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2022 Minerals Yearbook

HELIUM [ADVANCE RELEASE]

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Helium

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Domestic consumption of Grade-A helium (99.995% or greater purity) in 2022 was 53.6 million cubic meters[2] (1.93 billion cubic feet). Exports by private producers were reported by the U.S. Census Bureau to be 32.5 million cubic meters (1.17 billion cubic feet). Imports of helium were reported to be 8.6 million cubic meters (310 million cubic feet). Total sales of U.S.-produced helium were 77.5 million cubic meters (2.79 billion cubic feet), a slight increase from those in 2021 (table 1).

Government Actions and Legislation

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 established a timeline for the privatization of the helium marketplace. The Federal helium program would continue for a period of time 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 a transition in four phases.

Phase A, Allocation Transition.—The start of this phase began with the passage of the HSA and ended on September 30, 2014. This was a continuation of the Helium Privatization Act of 1996 (U.S. Congress, 1996) that directed the sale of much of the National Helium Reserve located at the Cliffside Field in Amarillo, TX, and prescribed sales volumes and conditions (U.S. Congress, 2013).

Phase B, Auction Implementation.—This phase initiated on October 1, 2014, and was prescribed by the HSA to end when crude helium stored in the Federal Helium Reserve was reduced to a level of 3 billion cubic feet (83.2 million cubic meters). In July 2014, the Bureau of Land Management (BLM) conducted the first auction of helium for delivery during fiscal year (FY) 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 2018 for deliveries in FY 2019. At the July 2018 auction, 5.8 million cubic meters (210 million cubic feet) was offered at the allocated sale, and 2.5 million cubic meters (90 million cubic feet) was sold at the nonallocated sale. This was the last auction and sale conducted under phase B as the volume of conservation helium in storage dropped to approximately 3 billion cubic feet (83.2 million cubic meters).

Phase C, Continued Access for Federal Users.—This phase began on January 1, 2019, as the remaining crude helium stored in the Federal Helium Reserve reached 3 billion cubic feet (83.2 million cubic meters). The BLM continued to provide crude helium for sale to Federal users. In 2019, there were no sales nor auctions of helium to private entities, but deliveries to private entities of helium sold during phase B continued. Deliveries and sales of helium from the Cliffside Field were prescribed to continue until phase D was completed.

Phase D, Disposal of Assets.—During this phase, the Secretary of the Interior was required to dispose of assets in the Federal helium program no later than September 30, 2021. These assets included 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 was no longer required to sell helium from the reserve in equal annual volumes. Under the HSA, sales could match the amount available for production from the reserve. This phase was delayed owing to the global coronavirus disease 2019 (COVID-19) pandemic disruptions. The management of helium assets was transferred from the BLM to the General Services Administration (GSA) on December 3, 2022, for the GSA to dispose of the helium assets as required by the HSA. Until the helium assets are disposed of, the BLM planned to continue to deliver helium.

On November 9, 2021, a proposed, revised U.S. Geological Survey (USGS) critical minerals list was published in the Federal Register (86 FR 62199). Helium was removed from this version of the critical minerals list because it did not have a single point of failure nor meet the quantitative threshold owing to the United States being the world's leading producer of helium and a net exporter of helium (U.S. Geological Survey, 2021). Following adjudication of public comments, the new critical minerals list was published on February 24, 2022 (87 FR 10381) (U.S. Geological Survey, 2022).

Production

In 2022, 11 companies operated 19 privately owned domestic helium plants. Of the 19 operating plants, 5 extracted helium from natural gas to produce a crude helium product, 8 produced Grade-A helium, and 6 produced gaseous helium. The six gaseous helium plants used a combination of pressure swing adsorption, membrane technology, and nitrogen rejection utilization to extract helium. All crude helium plants and Grade-A helium facilities used cryogenic extraction processes. The eight privately owned plants that produced Grade-A helium also produced liquefied helium (table 2).

Total sales of U.S.-produced helium in 2022 increased slightly compared with those in 2021 (table 1). All natural gas processed for helium recovery came from gasfields in Arizona, Colorado, Kansas, New Mexico, Oklahoma, Texas, Utah, and Wyoming (figs. 1, 2). Domestic production data for helium were developed

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[2]All 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).

by the USGS from an annual voluntary canvass of private U.S. operations and BLM operations. Of the eight Grade-A and gaseous helium-producing companies that the USGS canvassed, five provided production information. Those data, in conjunction with information from BLM operations, represented 72% of the total helium sales and 86% of the helium recovery data listed in table 3. Helium production from the Government's helium reserve at Cliffside Field in 2022 was 74% more than that in 2021 (table 3).

The BLM shut down its Crude Helium Enrichment Unit for more than 5 months starting in January for unplanned maintenance (Cockerill and Ellis, 2023). The BLM signed a contract with Messer, LLC to restart and take over operations of the Crude Helium Enrichment Unit (Kapadia, 2022). There was an explosion and fire at the Haven Midstream Gas Plant in Haven, KS, which shut down the helium processing plant (Wright, 2022).

