

Selling the Nation's Helium Reserve

Board on Physics and Astronomy
National Materials Advisory Board
National Research Council

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Context for Study

- Helium is the only element that is in danger to loss from the earth by diffusion. It took the earth 4 billion years to make it radioactive decay. We are in danger of dissipating the resource forever in a mere century.
- Helium-4's unique characteristics – used in many disparate enterprises
 - Purging/pressuring NASA and DOD rockets; MRI's; Welding; Cryogenic research; Facilities requiring superconducting magnets; Lifting – party balloons, airships.
- Mid-1960s cold war efforts led to the accumulation of a large reserve of crude helium-4 – over **35 billion cubic feet**
 - For comparison, annual U.S. (global) usage in mid-1970's – 600 (750) million cubic feet; currently U.S. (global) usage is approximately 3 (6) billion cubic feet.
- Crude helium stored – underground reservoir in West Texas. Together with pipeline across Texas, Kansas and Oklahoma and supporting equipment, constitutes the **Federal Helium Reserve**.
- Pipeline links crude helium sources, refining facilities owned by 4 companies and the reservoir. Reservoir also is available to private companies for short-term storage of crude helium – “flywheel concept,” discussed later.

Context for Study – (cont'd)

- Helium Privatization Act of 1996 (**1996 Act**) - substantially all federally owned helium be **sold off** by the year **2015** at prices sufficient to repay the federal government for its outlays associated with the helium program.
- **2000 Academies Study** - helium markets stable since the 1980s, it did not appear the sell-off would significantly impact critical users.
- After sell-off began, significant **price hikes** and **shortages** have been encountered.

Statement of Task

The study will determine whether selling off the U.S. Helium Reserve in the manner prescribed by law has had any adverse effect on U.S. scientific, technical, biomedical, and national security users of helium. To provide a meaningful context for this effort, the study will examine the helium market and the helium industry supply chain.

The study committee will address the following tasks:

- Review the report "The Impact of Selling the Federal Helium Reserve" (NAP, 2000) and compare projected expectations with actual outcome. Determine the reasons for the differences.
- Examine the availability and reliability of worldwide supply, technical opportunities to increase that supply—such as through improved recovery—and the relationships among supply, demand, and market price.
- Assess the current and projected U.S. marketplace for refined helium, including worldwide helium demand by industrial and other users. Assess the role of private industry in future conservation efforts.
- Assess the current "flywheel" concept for operating the Reserve. Develop scenarios for how the Reserve might be used to meet future helium demand.
- Assess the role that organizational and financial factors play in meeting the goals of the Federal Helium Program. Identify measures that would enable the Program to respond more effectively to the dynamics of the helium industry.

Helium Reserve Committee Membership

Committee drawn from the many communities that use helium, experts familiar with the resource and the helium market.

- Researchers from both small-scale laboratories and large facilities
- NASA's helium procurement officer
- Natural reservoir experts
- Economists – with both general and natural resources backgrounds
- Industrial expertise – experience in the helium market and its operations.

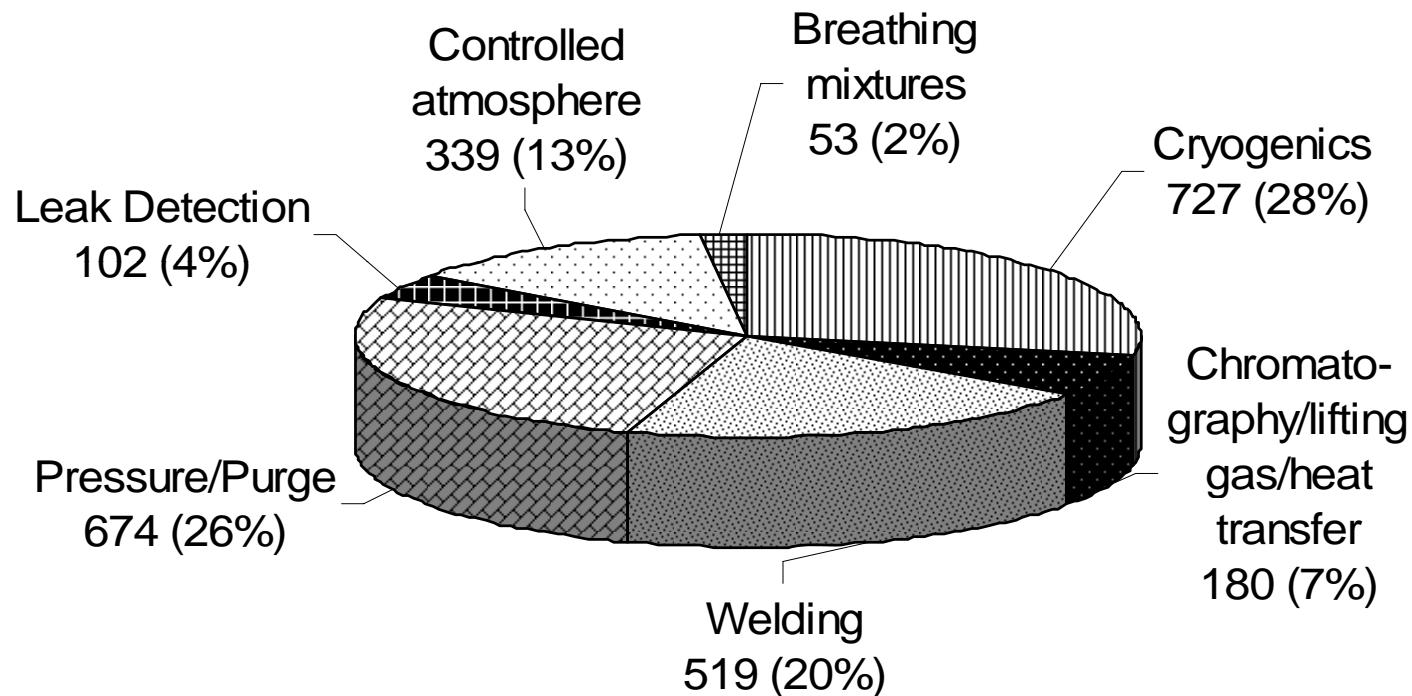
CHARLES G. GROAT, <i>Co-Chair</i> , University of Texas at Austin	ROBERT C. RICHARDSON, <i>Co-Chair</i> , Cornell University
ROBERT R. BEEBE, Independent Consultant	JOHN R. CAMPBELL, J.R. Campbell & Associates, Inc.
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CAROL A. DAHL, Colorado School of Mines	THOMAS ELAM, NASA
ALLEN M. GOLDMAN, University of Minnesota	NORMAN E. HARTNESS, Independent Consultant
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J. BENJAMIN REINOEHL, RMW Solutions, LLC	IGOR SEKACHEV, TRIUMF
THOMAS A. SIEWERT, National Institute of Standards and Technology	MARK H. THIEMENS, University of California, San Diego

