COMMITTEE ON
SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN BRIAN BABIN

SUBCOMMITTEE ON ENERGY

HEARING CHARTER

"*From Transformative Science to Technological Breakthroughs: DOE's National Laboratories*"

Wednesday, February 12, 2025
10:00 a.m.
2318 Rayburn House Office Building

Purpose
The purpose of this hearing is to explore the U.S. Department of Energy's (DOE) National Laboratories and their research, development, demonstration, and commercial application activities. This hearing will examine the National Laboratories' response to hostile threats, progress of their large infrastructure projects and user facilities, and role in developing emerging technologies such as Quantum and Artificial Intelligence. These topics are instrumental to U.S. competitiveness and ensuring secure, affordable, and reliable energy through innovation.

Witnesses
- **Dr. John Wagner,** Director, Idaho National Laboratory
- **Dr. Thom Mason,** Director, Los Alamos National Laboratory
- **Dr. Paul Kearns,** Director, Argonne National Laboratory
- **Dr. Kimberly Budil,** Director, Lawrence Livermore National Laboratory

Overarching Questions

- What role do the National Laboratories play in the U.S. scientific enterprise and the development of innovative technologies? How do the National Laboratories partner with industry and how beneficial is this relationship to U.S. competitiveness?

- Given increased attempts by hostile nations to infiltrate the national labs, how has the recent congressionally authorized language included in the CHIPS and Science Act (DOE Risk Matrix) and National Defense Authorization Act (NDAA) for fiscal year (FY) 2025 improved research security? What vulnerabilities remain?

- What is the status of the large research experiments and user facilities reauthorized in the CHIPS and Science Act?

- With the emergence of transformative technologies such as AI and Quantum Information Sciences, are the national laboratories equipped to support the development of these new technologies while facing new challenges that they present to U.S. security?

BACKGROUND

During World War II, the U.S. military brought together the world's top scientists and tasked them to develop the first nuclear bomb. Known as the Manhattan Project, this effort led to the creation of the first national laboratories. In the post war period, the U.S. government created the Atomic Energy Commission (AEC) to manage these newly created laboratories where they continued to develop nuclear weapons. In the 1950s, President Eisenhower through his "Atoms for Peace" initiative sought to harness the power of the atom for commercial energy uses, which expanded the labs' focus to include nonmilitary nuclear research and development projects. In 1971, President Nixon established the Energy Research and Development Administration (ERDA) to support the AEC's research activities as well as the development of non-nuclear forms of energy. To consolidate the government's research activities, President Carter signed the Department of Energy Organization Act, which transformed the AEC into the Department of Energy (DOE).[1]

Today, DOE employs over 14,000 federal employees, oversees 95,000 contractors, and operates 17 world-leading national laboratories that support cutting-edge research in a wider variety of scientific disciplines. Its mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.[2] With this mission, DOE is the largest federal sponsor of basic research in the physical sciences and plays a central role in the U.S. research enterprise, partnering with several other research agencies including the National Science Foundation (NSF), the National Institute of Standards and Technology (NIST), U.S. Geological Survey, and the National Aeronautics and Space Administration (NASA). In tandem, the Department is a leader in energy technology innovation pertaining to nuclear fission and fusion, geothermal technologies, petroleum and natural gas, and renewable energy.

Of the 17 facilities, 10 are managed by the Office of Science (SC) including Ames National Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Fermilab, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Princeton Plasma Physics Laboratory, SLAC National Accelerator Laboratory, and Thomas Jefferson National Accelerator Facility. Each national laboratory prioritizes one or more basic research programs including Advanced Scientific Computing Research (ASCR), Basic

[1] "History." *U.S. Department of Energy*, 4 Aug. 2020, www.energy.gov/lm/history.
[2] "Mission." *U.S. Department of Energy*, 3 Aug. 2011, www.energy.gov/mission.