Most domestic helium production was from the Midcontinent and Rocky Mountain regions. The measured U.S. helium reserves were located in fewer than 50 gasfields in eight States. Most of these reserves are contained in the Cliffside and Panhandle West Fields in Texas; the Hugoton Field in Kansas, Oklahoma, and Texas; the Keyes Field in Oklahoma; the Panoma Field in Kansas; and the Riley Ridge Area Fields in Wyoming (figs. 1, 2). The USGS estimated that the recoverable helium within known geologic natural gas formations in the United States was about 8.49 billion cubic meters (306 billion cubic feet) (Brennan and others, 2021).

Consumption

In 2022, U.S. domestic helium consumption increased by 3% to 53.6 million cubic meters (1.93 billion cubic feet) compared with consumption in 2021 (table 1). The major domestic end uses of helium were controlled atmospheres, fiber optics, and semiconductors (21%); analytical, engineering, lab, scientific, and specialty gases (19%); magnetic resonance imaging (18%); lifting gas (11%); and pressurizing, purging, and other gas and liquid (11%). Other uses, in descending order of use, included welding, leak detection, and diving (fig. 3) (Garvey, 2021).

In-kind crude helium sales regulations (43 CFR part 3195) require helium refiners that sold helium to Federal agencies and their contractors to buy an equivalent amount of crude helium from the BLM. In 2022, in-kind crude helium sales were 6.8 million cubic meters (245 million cubic feet) (table 3). The sales were made to nine companies through contracts with the BLM.

Stocks

The BLM helium storage system contained crude helium purchased under contract by the Government from 1962 to 1973, in addition to privately owned helium extracted by industry from natural-gas-supplying fuel markets and stored under contract (fig. 4). The volume of helium stored in the BLM helium storage system, including the pipeline network and the Cliffside Field, totaled approximately 108.6 million cubic meters (3.92 billion cubic feet) on December 31, 2022 (fig. 5, table 4). The privately owned helium in the BLM storage system was returned to the owners as needed for purification. During 2022, 9.1 million cubic meters (328 million cubic feet) of privately owned helium was delivered to the BLM's helium storage system, and 21.3 million cubic meters (768 million cubic feet) was withdrawn (table 3). Systemwide measurements showed that there was 1.1 million cubic meters (39.7 million cubic feet) lost from the BLM's helium storage system in 2022. There was a total net decrease of 13.3 million cubic meters (480 million cubic feet) of private helium in storage in 2022 (table 4).

Prices

The HSA required the BLM to use market-based pricing for its crude helium sales to private industry. For FY 2022, the conservation price was no longer posted. The BLM last posted conservation prices for FY 2018. In-kind crude helium sales regulations require helium refiners that sell helium to Federal agencies and their contractors to buy an equivalent amount of crude helium from the BLM. The in-kind crude helium price in FY 2022 was $3.61 per cubic meter ($100 per thousand cubic feet), virtually unchanged from that in FY 2021 (Bureau of Land Management, 2021).

Transportation

Private producers and (or) distributors shipped helium, predominantly as a liquid, in semitrailers delivered to distribution centers, where some of it was gasified and compressed into trailers and cylinders for delivery to end users. The remaining liquid helium was sold as bulk liquid or repackaged in dewars (specialized vacuum tanks used for storing cryogens) of various sizes.

Foreign Trade

In 2022, exports by private helium producers were reported by the U.S. Census Bureau to be 32.5 million cubic meters (1.17 billion cubic feet), a slight decrease from that in 2021 (tables 1, 5). The value of helium exports was $358 million, an 8% increase compared with that in 2021. The average unit value of exports in 2022 was $11.04 per cubic meter ($306.22 per thousand cubic feet), a 10% increase from that in 2021. Regionally, Asia and the Pacific received 36% of the helium exported from the United States; Europe, 31%; North America, Central America, and the Caribbean, combined, 21%; South America, 10%; the Middle East and Africa, combined, 1%; and Australia and New Zealand, combined, less than 1% (table 5). Private industry supplied all U.S. helium exports.

In 2022, imports for consumption of helium were 8.6 million cubic meters (310 million cubic feet), a 7% decrease from that in 2021 (tables 1, 6). The value of helium imports was $60.0 million, a 13% decrease compared with that in 2021. Global import congestion caused rising shipping costs and trade delays (Anderson, 2022). The average unit value of imports in 2022 was $6.94 per cubic meter ($192.49 per thousand cubic feet), a 7% decrease from that in 2021. Canada supplied 61% of the United States imports for consumption, and Qatar supplied 33% of imports for consumption (table 6). For 2022, import tariffs on helium remained at 3.7% for normal trade relations (NTR) nations and 25% for non-NTR nations.

