



2015 Minerals Yearbook

HELIUM [ADVANCE RELEASE]

HELIUM

By John E. Hamak¹

Domestic consumption of Grade-A helium (99.995% or greater purity) in 2015 was 42.3 million cubic meters (about 1.52 billion cubic feet). Exports by private producers were 64.8 million cubic meters² (about 2.33 billion cubic feet), and imports of helium were 15.7 million cubic meters (about 565 million cubic feet). Total sales of U.S.-produced helium were about 91.4 million cubic meters (about 3.29 billion cubic feet), a 10.8% decrease from that of 2014 (table 1). During 2015, domestic helium consumption remained about the same as in the previous year, and helium exports decreased by 4% compared with those of 2014. Helium imports more than doubled in 2015 and accounted for 17.2% of total helium sales.

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 Act 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 Act provides 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 continued the sales volumes and conditions contained in the Helium Privatization Act.

Phase B, Auction Implementation.—This phase began on October 1, 2014, and will end when the crude helium stored in the Federal Helium Reserve reaches 3 billion cubic feet. In July 2014, the U.S. Bureau of Land Management (BLM) conducted the first auction of helium for delivery during fiscal year (FY) 2015. As required by the HSA, 10% of the available helium for sale was offered through the auction. The auction was open to all qualified bidders as defined in 50 U.S.C. 167d (b). The remainder each year is to be sold to refiners with connections to the crude helium pipeline. The total sold in July 2014 was 25.7 million cubic meters (928 million cubic feet), of which 2.57 million cubic meters (92.8 million cubic feet) was sold at auction and 23.2 million cubic meters (835 million cubic feet) was sold at the average auction price to refiners and nonrefiners along the crude helium pipeline (CHPL). In this sale, 90% of the helium was allocated to

refiners according to their operational capacity on the CHPL, and 10% was offered to nonrefiners with storage contracts on a non-allocated basis. The average price paid at auction was \$5.80 per cubic meter (\$161 per thousand cubic feet). The next auction was conducted in July 2015, for FY 2016 deliveries. At this sale, 8.32 million cubic meters (300 million cubic feet) was auctioned at an average price of \$3.75 per cubic meter (\$104 per thousand cubic feet) and 16.6 million cubic meters (600 million cubic feet) was sold at the allocated and non-allocated sale, respectively. At the next sale, in 2016, 11.1 million cubic meters (400 million cubic feet) were to be offered at auction and 16.6 million cubic meters (600 million cubic feet) were to be sold at the allocated and non-allocated sale, respectively. In each subsequent year, the percentage to be auctioned 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 will 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 in Phase B may continue. Current projections show that this phase will begin on October 1, 2018, after helium sold for FY 2019 delivery has been transferred to private accounts.

Phase D, Disposal of Assets.—The Secretary of the Interior is required to dispose of assets by no later than September 30, 2021, during this phase. These assets include all underground natural resources and the United States rights to those assets. Unlike the 1996 legislation, the BLM was no longer 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 to 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 report are as follow:

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 with contributing agencies showing less confidence in their projections.

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²All metric helium volumes herein are at 101.325 kilopascals absolute (14.696 pounds per square inch absolute) and 15 °C (59 °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).

After the helium program ends in 2021, Federal users will need to obtain helium from other sources. The acquisition strategy for Federal agencies is comprised of five parts: (1) promulgating regulations to begin a royalty-in-kind program from helium extracted on Federal lands; (2) establishing an interagency working group that would include a Federal Strategic Sourcing Initiative to ensure that all Federal agencies and intramural contract holders are fully supplied; (3) providing funding for conservation, recycling, and recapturing efforts; (4) conducting an economic evaluation of options to continue a modified helium program beyond 2021; and (5) forming an interagency working group to monitor above strategies and suggest changes as the helium market evolves.

Although future price projections are uncertain, the U.S. Department of the Interior expects that the 20-year strategy also mitigates the effects on Federal agencies of higher prices for refined helium in the private market and deflects the immediate need for prioritization of helium uses. However, the BLM recommends forming an interagency working group to continuously assess the Federal agencies' helium needs, update helium demand and projections, and provide a process for prioritization of uses when necessary.

