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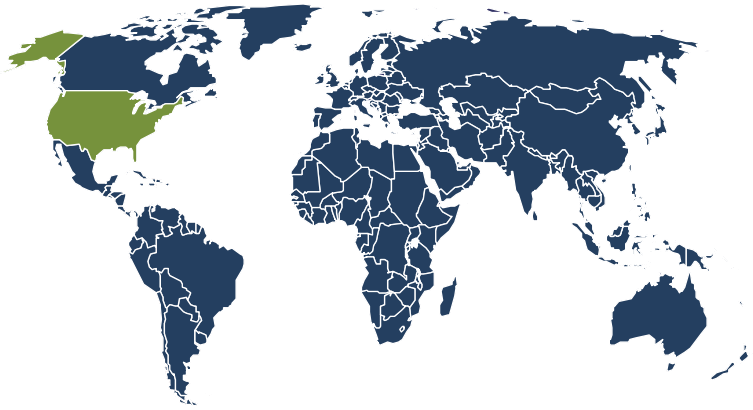
US Collection

Helium: United States

November 2012



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ABOUT THIS REPORT

Sources

Helium: United States represents the synthesis and analysis of data from various primary, secondary, macroeconomic, and demographic sources including:

- firms participating in the industry
- government/public agencies
- national, regional, and international non-governmental organizations
- trade associations and their publications
- the business and trade press
- The Freedonia Group Consensus Forecasts dated August 2012
- the findings of other industry studies by The Freedonia Group.

Specific sources and additional resources are listed in the Resources section of this publication for reference and to facilitate further research.

Scope and Method

This report provides total US helium demand and production in cubic meters. Total demand is segmented in terms of market by:

- cryogenics
- pressurizing and purging
- controlled atmospheres
- welding
- leak detection
- breathing mixtures
- other markets such as chromatography, lifting gas, and heat transfer.

Total demand, production, and the various segments are sized at five-year intervals for historical years 2006 and 2011 with a forecast to 2016. Forecasts emanate from the identification and analysis of pertinent statistical relationships and other historical trends/events as well as their expected progression/impact over the forecast period. Changes in quantities between reported years of a given total or segment are typically provided in terms of five-year compound annual growth rates (CAGRs). For the sake of brevity, forecasts are generally stated in smoothed CAGR-based descriptions to the forecast year, such as “demand is projected to rise 3.2% annually through 2016.” The result of any particular year over that period, however, may exhibit volatility and depart from a smoothed, long-term trend, as historical data typically illustrate.

Key macroeconomic indicators are also provided at five-year intervals with CAGRs for the years corresponding to other reported figures. Other various topics, including

profiles of pertinent leading suppliers, are covered in this report. A full outline of report items by page is available in the Table of Contents.

Industry Codes

The topic of this report is related to the following industry codes:

NAICS/SCIAN 2007 North American Industry Classification System		SIC Standard Industry Codes	
325120	Industrial Gas Manufacturing	2813	Industrial Gases
424690	Other Chemical and Allied Products Merchant Wholesalers	5169	Chemicals and Allied Products, NEC (merchant wholesalers)

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HIGHLIGHTS

- Helium demand in the US is expected to total 51.5 million cubic meters in 2016, representing annual declines of 1.7% from 56.0 million cubic meters in 2011. Demand will be negatively affected by supply and demand imbalances that will continue to add uncertainty and price volatility to the helium market.

- Through 2016, further declines in helium demand will be limited by the need for helium in medical applications such as magnetic resonance imaging (MRI) equipment.

- Demand for helium in the cryogenic market is forecast to total 18.0 million cubic meters in 2016 after experiencing a negligible change from 2011. An aging population and increases in the number of medical conditions will support the demand for helium as the need for MRI scans rise.

- Helium demand in the pressurizing and purging market is projected to remain at 10.0 million cubic meters in 2016. Suppliers will benefit from increasing domestic chemical and allied product shipments.

- Total global helium production in 2011 reached approximately 184 million cubic meters. Through 2016, global demand for and production of helium will be boosted by expanding manufacturing and economic activity.

- US helium exports totaled 84 million cubic meters in 2011, an increase from 61.9 million cubic meters in 2006. Through 2016, helium exports are expected to continue to grow due to rising global demand. However, further export gains will be limited by expansions in helium production facilities in offshore regions.

- Among the leading suppliers of helium to the US market in 2011 were Air Products and Chemicals, Linde (Germany), and Praxair.

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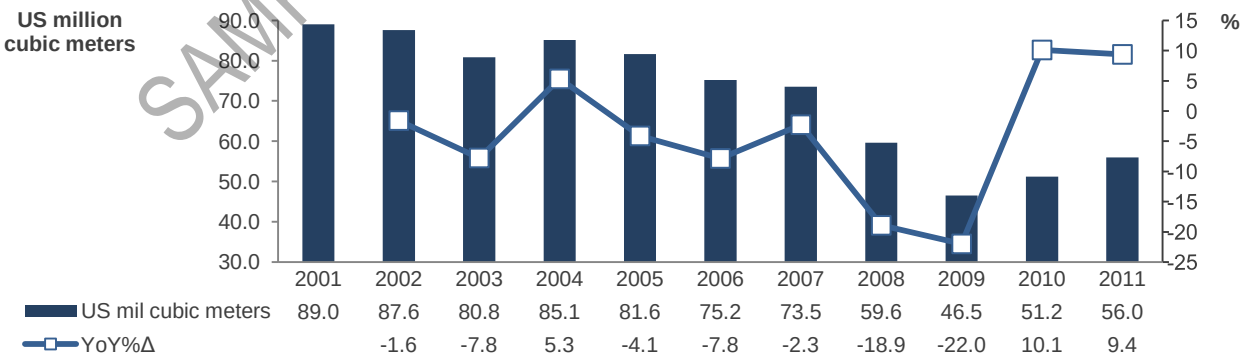
INDUSTRY OVERVIEW