Review Panel Membership

Julia Phillips, <i>Review Monitor/Coordinator</i> , Sandia National Laboratories	Gordon Baym, University of Illinois at Urbana-Champaign
John Curtis, Colorado School of Mines	Robert Dynes, University of California at San Diego
Donald Gessaman, EOP Group, Inc.	William Halperin, Northwestern University
Charles Howe, University of Colorado	Carl Johnson, retired
Robert Kephart, Fermilab	Jane Long, Lawrence Livermore National Laboratory
Chris Sims, Princeton University	G.J. Wasserburg, California Institute of Technology

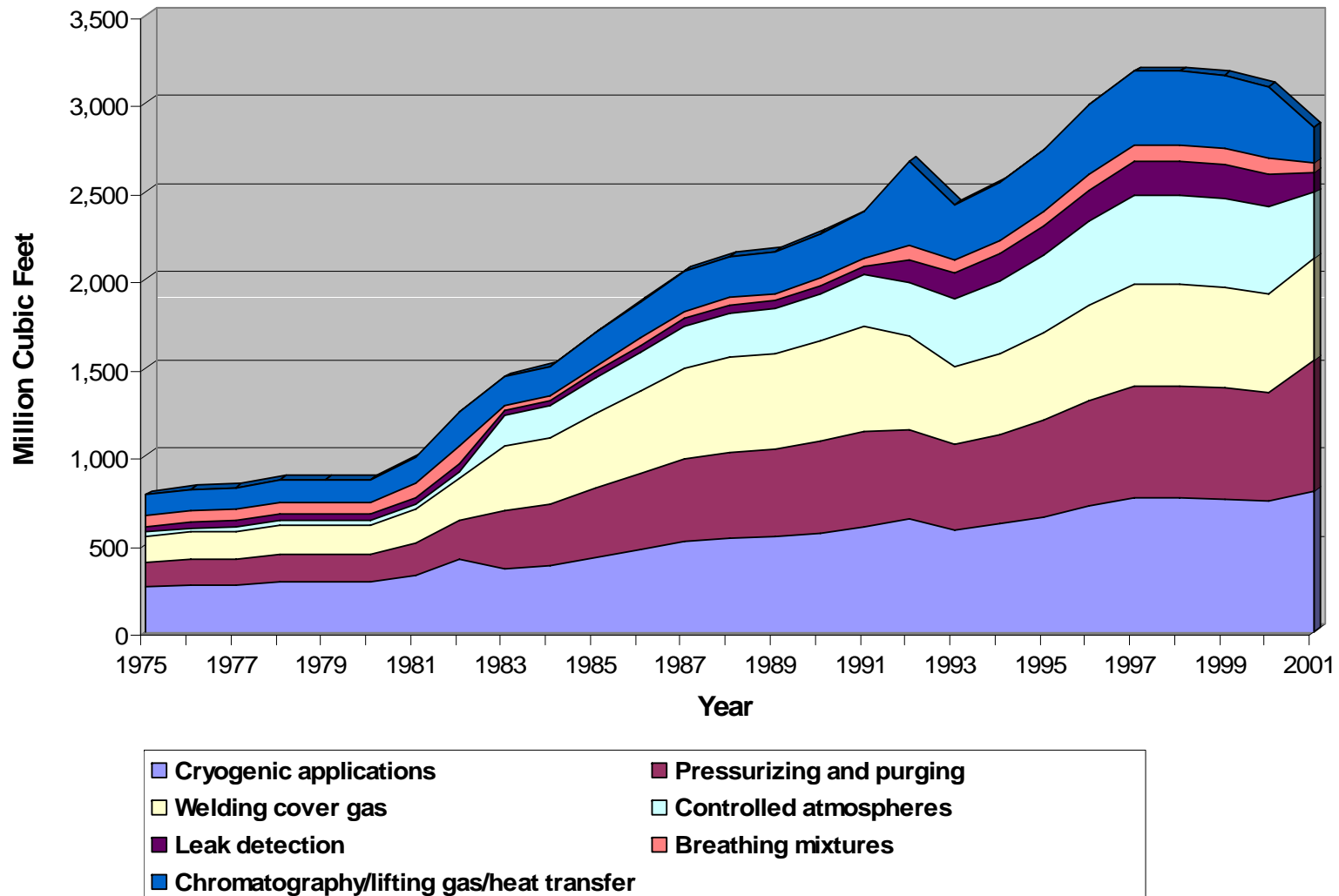
The review panel was chosen to have a similarly broad set of expertise and perspectives.