Production

In 2015, 10 companies operated 19 privately owned domestic helium plants. Of the 19 operating plants, 6 extracted helium from natural gas to produce a crude helium product, 6 produced Grade-A helium, and 7 produced a near-pure helium product containing about 95% to 98% helium. The seven near-pure helium plants use a combination of pressure swing adsorption and membrane technology to extract helium. All crude helium plants and Grade-A helium facilities use cryogenic extraction processes. The six privately owned plants that produced Grade-A helium also produced liquefied helium. Plant operators and plant locations are listed in table 2.

Total sales of U.S.-produced helium in 2015 decreased by about 11% compared with those of 2014. All natural gas processed for helium recovery came from gas fields in Arizona, 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 as well as 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.

About 20% less helium was produced from the Government's helium reserve at the Cliffside field in 2015 than in 2014. Most domestic helium production was from the Midcontinent and Rocky Mountain regions of the United States. The measured helium reserves from which helium is produced are located 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 in Wyoming.

Consumption

In 2015, private industry supplied 100% of domestic Grade-A helium for U.S. consumption. The major domestic end uses of helium were magnetic resonance imaging (30%); scientific, engineering, analytical, and specialty gas (20%); lifting gas (17%); welding (9%); and controlled atmosphere (9%) (fig. 4). Other uses included diving, leak detection, and pressurizing and purging (Campbell and Garvey, 2016).

In 2015, U.S. domestic Grade-A helium consumption remained nearly unchanged at 42.3 million cubic meters (1.52 billion cubic feet) compared with consumption in 2014. During 2015, U.S. helium exports decreased by 4% to 64.8 million cubic meters (about 2.33 billion cubic feet) compared with those of 2014 (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 helium from the BLM. In 2015, in-kind crude helium sales were about 3.5 million cubic meters (125 million cubic feet). The sales were made to eight companies through contracts with the BLM.

Stocks

The volume of helium stored in the BLM helium conservation storage system, including the conservation pipeline network and the Cliffside field, totaled 246 million cubic meters (8.87 billion cubic feet) on December 31, 2015. 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-supplying fuel markets and stored under contract. This privately owned helium is returned to the owners as needed for purification to supply private demand. During 2015, 10.3 million cubic meters (371 million cubic feet) of privately owned helium was delivered to the BLM's helium conservation system, and 29.9 million cubic meters (1.08 billion cubic feet) was withdrawn, for a net decrease of 19.6 million cubic meters (708 million 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 liquid helium to distribution centers, where some of it 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 2015, the conservation price was based on the annual auction results and an independent, confidential market survey of helium industry prices. The in-kind price is set at approximately 80% of the conservation price for the prior year. For FY 2015, the conservation price was \$3.82 per cubic meter (\$106 per thousand cubic feet) and the in-kind price was \$2.74 per cubic meter (\$76 per thousand cubic feet). The average unit value for imported helium was \$2.83 per cubic meter (\$78 per thousand cubic feet).

Foreign Trade

In 2015, exports of Grade-A helium decreased to 64.8 million cubic meters (2.33 billion cubic feet), a 4% decrease compared with those of 2014, and accounted for about 71% of sales of U.S.-produced helium; private industry supplied all U.S. helium exports (table 1). Regionally, North America, Central America, and the Caribbean, combined, received 33.1% of the helium exported from the United States; the Pacific Rim, excluding China, received 32.6%; Europe, 16.2%; South America, 10.0%; Asia, 5.4%; the Middle East and Africa, combined, 1.5%; and Australia and New Zealand, combined, 1.2%.

In 2015, imports of helium more than doubled to 15.7 million cubic meters from 7.4 million cubic meters in 2014 (table 1). More than 93% of imports come from Qatar, and about 3% each, from Algeria and Canada.

For 2015, import tariffs on helium remained at 3.7% for normal trade relations (NTR) nations and 25% for non-NTR nations.