Market Size & Trends

US demand for helium totaled 56.0 million cubic meters in 2011. Over the decade to 2011, helium demand followed a trend of steady, structural decline, which was amplified cyclically by a recession that began in late 2007. Average helium prices rose nearly every year over the period, often at double-digit rates, encouraging helium-consuming industries to use the gas more efficiently (such as by installing retrieving or recycling systems) and/or to employ cheaper substitutes (eg, argon). Indeed, US consumption peaked in the earliest year of the decade at 89 million cubic meters, never to reach that level again. As markets were overcome by cyclical factors in 2008 and 2009, demand dropped at an accelerated pace, approximately 20% each year. At that time, helium suppliers faced slumping output in key consuming sectors such as metal fabrication, chemical processing, and electronics manufacture. Due to ongoing supply shortages, helium prices continued to grow steadily, even as demand fell to a record low in 2009.

In spite of the underlying structural factors weighing on demand over the longer term, suppliers saw short-term annual demand growth of approximately 10% in 2010 and 2011 due to rebounding US manufacturing activity. Nevertheless, 2011 helium demand reached only 75% of pre-recession levels in 2006, and average prices continued to rise.

Chart 1 | United States: Helium Demand Trends, 2001-2011



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
US mil cubic meters	89.0	87.6	80.8	85.1	81.6	75.2	73.5	59.6	46.5	51.2	56.0
YoY%Δ		-1.6	-7.8	5.3	-4.1	-7.8	-2.3	-18.9	-22.0	10.1	9.4

Source: United States Geological Survey

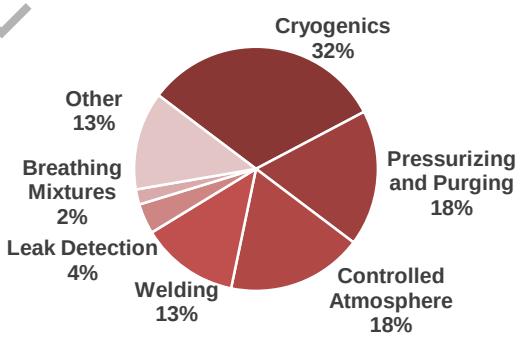
Market Segmentation

Helium demand in the US totaled 56.0 million cubic meters in 2011, a drop from 75.0 million cubic meters in 2006. Major helium markets include cryogenics, pressurizing and purging, controlled atmospheres, welding, leak detection, and breathing mixtures. Helium possesses three properties that drive its demand in industrial and commercial applications:

- it is lighter than air
- it is the most inert substance in the universe
- it remains gaseous (ie, has an extremely low boiling point) even at temperatures that approach absolute zero.

Helium's lightness and inflammability make it suitable in dirigibles, large balloon floats, and party balloons. Its inertness is appropriate for use as a blanketing agent in applications ranging from welding to food processing. Its properties at extremely low temperatures make it valuable in cryogenic applications. Although some applications (eg, lifting gas and MRI machines) are mature, helium is also being employed in advanced applications such as lasers, magnetic levitating trains, next-generation nuclear reactors, and plasma cleaning.

Chart 2 | United States: Helium Demand by Market, 2011
(56.0 million cubic meters)

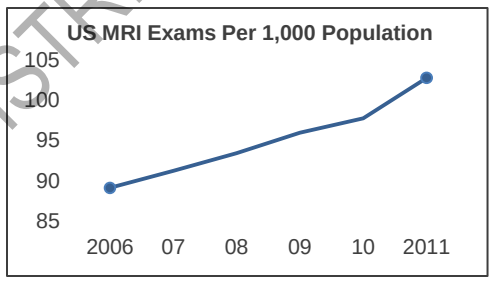


Source: United States Geological Survey

Cryogenics. Helium demand in the cryogenic market totaled 18.0 million cubic meters in 2011, a decline from 21.0 million cubic meters in 2006. Cryogenic applications can utilize liquefied gases such as nitrogen, hydrogen, or helium. However, if cryogenic

temperatures below -429°F are required, there is no substitute for helium. The leading liquid helium use in cryogenic applications is in magnetic resonance imaging (MRI) equipment. MRI machines can provide accurate diagnoses for conditions that previously would have required exploratory surgery. MRIs utilize magnetic fields to produce detailed cross-sectional images of the human body. These machines use superconducting magnets that produce the magnetic field. Liquid helium is utilized to cool the magnets, which create large amounts of heat. Helium's ability to remain fluid at temperatures near absolute zero makes it appropriate for use in this application.

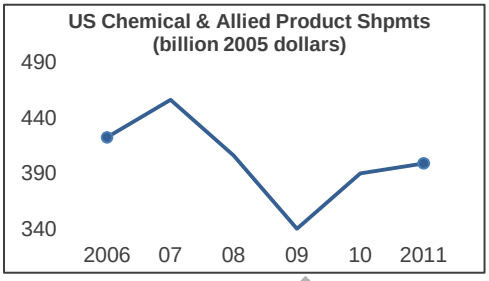
Although newer generations of MRI machines have reduced helium requirements, new and expanded uses of MRI techniques in medical diagnostics aid helium demand. Helium requirements have been lowered due to less material used at the initial fill, as well as an increase in time between refills. Expanding numbers of MRI exams over the 2006-2011 period due to an aging population prevented further declines in helium demand in the cryogenic market. Helium demand was also negatively impacted by a decrease in the construction expenditures for healthcare facilities in 2010 and 2011, some of which utilize MRI machines.