Domestic Uses of Helium

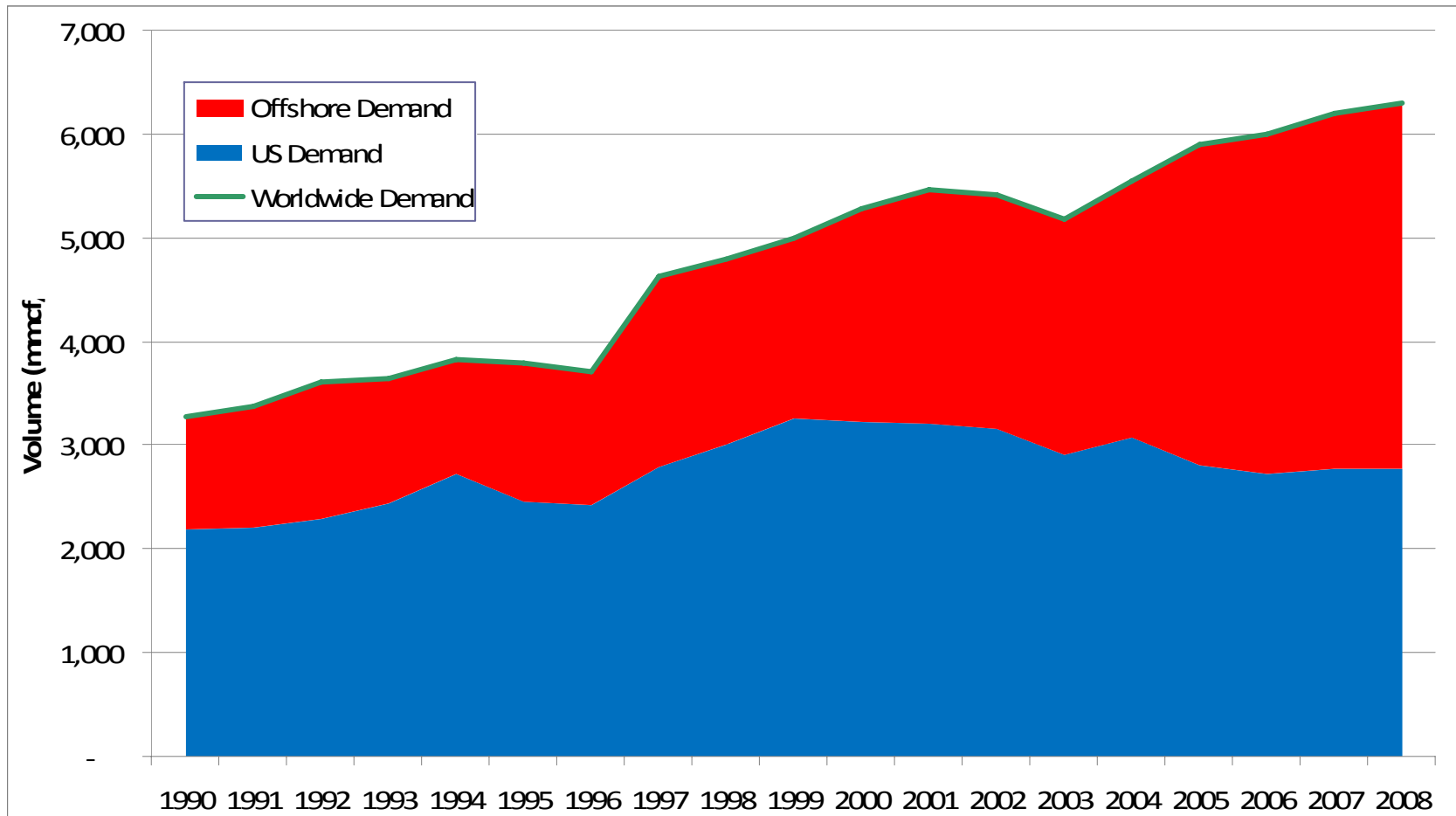


Figures – in million cubic feet, percentages are of domestic use.