World Review

Total world production was approximately 159 million cubic meters (about 5.73 billion cubic feet) in 2015. Excluding the United States, world production capacity of helium was estimated to be about 110 million cubic meters (3.97 billion cubic feet) in 2015 (table 5). Helium was produced in Algeria, Australia, Poland, Qatar, and Russia. Worldwide, one new helium plant was scheduled for startup by 2016 and an additional plant in 2018. Several more projects were in the planning stage.

Outlook

From 2008 through 2012, total global sales of helium produced in the United States increased by about 3.5% per year. That trend reversed in 2013 with the addition of capacity in Qatar and some demand destruction owing to several years of shortages. U.S. domestic helium consumption is expected to remain stable during 2016. Because of increased capacity of foreign plants and lower helium production in the United States, exports are expected to decrease during 2016 and imports are likely to continue.

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TABLE 1
SALES OF GRADE-A HELIUM
IN THE UNITED STATES¹

(Million cubic meters)

Year	Volume			Total sales of U.S.-produced helium
	Domestic consumption	Exports ²	Imports ²	
2011	47.8	82.3	--	130.1
2012	48.0	84.9	--	132.9
2013	39.2	81.2	2.4	118.0
2014	42.2	67.5	7.4	102.3
2015	42.3	64.8	15.7	91.4

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Source: U.S. Census Bureau.

TABLE 2
OWNERSHIP AND LOCATION OF HELIUM EXTRACTION PLANTS IN THE UNITED STATES IN 2015

Owner or operator	Plant name	Status	Location	Product purity
Air Products Corporation, Inc.	Liberal	Operating	Seward County, KS	Grade-A helium. ¹
Do.	Panhandle	Standby	Hansford County, TX	Do. ¹
Do.	Doe Canyon	Operating	Dolores County, CO	Do. ¹
DCP Midstream, LLC	Ladder Creek	do.	Cheyenne Wells, CO	Near-pure helium. ²
Do.	National	do.	Seward County, KS	Crude helium. ³
Do.	Rock Creek	do.	Hutchinson County, TX	Do. ³
Do.	Sher-Han	do.	Hansford County, TX	Do. ³
Denbury Onshore, LLC	Riley Ridge	Standby	Sublette County, WY	Do. ³
Eagle Rock Energy	Sunray	Operating	Moore County, TX	Do. ³
ExxonMobil Gas Marketing Co.	LaBarge	do.	Sweetwater County, WY	Grade-A helium. ¹
IACX Energy	Dineh-Bi-Keyah	do.	Apache County, AZ	Near-pure helium. ²
Do.	Harley Dome	do.	Grand County, UT	Do. ²
Do.	Hodgeman	do.	Hodgeman County, KS	Do. ²
Do.	IACX Otis	do.	Rush County, KS	Do. ²
Do.	Badger Wash	do.	Mesa County, CO	Do. ²
Do.	Paden	do.	Okfuskee County, OK	Do. ²
Do.	Woodside Dome	Under development	Emery County, UT	Do. ²
Linde Global Helium, Inc.	Linde Otis	Operating	Rush County, KS	Grade-A helium. ¹
Linn Energy, LLC	Jayhawk	do.	Grant County, KS	Crude helium. ³
Midstream Energy Services, LLC	Keyes	do.	Cimarron County, OK	Grade-A helium. ¹
Pioneer Natural Resources Co.	Fain	do.	Potter County, TX	Crude helium. ³
Praxair, Inc.	Ulysses/Jayhawk	do.	Grant County, KS	Grade-A helium. ¹
Do.	Bushton	Standby	Ellsworth County, KS	Do. ¹

Do., do. Ditto.

¹Including liquefaction, at least 99.99% helium.

²Generally contains between 95% and 98% helium.

³Generally contains between 60% and 80% helium.

