

Department of Energy Science for the Future

Title I
Division B: Research & Innovation
H.R. 4521, the America COMPETES Act

This bipartisan bill would provide the first ever comprehensive authorization for the Department of Energy's Office of Science. The Office of Science accounts for over half of DOE's non-defense R&D budget, and supports a wide range of research facilities and activities that are critical to U.S. competitiveness and to enabling our clean energy future.

The Office of Science at a glance

The Office of Science is the nation's largest supporter of research in the physical sciences, and it is the lead federal agency supporting scientific research for energy applications. The Office supports large-scale research programs in materials and chemical science, climate science, bioscience, carbon management, advanced computing, quantum information science, artificial intelligence, fusion energy, high energy physics, and nuclear physics.

It also provides a unique service to the U.S. research enterprise by operating ten of DOE's national laboratories and managing 28 national scientific user facilities, which are some of the most advanced tools of modern science. They include the world's fastest supercomputers, light sources and neutron sources to study the properties of new materials for a wide range of applications, accelerators to explore the building blocks of matter, and facilities for studying the nanoworld. The Office supports nearly 29,000 researchers from industry, universities, national laboratories, and other federal agencies.

The Department of Energy Science for the Future Act – highlights

- Authorizes \$8.8 billion for FY 2022, rising to \$11.3 billion in FY26 for the Office of Science. This is compared to \$7 billion enacted in FY21.
- Provides a 7% annual increase for each of the Office's core research programs.
- Ensures Office of Science construction projects and upgrades of major scientific user facilities have the resources they need to be completed on time and on budget, while incorporating COVID-19 related impacts.
 - Authorization levels for construction activities and total program funding ensure that support for core research is able to grow annually, independent of each project schedule.
- Invests in the fight against climate change. Through its support of research to advance the next generation of energy storage, solar, hydrogen, critical materials, fusion energy, manufacturing, carbon removal, and bioenergy technologies, among many other areas, the Office of Science is uniquely positioned to help us reach our shared goals of developing energy that is clean, sustainable, reliable, and affordable.
- Revitalizes nanoscience centers and bolsters support and guidance for research in emerging areas, including quantum information science and artificial intelligence.
- Prepares the next generation of diverse clean energy researchers, scientists, and professionals.

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- Ensures coordination and collaboration with other relevant programs supported by DOE as well as with other relevant federal agencies.
- A well-vetted, bipartisan product that has been over a decade in the making.

Office of Science - portfolio

The Office of Science portfolio has two principal thrusts: direct support of scientific research and support of the development, construction, and operation of unique, open-access scientific user facilities. These missions are primarily pursued by six major research programs: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, and Nuclear Physics. It also supports focused research and development activities in isotope production and accelerator technology, as well as education initiatives through its Workforce Development for Teachers and Scientists program and general infrastructure projects for research facilities.

Advanced Scientific Computing Research (ASCR)

The DOE Science for the Future Act authorizes research activities in applied mathematics, computational science, and computer science that are relevant to the mission of the Department and foundational to future scientific computing capabilities. The bill also authorizes an upgrade to the Energy Sciences Network, establishes targeted initiatives in next-generation, heterogeneous, and energy-efficient computing systems, and sustains activities that will maximize the scientific returns of the forthcoming exascale computing systems. The bill authorizes a significant funding increase to the Computational Science Graduate Fellowship program to ensure that workforce development keeps pace with ASCR's expanding research mandate. Finally, this section includes language establishing both a Quantum Network Infrastructure Research and Development program as well as the Quantum User Expansion for Science and Technology (QUEST) program. QUEST would encourage and facilitate access to quantum computing hardware and computing clouds for research purposes.

Basic Energy Sciences (BES)

The bill authorizes research activities in materials science and engineering, chemistry, physical biosciences, geosciences, and other disciplines to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels. Research in these areas is foundational to future energy technologies. The bill also authorizes targeted initiatives in sustainable chemistry, energy storage, and artificial photosynthesis, as well as computational materials and chemistry centers. Finally, the bill authorizes appropriations for construction activities at BES user and maintenance facilities, including the Advanced Photon Source Upgrade, Spallation Neutron Source Proton Power Upgrade and Second Target Station, Advanced Light Source Upgrade, Linac Coherent Light Source II High Energy Upgrade, and the Nanoscale Science Research Center Recapitalization Project

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Biological and Environmental Research (BER)