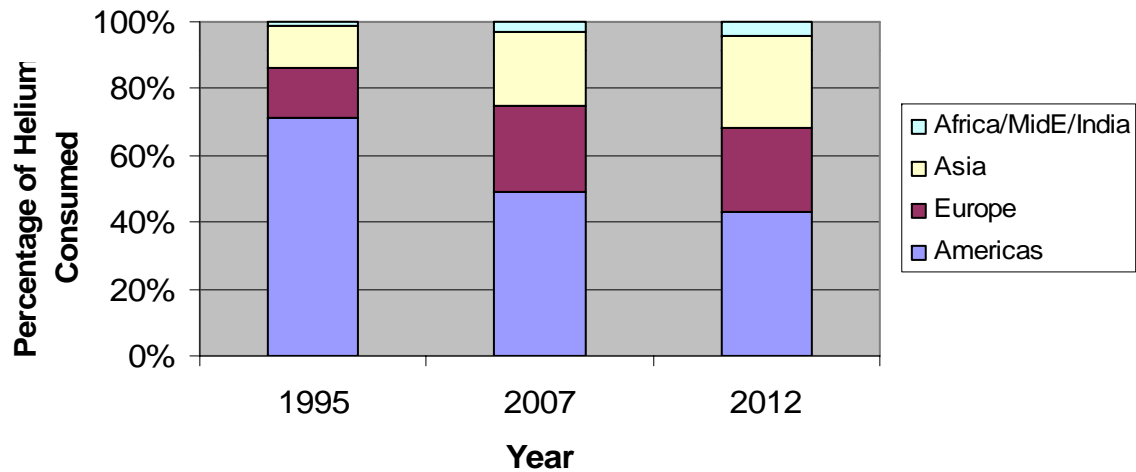
Domestic Uses – Changes over time



Worldwide Helium Demand



Demand by global region

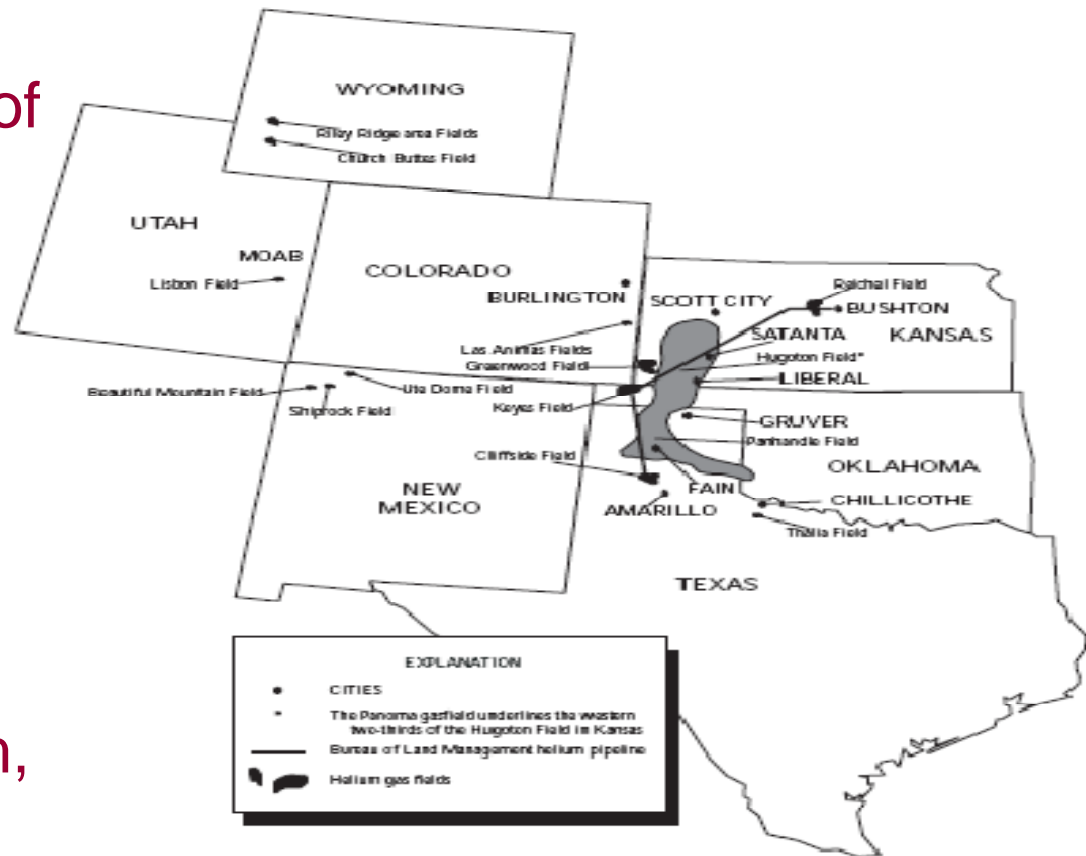


Helium Sources

1. Extracting helium as part of the process of producing methane and natural gas liquids (propane, ethane, butane, benzene). Requires $>0.3\%$ helium.
2. Direct processing - helium and other non-fuel gases (sulfur and CO_2) are in sufficient concentrations to justify processing the gas for non-fuel constituents. Requires $>0.3\%$ helium.
3. Extracting helium as part of the process of producing liquefied natural gas (LNG). Only trace amounts of helium needed.

U.S. (Domestic) Sources

- In the U.S., most helium from 1st method – byproduct of producing methane, natural gas liquids
- U.S. Helium Reserve shown
- Wyoming – principal source not linked to pipeline; helium extracted using 2nd method - Direct processing for helium, other gases.
- Potential reserves, - 4 corners area.



Helium Sources Outside of the United States

- Only small reserves of first two sources discovered to date.
- Production of LNG (the third recovery method) has begun to open up new, potential sources – Australia (small amount), Algeria, Qatar, Russia.

