American Physical Society
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March 6, 2023

The Honorable James D. Applegate
Director, U.S. Geological Survey
12201 Sunrise Valley Drive
Reston, VA 20192

Dear Director Applegate:

The American Physical Society (APS) — the largest physics membership organization in the United States — appreciates the opportunity to provide public comment to the recent request for information: *Request for Comments on Helium Supply Risk*, U.S. Geological Survey, Department of the Interior; 5904 Federal Register / Vol. 88, No. 19 / Monday, January 30, 2023. In this letter, APS responds to the following questions pertaining to a potential disruption in the supply of helium:

- Determining domestic helium consumers and their primary uses for helium
- Whether such a supply disruption would jeopardize the manufacturing or use of products vital to the defense, healthcare, aerospace, consumer electronics, and other industries

APS represents more than 50,000 members across academia, the national labs, and the private sector. For thousands of our members — and tens of thousands more scientists and engineers across the United States — helium is absolutely essential. Because of helium's vitalness to our community and the broader U.S. scientific ecosystem, we recommend that the federal government continue to maintain its responsibility of the unclaimed helium currently in the Federal Helium Reserve and retain it for use in federally supported research. In the case where the federal government chooses to move forward with the sale of the Reserve, we recommend including a "condition of sale" that requires the purchaser to maintain the in-kind helium program for federal research grantees, to ensure that they have continued access to this critical resource.

Helium is a scarce, irreplaceable, and non-renewable natural resource. Its unique ability to remain liquid at ultra-cold temperatures enables scientists to reach temperatures that approach absolute zero. Consequently, the vast majority of scientific equipment and experiments that require reaching these ultra-low temperatures rely on liquid helium. This includes some of our most ambitious experiments and instrumentation, such as cooling both the superconducting

magnets in the Large Hadron Collider and the infrared detectors on the James Webb Space Telescope.

Helium has enabled breakthrough discoveries in medicine, national security, computer technology, and fundamental science. These breakthroughs — including magnetic resonance imaging and semiconductor devices — have spawned billion-dollar industries. Today, helium fuels the development of national priority technologies in quantum computing, next-generation energy materials, and space applications. Put simply, there is no replacement for helium, and America's research enterprise relies on access to a steady, reliable supply. For researchers at universities across the U.S., supply stability and affordability are especially crucial.

According to the 2016 APS-ACS-MRS report[1] titled "Responding to the U.S. Research Community's Liquid Helium Crisis," an estimated 400 research groups rely on liquid helium for low-temperature experiments, primarily in the physical sciences, and several thousand research groups utilize liquid helium-enabled instruments, such as nuclear magnetic resonance (NMR) spectrometers and superconducting quantum interference devices (SQUIDs), for their research. A typical research-intensive university in the United States might have two dozen such instruments across multiple academic departments.

This instrumentation ranges in purchase price from a few hundred thousand to several million dollars and generally requires that liquid helium be continuously supplied for the equipment to remain ultra-cold for extended periods of time. If the liquid helium supply were to be suddenly disrupted and cut off, such equipment could become useless and/or permanently damaged if it were to warm above its threshold temperature.

Without the market power of larger helium consumers, scientific users are especially vulnerable to price variability and supply disruption. Academic research is carried out largely through the support of federal grants, and limited funds are carefully apportioned to support researchers, the training of their students, and the provisioning of their laboratories. When helium prices spike, grant money is consumed faster than planned, forcing researchers to choose between an adequate supply of helium to perform their work or their ability to support trainees. In severe cases, research requiring helium may be halted altogether. Dr. Sophia Hayes, a professor and APS member, described an increasingly common situation in her testimony[2] at a 2019 House Science, Space, and Technology Committee hearing titled "Research and Innovation to Address the Critical Materials Challenge":

> *"For researchers like myself who receive fixed budgets from the National Science Foundation, we cannot weather the tremendous price increases we have seen. At my institution, the price for liquid helium has increased more than 400% from the start of my career – but the grants we receive have been flat, not accounting for such massive inflation in the price of a critical line-item in budgets. For researchers like myself, it means I have to choose between paying for helium or paying the salary to support a graduate student in getting a PhD. In my case, I have had to decommission magnets – reducing my lab's research capacity – simply because I couldn't afford to purchase the helium necessary to sustain them." – Professor Sophia E. Hayes, Washington University in St. Louis*

Whether choices are made to scale back research projects or lessen support for trainees, U.S. innovation suffers. In this era of heightened global competition, the United States has made massive federal investments in science and technology workforce development. Failing to maintain a stable helium supply would mean less research output and fewer new researchers being trained. The 2018 National Quantum

[1] This RFI response draws from the 2016 joint report of the American Physical Society, American Chemical Society and Materials Research Society (APS, ACS and MRS) https://www.aps.org/policy/reports/popa-reports/upload/HeliumReport.pdf
[2] https://www.congress.gov/116/meeting/house/110321/witnesses/HHRG-116-SY20-Wstate-HayesS-20191210.pdf

Initiative, for example, authorized more than $1 billion in funding for research and workforce training in quantum science. But liquid helium is an essential component of quantum science — and the national initiative will not succeed without it.

While federal science agencies and researchers are taking steps to bolster helium recycling programs and infrastructure, it is also vital that the U.S. research enterprise maintains access to a supply of helium that is shepherded by the federal government or otherwise stabilized. Ideally, the federal government would continue to maintain responsibility for the 2 billion cubic feet of unclaimed helium — the equivalent of approximately 81 million liters of liquid helium — currently in the Federal Helium Reserve and retain it for use in federally supported research.

Should the federal government continue to move forward with the complete sale of the Federal Helium Reserve and all associated assets, it must ensure researchers have continued access to helium. This critical access can be secured by including a "condition of sale" — as proposed in the Securing Helium for Science Act (H.R. 655; 117th Congress) — that requires the purchaser of the Reserve to maintain the in-kind helium program for federal research grantees. Maintaining a federal supply or in-kind program would maintain the federal government's historical commitment to the nation's scientific enterprise.

While scientific research accounts for only a small fraction of the global helium usage, this fraction has an outsized impact on U.S. innovation and competitiveness. It has fostered the development of billion-dollar industries, fueled essential lifesaving medical tools, supported work leading to more than 5,000 patents, and helped generate multiple Nobel Prizes. In short, helium is crucial to innovation, and a reliable and affordable supply of helium must be maintained for the fundamental research community.

Thank you for your consideration.

Sincerely,

Robert Rosner, President, American Physical Society
Smitha Vishveshwara, Chair, APS Division of Condensed Matter Physics
Vivien Zapf, Chair, APS Division of Materials Physics