The bill authorizes the establishment and support of up to six bioenergy research centers to conduct fundamental research in plant and microbial systems biology, biological imaging and analysis, and genomics, and to accelerate advanced R&D of biomass-based liquid transportation fuels, bioenergy, or biobased materials, chemicals, and products that are produced from a variety of regionally diverse feedstocks. It authorizes appropriations for the low-dose radiation research program within BER. The bill provides guidance for earth and environmental system science observational and computational research activities, including atmospheric research to understand the effects of increased concentrations of greenhouse gas emissions and associated changes in climate; biogeochemical subsurface research to mitigate the impacts of energy production-derived contaminants; and carbon and water cycle terrestrial resource management research, among other areas. It also authorizes a coastal zone research program.

Fusion Energy Research

The bill extends authorizations for new and expanded fusion energy research activities authorized in the Energy Act of 2020, including support for alternative and enabling concepts, inertial fusion energy, a milestone-based public-private partnership program, and the support required to maintain the schedule for the U.S. contribution to the ITER international fusion project and minimize its total project cost. Consistent with recently released reports from the Fusion Energy Sciences Advisory Committee and the National Academies that provide long-term guidance for U.S. fusion research, development, and commercialization activities, the bill also provides authorization levels for fusion materials R&D, fusion system design activities, and for the Materials Plasma Exposure Experiment. In addition, it authorizes the Matter in Extreme Conditions Instrument Upgrade and provides guidance for collaborative high performance computing activities for fusion research applications.

High Energy Physics

The bill authorizes theoretical and experimental research in elementary particle physics and fundamental accelerator science and technology development. Specific activities are detailed for high energy and cosmic frontier research, and the bill provides explicit direction regarding international collaborations such as those in support of the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment (LBNF/DUNE) and the Large Hadron Collider (LHC). The bill authorizes annual appropriations for the construction of LBNF/DUNE and the Cosmic Microwave Background-Stage 4, and includes support for other projects articulated in the most recent Particle Physics Project Prioritization Panel (P5) report from the High Energy Physics Advisory Panel. Finally, the bill authorizes targeted initiatives in underground science and in accelerator and detector research and development.

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Nuclear Physics

The bill authorizes research to discover and understand various forms of nuclear matter. It also authorizes appropriations for the construction of the Electron Ion Collider and the Facility for Rare Isotope Beams.

Accelerator Research and Development

The bill authorizes research to advance accelerator science and technology. It also supports activities to improve stakeholder partnerships to develop accelerator technology and support the accelerator research workforce.

Isotope Research, Development, and Production

The bill authorizes a research, development, and production program for isotopes that are needed for research, medical, and industrial purposes.

Science Laboratories Infrastructure

The bill would authorize the use of various mechanisms and approaches for enabling the construction and maintenance of general purpose infrastructure at DOE's National Laboratories. This includes authorization for contractors for the Office of Science to enter into the lease-purchase of research facilities and infrastructure, subject to certain limitations. These types of alternative financing arrangements can significantly accelerate the completion and reduce the total cost of infrastructure projects by making funding more readily available up front. Finally, this section also directs the Director of the Office of Science to establish a mid-scale instrumentation program to enable the development and acquisition of novel, state-of-the-art instruments that would significantly accelerate scientific breakthroughs at user facilities.

Workforce Development for Teachers and Scientists

The bill directs the Department to expand opportunities to increase the number and the diversity, equity, and inclusion of highly skilled STEM professionals working in DOE mission-relevant disciplines and broaden the recruitment pool to increase diversity, including expanded partnerships with minority-serving institutions, emerging research institutions, and scientific societies. The bill also directs the Office of Science to collaborate with the National Science Foundation (NSF) to support and leverage the National Science Foundation Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES) National Network to expand the number of students, early-career researchers, and faculty from underrepresented groups pursuing and attaining skills or undergraduate and graduate degrees in science, technology, engineering, and mathematics fields relevant to the Department's mission.



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Crosscutting initiatives

The bill establishes a high intensity laser research initiative to support R&D of petawatt-scale and high average power laser technologies for a broad range of discovery science and energy technology applications, consistent with the recommendations of a recent National Academies report. The bill also establishes an emerging infectious diseases computing research initiative in coordination with other relevant agencies as well as a program to reduce the consumption of helium for DOE research grant recipients and to encourage helium recycling and reuse. In addition, the bill allows the Office of Science to allocate any funds authorized in the bill to the National Virtual Biotechnology Laboratory as relevant to the purpose of such authorization.