Principal task of committee

- Has the sell off of the Helium Reserve pursuant to the 1996 Act had any adverse effect on U.S. scientific, technical, biomedical, and national security users of helium?

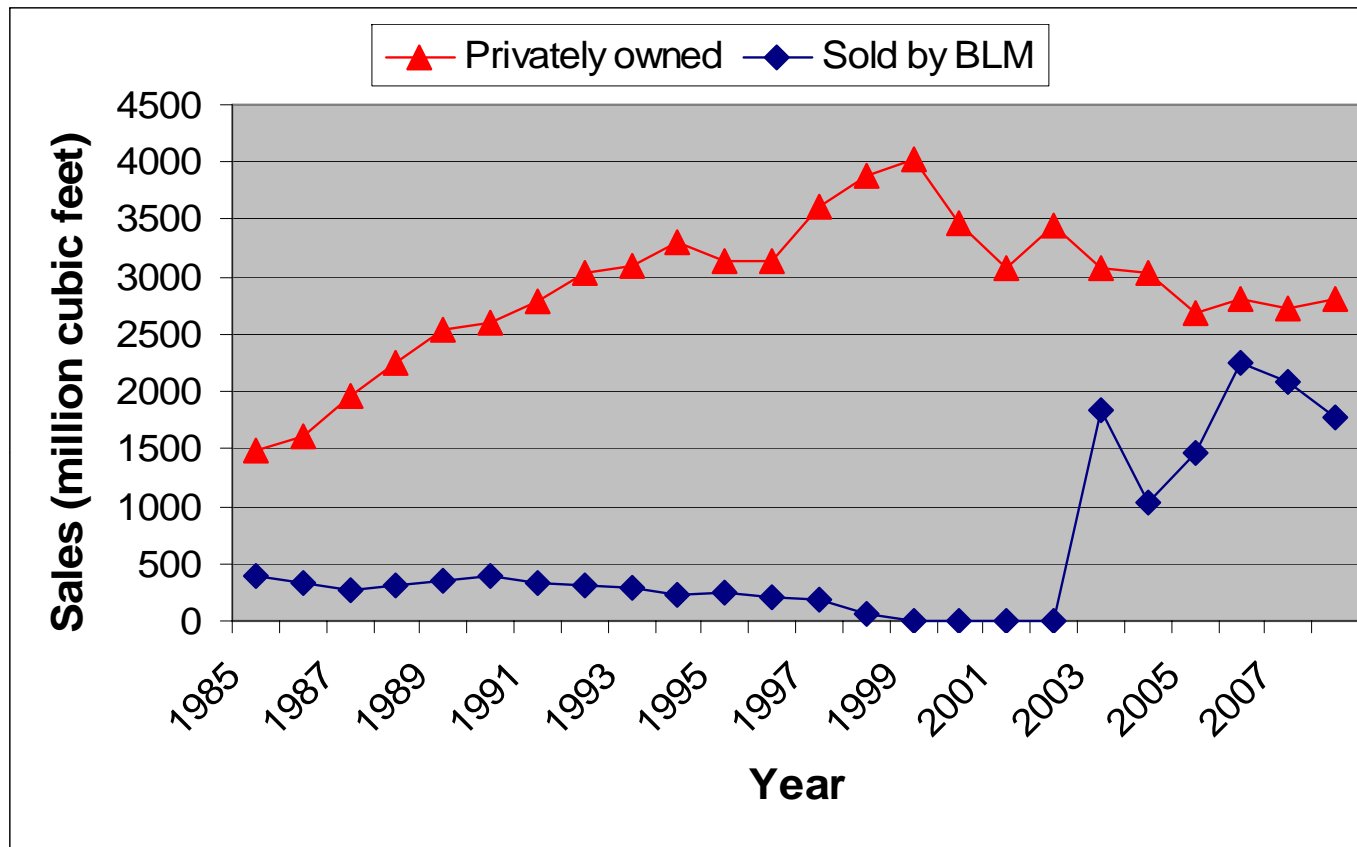
Conclusion

- Committee concludes that it has and will continue to have such an impact.
 - Significantly affected pricing and effectively influences most aspects of helium market.
 - With the sell-off of substantially all federally owned helium the United States will become a net importer of helium in the next 10-15 years, the principal foreign sources of which will be the Middle East and Russia.

2000 Academy Report

- Academy's report issued in 2000 to assess the prospective impact of 1996 Act noted – prices and demands – stable since the 1980's. Sales price required by 1996 Act – roughly double comparable price for private crude helium.
- Principal conclusion of that report – because of price difference, very little federal helium would be sold until private prices gradually caught up; consequently, the 1996 Act will have very little impact on users.

