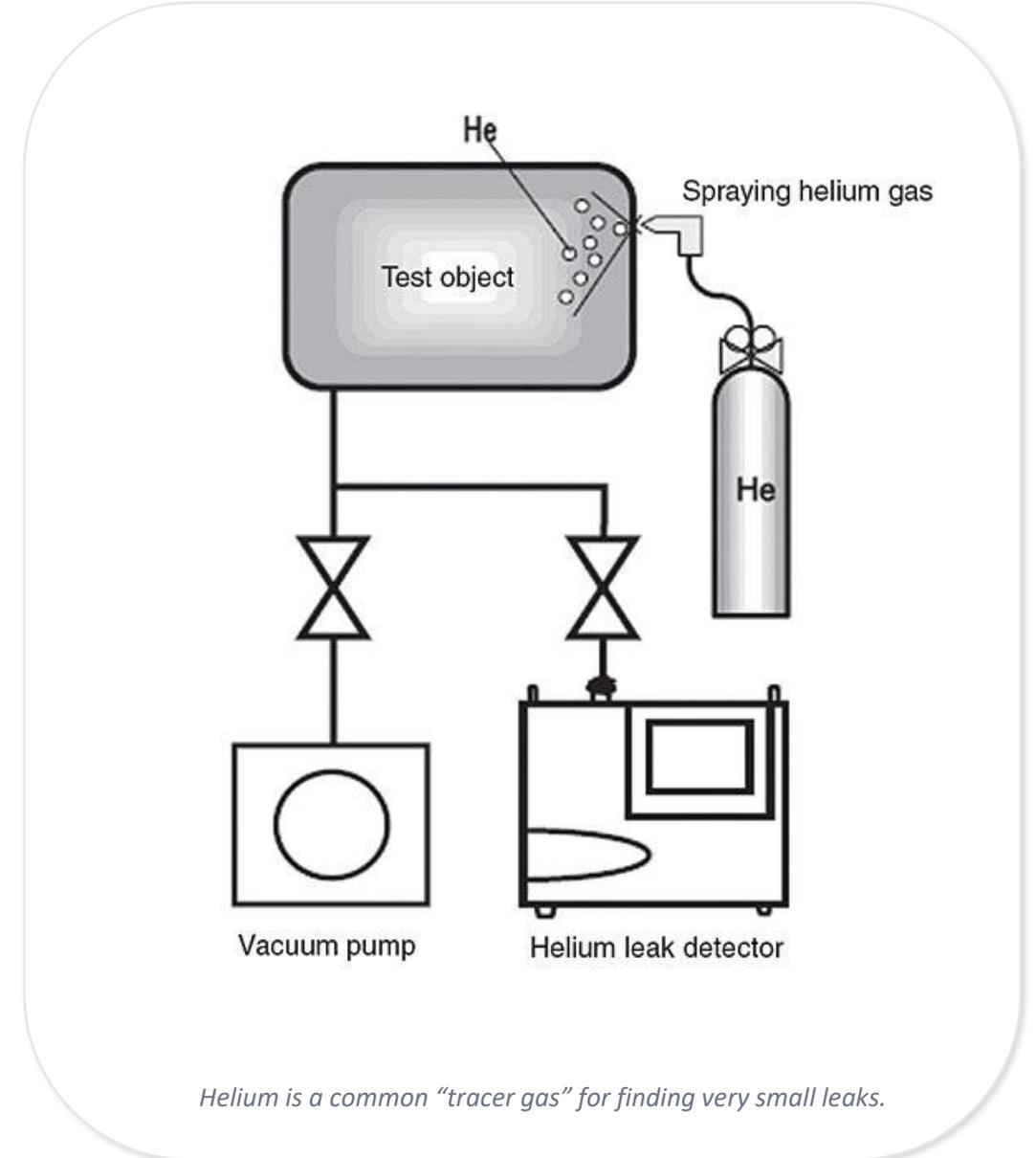
Helium is a common "tracer gas" for finding very small leaks.

Big picture

- Much rarer than regular helium (He)
- Historically critical for neutron detection (security)
- Also used in ultra-low-temperature research systems
- Demand is spiking due to Quantum Computing
- Shortages have led to rationing and Lunar Mining Investments

Where demand shows up

- Security & safeguards (ports, borders, critical sites)
- Scientific facilities (neutron science, nuclear labs)
- Quantum / low-temperature research labs

Many neutron detectors historically used ³He proportional counters.

What helium-3 does here

- Enables sensitive neutron detection (often via proportional counters)
- Used in portal monitors at ports and borders
- Also used in scientific neutron detection instruments

Example users / buyers (illustrative)

- Border and port security agencies (e.g., U.S. CBP / DHS)
- Nuclear regulators & safeguards organizations (e.g., IAEA use cases)
- Detection system integrators & OEMs (radiation monitoring vendors)

Radiation portal monitors screen vehicles and cargo for nuclear material.