World Review

Total world helium production was an estimated 159 million cubic meters (5.72 billion cubic feet) in 2022 (table 8). World production capacity of helium was estimated to be 341 million cubic meters per year (12.3 billion cubic feet per year) in 2022 (table 7). In addition to the United States, helium was produced in Algeria, Australia, Canada, Poland, Qatar, and Russia.

Worldwide, several helium projects started or were in the planning stage in 2022. There were multiple operations throughout North America in the planning stage. Desert Mountain Energy, Blue Star Helium, and Total Helium were expected to begin production of helium in the United States in 2023 (Burgess, 2023a).

Algeria.—Algeria had reduced feedgas for helium production owing to more natural gas being sent directly to Europe via undersea pipelines. More natural gas was sent directly to Europe owing to less imports of natural gas into Europe from Russia as a result of the war in Ukraine (Kornbluth, 2022a).

Australia.—The BOC Darwin Helium Plant in Australia began producing less helium owing to the gasfield used for feedgas nearing depletion (Fitzgerald, 2023).

Canada.—Canada continued to expand production with North American Helium Inc. (Canada), adding two production facilities and expanding on the capacity for an existing plant in 2022 (Burgess, 2022). North American Helium Inc. planned to start up three additional helium operations in 2023. Royal Helium Ltd. (Canada) planned to start up a helium operation in Alberta in 2023 (Burgess, 2023a).

Qatar.—Two of the three helium plants in Qatar were shut down for scheduled maintenance for less than 2 months starting in February (Cockerill and Ellis, 2023). Qatargas Operating Co. Ltd. planned to start up a fourth helium plant (Qatar 4) by 2025. That plant was expected to have a liquid helium capacity of 27.7 million cubic meters per year (1.00 billion cubic feet per year) (Anderson, 2022).

Russia.—In Amur, a 60-million-cubic-meter-per-year (2.16-billion-cubic-foot-per-year) helium-processing plant was commissioned by PJSC Gazprom in 2021. The first of three 20-million-cubic-meter-per-year (721-billion-cubic-foot-per-year) helium production trains started production in fall 2021. A fire and explosion took place in January 2022, which stopped production of helium for the entirety of 2022. The commissioning of the other two 20-million-cubic-meter-per-year (721-billion-cubic-foot-per-year) trains in Amur was also delayed (Kornbluth, 2022b). Gazprom was expected to restart production of the first train in 2023 and then continue to start up the other two trains. Irkutsk Oil Co. planned to start up a plant with a planned capacity of 7.5 million cubic meters per year (270 million cubic feet per year) in Irkutsk in 2023 (Kapadia, 2023).

Outlook

U.S. domestic helium consumption is expected to remain stable during 2023. Multiple companies are exploring for helium deposits throughout North America, some of which are nonhydrocarbon sourced (Cockerill, 2023). Two companies are exploring for helium in the Lake Rukwa area of Tanzania (Burgess, 2023a). The BLM is expected to dispose of assets in the Federal helium program in 2023. The BLM and the GSA are working together to determine how to transition all Federal helium assets to private ownership (Burgess, 2023b).

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TABLE 1
SALIENT HELIUM STATISTICS[1]

(Million cubic meters)

	Volume			
Year	Domestic consumption	Exports[2]	Imports[2]	Total sales of U.S.-produced helium
2018	45.0 [e, 3]	83.6	7.5	89.9
2019	45.0 [e, 3]	57.8	6.8	86.2
2020	53.0	35.2	6.7	81.5
2021	52.0	33.1	9.2	75.9
2022	53.6	32.5	8.6	77.5

[e]Estimated.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Source: U.S. Census Bureau.
[3]Consumption is estimated because of unusually high exports reported by the U.S. Census Bureau.

TABLE 2
OWNERSHIP AND LOCATION OF ACTIVE HELIUM EXTRACTION PLANTS IN THE UNITED STATES IN 2022

Owner or operator	Plant name	Location	Product purity[1]
Air Products Corporation, Inc.	Doe Canyon	Dolores County, CO	Grade-A helium.
Do.	Liberal	Seward County, KS	Do.
DCP Midstream, LLC	National	do.	Crude helium.
Do.	Rock Creek	Hutchinson County, TX	Do.
Do.	Sher-Han	Hansford County, TX	Do.
Energy Transfer	Sunray	Moore County, TX	Do.
ExxonMobil Gas Marketing Co.	LaBarge	Sweetwater County, WY	Grade-A helium.
IACX Energy	Dineh-Bi-Keyah	Apache County, AZ	Gaseous helium.
Do.	Harley Dome	Grand County, UT	Do.
Do.	Hodgeman	Hodgeman County, KS	Do.
Do.	IACX Otis	Rush County, KS	Do.
Do.	Paden	Okfuskee County, OK	Do.
Do.	Roswell	Chaves County, NM	Do.
Linde Global Helium, Inc.	Ulysses	Grant County, KS	Grade-A helium.
Messer, LLC	Messer Otis	Rush County, KS	Do.
Midstream Energy Services, LLC	Keyes	Cimarron County, OK	Do.
Paradox Resources	Lisbon	San Juan, UT	Do.
Scout Energy	Jayhawk	Grant County, KS	Crude helium.
Tumbleweed Resources	Ladder Creek	Cheyenne County, CO	Grade-A helium.