Among other applications, liquid helium is required in scientific research. For example, it is used to keep the magnets in particle accelerators cooled. Similar to MRI applications, nuclear magnetic resonance (NMR) spectroscopy also utilizes the superconducting properties of liquid helium.

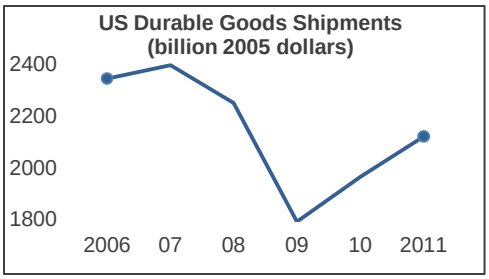
Pressurizing and Purging. Demand for helium in the pressurizing and purging market amounted to 10.0 million cubic meters in 2011, a decrease from 19.5 million cubic meters in 2006. Helium can be used to purge fuel delivery systems and tanks filled with liquid oxygen, liquid hydrogen, and other cold liquids. This is due to the fact that helium remains a gas at low temperatures. Helium's low solubility, boiling point, and inertness make it valuable for use in the chemical industry as a purging gas to clean or

flush out chemical vapors from tanks, pipelines, and containment vessels. Because it is inert, helium will not react with the chemical being purged. In 2008 and 2009, this market was adversely impacted by declines in chemical and allied product shipments due to the 2007-2009 recession. As shipments began to recover in 2010 and 2011, helium demand rebounded.



Helium is also used to purge and pressurize the liquid hydrogen fuel systems of rockets and spacecraft. However, there are developments in space vehicles that do not rely on helium-fed propellent systems.

Controlled Atmospheres. Helium demand in the controlled atmosphere market totaled 10.0 million cubic meters in 2011, an increase from 9.7 million cubic meters in 2006. Helium is utilized in controlled atmospheres because it is inert, has a low density, and a high thermal conductivity. Other lower cost gases, such as nitrogen and argon, can also be used in this application. Among the manufacturing and repair processes that utilize helium controlled atmospheres are the production optical fibers and metallurgical processes. Due to its use in the manufacturing of metals and electronics, helium demand is impacted by trends in durable goods shipments, which experienced declines in 2008 and 2009, before beginning to recover in 2010 and 2011.

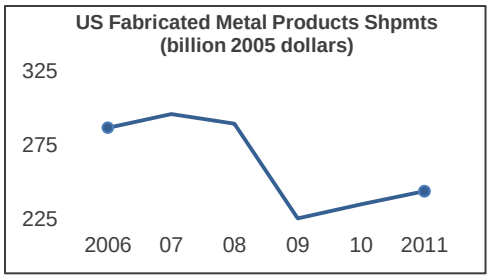


For example, helium can be used to create a protective atmosphere in metal production. However, due to the helium's high cost, it is used only in niche applications. Helium's high arc temperature, high thermal conductivity, and inertness enable the extraction, smelting, and refinement of exotic metals such as niobium and tantalum used in the production of superconductor wire. Other metals that are highly reactive at elevated temperatures, such as titanium and zirconium, are also processed with the help of helium protective atmospheres.

In semiconductor processing, helium is valued for its high thermal conductivity and inertness. Producers of semiconductors employ ultra high purity helium, which may be used in combination with other gases to create an inert atmosphere during the production of semiconductors.

Welding. Demand for helium in the welding market amounted to 7.3 million cubic meters in 2011, a drop from 15.0 million cubic meters in 2006. Any welding process in which the metal is melted before it is joined requires shielding of some sort to protect the molten metal from atmospheric contamination. Helium is used as a shielding gas in welding applications such as gas metal arc welding (GMAW, or MIG, for metal inert gas) and gas tungsten arc welding (GTAW, or TIG, for tungsten inert gas). Helium is also the preferred shielding gas for laser welding.

Trends in the shipments of fabricated metal products impact the need for welding and related demand for shielding gases such as helium. Fabricated metal product shipments dropped in 2008 and 2009 due to the recession before beginning to recover in 2010 and 2011. Helium faces competition from lower cost gases (primarily argon) in welding applications.



Compounding the problem of cost is that helium (because it is so light) does not blanket the weld pool as effectively as a heavier gas (such as argon), thus a higher flow rate of helium gas is required when welding. Therefore, helium is only used when the highest levels of performance are required, such as the welding of certain metal alloys or in quality-critical applications. However, because of its high cost and high performance properties, helium is often combined with argon to provide properties such as a deeper weld penetration and a lower cost.

Leak Detection. Helium demand in the leak detection market totaled 2.3 million cubic meters in 2011, a decline from 3.0 million cubic meters in 2006. In leak detection, helium is carried by nitrogen through pipelines, tanks, reactors, and/or containment

vessels. Because helium atoms are so small and light, they easily escape closed, leak-proof systems if there is any breach or faulty connection. Any escaped helium around such closed systems is easily detected and the leak can be repaired. However, due to helium's cost and supply issues, lower cost alternatives such as diluted hydrogen are being employed in this market.

Breathing Mixtures. Demand for helium in the breathing mixture market amounted to 1.1 million cubic meters in 2011, a decrease from 1.5 million cubic meters in 2006. Helium, in combination with oxygen, can be used as a breathing aid for patients with respiratory problems such as asthma and for individuals who are exposed to high pressures (eg, deep sea divers) for extended periods of time. Helium is the preferred gas because it is quickly absorbed and released by human tissue. In deep sea diving applications, alternatives to helium such as hydrogen are being developed.

