

2017 Minerals Yearbook

HELIUM [ADVANCE RELEASE]

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Domestic consumption of Grade-A helium (99.995% or greater purity) in 2017 was 45.3 million cubic meters² (1.63 billion cubic feet). Exports by private producers were 73.7 million cubic meters (2.66 billion cubic feet), and imports of helium were 18.5 million cubic meters (667 million cubic feet). Total sales of U.S.-produced helium totaled 101 million cubic meters (3.62 billion cubic feet), a 12% increase from that in 2016. In 2017, domestic helium consumption decreased by 14%, helium exports increased by 21%, and helium imports decreased by 22% from those in the prior year (table 1).

Legislation and Government Programs

On October 2, 2013, the U.S. Congress passed the Helium Stewardship Act of 2013 (HSA; U.S. Congress, 2013). With the passage of the HSA, Congress assured continuation of the Federal helium program, but with significant changes to its operation. The HSA sought to mitigate helium shortages by enabling the sale of crude helium from the Federal Helium Reserve with the expectation of increasing taxpayer returns, while also stimulating investment in private helium sources through market-driven sales. The HSA provided for an orderly transition in four phases.

Phase A, Allocation Transition.—This phase began upon passage of the HSA and ended on September 30, 2014. This phase was a continuation of the instructions to the U.S. Government in the Helium Privatization Act of 1996 to sell much of the National Helium Reserve and the prescribed sales volumes and conditions (U.S. Congress, 2013).

Phase B, Auction Implementation.—Initiated on October 1, 2014, this phase will end when the crude helium stored in the Federal Helium Reserve reaches 3 billion cubic feet. In July 2014, the Bureau of Land Management (BLM) conducted the first auction of helium for delivery during fiscal year 2015. The auction was open to all qualified bidders as defined in 50 U.S.C. 167d(b). The latest auction and sale were conducted in July 2017 for deliveries in fiscal year 2018. At the 2017 sale, 11.1 million cubic meters (400 million cubic feet) were to be offered at auction and 13.9 million cubic meters (500 million cubic feet) were to be sold at the allocated and non-allocated sale, respectively. At the next sale in 2018, 70% of the helium available for sale is to be sold at auction, and subsequently the amount is to increase by at least 15% from that of the previous year until 100% is achieved.

Phase C, Continued Access for Federal Users.—This phase is to begin when the remaining crude helium stored in the Federal Helium Reserve reaches 3 billion cubic feet. The BLM would continue to provide crude helium for sale to Federal users. There would be no sale or auction of helium to private entities, but deliveries to private entities of helium sold during phase B may continue. Current projections show that phase C would begin on October 1, 2018, after helium sold for delivery in fiscal year 2019 has been transferred to private accounts.

Phase D, Disposal of Assets.—During this phase, the Secretary of the Interior is required to dispose of assets no later than September 30, 2021. These assets include all underground natural resources and the United States' rights to those assets. Unlike the requirements of the Helium Privatization Act of 1996 (U.S. Congress, 1996), the BLM will no longer be required to sell helium from the reserve in equal annual volumes. Under the HSA, sales can match the amount available for production from the reserve.

The HSA also contains four sections requiring studies and evaluations by the U.S. Geological Survey (USGS), the U.S. Department of Energy (DOE), and the BLM. The USGS is required to complete a helium gas resource assessment, and the DOE is required to support research into low-British thermal unit (Btu) gas separation and helium conservation and determine the feasibility of separating helium-3 gas from crude helium or other sources. The BLM, in cooperation with Federal users of helium, is to complete an assessment of consumption and demand for helium by Federal users and a 20-year strategic helium acquisition plan for Federal users.

The USGS is expected to complete the helium gas resource assessment by 2018. The DOE is sponsoring at least one low-Btu gas separation project. The BLM-sponsored assessment and 20-year strategic acquisition plan were completed in April 2015. Highlights of the BLM the report are as follows:

Federal helium demand is expected to remain relatively flat from 2015 through 2021. The demand projections for the next 20 years are also flat but contributing Federal agencies that use helium show less confidence in these projections.

After the helium program ends in 2021, Federal users must obtain helium from other sources. The acquisition strategy for Federal agencies comprised five parts: (1) promulgate regulations to begin a royalty-in-kind program from helium extracted on Federal lands; (2) establish an interagency working group that includes a Federal Strategic Sourcing Initiative to ensure all Federal agencies and intramural contract holders are fully supplied; (3) provide funding for conservation, recycling, and recapture efforts; (4) conduct an economic evaluation of options to continue a modified helium program beyond 2021; and (5) form an interagency working group to monitor these strategies and suggest changes as the helium market evolves.