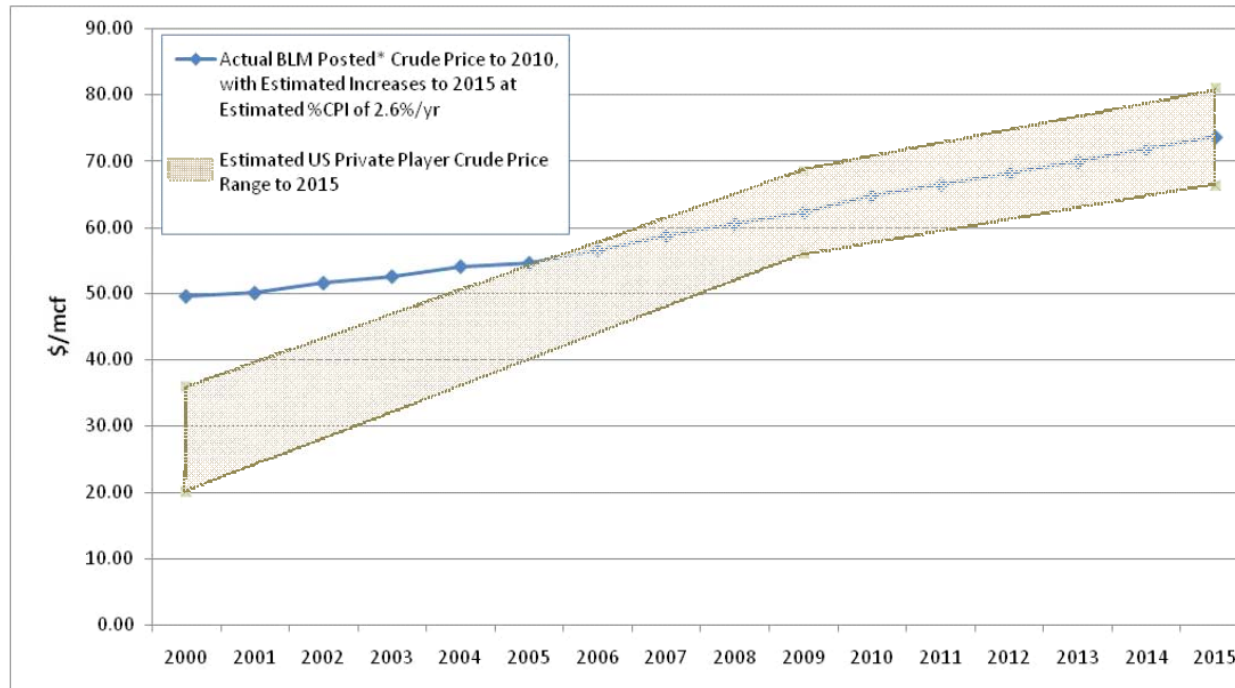
Domestic Sales of Helium



Events did not unfold as expected -

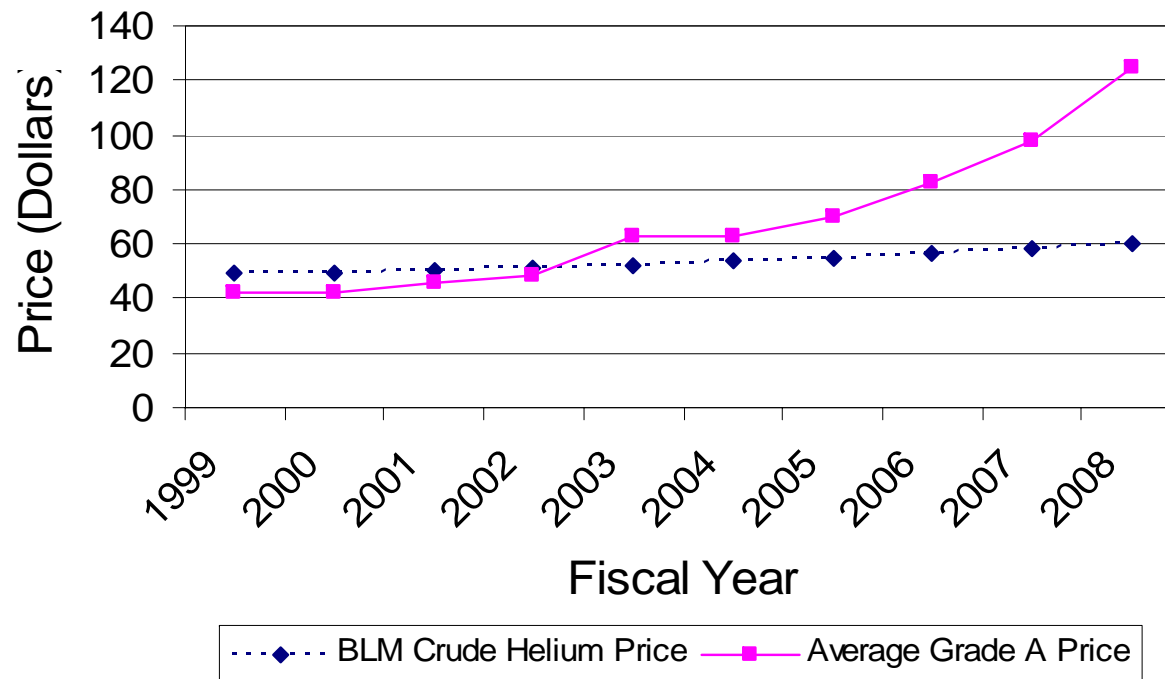
- Prior to 1996 Act, BLM sold only a small portion of total helium on market.
- Higher prices did not suppress sale of federal helium. For past 6 years, BLM has been averaging sales of approximately 1.75 billion cubic feet – over half of domestic requirements, almost 1/3 of total global demand.