Other Markets. Aggregate helium demand in all other markets totaled 7.3 million cubic meters in 2011, an increase from 5.3 million cubic meters in 2006. Other helium markets include lifting gas, chromatography, and heat transfer. As a lifting gas, helium is employed in a variety of balloons (eg, weather and party types), and in blimps and other airships. In some lighter-than-air applications, hydrogen can be substituted for helium. However, hydrogen's flammable nature limits this substitution. In some noncritical applications, helium has been rationed by suppliers to their customers. The use of helium in party balloons, for example, though still popular, has lessened due to shortages and high prices. In many cases, balloons are now filled with a mixture of helium and air to stretch the helium supply.

Among other helium applications, the gas is employed in chromatography, which benefits from helium's inert and non-explosive properties. It is used as a carrier gas for calibrating gas chromatographs and to analyze the purity and composition of any chemical substance. However, helium faces competition in chromatography applications from lower cost gases such as nitrogen and hydrogen. Helium is also used in heat transfer applications because the gas is an efficient heat conductor.

Regulatory Issues

The US Congress established the National Helium Reserve in 1925, which is a strategic supply of the gas stored in a natural geologic gas storage formation near Amarillo, Texas. It was originally established as a supply of lifting gas for airships, and in the 1950s and 1960s was an important source of coolant during the space race and the Cold War. After the Helium Act Amendments of 1960, the US Bureau of Mines arranged for private plants to recover helium from natural gas and ship it via pipeline to keep the reserve filled. This store of helium, administered under the Federal Helium Program (FHP), was refined and sold for years. By 1995, a billion cubic meters of the gas had been collected and the reserve was $1.3 billion in debt, prompting the passage of the Helium Privatization Act of 1996 by Congress. This legislation effectively discontinued the FHP's production and sale of refined helium in 1998. It also directed the government to sell the helium reserve in excess of 600 million cubic feet by 2015, gradually and effectively putting the US government out of the helium business and shifting the onus of meeting future global supply and production targets entirely on the private sector. Due to concerns about helium shortages, the Helium Stewardship Act of 2012 was introduced in April 2012 by the US Senate to extend the sell-down date of the FHP reserve beyond 2015 and sell the government's helium at market prices. However, as of October 2012, the legislation had not been signed into law.

The US Department of the Interior's Bureau of Land Management (BLM) directs the FHP, which includes the government's crude helium pipeline system and the Texas-based Cliffside Field helium storage reservoir. The BLM no longer supplies Grade-A helium to federal agencies; however, private firms must purchase a like amount of crude helium from the BLM if they sell Grade-A helium to federal agencies.

Among other regulations that impact the helium market, the use of industrial gases such as oxygen and helium in medical and healthcare applications falls under the jurisdiction of the US Food and Drug Administration, which must approve their use on human patients.

Production Overview

The helium market is atypical of most other industrial gas markets. Although helium is found in the atmosphere, it is not economically feasible to recover the gas through air separation methods. Because helium accounts for less than 1% of the atmosphere, it is not easily separated from the air like nitrogen or oxygen, nor is it easily manufactured, as is the case for gases such as acetylene. Rather, helium is most commonly obtained as a byproduct of natural gas processing. Therefore, the availability of helium is dependent upon natural gas deposits. The US possesses large deposits of natural helium resources. In 2011, US helium shipments totaled 140 million cubic meters, nearly 60% of which were extracted from natural gas deposits with the remainder deriving from storage. US helium recovery originates from natural gas fields in Colorado, Kansas, New Mexico, Oklahoma, Texas, Utah, and Wyoming.

The radioactive decay of heavy elements (eg, thorium and uranium) generates helium underground. Some of this helium becomes trapped under layers of rock and mixes with natural gas. Most helium is recovered from natural gas through cryogenic extraction processes. In addition, membrane separation systems can be used for recovery applications of helium and other industrial gases. For instance, membrane separation systems can be used for the recovery of hydrogen as a byproduct of crude oil refining, as well as for the recovery of carbon dioxide or helium from natural gas streams.

Once extracted, helium must be refined to 99.99+% purity for commercial use. Purification of the extracted helium is achieved via either pressure swing adsorption (PSA) methods or further cryogenic methods. PSA is the most mature of all major non-cryogenic technologies. This method of air separation employs an adsorbent material to separate a particular gas from an air stream. Helium is categorized into grades based on level of purity. For example, Grade-A helium features a 99.995% or greater purity, while ultra high purity helium has a purity level of 99.999% for use in sensitive applications such as semiconductor manufacturing.

Producers also liquefy helium for storage or transportation in liquid bulk trailers or, in gas form, transport via a helium gas tube trailer. As a gas, helium can be distributed at normal temperature in a pressurized steel or aluminum cylinder. Liquid helium must be kept in a cryogenic insulated container. Customers who receive helium in liquid form may choose to regasify it upon delivery, depending on the use for which it is intended.

Approximately 19 plants in the US were extracting helium from natural gas in 2011. There are also developments in increasing US helium capacity. **Air Products and Chemicals** and **Matheson Tri-Gas** (owned by Japan-based **Taiyo Nippon Sanso**) announced in October 2007 a joint venture to construct and operate a liquid helium production plant near Big Piney, Wyoming. The plant is designed to manufacture 200 million standard cubic feet annually at start-up and has expectations for additional capacity expansion. Crude helium will be processed at the new plant that is produced by a natural gas processing facility owned by **Cimarex Energy** and its partner, **Riley Ridge** (an affiliate of **Wold Companies**). The Cimarex facility will process natural gas from the Riley Ridge Field in Wyoming; this helium-rich natural gas field is believed to contain helium reserves to sustain production for decades. The plant is anticipated to be onstream in late 2012. Upon completion, the Big Piney helium manufacturing plant will represent the tenth liquid helium facility operating in the US, and the first new US facility since 2000.

