The CHIPS and Science Act

Title I: Department of Energy Science for the Future

This title 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 Title – highlights

- Authorizes $8.9 billion for FY 2023, rising to $10.9 billion in FY27 for the Office of Science. This is compared to $7.5 billion enacted in FY22.
- Provides a 6% 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.

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- 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.
- Ensures coordination and collaboration with other relevant programs supported by DOE as well as with other relevant federal agencies.
- Endorsed by over 110 respected academic institutions, industrial organizations, and scientific and professional societies.

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 Title 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 title 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. Guidance on mitigating algorithmic bias is also included. The title authorizes robust and sustained funding increases 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 title 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 title alsoauthorizes targeted initiatives in sustainable chemistry, energy storage, artificial photosynthesis, foundational nuclear science, carbon materials science, carbon sequestration research, and geologic computational science, as well as computational materials and chemistry centers. Finally, the title 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

Biological and Environmental Research (BER)

The title 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 title 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 terrestrial-aquatic interface research initiative.

Fusion Energy Research

The title 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 title 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 title 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 title 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 title 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 title authorizes targeted initiatives in underground science and in accelerator and detector research and development.

Nuclear Physics

The title authorizes research to discover and understand various forms of nuclear matter. It also authorizes appropriations for the construction of the Electron Ion.

Accelerator Research and Development

The title 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 title authorizes a research, development, and production program for isotopes that are needed for research, medical, and industrial purposes. It also authorizes appropriations for the construction of the Stable Isotope Production and Research Center and the Radioisotope Processing Facility.

Science Laboratories Infrastructure

The title would authorize the use of various mechanisms and approaches for enabling the construction and maintenance of general purpose infrastructure at DOE's National Laboratories. These include alternative financing arrangements that can significantly accelerate the completion and reduce the total cost of infrastructure projects by making funding more readily available up front. Finally, this section directs the Secretary to submit an annual report to Congress providing a description and funding profile for each of the projects supported under this section

Increased Collaboration for Teachers and Scientists

The title 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 title 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.

Crosscutting initiatives

The title 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 title also establishes an 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. Finally, the title 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.

Research Security

The title directs the Secretary to develop and maintain tools and processes to manage and mitigate research security risks to determine the risk of loss of United States intellectual property or threats to our national security.

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Title II: National Institute of Standards and Technology For The Future

Supports Critical Technology Research and Standards. Increases overall funding for the agency by 40 percent to $1.5 billion in fiscal year 2023, with smaller but steady growth thereafter to $2.3 billion in fiscal year 2027. This funding would help advance important research and support standards development for industries of the future, including quantum information science, artificial intelligence, cybersecurity, privacy, engineering biology, advanced communications technologies, semiconductors, and much more

Supports U.S. Manufacturing. Authorizes a significant increase in funding and expansion of the Manufacturing Extension Partnership (MEP) program, including to track supply chain disruptions and address the resilience of domestic supply chains. Authorizes a significant increase in funding and expansion of the Manufacturing USA program to support over ten new competitively awarded institutes. Supports new activities to increase access to domestic manufacturing opportunities for traditionally underserved populations through both the MEP and Manufacturing USA programs.

Addresses Pressing Technology Challenges. Supports agency activities for software supply chain security to address open-source and SolarWinds-style cyberattacks. Expands NIST testing and standards activities for biometric identification systems, such as facial recognition systems, helping to identify and mitigate bias in such systems.

Helps Tackle Climate Change. Expands NIST's greenhouse gas measurement activities to help governments and organizations accurately measure emissions at all scales.

Promotes U.S. Competitiveness in International Standards. Expands interagency coordination and information exchange activities to support private sector engagement and ensure effective Federal engagement in the development and use of international standards.