Do., do. Ditto.
[1]Grade-A helium, including liquefaction, is at least 99.995% helium. Gaseous helium is generally greater than 98% helium. Crude helium generally contains between 60% and 80% helium.

TABLE 3
HELIUM RECOVERY IN THE UNITED STATES[1]

(Million cubic meters)

	2018	2019	2020	2021	2022
Bureau of Land Management (BLM) crude helium sold (in-kind and open market)	13.4	5.0 [2]	5.9 [2]	4.4 [2]	6.8 [2]
Crude helium accepted and stored by BLM	3.1	3.2	5.1	7.1	9.1
Crude helium withdrawn from storage	-31.2	-25.0	-14.7	-14.2	-21.3
Total net crude helium put into storage[3]	-28.2	-21.8	-9.6	-7.0	-12.2
Private industry gaseous or Grade-A helium sold	89.9	86.2	81.5	75.9	77.5
Total helium recovered from natural gas[3]	61.7	64.4	71.9	68.9	65.3

[1]Negative numbers denote a net withdrawal from BLM's underground storage facility, a partially depleted natural gas reservoir at the Cliffside Field near Amarillo, TX.
[2]This only represents in-kind sales. Open market sales ended in 2018.
[3]Numbers may not add to totals shown due to rounding and conversions.

TABLE 4
SUMMARY OF BUREAU OF LAND MANAGEMENT (BLM) HELIUM CONSERVATION STORAGE SYSTEM OPERATIONS[1, 2]

(Million cubic meters)

	2018	2019	2020	2021	2022
Helium in conservation storage system on January 1:					
Stored under BLM conservation program	97.9	83.1	77.5	68.9	60.7
Stored for private producers under contract	98.6	82.0	65.2	61.7	61.0
Total[3]	196.5	165.1	142.7	130.6	121.7
Additions to system					
Stored for private producers under contract	3.1	3.2	5.1	7.1	9.1
Redelivery of helium stored for private producers under contract	-31.2	-25.0	-14.7	-14.2	-21.3
Systemwide measurement and plant losses or gains	-3.3	-0.6	-2.6	-1.9 r	-1.1
Net addition to system[3, 4]	-31.4	-22.4	-12.2	-9.0 r	-13.3
Helium in conservation storage system on December 31:					
Stored under BLM conservation program[4]	83.1	77.5	68.9	60.7	52.9
Stored for private producers under contract	82.0	65.2	61.7	61.0	55.7
Total[3]	165.1	142.7	130.6	121.7	108.6

[r]Revised.
[1]Crude 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.
[2]Negative numbers denote a net withdrawal from BLM's underground storage facility.
[3]Numbers may not add to totals shown due to rounding and conversions.
[4]Net additions to system do not include in-kind crude sales or transfers. Totals, however, include crude sales and transfers.

TABLE 5
U.S. EXPORTS OF HELIUM, BY REGION AND COUNTRY OR LOCALITY[1]

(Million cubic meters, thousand dollars, and dollars per cubic meter)

Destination	2021			2022		
	Quantity	Value[2]	Unit value	Quantity	Value[2]	Unit value
Africa and the Middle East	1	4,470	8.39	(3)	2,670	14.30
Asia:						
China[4]	1	14,000	11.24	3	32,600	12.56
Japan	3	51,500	17.24	2	41,800	17.09
Korea, Republic of	4	60,800	14.15	4	50,900	12.53
Taiwan	3	42,200	14.69	3	35,900	14.10
Other	(3)	489	11.37	(3)	1,390	11.05
Total	11	169,000	14.76	12	163,000	13.81
Europe:						
Belgium	4	46,700	12.17	5	65,100	12.09
Germany	1	9,180	7.25	2	20,200	8.91
Ireland	(3)	3,370	48.08	1	12,900	19.31
Netherlands	1	373	0.44 r	1	2,830	4.37
United Kingdom	1	10,700	8.12	1	5,300	9.25
Other	1	6,460 r	9.94 r	1	6,230	10.16
Total	8	76,800	9.61	10	113,000	11.09
North America:						
Canada	4	29,600	8.31	3	21,700	7.98
Costa Rica	1	427	0.43	1	2,670	2.67
Mexico	3	25,200	7.52	5	43,200	9.39
Other	2	3,870	1.58	2	4,500	2.64
Total	10	59,100	5.89	7	48,500	6.99
Oceania, Australia	(3)	459	1.50	(3)	386	4.33
South America:						
Brazil	1	15,300	10.71	2	19,200	11.49
Chile	(3)	2,740	7.15	1	4,120	7.51
Other	1	5,700 r	5.93 r	1	8,350	7.61
Total	3	23,700	8.56	3	31,700	9.55
Grand total	33.1	333,000	10.08	32.5	358,000	11.04