The domestic production of helium can be adversely affected by manufacturing plant shutdowns and by developments in alternative materials. For instance, a temporary maintenance shutdown occurred in 2011 at **Exxon Mobil**'s helium plant in Wyoming, which is the largest helium facility in the world. In response to high prices and adverse market conditions for helium, gas manufacturers are developing new gas blends that use much less helium or no helium at all. **Praxair**, for example, produces a helium-free mixture, ***STARGON SS***, that is claimed to perform well in stainless steel welding applications.

Pricing Trends

Traditionally, little flexibility existed in the pricing structure of helium due to the presence of the US federal government in the helium market because government-recovered helium was sold at preset prices. However, when this situation changed in 1998, helium pricing became subject to the same supply and demand considerations that determine pricing in other industrial gas segments.

The helium industry is impacted by shortages of helium that have driven up prices and limited supplies. Underpinning the shortages and price increases are two facts. The first is that helium, though the second most common element in the universe, is non-renewable and essentially irreplaceable on this planet, although in many applications it can be recovered and recycled. The second is that, like oil and gas, the easiest to extract and cheapest helium supplies have already been tapped. The expectation is that helium prices will track a pattern similar to that followed by petroleum prices – inexorably upward in the long term and often volatile in the short term. Suppliers of helium recovery and recycling systems will benefit from shortages and high pricing. In addition to the effects of supply and demand on pricing, the costs of helium production, storage, and delivery are also brought to bear on pricing.

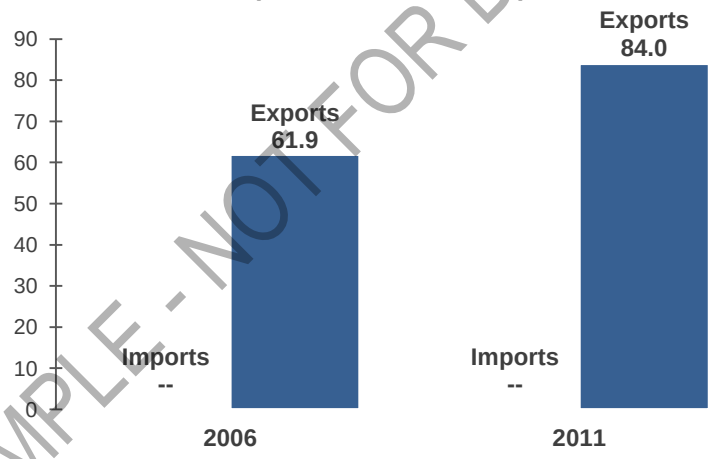
The price for government-owned helium (which was $2.70 per cubic meter for crude helium in FY 2011) is mandated by the Helium Privatization Act of 1996. The estimated price of private industry Grade-A gaseous helium was more than $5.75 per cubic meter in 2011. Over the decade to 2011, there has been a direct correlation between the rise in private industry helium prices and the drop in overall helium consumption as many consumers turned to lower cost alternative gases such as argon and hydrogen. Because aggregate increases in global demand for helium have outpaced growth in supply, helium prices have escalated. Supply and demand imbalances have surfaced in some global and regional markets, and because the global supply chain can affect helium prices even at the local level, production disruptions in foreign plants and delays in new plant completions have caused helium prices to rise.

Trade

The finite supply of helium and its high value make it one of the few industrial gases to support significant foreign trade activity. Exports are a major component of the US helium industry and totaled 84.0 million cubic meters in 2011, an increase from 61.9 million cubic meters in 2006. Imports, however, are negligible. Between 2006 and 2011, helium exports expanded due to rising global demand and world supply disruptions resulting from delayed development projects in Algeria and Qatar.

The bulk of US helium exports were sent to countries in the Asia/Pacific region such as Japan, South Korea, China, and Taiwan. Other major export destinations included Canada and West European countries (eg, Belgium, the United Kingdom, and France).

Chart 3 | United States: Helium Trade (million cubic meters)



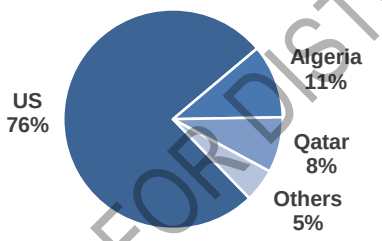
Source: United States Geological Survey

Through 2016, helium exports are expected to continue to grow due to the large levels of US helium reserves and production, and rising global demand. However, further export gains will be limited by expansions in helium production facilities in offshore regions. The US is not expected to import significant amounts of helium in the near future due to the country's large helium reserves. In addition, the US will continue to search and drill for new domestically located gas-bearing fields.

Global Overview

Total global helium production in 2011 amounted to approximately 184 million cubic meters. There is an existing and continually looming global shortage of helium that has driven up prices and limited supplies at a time when demand is blossoming in many developed and developing areas. The US holds less than one-fifth of the earth's known helium reserves but accounts for approximately three-fourths of the world's helium production capacity. The remaining global helium production capacity is located in Algeria, Canada, China, Poland, Qatar, and Russia.

Chart 4 | World Helium Production, 2011
(184 million cubic meters)



Source: United States Geological Survey

Through 2016, global demand for helium is projected to be boosted by expanding manufacturing and economic activity. For example, rising semiconductor production in Asia will spur demand for helium in controlled atmospheres.