TABLE 3
HELIUM RECOVERY IN THE UNITED STATES¹

(Million cubic meters)

	2011	2012	2013	2014	2015
Crude helium:					
Bureau of Land Management (BLM) sold (in-kind and open market)	62.8	60.6	61.8	53.2	28.5
Private industry:					
Private helium accepted and stored by BLM	11.4	10.2	11.7	10.6	10.3
Helium withdrawn from storage	-70.8	-70.3	-60.8	-37.7	-29.9
Total net helium put into storage	-59.4	-60.1	-49.1	-27.1	-19.6
Grade-A helium:					
Private industry sold	130.1	132.9	118.0	102.3	91.4
Total helium stored	-59.4	-60.1	-49.1	-27.1	-19.6
Helium recovery from natural gas	70.7	72.8	68.9	75.2	71.8

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 HELIUM CONSERVATION STORAGE SYSTEM OPERATIONS^{1,2}

(Million cubic meters)

	2011	2012	2013	2014	2015
Helium in conservation storage system on January 1:					
Stored under BLM conservation program ³	433.0	368.5	306.1	242.9	188.4
Stored for private producers under contract	31.8	34.4	37.4	51.1	77.7
Total³	464.8	402.9	343.5	294.0	266.1
Input to system:					
Net deliveries from BLM plants	--	--	--	--	--
Stored for private producers under contract	11.4	10.2	11.7	10.6	10.3
Total³	11.4	10.2	11.7	10.6	10.3
Redelivery of helium stored for private producers under contract	-70.8	-70.3	-60.8	-37.7	-29.9
Systemwide measurement and plant losses/gains ⁴	-2.6	0.6	-0.4	-0.8	-0.5
Net addition to system³	-62.0	-60.1	-49.1	-27.1	-19.6
Helium in conservation storage system on December 31:					
Stored under BLM conservation program ³	368.5	306.1	242.9	188.4	159.5
Stored for private producers under contract	34.4	37.4	51.1	77.7	86.5
Total³	402.9	343.5	294.0	266.1	246.0

-- 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.

⁴Previously not reported.

TABLE 5
WORLD GRADE-A HELIUM
ANNUAL PRODUCTION CAPACITY
AS OF DECEMBER 31, 2015

(Million cubic meters)

	Capacity
United States ¹	136
Rest of world ^c	110
Total^c	246

^cEstimated.

¹Includes plants on standby as well as operating plants.