Although future price projections are uncertain, the U.S. Department of the Interior (DOI) expected that the 20-year

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²All metric helium volumes herein are at 101.325 kilopascals absolute (14.696 pounds per square inch absolute) and 15 degrees Celsius (°C) [59 degrees Fahrenheit (°F)]. Helium volumes, reported in parentheses following metric units, are measured in cubic feet at 14.7 pounds per square inch absolute and 70 °F—1,000 cubic feet (14.7 pounds per square inch absolute and 70 °F) equals 27.737 cubic meters (101.325 kilopascals absolute and 15 °C) and 1 cubic meter (101.325 kilopascals and 15°C) equals 36.053 cubic feet (14.7 pounds per square inch absolute and 70 °F)

strategy also would mitigate the effects on Federal agencies of higher prices for refined helium in the private market. This strategy might also deflect the immediate need for prioritization of helium uses. However, the BLM recommended formation of an interagency working group to continuously assess Federal agencies' helium needs, update helium demand and projections, and provide a process for the prioritization of uses when necessary.

Production

In 2017, 10 companies operated 18 privately owned domestic helium plants. Of the 18 operating plants, 6 extracted helium from natural gas to produce a crude helium product, 6 produced Grade-A helium, and 6 produced a gaseous helium product containing about 99% helium (table 2). The six gaseous helium plants used a combination of pressure swing adsorption and membrane technology to extract helium. All crude helium plants and Grade-A helium facilities used cryogenic extraction processes. The six privately owned plants that produced Grade-A helium also produced liquefied helium.

Total sales of U.S.-produced helium in 2017 increased by 12% compared with those in 2016 (table 1). All of the natural gas processed for helium recovery came from gas fields in Colorado, Kansas, Oklahoma, Texas, Utah, and Wyoming (figs. 1, 2). Domestic production data for helium were developed by the BLM from records of its own operations and from an annual voluntary canvass of private U.S. operations. Of the 10 operations to which a survey request was sent, 9 responded, and those data, in conjunction with information from BLM operations, represent 100% of the total helium sales and recovery data listed in table 3.

Most domestic helium production was from the Midcontinent and Rocky Mountain regions. The measured helium reserves from which helium is produced are in approximately 104 gas fields in 11 States. Most of these reserves are contained in the Hugoton Field in Kansas, Oklahoma, and Texas; the Panoma Field in Kansas; the Keyes Field in Oklahoma; the Panhandle West and Cliffside Fields in Texas; and the Riley Ridge Area Fields in Wyoming. About 20% more helium was produced in 2017 than in 2016 from the Government's helium reserve at Cliffside Field, near Amarillo, TX.

Consumption

The major domestic end uses of helium were magnetic resonance imaging (30%); scientific, engineering, analytical, lab, and specialty gases (20%); lifting gases (17%); welding (9%); and controlled atmosphere, fiber optics, and semiconductors (9%) (fig. 3). Other uses included diving, leak detection, and pressurizing and purging (Campbell and Garvey, 2016).

In 2017, U.S. domestic helium consumption decreased by 14% to 45.3 million cubic meters (1.63 billion cubic feet) compared with consumption in 2016. In 2017, U.S. helium exports increased by 21% to 73.7 million cubic meters (2.66 billion cubic feet) compared with those in 2016 (table 1).

In-kind crude helium sales regulations (43 CFR part 3195) require helium refiners that sell helium to Federal agencies and their contractors to buy an equivalent amount of crude

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In 2017, U.S. helium exports increased by 21% to 73.7 million cubic meters (2.66 billion cubic feet) compared with those in 2016 and accounted for 75% of sales of U.S.-produced helium; private industry supplied all of the U.S. helium exports (table 1). Regionally, North America, Central America, and the Caribbean, combined, received 27.1% of the helium exported from the United States; Asia and the Pacific received 47.8%; Europe, 12.5%; South America, 9.0%; the Middle East and Africa, combined, 3.0%; and Australia and New Zealand, combined, 0.7%.

In 2017, imports of helium decreased by 22% to 18.5 million cubic meters (667 million cubic feet) from 23.7 million cubic meters (854 million cubic feet) in 2016 (table 1). This was the first year that helium imports decreased after several years of increased helium imports.