As production facility projects are completed and new supplies of helium are discovered, supply shortages will lessen. For instance, in March 2010, German-based **Linde**'s BOC division opened a helium plant in Australia, the first in the southern hemisphere. In 2013, an expansion of helium capacity in Algeria is expected to be completed. A production facility in Qatar is also projected to open by **RasGas Company** (Qatar) in 2013, which will make the country the second largest global helium producer. Developments to extract helium in Russia from natural gas fields in eastern Siberia will also boost global supply over the forecast period.

DEMAND FORECASTS

Market Environment

All macroeconomic indicators related to demand for helium are expected to see growth between 2011 and 2016. Those related to manufacturing generally represent recovery from low levels of activity following the 2007-2009 recession, while healthcare factors are expected to continue advancing at a steady pace.

Table 1 | United States: Key Indicators for Helium Demand (billion 2005 dollars)

Item	2006	2011	2016	CAGR % 11/06	CAGR % 16/11
Gross Domestic Product	12959	13299	15200	0.5	2.7
Resident Population (million)	298.4	311.6	326.4	0.9	0.9
Manufacturers' Shipments	4546	4123	4640	-1.9	2.4
Metal Product Shipments	485.2	457.4	507.0	-1.2	2.1
Chemical & Allied Products Shipments	422.2	398.7	452.5	-1.1	2.6
Semiconductor Shipments (million dollars)	68600	77500	80000	2.5	0.6
National Health Expenditures	2079	2210	2470	1.2	2.2
Total Medical Conditions (million)*	1265	1384	1499	1.8	1.6

*Note: excludes psychological disorders and correctable visual impairments. Source: The Freedonia Group, Inc.

Aggregate real (inflation-adjusted) manufacturers' shipments in the US are expected to advance 2.4% annually through 2016, an improvement from the declines of the 2006-2011 period. Manufacturers' shipments will recover based on a turnaround in durable goods production, particularly output of motor vehicles. Other industries registering respectable growth will include fabricated metal products, and aerospace and other transportation equipment. Growth in nondurable goods shipments will also improve, with notable gains in the chemical and plastics industries.

Inflation-adjusted national health expenditures in the US are projected to increase 2.2% annually through 2016. Advances in medical technologies and materials, shifting age distribution patterns, consumer pressures for higher quality products and services, and the extension of health insurance coverage will promote gains. Based on aging demographic patterns, the incidence of acute conditions and prevalence of chronic conditions will increase steadily over the long term, reaching 1.5 billion in 2016.

Market Forecasts

Helium demand in the US is expected to total 51.5 million cubic meters in 2016, representing annual decreases of 1.7% from 56.0 million cubic meters in 2011. These losses will occur due to supply and demand imbalances that will continue to add uncertainty and price volatility to the helium market. The high cost of helium will place particular restraint on its use in some applications such as welding. Increases in the installation of systems to retrieve and recycle helium are expected to become more attractive and affordable as helium prices rise, which will have a damping effect on helium demand.

However, further declines will be limited by the need for helium in medical/healthcare (eg, MRI equipment) applications. The use of helium in advanced developments (eg, cooling next-generation nuclear reactors) will also prevent further decreases.

Table 2 | United States: Helium Demand by Market (million cubic meters)

Item	2006	2011	2016	CAGR % 11/06	CAGR % 16/11
Helium Demand	75.0	56.0	51.5	-5.7	-1.7
Cryogenics	21.0	18.0	18.0	-3.0	0.0
Pressurizing and Purging	19.5	10.0	10.0	-12.5	0.0
Controlled Atmosphere	9.7	10.0	8.6	0.6	-3.0
Welding	15.0	7.3	6.2	-13.4	-3.2
Leak Detection	3.0	2.3	1.9	-5.6	-3.3
Breathing Mixtures	1.5	1.1	1.0	-6.0	-2.5
Other	5.3	7.3	5.8	6.8	-4.5
Helium Exports	61.9	84.0	105.0	6.3	4.6
Helium Production*	136.9	140.0	156.5	0.4	2.2

*Extracted from natural gas and withdrawn from storage

Source: The Freedonia Group, Inc.

Furthermore, developments in new helium-based products will create opportunities for domestic helium producers, either by exporting helium to the countries that will produce these products or by rising domestic demand if the products are manufactured in the US. For instance, in September 2012, Western Digital Corporation's HGST subsidiary announced a new helium-filled hard disk drive platform. The new platform, with products

anticipated in 2013, offers benefits such as greater capacity and lower operating temperature.

Cryogenics. Demand for helium in the cryogenic market is forecast to total 18.0 million cubic meters in 2016 after experiencing a negligible change from 2011. An aging population and rise in the number of medical conditions will aid demand for helium as the need for MRI scans increases. Growth in the number of MRI machines utilized at medical facilities will also spur helium demand, as will expanding construction expenditures on new healthcare facilities, some of which will utilize MRI equipment. However, these gains will be offset as newer generations of MRI machines have lower helium requirements. For example, in July 2012, **Siemens** (Germany) announced its ***MAGNETOM SPECTRA 3 TESLA*** MRI system received clearance from the US Food and Drug Administration. The ***MAGNETOM SPECTRA 3 TESLA*** MRI system is designed to reduce the total cost of ownership by containing the magnet-cooling helium in a closed loop, which prevents gas from escaping and reduces the need for refills.

The use of particle accelerators and NMR spectroscopy for ongoing scientific research will aid the demand for liquid helium. However, government budget constraints will limit further demand for helium in research applications. For example, in September 2011, the Tevatron machine, which was the largest particle accelerator in the US (located at the Fermi National Accelerator Laboratory in Illinois), was shut down due to lack of funding and from being superseded by the more powerful Large Hadron Collider located near Geneva, Switzerland.