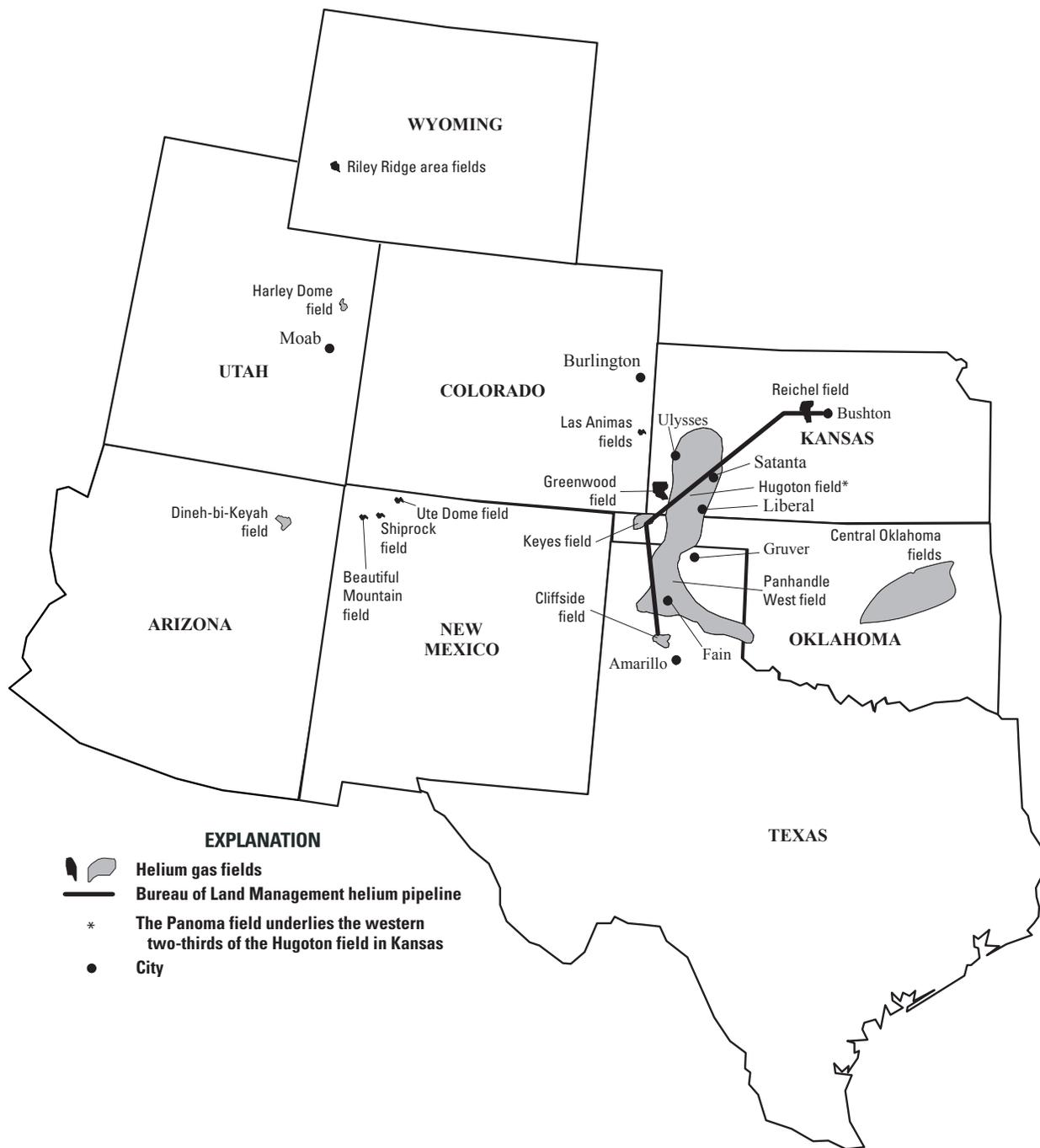


Figure 1. Major helium-bearing natural gas fields in the United States.