Creates a 21st Century NIST. Authorizes funds to help the agency address its large construction and maintenance backlog. Updates authorities to provide additional flexibility and enable the agency to better do its job. Supports education and workforce development activities, including opportunities for students attending minority serving institutions

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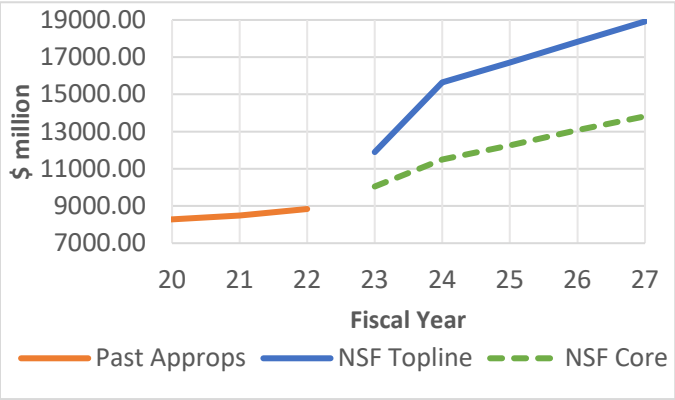
Title III: National Science Foundation for the Future



Funds more excellent research.
The research community has the capacity to pursue far more research ideas than the National Science Foundation (NSF) can fund. These unfunded projects represent an enormous untapped potential to create new knowledge and drive innovations that spawn new industries and solve problems for the benefit of the American people. This provision authorizes a significant increase in funding for the agency.

Increases overall funding for the agency (minus the new directorate) by $1.2 billion in fiscal year 2023, to $10 billion, and grows at an average annual rate of 8%, to $13.8 billion in fiscal year 2027.

Directs investments in critical research-enabling infrastructure, including a 50% increase to the Mid-Scale Research Infrastructure program, support for helium conservation equipment, and a roadmap for meeting the research community's growing need for advanced computing capabilities.

Improves STEM education and Research Training

- Establishes a new centers program to support translational research and development to help scale up effective PreK-12 STEM education innovations.
- Encourages efforts to align undergraduate STEM education with workforce needs.
- Advances policies and funding to raise the bar for the training, mentoring, and professional development of graduate students and postdoctoral researchers.
- Advances diversity, equity, and inclusion by codifying the NSF INCLUDES program, establishing a Chief Diversity Officer position, and supporting research and reform efforts to identify and remove barriers to equity for STEM faculty and undergraduate STEM students.
- Establishes a pilot program to support partnerships that will expand research opportunities to students who attend minority serving institutions or other emerging research institutions.
- Sets EPSCoR jurisdictions on a path to receive 20% of NSF funding for research and STEM education activities by FY2029 and 20% of NSF funding for scholarships, fellowships, and traineeships by FY2025.
- Encourages expanded data collection on the makeup of the STEM workforce.

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Title III: National Science Foundation for the Future (continued)

- Expands education and workforce activities for critical technologies, including to establish an artificial intelligence scholarship-for-service program, a national network for microelectronics education, and cybersecurity workforce development programs.

Federally funded research must be accessible and accountable to the American public. In addition, threats to research security have the potential to undermine the integrity of federally funded research projects. The provision addresses these challenges at multiple levels of accountability.

Increases research accessibility, accountability, & security

- Supports improved implementation of the Broader Impacts criterion and creates a new requirement for researchers to prepare a statement on possible security or other risks to society from their research in order to encourage researchers to always consider their research in a societal context.
- Expands access to data and other research products resulting from Foundation-funded projects through new data stewardship requirements and investments in open science tools and infrastructure.
- Supports research related to climate change, the food-energy-water system, sustainable chemistry, risk and resilience, UAV technologies, clean water systems, technology and mental health, critical minerals, precision agriculture, and the impact of satellite constellations on NSF-funded science.
- Codifies the Office of Research Security and Policy and the Chief of Research Security position to provide guidance and resources to researchers and funds the development of training and the establishment of an independent risk assessment center to help institutions and researchers understand and mitigate security risks. Directs NSF to establish due diligence processes for controlling access to classified or controlled-unclassified information related to Foundation-supported research and requires universities to submit an annual summary of foreign financial support.