Pressurizing and Purging. Helium demand in the pressurizing and purging market is projected to remain at 10.0 million cubic meters in 2016. Suppliers will benefit from increasing domestic chemical and allied product shipments, which will spur the need for helium to purge chemical vapors. Growth in the production of aerospace equipment in the US will aid the need for helium to purge and pressurize liquid hydrogen fuel systems.

Controlled Atmospheres. Demand for helium in the controlled atmosphere market is expected to decline 3.0% annually through 2016 to 8.6 million cubic meters. This market will continue to face competition from lower cost inert gases such as argon and nitrogen. However, further declines will be limited by expanding domestic metal product shipments, such as the processing of advanced metals like titanium. Rising domestic semiconductor production will aid demand for ultra high purity helium for creating inert atmospheres.

Welding. Helium demand in the welding market is forecast to decrease 3.2% per year to 6.2 million cubic meters in 2016. Helium shortages and price increases will continue to restrain demand for helium in welding. However, growth in fabricated metal product shipments through 2016 and the need for helium in the welding of advanced alloys will prevent further declines in demand. Helium will continue to face competition from argon, a gas that has a lower cost and is often preferred because it is much heavier than helium. However, further decreases will be limited by helium's use in combinations with argon. A helium/argon shielding gas mixture offers lower cost, while still providing some of the favorable properties, such as deeper weld penetration, generally associated with helium.

Leak Detection. Demand for helium in the leak detection market is expected to decline 3.3% annually through 2016 to 1.9 million cubic meters. Helium will continue to face competition from lower cost alternatives such as hydrogen. However, further declines will be limited by an ongoing need to maintain and repair pipelines, tanks, reactors, and containment vessels.

Breathing Mixtures. Helium demand in the breathing mixture market is forecast to decrease 2.5% per year to 1.0 million cubic meters in 2016. Helium will continue to face competition from alternative gases (eg, hydrogen) in deep sea diving mixtures. However, further decreases will be limited by the growing population of residents age 55 and over, as this age group is the most likely to require respiratory therapies that utilize

helium in breathing mixtures.

Other Markets. Aggregate demand for helium in all other markets is expected to drop 4.5% annually through 2016 to 5.8 million cubic meters. Demand for helium as a lifting gas will be restrained by shortages and high prices, which will limit its use in applications such as party balloons. Chromatography applications for helium will continue to face competition from lower cost gases such as nitrogen and hydrogen.

INDUSTRY STRUCTURE

Industry Composition

Helium demand in the US is served by both domestic- and foreign-based suppliers that operate helium extraction facilities in the US. Imports are not as much of a factor in US helium demand as the US is the dominant global helium producer. However, rising global demand for helium is creating export opportunities for helium production operations in the US.

The US helium industry is led by large, multinational gas companies. Among the leading suppliers of helium to the US market in 2011 were **Air Products and Chemicals**, **Linde** (Germany), and **Praxair**. Other suppliers are involved through the ownership and operation of domestic helium extraction facilities, such as **BP** (United Kingdom), **DCP Midstream** (a joint venture between **Phillips 66 Company** and **Spectra Energy**), **EnCana Corporation** (Canada), **Exxon Mobil Corporation**, **IACX Energy**, **K-L Energy Partners**, **Midstream Energy Services**, **Nacogdoches Oil & Gas**, **ONEOK**, **Pioneer Natural Resources Company**, and **SemGroup Corporation**. Other companies involved in the industry include **Airgas**, **L' Air Liquide** (France), and Japan-based **Taiyo Nippon Sanso**'s **Matheson Tri-Gas** subsidiary.

Joint ventures, supply agreements, and other cooperative agreements are important tools for expanding product offerings and technological expertise, and sharing investment risks. Such agreements can give participants access to new product lines or new market segments, or can be used to reduce research and development costs. For instance, **Airgas** maintains long-term supply agreements, such as one that runs through August 2017 to purchase helium and other gases from **Air Products and Chemicals**, and agreements that will expire at various dates through July 2019 with **Linde** for the purchase of helium and other gases. In May 2012, **Praxair** and **Vapotherm** signed multi-year agreement for the distribution and marketing of a new heliox (a respiratory gas comprised of oxygen and helium) delivery system to hospitals in North America and other regions.

Industry Leaders

Air Products and Chemicals Incorporated (NYSE:APD)

7201 Hamilton Boulevard
Allentown, PA 18195
USA
+1-610-481-4911
www.airproducts.com

Air Products and Chemicals (Air Products), a leading supplier of helium to the US market in 2011, is a producer of industrial gases and related equipment, as well as specialty and intermediate chemicals. In FY 2011, the company reported sales of $10.1 billion, of which $4.4 billion were attributed to the US, and employed 18,900.

Air Products participates in the helium industry through its Merchant Gases, and Equipment and Energy segments. The Merchant Gases segment, which reported sales of $4.1 billion in FY 2011, produces atmospheric gases (eg, argon, nitrogen, and oxygen) and process gases (such as hydrogen and helium). The segment's operations include 154 facilities in North and South America, including helium recovery sites in Kansas and Texas. Air Products' ***BIP*** purification technology, which utilizes a specially designed purifier bed and valve, can offer helium and other gases that are up to 300 times purer when compared to normal cylinder gases. Air Products' industrial gas-related services include the ***KEEPCOLD*** service, through which the company supplies helium for filling and maintaining MRI equipment. The company is also involved in the helium market through agreements with third-party firms. For example, in May 2012, Air Products signed a long-term helium supply contract with DCP Midstream's National Helium subsidiary. National Helium provides helium feedstock for Air Products' liquid helium plant, which is located near Liberal, Kansas.