Energy Sciences (BES), Biological and Environmental Research (BER), Fusion Energy Sciences (FES), High Energy Physics (HEP), Accelerator R&D and Production, Isotope R&D and Production, and Nuclear Physics (NP). In addition, these laboratories are home to world class user facilities, which accelerate scientific breakthroughs. Four of the seven remaining national laboratories are managed by the applied energy offices within DOE, which prioritize more mature energy technologies. These include Nuclear Energy (Idaho National Laboratory), Environmental Management (Savannah River National Laboratory), Energy Efficiency and Renewable Energy (National Renewable Energy Laboratory), and Fossil Energy (National Energy Technology Laboratory). Lastly, under the National Nuclear Security Administration (NNSA), DOE maintains the U.S. nuclear arsenal along with several other national security missions at Lawrence Livermore, Los Alamos, and Sandia.

The House Committee on Science, Space, and Technology has jurisdiction over DOE's civilian research, development, demonstration, and commercial application programs. In total, the Committee oversees and authorizes over $17 billion in DOE activities, approximately one third of the Department's annual budget. In FY24, the national laboratories in the Committee's jurisdiction received $10.5 billion.[3]

Research Security

With the rise of hostile powers such as the Chinese Communist Party (CCP), the United States research enterprise has been subject to foreign interference. These malign actors have sought to secure sensitive technologies through various means. For instance, the CCP recruited researchers at leading universities through its Thousand Talents plan.[4] As a response, Congress passed provisions in the CHIPS and Science Act to protect U.S. research from these types of tactics. In addition, Congress directed DOE to develop and implement a risk matrix to protect intellectual property and reduce research risks posed by national security threats and entities of concern. DOE has implemented this congressional directive, but threats continue to advance. In the National Defense Authorization Act FY2024, Congress further directed DOE to restrict access to foreign individuals from countries of risk to protect research activities at the National Laboratories. Despite these newly enacted measures, hostile actors have evolved their tactics to gain access to DOE researchers, government-funded technologies, and federal dollars through contracts and grants.[5] The CCP is also investing billions of dollars in key emerging technology areas in hopes to supplant the leadership of United States research and development. Their hope is over the next few decades to have world leading science facilities that will attract researchers from around the world to China.[6]

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[3] *Department of Energy FY 2025 Laboratory Tables*, 9 Mar. 2024, www.energy.gov/sites/default/files/2024-03/doe-fy-2025-budget-lab-table.pdf.
[4] Robinson, Tilly R., and Neil H. Shah. "After Conviction for Lying About China Ties, Ex-Harvard Chemist Gets Approval to Visit Beijing." *The Harvard Crimson*, 30 Oct. 2024, www.thecrimson.com/article/2024/10/30/lieber-approval-china-visit/.
[5] "Strategic Environment." *National Security Agency*, 3 May 2016, www.nsa.gov/About/Strategic-Environment/.
[6] Atkinson, Robert D. "China Is Rapidly Becoming a Leading Innovator in Advanced Industries." *Information Technology and Innovation Foundation | ITIF*, 16 Sept. 2024, itif.org/publications/2024/09/16/china-is-rapidly-becoming-a-leading-innovator-in-advanced-industries/.

Infrastructure and Large Experimental Research Facilities

The national laboratories are home to world-class research experiments and user facilities where each laboratory specializes in important research topics. Argonne National Laboratory specializes in BES and ASCR where it manages the Advanced Photon Source (APS-U) and Aurora, a supercomputer, at the Argonne Leadership Computing Facility (ALCF). Brookhaven National Laboratory prioritizes Nuclear Physics and Isotope R&D and Production where it is home to the Accelerator Test Facility (ATF), Realistic Heavy Ion Collider (RHIC), and National Synchrotron Light Source II (NSLS-II). Fermilab specializes in HEP where it manages the Accelerator Complex and is currently constructing the Long Baseline Neutrino Facility (LBNF) to support the Deep Underground Neutrino Experiment (DUNE). Idaho National Laboratory, an applied sciences lab, focuses on nuclear technologies and is home to the Advanced Test Reactor. Lawrence Berkeley National Laboratory has a broad portfolio of programs but oversees the National Energy Research Scientific Computing Center (NERSC), Advanced Light Source (ALS-U), and the Human Genome Project. Princeton Plasma Physics Laboratory specializes in fusion energy sciences and manages the National Spherical Torus Experiment (NSTX-U). Thomas Jefferson focuses on Accelerator R&D and Production where it is home to the Continuous Electron Beam Accelerator Facility (CEBAF). The National Renewable Energy Laboratory, an applied energy laboratory, supports the Energy Systems Integration Facility (ESIF). Pacific Northwest National Laboratory specializes in BER where it oversees the Environmental Molecular Science Laboratory (EMSL), assists the Environmental Management work conducted at the Hanford Superfund site, and operates the Sequim marine research facility. Oak Ridge has a broad portfolio of programs but manages the High Flux Isotope Reactor (HFIR), Spallation Neutron Source (SNS), and the Frontier supercomputer housed at the Oak Ridge Leadership Computing Facility.

