

Helium

What is helium?

Helium is the second most abundant element in the universe! But on Earth it is a relatively rare, non-renewable resource.

Helium is an inert gas, lighter than air. "Inert" means that it does not react chemically with other substances. Helium is a colorless and odorless gas.

Where does helium come from?

Helium is formed underground from the radioactive decay of minerals, like uranium and thorium.

Most helium escapes into the atmosphere, where it eventually leaks into outer space. Airborne helium concentrations are so low at any given time (5.2 parts per million) that it is not economically feasible to extract helium from the air.

Some helium remains trapped in the same underground rock formations that trap natural gas. All commercially used helium is removed from natural gas, but only some natural gas fields contain enough helium content to make it worth extracting.



Helium in Red Valley

Helium is generally thought to be worth recovering from natural gas if it is present in concentrations of at least 0.3%.

In the Dineh Bi Keyah field on the Navajo Nation (Red Valley, Arizona), helium concentrations average at around 4.9%. This is partly why, since 2003, the area has been a target for helium development.

How is helium extracted?

There are two primary steps to extracting helium for commercial, industrial, and research uses:

1. Crude Helium Extraction - First, crude helium is separated from natural gas that has been extracted from the Earth. A natural gas is considered "crude helium" when it is composed of 50-80% helium and contains limited amounts of other substances, like hydrogen. The techniques used to separate helium from the natural gas stream vary depending on the composition of the natural gas. Methods include removing impurities like water and carbon dioxide from the gas mixture, passing the mixture through a filter to remove hydrocarbons, and "cryogenic distillation" (cooling a gas mixture to cause gases to separate).

2. Refined Helium Production – Next, the crude helium is further purified to commercial grade. Commercial grade helium, otherwise known as "Grade A" helium, must be at least 99.996% pure. Several methods can be used, again depending on the composition of the gas. These methods typically involve cooling the crude helium mixture to further separate methane and nitrogen from it. When cooled to extreme temperatures, methane and nitrogen liquify. These liquids are then drained off. The remaining gas is warmed and goes through yet another separation process, eventually yielding commercial grade helium.

What is helium used for?

Helium (either in liquid or gas form) has many uses. Some of these uses are more beneficial to the public good than others.

Magnetic Resonance Imaging (MRI)

technology in the healthcare sector [liquid]: MRI scans are an important non-x-ray technique that provide detailed images of the body. MRIs use superconducting magnets to generate these images, and helium is used to cool down the magnets to the right temperature – approximately -270°C . There is currently no replacement for helium in MRI technology.

Scientific research and engineering [liquid]:

Helium is used in scientific research to keep superconducting magnets and devices cool. Research magnets are used in many branches of science, including physics, biochemistry, geochemistry, biology, and materials science and engineering. Other scientific equipment, such as particle accelerators, contain superconducting magnets, cavities, and other superconducting components that must be cooled. Liquid helium is an ideal, and perhaps the only, substance to perform this cooling function because of its low boiling point and high thermal conductivity.

Leak detection [gas]: Helium is a popular tracer gas used to detect small and large leaks in several products, like pipes, refrigeration and air conditioning systems, automotive parts, vacuum systems, and more.

Diving and breathing mixtures [gas]: Helium is mixed with oxygen to form breathing mixtures that are used as respiratory treatments for conditions like asthma, bronchitis, or emphysema. These mixtures are also used recreationally in underwater diving.

Lifting gas [gas]: Helium is much lighter than air, making it very buoyant and effective for air lifting. In comparison to its counterpart hydrogen, the only element that is lighter than it, helium is not flammable and does not pose a risk of explosion. Helium is used to inflate party balloons, weather balloons, and blimps. The U.S. Department of Defense uses gaseous helium in military reconnaissance research in the development of high-energy lasers and gas-filled nuclear reactors and in weather monitoring, and military reconnaissance.

Welding [gas]: Helium is used as a shielding gas during welding operations.

Controlled atmosphere to produce semiconductors and fiberoptics: Helium is used in the manufacturing of semiconductor chips that are placed in common electronic devices, such as phones, televisions, computers, as well as in the production of fiberoptic cables.

Purge and pressurization [gas]: Helium is used to purge and pressurize rocket systems to prevent explosions. Purging essentially means using helium to remove any potential hazardous gas from an enclosed space, while pressurizing means injecting helium into an enclosure to create a high-pressure environment that prevents hazardous gases from entering. In the United States, the biggest users of helium for purge and pressurization functions are NASA and the Department of Defense.