rRevised.
[1]Table includes data available through June 12, 2023. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Free alongside ship value of material at U.S. port of export. Based on transaction price; includes all charges incurred in placing material alongside ship.
[3]Less than ½ unit.
[4]Includes Hong Kong.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS OF HELIUM, BY REGION AND COUNTRY OR LOCALITY[1]

(Million cubic meters, thousand dollars, and dollars per cubic meter)

	2021			2022		
Country or locality	Quantity	Value[2]	Unit value	Quantity	Value[2]	Unit value
Algeria	1	4,620	7.06	(3)	715	7.14
Canada	3	21,000	6.39	5	37,200	7.05
Germany	1	5,890	7.40	(3)	829	3.95
Qatar	4	32,100	8.80	3	20,300	7.18
Russia	1	4,080	5.97	(3)	636	5.05
Other	(3)	985	5.66	(3)	326	3.20
Total	9.2 r	68,700	7.43	8.6	60,000	6.94

rRevised.
[1]Table includes data available through June 12, 2023. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Cost, insurance, and freight value of material at U.S. port of entry. Based on purchase price; includes all charges (except U.S. import duties) in bringing material from foreign country to alongside carrier.
[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7
ESTIMATED WORLD ANNUAL GRADE-A AND GASEOUS HELIUM PRODUCTION CAPACITY, DECEMBER 31, 2022[1]

(Million cubic meters)

Country or locality	Capacity
Algeria	50
Australia	6
Canada	7
Poland	3
Qatar	72
Russia	26
South Africa	1
United States	176
Total	341

[1]Includes capacity at operating plants and at plants on standby basis. Data may not add to total shown.

TABLE 8
HELIUM: WORLD PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Million cubic meters)

Country or locality	2018	2019	2020	2021	2022
Algeria[e]	14	14	14	10	8
Australia[e]	4	4	4	4	3
Canada	(2) r, e	(2) r	1	2 r	3
Poland	3	3	3	3	3
Qatar[e]	45	45	51	61	59
Russia[e]	3	5	5	5	5
United States	90	86	82	76	78
Total	159 r	157 r	159 r	161	159

eEstimated. rRevised.
[1]Table includes data available through September 12, 2023. All data are reported unless otherwise noted; totals may include estimated data. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Less than ½ unit.