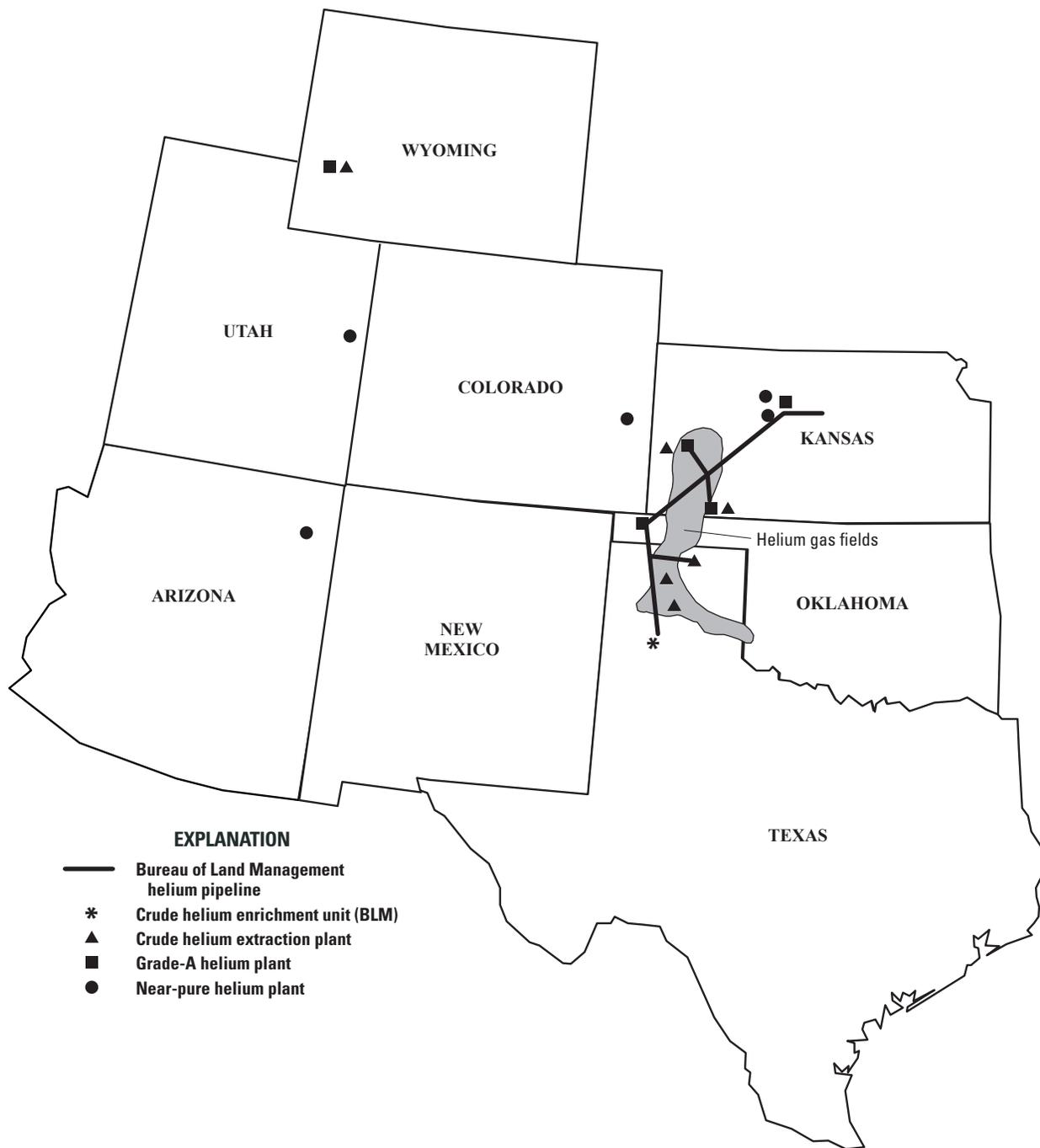


Figure 2. Active helium extraction and refining plants in the United States.