Stocks

The volume of helium stored in the BLM helium conservation storage system, including the conservation pipeline network and the Cliffside Field, totaled 196.5 million cubic meters (7.08 billion cubic feet) on December 31, 2017. The storage system contained crude helium purchased under contract by the Government from 1962 to 1973 and privately owned helium extracted by industry from natural-gas-supply fuel markets and stored under contract (fig. 4). This privately owned helium is returned to the owners as needed for purification to supply private demand. During 2017, 4.5 million cubic meters (162 million cubic feet) of privately owned helium were delivered to the BLM's helium conservation system, and 32.7 million cubic meters (1.18 billion cubic feet) were withdrawn, for a net decrease of 28.2 million cubic meters (1.02 billion cubic feet) of private helium in storage (table 4).

Transportation

Private producers and (or) distributors shipped helium, predominantly as a liquid, in semitrailers, which delivered the helium to distribution centers. Once received, some helium was gasified and compressed into trailers and small cylinders for delivery to end users. The remaining liquid helium was sold as bulk liquid or repackaged in dewars of various sizes for delivery.

Prices

The HSA required the BLM to use market-based pricing for its crude helium sales to private industry. In 2017, the conservation price was based on the annual auction results and an independent, confidential, market survey of helium industry prices. The in-kind price was set at approximately 80% of the conservation price for the prior year. For fiscal year 2017, the conservation price was \$3.86 per cubic meter (\$107 per thousand cubic feet) and the in-kind price was \$2.99 per cubic meter (\$83 per thousand cubic feet).

Foreign Trade

World Review

Total world production capacity was approximately 270 million cubic meters (9.73 billion cubic feet) in 2017. Excluding the United States, world production capacity of helium was estimated to be 110 million cubic meters (3.97 billion cubic feet) in 2017 (table 5). U.S. helium production capacity accounted for an estimated 59% of the world production capacity. In addition to the United States, helium was produced in Algeria, Australia, Poland, Russia, and Qatar. Worldwide, several projects were in the planning stage.

Outlook

From 2008 through 2012, total global sales of helium produced in the United States increased by 3.5% per year. That trend reversed in 2013 with the addition of capacity in Qatar and a decrease in global demand. U.S. domestic helium consumption is expected to remain stable during 2018. Because of increased capacity of foreign plants and lower helium production in the United States, exports are expected to decrease, and imports are expected to increase during 2018.

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TABLE 1 SALES OF GRADE-A HELIUM IN THE UNITED STATES

(Million cubic meters)

	Volume ¹					
	Domestic			Total sales of		
Year	consumption ²	Exports ³	Imports ³	U.Sproduced helium		
2013	39.2 ^r	81.2 r	2.4	118.0		
2014	42.2 ^r	67.5 ^r	7.4 ^r	102.3 ^r		
2015	41.6 ^r	64.8 r	15.7 ^r	90.7		
2016	52.8 ^r	60.8 ^r	23.7 ^r	89.9 ^r		
2017	45.3	73.7	18.5	100.6		

^rRevised.

¹Data are rounded to no more than three significant digits.

²Defined as total sales of U.S.-produced helium plus imports minus exports; may not add to totals shown.

³Source: U.S. Census Bureau.

TABLE 2 OWNERSHIP AND LOCATION OF HELIUM EXTRACTION PLANTS IN THE UNITED STATES IN 2017

Owner or operator	Plant name	Status	Location	Product purity ¹
Air Products Corporation, Inc.	Liberal	Operating	Seward County, KS	Grade-A helium.
Do.	Panhandle	Standby	Hansford County, TX	Do.
Do.	Doe Canyon	Operating	Dolores County, CO	Do.
Do.	AP/MTG	Standby	Sublette County, WY	Do.
DCP Midstream, LLC	Ladder Creek	do.	Cheyenne County, CO	Do.
Do.	National	Operating	Seward County, KS	Crude helium.
Do.	Rock Creek	do.	Hutchinson County, TX	Do.
Do.	Sher-Han	do.	Hansford County, TX	Do.
DenburyOnshore, LLC	Riley Ridge	Standby	Sublette County, WY	Do.
Eagle Rock Energy	Sunray	Operating	Moore County, TX	Do.
ExxonMobil Gas Marketing Co.	LaBarge	do.	Sweetwater County, WY	Grade-A helium.
IACX Energy	Dineh-Bi-Keyah	do.	Apache County, AZ	Produces gaseous helium only.
Do.	Harley Dome	do.	Grand County, UT	Do.
Do.	Hodgeman	do.	Hodgeman County, KS	Do.
Do.	IACX Otis	do.	Rush County, KS	Do.
Do.	Badger Wash	do.	Mesa County, CO	Do.
Do.	Paden	do.	Okfuskee County, OK	Do.
Linde Global Helium, Inc.	Linde Otis	do.	Rush County, KS	Grade-A helium.
Linn Energy, LLC	Jayhawk	do.	Grant County, KS	Crude helium.
Midstream Energy Services, LLC	Keyes	do.	Cimarron County, OK	Grade-A helium.
Pioneer Natural Resources Co.	Fain	do.	Potter County, TX	Crude helium.
Praxair, Inc.	Ulysses/Jayhawk	do.	Grant County, KS	Grade-A helium.
Do.	Bushton	Standby	Ellsworth County, KS	Do.