Over the last few years, DOE has sought to improve and upgrade existing research facilities and establish new research facilities. Congress authorized improvements and upgrades in the CHIPS and Science Act, including the Second Target Station for the SNS at Oak Ridge, ALS-U at Lawrence Berkeley, and Matters in Extreme Conditions (MEC) end station and Linac Coherent Light Source II (LCLS-II) at SLAC. In addition, DOE is building new facilities such as the Electron Ion Collider (EIC) at Brookhaven and DUNE at Fermilab. With the completion of these projects over the next decade, the U.S. will continue to be at the forefront of scientific discovery and achievement. Along with these large projects, DOE manages offices and infrastructure to support its research and development activities.

Critical and Emerging Technologies

Throughout their history, the National Labs have been vital for the U.S. to remain at the frontier of critical and emerging technologies. From powering various National Aeronautics and Space Administration (NASA) spacecraft to jumpstarting the shale gas revolution, the National Labs have played critical roles in not only scientific discovery but improving people's quality of life.[7] Of the numerous technologies the National Labs are working on, artificial intelligence (AI), quantum information sciences (QIS), semiconductors and microelectronics, and fusion are poised to be leading sources of discovery and breakthroughs that are key to ensuring our economic prosperity and national security.

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[7] "75 Breakthroughs by America's National Laboratories." U.S. *Department of Energy*, 14 Feb. 2018, www.energy.gov/articles/75-breakthroughs-americas-national-laboratories-0.

Artificial Intelligence (AI)

Due to DOE's computing infrastructure and access to terabytes of data, the National Laboratories are playing a significant role in the development of AI. Through the ASCR program, the National Labs are home to several of the fastest supercomputers in the world, many of which power AI models.[8] In the Top500, El Capitan at Lawrence Livermore is ranked first; Frontier at Oak Ridge is ranked second; Aurora at Argonne is ranked third; and Tuolumne at Lawrence Livermore is ranked tenth.[9]

With this infrastructure, the National Laboratories use AI to advance scientific discoveries and national security. For instance, Argonne employs ArouraGPT to support scientific research while Los Alamos National Laboratory uses AI to bolster confidence in our strategic deterrent.[10] In addition, DOE partners with other departments including the Department of Veterans' Affairs to advance Veterans' healthcare outcomes.[11] Moreover, Congress strongly supports DOE's AI research activities, which was formally authorized with the passage of the National Artificial Intelligence Initiative in 2020.

Quantum Information Sciences (QIS)

With the potential for QIS to revolutionize computing and processing power, DOE's National Labs are focused on QIS and its development. Authorized in the National Quantum Initiative Act (NQIA) of 2018, Congress directed DOE to establish a QIS research program and the Office of Science to create at least two National Quantum Information Science Centers (NQISRCs). In 2020, DOE selected Brookhaven, Argonne, Oak Ridge, Lawrence Berkeley, and Fermi to host the NQISRCs. Although distinct in their focus area, these centers combine basic research with engineering and technology development to advance quantum communication, computing, simulation, devices and sensors, materials and chemistry, and foundries. The National Labs, through its centers, partners with over 1,500 scientists and 115 academic, industry, and national science institutions to advance QIS.[12] In addition, Congress established the Quantum User Expansion for Science and Technology (QUEST) program in the CHIPS and Science Act. This program further encourages and facilitates access to quantum computing hardware for research purposes.