Impact on Crude Helium Prices



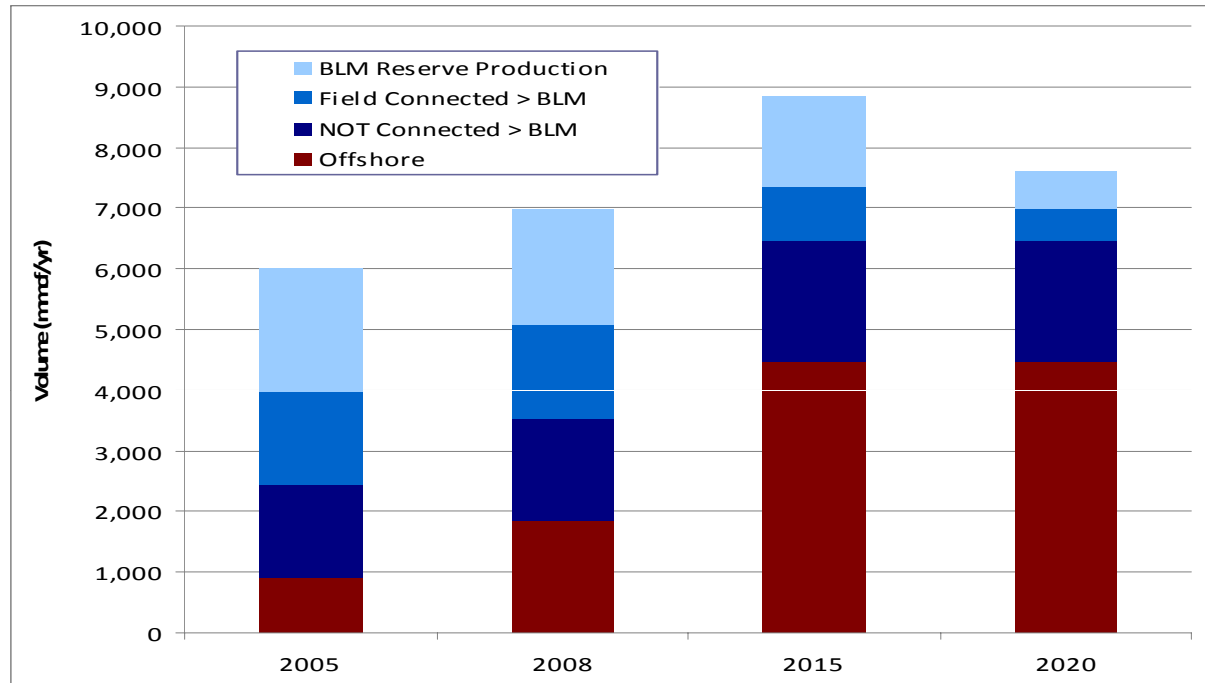
- Market response – rather than refuse to pay for higher-priced federal helium, prices of comparable privately owned helium rapidly increased.
- Currently, much of the privately owned crude helium is being sold at higher prices than federally owned helium.
- Most contracts for sale of privately owned helium set prices expressly tied to federal price.
- In essence, federal sales price, as established by 1996 Act is setting the price for crude helium, rather than current market conditions.

Impact on Retail Helium Prices



- Higher crude helium prices reflected in pricing for retail helium. Representative price more than doubled over 4 year period, and tripled over the decade.
- Tight markets also produced periods in 2006 and 2007 of prolonged shortages and disruptions in supply.

Projected Helium Sources



- Under current sell-down schedule, BLM reserves will be essentially depleted before 2020.
- Fields connected to the Reserve are mature and will see reduction in their productivity.
- Foreign sources are expected to make up most of the difference – principally in Algeria, Qatar and Russia, as part of LNG production facilities.

Immediate Recommendations

Specific recommendations for immediate improvements

- Changing the methods for pricing the helium being sold
- Committing more resources to managing the physical facilities at the Federal Helium Reserve
- Expanding the sales program for government users to include those in the science communities.

Pricing Recommendation

- Pricing federally owned helium lower than the price the market would otherwise set for crude helium could lead to
 - inaccurate market signals, increased consumption, and accelerated depletion of the Federal Helium Reserve;
 - retard efforts to conserve and develop alternative sources of crude helium, and
 - result in transfers of taxpayer assets to private purchasers at below-market values.
- **Recommendation - The Bureau of Land Management (BLM) should adopt policies that open its crude helium sales to a broader array of buyers and make the process for establishing the selling price of crude helium from the Federal Helium Reserve more transparent. Such policies are likely to require that BLM negotiate with the companies owning helium refining facilities connected to the helium pipeline the conditions under which unused refining capacity at those facilities will be made available to all buyers of federally owned crude helium, thereby allowing them to process the crude helium they purchase into retail helium for commercial sale.**

Management Resources Recommendation

- The short-term nature of the sell-off might be adversely affecting management of the reserve, with the consequence of potentially losing access to significant portions of the helium on deposit.
- **Recommendation - BLM should develop and implement a long-term plan that incorporates appropriate technology and operating practices for delivering crude helium from the Reserve in the most cost-effective manner.**

Detailed Management Resources Recommendation

- Encourage either the remove of helium production rate constraints in the Helium Enrichment Unit (HEU) or find a more economical alternative to increase capacity from the unit.
- Implement expert recommendations to meet crude helium production demands from the Bush Dome Reservoir or find more economical alternatives. These recommendations include
 - Short-term solutions
 - Add compression to Well Bi-A6
 - Work over Well Bi-A3 (currently rate-limited due to water production) to increase productivity from 1 mmcf/d to over 2 mmcf/d
 - Medium- to long-range solutions
 - Upgrade production capability with compression and new wells
 - Reduce constraints imposed by Helium Enrichment Unit
 - Encourage owners of helium refineries to improve facilities at their plants by increasing ability to process lower quality crude helium
- The possibility cannot be excluded that an emergency situation (helium production shortfall) could arise at any time prior to adequate upgrading of facilities in the field and HEU. To avoid sustaining this risk into the future, upgrading should commence as soon as possible.