Do., do. Ditto.

¹Grade-A helium, including liquefaction, contains at least 99.99% helium. Gaseous helium generally contains at least 98% helium. Crude helium generally contains between 60% and 80% helium.

TABLE 3 HELIUM RECOVERY IN THE UNITED STATES¹

(Million cubic meters)

	2013	2014	2015	2016	2017
Crude helium:					
Bureau of Land Management (BLM) sold (in-kind					
and open market)	61.8	53.2	28.1 ^r	31.7 ^r	28.6
Private industry:					
Private helium accepted and stored by BLM	11.7	10.6	10.3	12.6	4.5
Helium withdrawn from storage	-60.8	-37.7	-29.9	-35.6	-32.7
Total net helium put into storage	-49.1	-27.1	-19.6	-23.0	-28.1
Grade-A helium:					
Private industry sold	118.0	102.3 ^r	90.7	89.9 ^r	100.6
Total helium stored	-49.1	-27.1	-19.6	-23.0	-28.1
Helium recovery from natural gas	68.9	75.2 ^r	71.1	66.9 ^r	72.4

^rRevised.

¹Negative numbers denote a net withdrawal from BLM's underground storage facility, a partially depleted natural gas reservoir at the Cliffside Field near Amarillo, TX.

TABLE 4

SUMMARY OF BUREAU OF LAND MANAGEMENT (BLM) HELIUM CONSERVATION STORAGE SYSTEM OPERATIONS^{1, 2}

(Million cubic meters)

	2013	2014	2015	2016	2017
Helium in conservation storage system on January 1:					
Stored under BLM conservation program ³	306.1	242.9	188.4	159.5	126.3
Stored for private producers under contract	37.4	51.1	77.7	86.5	95.5
Total ³	343.5	294.0	266.1	246.0	221.8
Input to system:					
Net deliveries from BLM plants					
Stored for private producers under contract	11.7	10.6	10.3	12.6	4.5
Total ³	11.7	10.6	10.3	12.6	4.5
Redelivery of helium stored for private producers under contract	-60.8	-37.7	-29.9	-35.6	-32.7
Systemwide measurement and plant losses or gains	-0.4	-0.8	-0.5	-1.1	2.8
Net addition to system ³	-49.5 ^r	-27.1	-19.6	-23.0	-28.2
Helium in conservation storage system on December 31:					
Stored under BLM conservation program ³	242.9	188.4	159.5	126.3	97.9
Stored for private producers under contract	51.1	77.7	86.5	95.5	98.6
Total ³	294.0	266.1	246.0	221.8	196.5

^rRevised. -- Zero.

¹Crude helium is injected into or withdrawn from BLM's underground storage facility, a partially depleted natural gas reservoir at the Cliffside Field near Amarillo, TX.

²Negative numbers denote a net withdrawal from BLM's underground storage facility.

³Net additions to system do not include in-kind crude sales or transfers. Totals, however, do include crude sales and transfers.

TABLE 5 WORLD GRADE-A HELIUM ANNUAL PRODUCTION CAPACITY AS OF DECEMBER 31, 2017

(Million cubic meters)

	Capacity
United States ¹	160
Rest of world ^e	110
Total ^e	270
^e Estimated.	

¹Includes plants on standby as well as operating plants.



Figure 1. Major helium-bearing natural gas fields in the United States.



Figure 2. Active helium extraction and refining plants in the United States.



Figure 3. Estimated helium consumption in the United States in 2017, by end use, in million cubic meters. Total helium used in the United States in 2017 was estimated to be 45.3 million cubic meters. Source: Campbell and Garvey (2016).



Figure 4. Helium recovery in the United States, 1960–2017.