What helium-3 does here

- Cooling power comes from mixing He-3 and He-4 at very low temperatures
- Enables millikelvin environments for physics and quantum research
- Demand tied to research capacity and quantum hardware build-outs

Example users / buyers (illustrative)

- National labs & universities (cryogenic physics)
- Quantum computing programs (industry + academia)
- Cryogenic system makers and their installed base (e.g., Bluefors, Oxford Instruments)
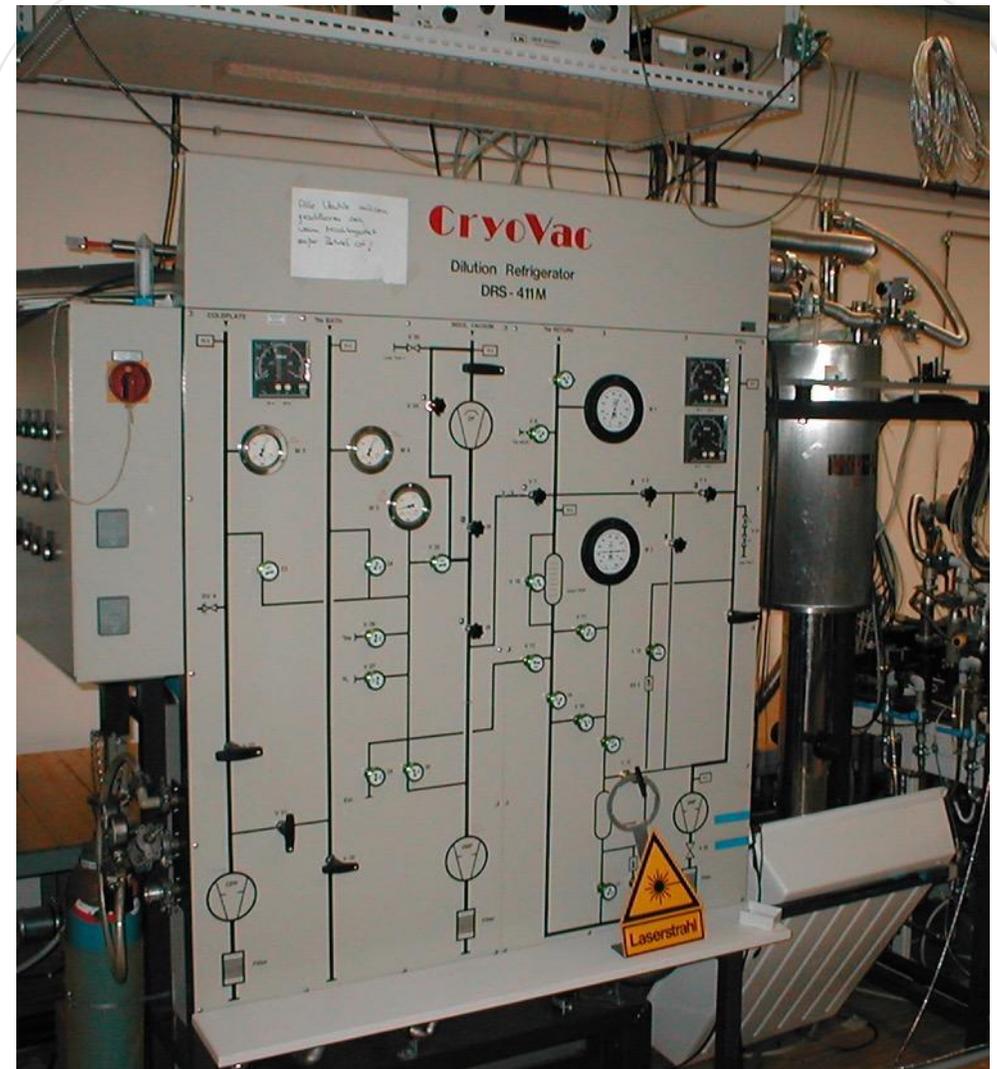
Dilution refrigerators use a He-3 / He-4 mixture to reach millikelvin temperatures.

What CO$_2$ does here

- Adds carbonation ("fizz") and helps with beverage handling

- Used in bottling lines, breweries, and fountain systems

- Demand often tracks beverage output and on-premise activity

Example users / buyers (illustrative)

- Soft drink companies (e.g., Coca-Cola, PepsiCo, Keurig Dr Pepper)

- Brewers (e.g., AB InBev, Heineken, Molson Coors)

- Restaurants & convenience retail (fountain / draft systems)

CO$_2$ is used to carbonate beverages (soft drinks, beer, sparkling water).

What CO₂ does here

- Dry ice keeps products cold during transport (no liquid mess)
- Used for food, pharma, lab samples, and specialty logistics
- Demand spikes around shipping cycles and seasonal peaks

Example users / buyers (illustrative)

- Cold-chain logistics (e.g., UPS, FedEx, airline cargo)
- Pharma distributors & labs (temperature-controlled shipments)
- Food processors and meal-kit / grocery delivery networks

Dry ice is solid CO₂ that sublimates (solid → gas) and provides cooling.

What CO$_2$ does here

- Dissolves into water and forms carbonic acid (gently lowers pH)

- Often positioned as safer than strong mineral acids

- Used for pH adjustment in various water streams

Example users / buyers (illustrative)

- Municipal water utilities and wastewater plants
- Private utility operators (e.g., Veolia, American Water)
- Industrial gas providers supplying bulk CO$_2$ systems

CO$_2$ injection can be used as a controlled, self-buffering way to lower pH.

Where CO$_2$ can fit

- Used where a controlled pH reduction is needed (forms carbonic acid)

- Can complement other treatment steps (neutralization, precipitation)

- Demand tied to site water volumes and compliance requirements

Example users / buyers (illustrative)

- Mining operators (e.g., Rio Tinto, BHP, Freeport-McMoRan)
- Industrial sites with wastewater neutralization needs
- Engineering firms that design treatment systems
- Municipality Water Supply & Treatment

Mining and industrial sites manage water chemistry (pH control is central).

Wrap-up: "cheat sheet" by end-use

Helium (He)

MRI / medical
NMR & labs
Semiconductors
Aerospace
Leak detection
Ship Building
Advanced Welding

Helium-3 (^{3}He)

Neutron detection
Dilution refrigeration
 (mK research / quantum)
Quantum AI
Cold Temp Physics Research

Merchant CO_2

Carbonation
Dry ice / cold chain
Water / wastewater pH
Industrial pH control (Mining/AG)
Food Packaging
Medical
Welding

Q&A