Semiconductors and Microelectronics

Authorized in the CHIPS and Science Act, Congress directed DOE to establish a microelectronics research, development, and demonstration program and up to four Microelectronics Science Research Centers (MSRCs) to conduct research in the design, development, and fabrication of microelectronics. In 2024, DOE announced three MSRCs: the Microelectronics Energy Efficiency Research Center for Advanced Technologies (MEERCAT), the Co-design and Heterogeneous Integration in Microelectronics for Extreme Environments (CHIME), the Extreme Lithography & Materials Innovation Center (ELMIC).[13] These centers created sixteen projects, which involve ten

[8] "Top500 List - November 2024." *TOP500*, 18 Nov. 2024, top500.org/lists/top500/list/2024/11/.
[9] "November 2024." *TOP500*, 18 Nov. 2024, top500.org/lists/top500/2024/11/.
[10] Los Alamos National Laboratory. "Artificial Intelligence." *Los Alamos National Laboratory*, 25 June 2024, www.lanl.gov/science-engineering/ai.
[11] "DOE and VA Team Up to Improve Healthcare for Veterans." *U.S. Department of Energy*, 18 May 2017, www.energy.gov/articles/doe-and-va-team-improve-healthcare-veterans.
[12] "National Quantum Information Science Research Centers." *U.S. Department of Energy*, 5 Mar. 2024, nqisrc.org/.
[13] "Department of Energy Announces $179 Million for Microelectronics Science Research Centers." *U.S. Department*

national laboratories. In addition, Argonne and Princeton Plasma Physics have unique expertise in this area. Given Princeton Plasma Physics specialization in plasma sciences, Princeton uses this energy form to fabricate microchips using diamonds.[14] Meanwhile at Argonne's Microelectronics Institute, scientists use the lab's scientific user facilities such as the APS-U to develop advanced electronics.[15]

Fusion

Through the Office of Science's Fusion Energy Sciences Program, the National Laboratories conduct fundamental research into plasma sciences and develop the first fusion power plant. DOE has two main national laboratories, Lawrence Livermore National Laboratory and Princeton Plasma Physics Laboratory (PPPL), conducting research into fusion. The National Ignition Facility (NIF) at LLNL specializes in inertial fusion. In 2023, NIF achieved fusion ignition where it yielded an output of 3.15 megajoules with an input of 2.05 megajoules. [16] Meanwhile, Princeton Plasma Physics Laboratory specializes in magnetic fusion. At PPPL, the NSTX-U, a large tokamak, is a testbed to study torus designs and plasma.[17] In addition, the labs partner with DIII-D and the International Thermonuclear Experimental Reactor (ITER) to advance the development of the first commercial reactor. Likewise, in 2023, DOE announced the establishment of the Fusion Innovative Research Engine (FIRE) Collaborative to accelerate the development of commercial fusion. The FIRE Collaborations focus on four cross-cutting research topics including fusion materials, fusion enabling technologies, fusion blanket and fuel cycle systems, and advanced simulations for design and optimization. DOE announced that Idaho, Oak Ridge, SLAC, LLNL, Savannah River, and PPPL are part of this new program.[18]

Tech Transfer

The National Laboratories also serve as catalysts for the commercialization of energy, industrial, and manufacturing technologies. By working closely with the labs small businesses can work to innovate from a concept to a business plan that can be successful in the marketplace. This boosts the U.S. global technological leadership, energizes economic growth and reinforces energy security.

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of Energy, 23 Dec. 2024, www.energy.gov/science/articles/department-energy-announces-179-million-microelectronics-science-research-centers.

[14] Kremen, Rachel. "Ensuring a Bright Future for Diamond Electronics and Sensors." *Princeton Plasma Physics Laboratory*, 5 Nov. 2024, www.pppl.gov/news/2024/ensuring-bright-future-diamond-electronics-and-sensors.

[15] "Imaging Memristive Behavior with Operando X-ray Microscopy." *Argonne National Laboratory*, 19 Jan. 2023, https://www.anl.gov/imaging-memristive-behavior-with-operando-xray-microscopy

[16] "Achieving Fusion Ignition." *National Ignition Facility & Photon Science*, 7 Jan. 2025, lasers.llnl.gov/science/achieving-fusion-ignition.

[17] "DOE Explains...Tokamaks." *U.S. Department of Energy*, 25 June 2020, www.energy.gov/science/doe-explainstokamaks.

[18] "Fusion Fired up? Milestones Met and Six FIRE Collaboratives Named." *Nuclear Newswire*, 22 Jan. 2025, www.ans.org/news/2025-01-22/article-6698/fusion-fired-up-milestones-met-and-six-fire-collaboratives-named/.