In carrying out its fundamental science and engineering mission over the past seven decades, the Foundation has delivered enormous benefits to society. **It is time to build on that legacy and move the Foundation forward.** To that end, the provision creates a creates a new directorate, the **Directorate for Technology, Innovation, and Partnerships (TIP)**, that will enable the Foundation to take big risks and experiment with new approaches to accelerating progress in key technology areas and in translating science and technology into solutions to society's major challenges. A critical consideration for the new TIP directorate is its impact on the rest of the agency. The provision creates a structure, a funding profile, and feedback mechanisms to mitigate risks to the longstanding basic research mission of the Foundation and encourage collaboration across the agency.

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Title III: National Science Foundation for the Future (continued)

Accelerates research to address major societal challenges

- Encourages an ecosystem of partnerships and collaborations in use-inspired and translational research, including through support for regional innovation engines, translation accelerators, technology transfer capacity building activities, test beds, and entrepreneurial fellowships.
- Authorizes $1.85 billion for the TIP directorate in fiscal year 2023 with an average annual increase of 36% to $5.1 billion in fiscal year 2027. This budget is in balance with the budget for the rest of the agency, reaching 27% of the total agency budget in its fifth year.

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Title III: Bioeconomy Research and Development

The bioeconomy will drive the 21st century global economy and will play a central role in our climate mitigation strategy.

- Already in 2016, the bioeconomy was estimated to account for roughly 5 percent of the U.S. GDP.
- Innovations in the bioeconomy will address some of the most serious challenges facing our nation, including food production, clean energy, environmental cleanup, and health.
- It will revolutionize manufacturing to make it significantly more energy and water efficient, and it will reduce our dependence on fossil fuels.
- It will also give us more tools to secure our supply chain and respond rapidly to public health emergencies.

The Bioeconomy Research and Development Act of 2021 creates the foundation for U.S. leadership in the bioeconomy while also ensuring that the United States is positioned to lead global discussions about responsible development and governance of emerging biotechnologies.

- Growth in the bioeconomy will be built on research and innovation in engineering biology and biomanufacturing.
- The Bioeconomy Research and Development Act will establish a federal engineering biology research initiative and require a national strategy for our investments and a framework for interagency coordination.
- The legislation will also expand public-private partnerships and expand education and training for the next generation of engineering biology researchers.
- Coordinated Federal efforts on the bioeconomy included in this legislation will help generate the numerous technological, societal, and economic benefits of engineering biology.
- The legislation also ensures a coordinated, proactive, and comprehensive approach to any ethical, legal, environmental, and societal issues relevant to the bioeconomy.

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Title V: Broadening Participation in Science

Subtitle A: STEM Opportunities

Introduced by Chairwoman Eddie Bernice Johnson (D-TX)

This legislation supports policy reforms, research, and data collection to identify and lower barriers facing women, minorities, and other groups underrepresented in science, technology, engineering, and mathematics (STEM) studies and research careers.

- This bipartisan legislation passed the House in May 2021
- The STEM Opportunities Act would empower Federal agencies and universities to identify and lower barriers to the recruitment, retention, and advancement of women, minorities, and other groups underrepresented in STEM studies and careers.
- It requires agencies to collect comprehensive demographic data on the merit review process and on STEM faculty at U.S. universities.
- The provision supports research on participation and career trajectories and the implementation of best practices for increasing the recruitment and retention of minority students and faculty.
- This provision also pushes Federal agencies to do more to ensure all researchers have a fair shot at receiving funding for their work.
- According to the National Science Foundation's recently released report entitled, Women, Minorities, and Persons with Disabilities in Science and Engineering, women hold only 25 percent of full professor positions in STEM.
- The numbers are even more striking for faculty in racial and ethnic minority groups. Black STEM faculty represent only 2.5 percent of full professors across all science disciplines, while only 4.6 percent of full professors are Hispanic.
- In some fields, the disparity is particularly stark. Women make up only 19 percent of full professors in computer science and 11 percent in engineering.
- The number of Black and Hispanic professors in computer science are so small, they cannot be reported without compromising their privacy. In engineering, 2.5 percent of professors are Black and 4.3 percent are Hispanic.