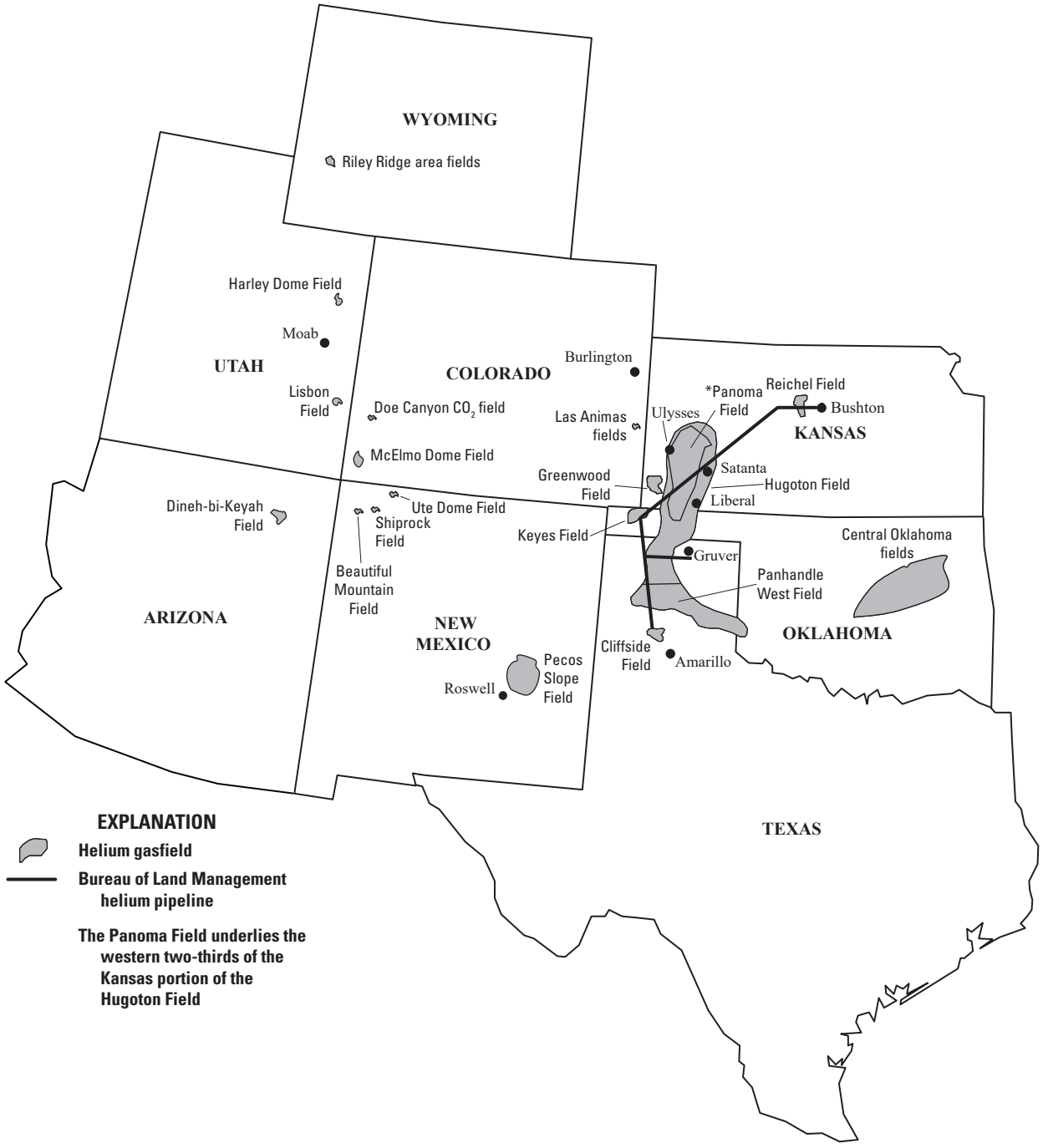

Figure 1. Major helium-bearing natural gas fields in the United States.