The Equipment and Energy segment, which generated FY 2011 revenues of $401 million, manufactures products such as cryogenic equipment for air separation, and helium distribution products such as cryogenic transportation containers.

Linde AG (FRA:LIN)

Klosterhofstrasse 1
80331 München
Germany
+49-89-35757-01
www.linde.de

Linde North America Incorporated

575 Mountain Avenue
Murray Hill, NJ 07974
USA
+1-908-464-8100
www.lindeus.com

Linde, a leading supplier of helium to the US market in 2011, is an international technology group. In 2011, the company reported sales of $19.2 billion, of which North America represented $2.6 billion, and employed 50,420.

Linde participates in the helium industry primarily through its Gases and Engineering divisions. The Gases division, which reported sales of $15.4 billion in 2011, offers both industrial and medical gases. The company produces industrial gases such as oxygen, nitrogen, carbon dioxide, hydrogen, helium, electronic gases, argon, and other gases and gas mixtures. The company operates a helium plant in Otis, Kansas, as well as facilities in Algeria, Australia, and Qatar. In addition, more than 50 helium transfill facilities are located in major global helium markets. Specific helium products include helium/neon excimer laser gas mixtures, and ***HIQ*** high purity helium gases ranging from process grades to 99.9999% purity. For welding, the company offers products such as ***LASGON C*** mixtures of helium, carbon dioxide, and argon for use with mild and low-alloy steel. Linde's ***CRYOFILL*** service provides liquid helium supplies to MRI systems. Through Linde Healthcare, the company supplies products such as compressed medical gases that include ***HELONTIX*** medical oxygen/helium mixtures. In January 2012, Linde introduced the ***GENIE*** range of gas cylinders, which are lighter than traditional steel cylinders and can be used for helium and other gases and mixtures.

Linde also designs and builds plants that produce gases through its Engineering segment, which generated sales of $3.5 billion in 2011. Among these are tonnage air separation plants, which can produce rare gases such as helium in some special cases; PSA plants, which can be used for helium recovery and purification; and cryogenic plants for applications such as helium liquefying and recovery.

Praxair Incorporated (NYSE:PX)

39 Old Ridgebury Road
Danbury, CT 06810
USA
+1-203-837-2000
www.praxair.com

Praxair, a leading supplier of helium to the US market in 2011, is a major producer of industrial gases, including atmospheric and process gases. In 2011, the company reported sales of $11.3 billion, including US sales of $4.2 billion, and employed 26,185.

Praxair participates in the US helium industry through its North America segment, which reported sales of $5.5 billion in 2011. Through this segment, the company markets process gases such as carbon dioxide, helium, hydrogen, acetylene, electronic gases, and specialty gases. Praxair's helium supply options include bulk gas delivery in high pressure tube trailers, small volume gas in high pressure cylinders, super insulated liquid helium dewars, and bulk liquid delivery in tank trucks. The company serves helium markets such as MRI/NMR, welding, electronics, diving, balloons, aerospace, and atmospheric plasma. In addition to standard products, Praxair manufactures a variety of gas mixtures for specific applications. For example, gas blends for metal fabrication applications include the ***HELISTAR*** product line. Among these products are ***HELISTAR*** argon/helium blends for GTAW and GMAW welding applications. Praxair's ***CRYOMAG SERVICES*** provides services for MRI superconducting magnets, such as helium delivery, transfilling, maintenance, and emergency services. The ***HELITEC*** leak detection service locates leaks in buried pipelines using a helium tracer in nitrogen.

Praxair's US, Canada, and Mexico production sites include 245 cryogenic air separation, hydrogen, and carbon dioxide plants. The company also operates helium and specialty gas plants (including helium facilities in Ulysses and Bushton, Kansas), and packaged gas facilities. In November 2011, Praxair acquired American Gas Group, a global supplier of gases such as helium and argon welding mixtures.

Additional Companies Cited

Airgas Incorporated (NYSE:ARG)	www.airgas.com
BP plc (NYSE:BP & LSE:BP)	www.bp.com
Cimarex Energy Company (NYSE:XEC)	www.cimarex.com
DCP Midstream LLC	www.dcpmidstream.com
EnCana Corporation (NYSE:ECA & TSX:ECA)	www.encana.com
Exxon Mobil Corporation (NYSE:XOM)	www.exxonmobil.com
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K-L Energy Partners LLC	www.klenergy.com
L'Air Liquide SA (EPA:AI)	www.airliquide.com
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ONEOK Incorporated (NYSE:OKE)	www.oneok.com
Phillips 66 Company (NYSE:PSX)	www.phillips66.com
Pioneer Natural Resources Company (NYSE:PXD)	www.pxd.com
RasGas Company Limited	www.rasgas.com
SemGroup Corporation (NYSE:SEMG)	www.semgroupcorp.com
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Spectra Energy Corporation (NYSE:SE)	www.spectraenergy.com
Taiyo Nippon Sanso Corporation (TSE:4091)	www.tn-sanso.co.jp
Matheson Tri-Gas Incorporated	www.mathesongas.com
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RESOURCES

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Related Industry Studies

2895 World Hydrogen, July 2012	see study contents
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Agencies and Associations

Compressed Gas Association	www.cganet.com
Gases and Welding Distributors Association	www.gawda.org
Organisation for Economic Co-operation and Development	www.oecd.org
United States Census Bureau	www.census.gov
United States Department of the Interior	www.doi.gov
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USA
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+1 440 646 0484 fax
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