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Subtitle B: Rural STEM Education Research

Introduced by Rep. Frank Lucas (R-OK)

For students who grow up in rural areas of this country, even in states that boast some of the world's best research universities, a STEM career may seem unattainable. This legislation addresses iniquities faced by rural students that make it harder to access quality STEM education.

- This bipartisan legislation passed the House in May 2021
- The Rural STEM Education Act provides for research and development to increase access to STEM education opportunities in rural schools and to provide teachers with the resources they need to teach more effectively.
- The provision also directs the National Institute of Standards and Technology (NIST) to develop a prize competition to advance research and development of creative technologies for expanded broadband access.
- This provision further provides for assessments of Federal investments in rural STEM education to be conducted by the National Academies and the Government Accountability Office.

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Subtitle C: MSI STEM Achievement

The MSI STEM Achievement Act will direct Federal science agencies and the Office of Science and Technology Policy (OSTP) to undertake activities to improve the quality of undergraduate STEM education and enhance the research capacity within our Nation's Historically Black Colleges and Universities, Tribal Colleges and Universities, Hispanic Serving Institutions, and Minority Serving Institutions.

Minority serving institutions have long played a critical role in training and educating students of color in STEM fields.

- Student bodies at Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), and Hispanic Serving Institutions (HSIs) are the most diverse in the nation.
- These and other minority serving institutions (MSIs) offer access to STEM education and a pathway to research or other STEM careers to students who might otherwise have limited opportunities.
- MSIs employ tailored initiatives, policies, and practices that meet students where they are, academically, financially, and socially, while empowering students to reach higher levels of academic achievement.

MSIs have a proven track record of recruiting, retaining, and graduating underrepresented minority students with STEM degrees. Today, the nation's 106 HBCUs make up just 3% of America's colleges and universities, yet they produce 25% of African American graduates in STEM fields. However, more investment and outreach are needed to enable MSIs to fully realize their potential to contribute to the STEM workforce.

The MSI STEM Achievement Act advances research to better understand the challenges MSIs face, their unique contributions to the STEM workforce, and effective approaches to enhancing their capacity to compete for Federal STEM education and research funds.

- The MSI STEM Achievement Act provides for increased transparency, accountability, and accessibility of Federal STEM education and research funding for MSIs.
- The provision directs the Government Accountability Office to compile an inventory of programs targeted to MSIs and make recommendations for how agencies can increase competitiveness of MSIs in such programs.
- The provision also supports research on the challenges and successes MSIs have had in contributing to the STEM workforce, and provides funding for institutional research capacity building activities, including support for MSI Centers of Innovation to help scale up successful practices pioneered at MSIs

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Subtitle C: MSI STEM Achievement (continued)

- The provision requires the Office of Science and Technology Policy (OSTP) to issue policy guidance for Federal science agencies to improve engagement with MSIs to increase awareness of and competitiveness in agency funding opportunities.

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Subtitle D: Combating Sexual Harassment in Science

The nation at large has made important strides in dealing with the pervasiveness of sexual harassment and its impact on the lives and careers of women, but the work is far from over. Survey data show 58% of women in the academic workplace experience sexual harassment, the second highest rate when compared to the military, private sector, and government. In 2018, the National Academies released a landmark report that examined the factors that foster an environment tolerant of sexual harassment and the impact this has on the careers of women in academia. The *Combating Sexual Harassment in Science Act* addresses key recommendations from the report and builds on steps science agencies have taken to combat sexual harassment in the scientific workplace.