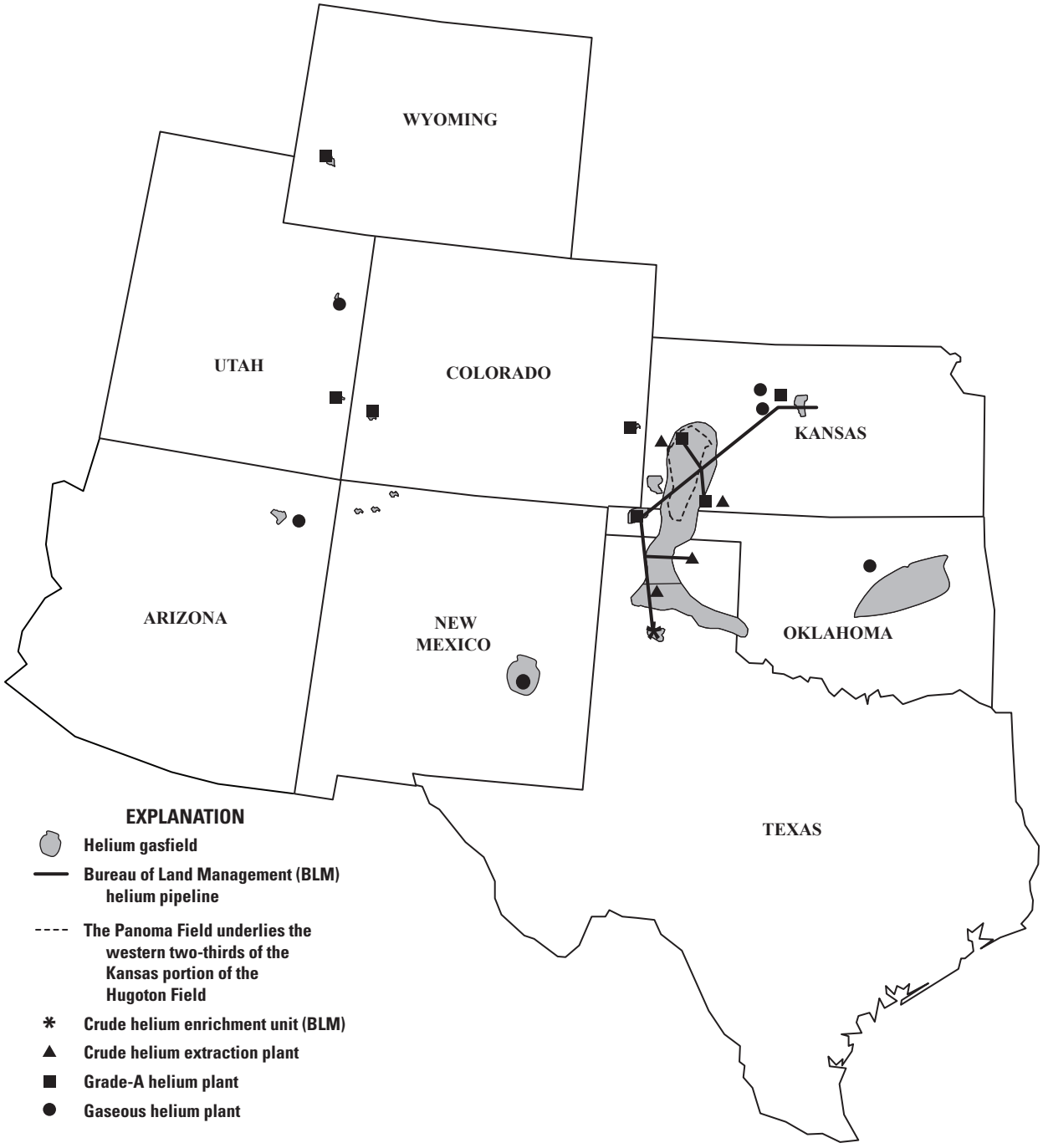

Figure 2. Active helium extraction and refining plants in the United States.

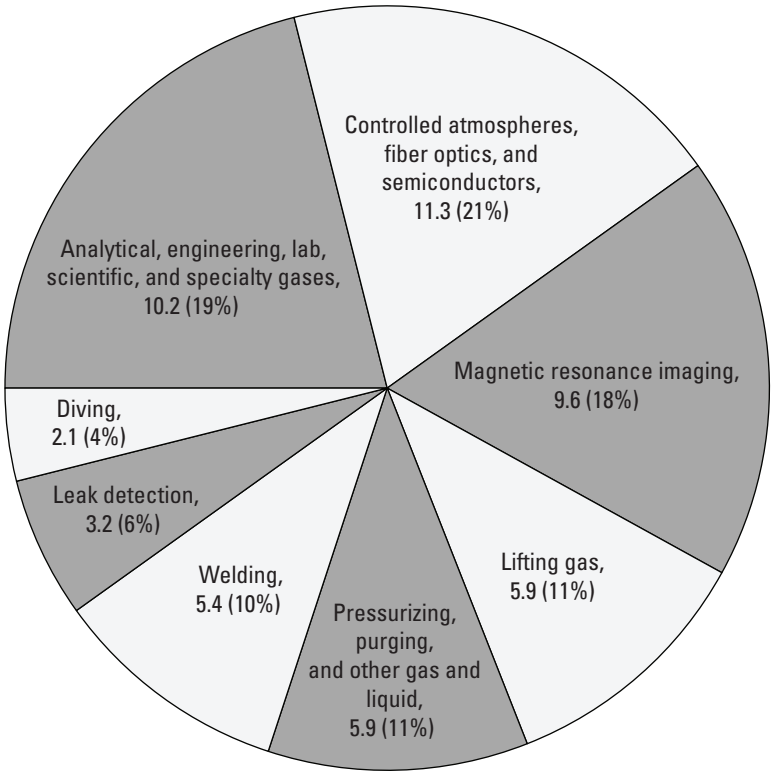

Figure 3. Estimated helium consumption in the United States in 2022, by end use, reported in million cubic meters (Garvey, 2021).