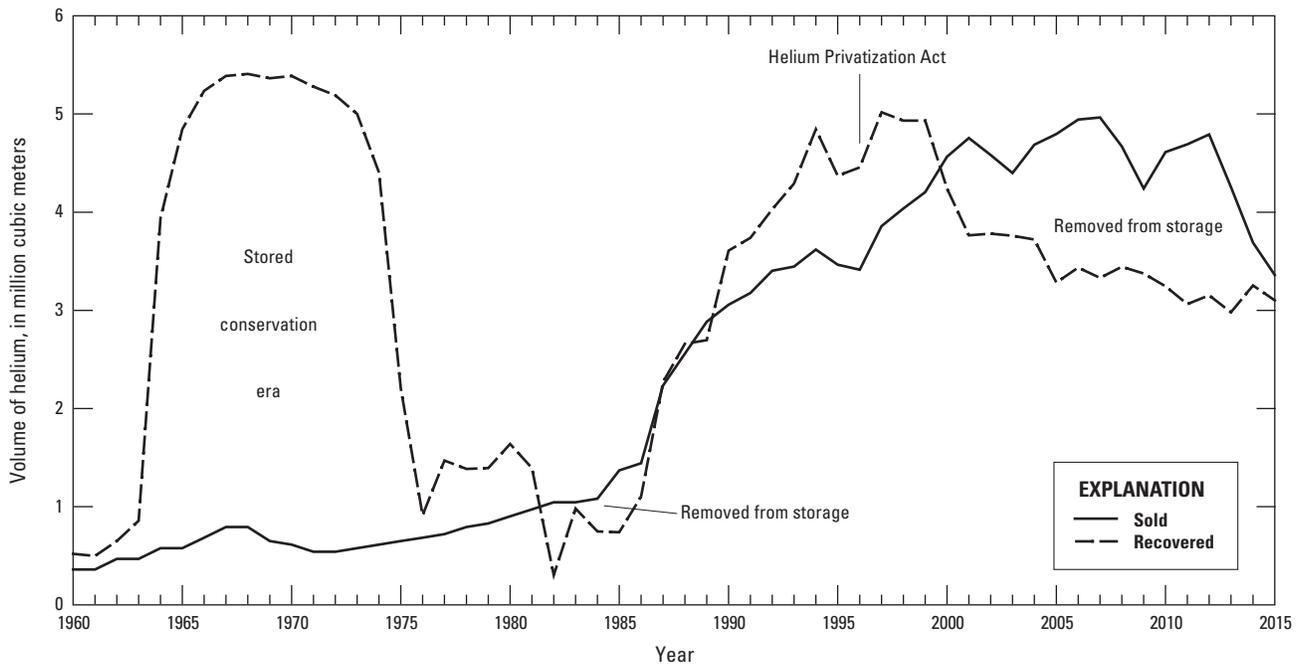


Figure 3. Helium recovery in the United States, 1960–2015.

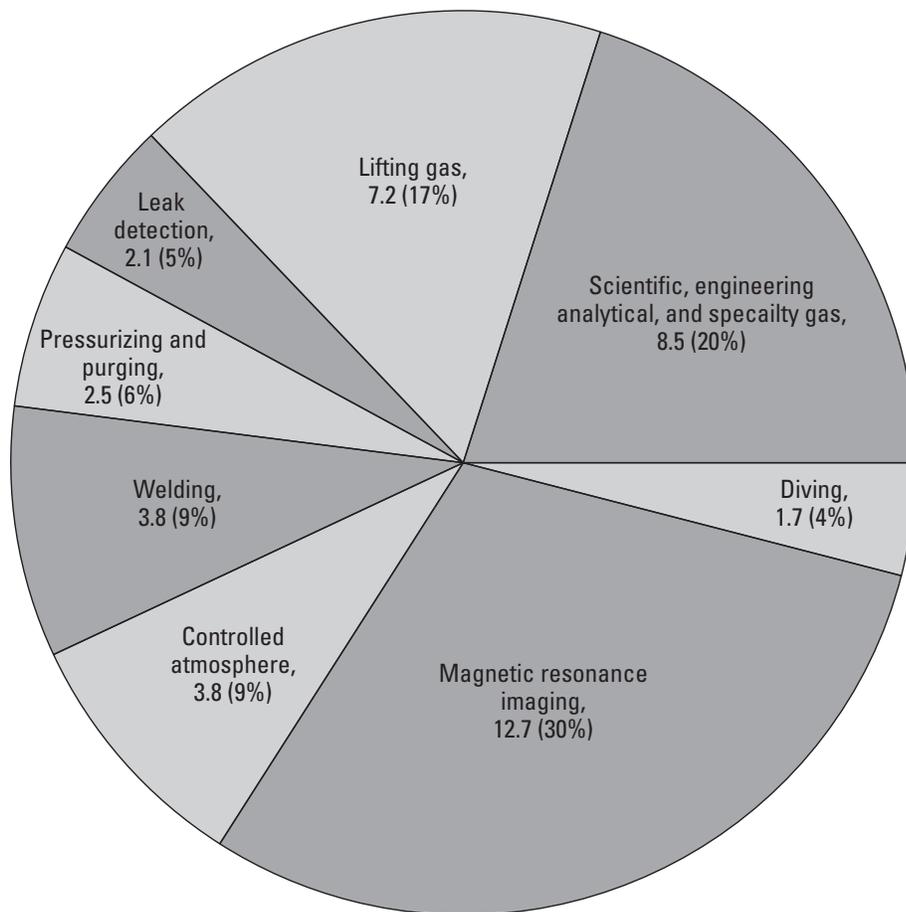


Figure 4. Estimated helium consumption in the United States in 2015, by end use, reported in million cubic meters. Total helium used in the United States in 2015 was estimated to be 42.3 million cubic meters.