The legislation will:

- Establish a National Science Foundation program to award grants for research into the factors contributing to and the consequences of sexual harassment in the scientific workforce;
- Direct the Office of Science and Technology Policy to issue sexual harassment policy guidelines for agencies making extramural research awards, emphasizing the importance of information sharing among Federal research agencies;
- Convene an Interagency Working Group to coordinate Federal research agency efforts to implement policy changes to address sexual harassment.
- Direct the National Academies to issue an updated responsible conduct in research guide addressing sexual harassment;
- Direct the National Academies to conduct a follow-up study to their 2018 report to assess the progress of efforts to combat sexual harassment.
- Direct the Government Accountability Office to assess Federal research agency implementation of OSTP policy guidance and make recommendations on potential changes.

Authorize $32.5 million to be appropriated to the Director of the National Science Foundation to carry out the activities in the Act.

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Title VI: Miscellaneous Science and Technology Provisions

Subtitle B: National Science and Technology Strategy

The Federal R&D enterprise is spread across more than a dozen Federal agencies. The Office of Science and Technology Policy (OSTP) is charged with coordinating across all of those agencies and advising the President on cross-cutting S&T issues. Congress has tasked OSTP with developing cross-agency strategies on specific topics, such as artificial intelligence and climate change science. However, there is no existing requirement or practice of developing a comprehensive outlook and strategy for Federal investments in science and technology. Given the importance of the U.S. R&D enterprise, it is critical that we approach it strategically and holistically. By developing a cross-cutting strategy for Science & Technology, as is already done for national defense, homeland security, and energy, the U.S. can address emerging challenges and set priorities.

H.R. 3858 directs OSTP to complete a comprehensive quadrennial review that will provide an overview of the nation's innovation landscape and provide policymakers, industry, researchers, and other stakeholders with unbiased data and analysis to identify the future needs, barriers, and opportunities for U.S. science and technology.

It also directs OSTP to take this analysis and develop a national science and technology strategy to provide recommendations for maintaining global leadership in science and technology.

- This bipartisan bill passed favorably out of Committee in July 2021
- It is critical for policymakers, industry, researchers, and other stakeholders to have unbiased data and analysis to identify the future needs, barriers, and opportunities for U.S. science and technology.
- We must develop a national science and technology strategy to maintaining global leadership in science and technology.

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Subtitle C: Regional Innovation

The Regional Innovation Act of 2021 authorizes the Department of Commerce to create a regional innovation and technology hub program to be implemented throughout the next five years. This legislation would boost both U.S. competitiveness and shared prosperity from our advanced technology industries.

The Regional Innovation and Technology Hub Program will designate and support regional innovation centers across the country. The program will use a merit-based competitive process to bring together consortia consisting of local and state governments, universities, industry, labor organizations, and other groups to promote innovation and shared prosperity in a region. Each consortium will develop a regional plan to leverage their community, regional industry, and the unique capacity of their area with a vision to build and scale an Innovation and Technology Hub. Grants and cooperative agreements offered under the program can either be used to create regional innovation strategies or to implement those strategies. Implementation funds can be used for workforce, entrepreneurship, and technology development, as well as infrastructure-related activities to develop regions into innovation economies. This effort will support regional economic development and resilience, including in small cities and rural areas, and promote increased geographic diversity of innovation across the United States.

This program will also address access to quality STEM education, opportunity, and investment in economically disadvantaged communities, and sustaining regional partnership development in review of proposals. This effort supports a holistic investment in regional economies that will sustain technology and innovation hubs.

While the Department of Commerce program will have broad remit to bolster support for all types of innovation industries, this program will focus on boosting regional clean energy innovation capacity to meet our changing energy needs.