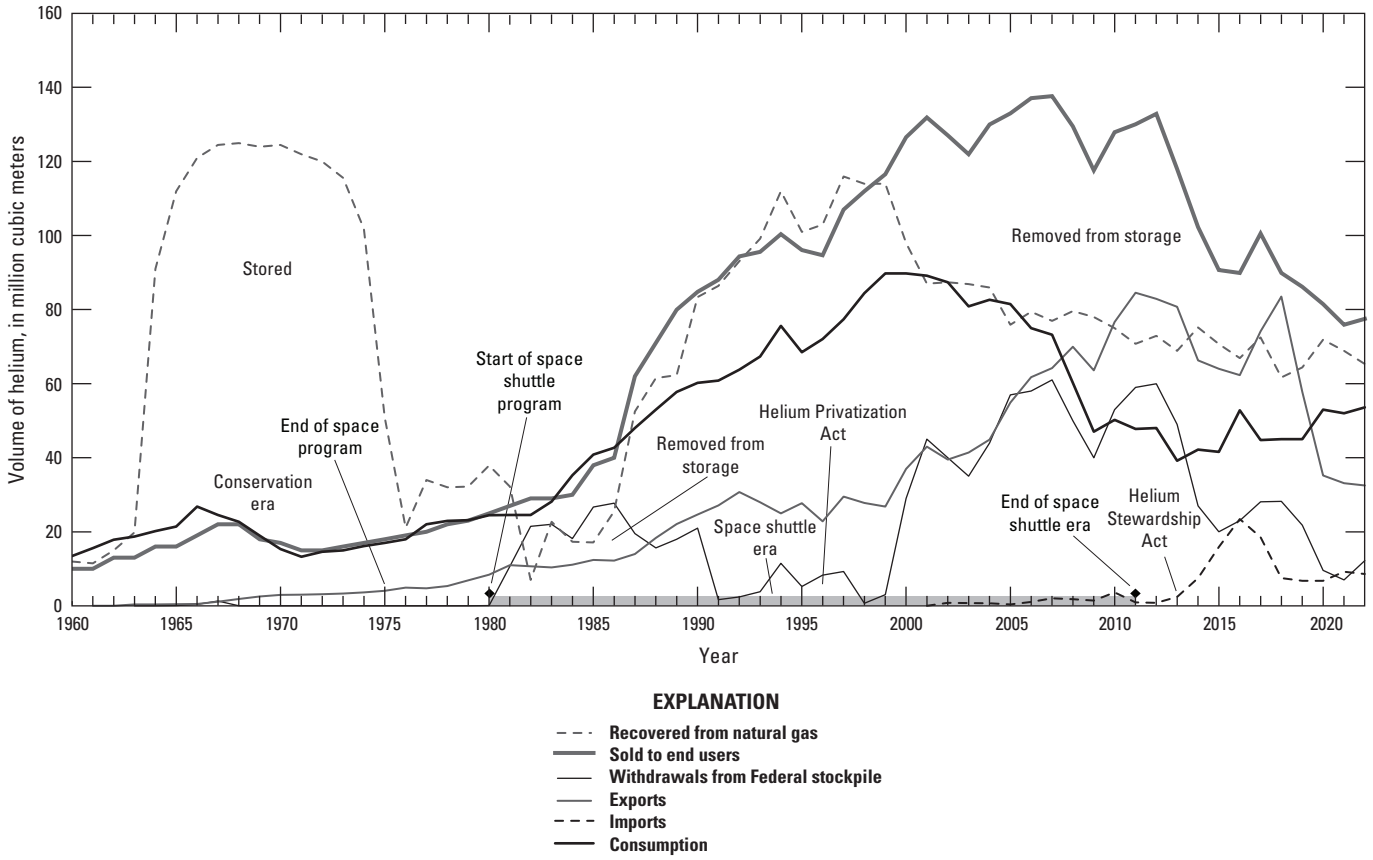

Figure 4. Yearend helium recovery in the United States, 1960–2022.

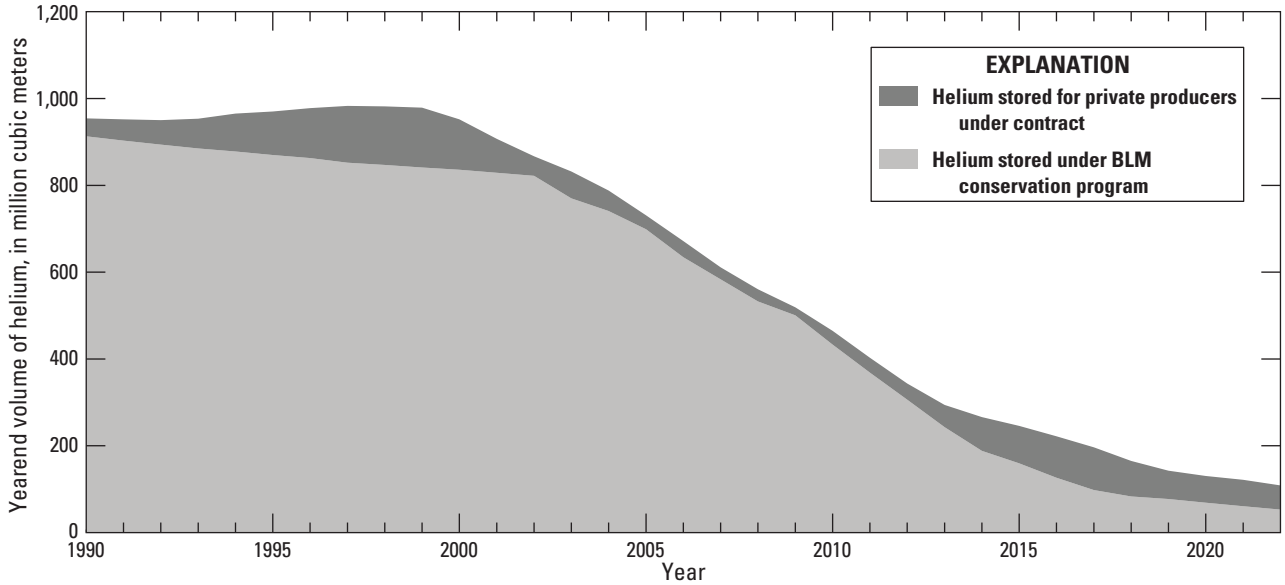

Figure 5. Yearend helium in the Bureau of Land Management (BLM) conservation storage system, 1990–2022.