Assistance for Small-Scale Researchers Recommendations

- Soaring prices and supply volatility have hit small-scale researchers particularly hard. In general, federal grant programs that support these researchers simply are not designed to respond to pricing shifts and other market volatilities such as have been experienced here.
- Currently, government users of helium purchase indirectly from BLM in “in-kind” program on a cost-plus basis. Importantly, these users are entitled to priority in event of shortages.
- **Recommendation.** The crude helium in-kind program and its associated customer priorities should be extended by BLM, in cooperation with the main federal agencies not currently participating in the in-kind program—for example, the National Science Foundation, the National Institutes of Health, and the extramural grant programs of the Department of Energy—to research being funded in whole or in part by government grants.

Assistance for Small-Scale Researchers Recommendations (cont'd)

- Further, conservation and reuse of helium by these users should be promoted by funding agencies. Although may be costly in the short-run, such policies will save money in the long-run, will help address negative effects of price and supply disruptions encountered in recent years.
- **Recommendation.** Federal agencies such as the Department of Energy, the National Science Foundation, the National Aeronautics and Space Administration and the Department of Defense that support research using helium should help researchers at U.S. universities and national laboratories acquire systems that recycle helium or reduce its consumption, including low-boil-off cryostats, modular liquefaction systems and gaseous recovery systems.

Long-Range Recommendations

More general recommendations are made for meeting long-term U.S. Helium Needs

- Collection, Dissemination of Information
- Long-Range Planning

Recommendations on Collection, Dissemination of Information

- Lack of timely and sufficient information to evaluate the helium market, especially non-U.S. sources of supply and demand, and the operation of the Federal Helium Reserve. Such information is needed to formulate, and carry out U.S. policies on helium.
- **Recommendation.** BLM should acquire, store, and make available to any interested party the necessary data to fill current gaps in (1) modern seismic and geophysical log data required for characterization of the Bush Dome Reservoir, (2) information on the helium content of gas reservoirs throughout the world including the raw data, methodology, and economic assessment for the classification of reserves contained in specific fields, and (3) trends in world demand. BLM or other agencies with the necessary expertise such as the United States Geological Survey (USGS), should develop a forecast over the long term (10-15 years) of all U.S. demand for helium for scientific, research, space, and military purposes.
- **Recommendation.** Unless expressly prohibited from doing so, BLM should publish its database on the helium concentrations in the more than 21,500 gas samples that have been measured throughout the world, and provide its interpretations of gas sample analyses, especially those reflecting likely prospective fields for helium.

Recommendations on Long-Range Planning

- Helium is critically important to many U.S. scientific, industrial, and national defense sectors. Further, the helium market is rapidly changing and because the Reserve is so large, steps undertaken with respect to the Reserve can have unintended consequences.
- **Recommendation.** The Bureau of Land Management should promptly initiate investigations into the feasibility of extending the Helium Pipeline to other fields with deposits of commercially available helium as a way of extending the productive life of the Helium Reserve and the refining facilities connected to it.
- **Recommendation.** The Bureau of Land Management should form a standing committee with representation from all sectors of the helium market, including scientific and technological users, to regularly assess whether national needs are being appropriately met, to assist BLM in improving their operation of the Federal Helium Reserve, and to respond to other recommendations in this report.

Recommendations on Long-Range Planning (cont'd)

- **Recommendation.** The Bureau of Land Management, in consultation with the Office of Science and Technology Policy and relevant congressional committees, should commission a study to determine the best method of delivering helium to the in-kind program, especially after the functional depletion of the Bush Dome Reservoir, recognizing that this will not happen until well after 2015.
- **Recommendation.** The congressional committee or committees cognizant of and having oversight of the federal helium program should reevaluate the policies behind the portions of the 1996 Act that call for the sale of substantially all federally-owned helium on a straight-line basis. It or they should then decide whether the national interest would be better served by adopting a different sell-down schedule and retaining a portion of the remaining helium as a strategic reserve, making this reserve available to critical users in times of sustained shortages or pursuant to other predetermined priority needs.

Issues to be addressed

- Securing a stable and accessible helium supply in the future requires addressing several important issues that are beyond the scope of this study. However, those issues should be addressed.
 - The legislative framework for operation of the federal helium program is silent on its management after January 1, 2015—the mandated date for disposal of substantially all federally owned crude helium. What is to be done with the remaining federally owned crude helium? How will BLM operations beyond 2015 be financed? Should the Reserve, either a federal or a private entity, as appropriate, continue to exist after the BLM debt to the U.S. Treasury has been retired?
 - While the committee supports maintaining a strategic reserve, addressing these issues requires the involvement of Congress and the broader federal science policy establishment because they go well beyond the reserve management responsibilities of BLM.

Questions and Comments