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Subtitle E: Coastal and Ocean Acidification Research and Innovation

The Coastal and Ocean Acidification Research and Innovation subtitle will:

- **Strengthen investments in ocean and coastal acidification research and monitoring in the context of other environmental stressors.** The provision reauthorizes the Federal Ocean Acidification Research and Monitoring Act funding for NOAA and the NSF through FY27. Authorization has lapsed since FY12.
- **Recognize the effects of ocean acidification on estuaries and integrate research, monitoring, and adaptation strategies for coastal acidification throughout the provision.** The provision expands the definition of ocean acidification to include estuaries and includes a definition of coastal acidification to recognize mechanisms that cause changes in coastal chemistry.
- **Increase our understanding of the socioeconomic effects of ocean acidification and coastal acidification.** The provision expands the Interagency Working Group's strategic research plan to also address socioeconomic effects of ocean and coastal acidification and assess adaptation and mitigation strategies.
- **Establish an Advisory Board to increase coordination among stakeholders.** The Advisory Board, comprised of members with a regional balance representing the shellfish, lobster, and crab industry, finfish industry, seafood processors, recreational fishing, academia, nongovernmental organizations, state, local, and Tribal governments, and regional coastal acidification networks, will advise the Interagency Working Group on ocean acidification and coastal acidification research and monitoring activities.
- **Establish an ocean acidification prize competition.** Federal agencies that are a part of the Interagency Working Group in this provision can carry out a prize competition related to ocean and coastal acidification. Any prize competitions shall stimulate innovation to advance research and response to ocean and coastal acidification.
- **Designate NOAA as the lead federal agency responsible for coordinating the federal response to ocean acidification and coastal acidification.** The provision directs NOAA to facilitate coordination of the monitoring and research efforts among federal agencies, manage the Ocean Acidification Information Exchange, and maintain an ocean acidification data archive system.
- **Provides for the long-term stewardship and standardization of data.** The provision directs NOAA to support an ocean acidification data archive system that collects and provides access to data from federally funded research, research from State and local agencies, data voluntarily submitted by Tribes or Tribal governments, academic and citizen scientists, and industry organizations on ocean acidification and coastal acidification. The system will incorporate existing global or national data assets currently maintained in Federal agencies and ensure that all data meets standards to support public findability, accessibility, interoperability, and reusability of such data.

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Subtitle G: Quantum Networking and Communications

While the United States leads the world in many aspects of quantum information science research and development, challenges remain to ensuring the U.S. remains competitive in this field. Quantum networking and communications is the area of quantum technology development for which the U.S. is most at risk of ceding its leadership. In addition to funding research in this area, the U.S. will need to prepare students for careers in quantum information science to meet the increasing demand for quantum workers.

The Quantum Network Infrastructure and Workforce Development Act builds upon the National Quantum Initiative Act to support quantum workforce development and strengthen Federal research efforts in quantum networking and communications technology. The legislation:

- Builds upon existing interagency initiatives to bolster quantum networking and communications research and standardization, including support for securing sensitive networks through post-quantum classical encryption.
- Requires a National Academies study of the educational challenges associated with creating a diverse, flexible, and sustainable quantum workforce.
- Promotes the integration of the principles of quantum mechanics and quantum initiative science into K-12 and higher education curricula, including through resources and training for K-12 educators.
- Establishes a quantum education pilot program to promote quantum information science workforce development across the nation.

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Subtitle I: Partnerships for Energy Security and Innovation

Representative Melanie Stansbury (D-NM) introduced **H.R. 4863, the Partnerships for Energy Security and Innovation Act** on July 30, 2021 on behalf of herself and Representative Young Kim (R-CA), Chairwoman Eddie Bernice Johnson (D-TX), Ranking Member Frank Lucas (R-OK), Representative Teresa Leger Fernandez (D-NM), and Representative Anthony Gonzalez (R-OH).

This subtitle directs the Secretary of Energy to establish a nonprofit corporation entitled the "Foundation for Energy Security and Innovation" (the Foundation). The purpose of the Foundation is to serve as a mechanism for fostering public-private partnerships that reinforces and advances the mission of the Department by:

- Supplementing Department-supported R&D with private sector funding;
- Facilitating the commercialization of energy technologies;
- Contributing to energy workforce development; and
- Enabling information exchange and the sharing of best practices between the Department and its external collaborators.

In realizing the purpose outlined above, the Foundation is authorized to carry out studies, competitions, projects, fellowships, and grants that support research, development, demonstration, or commercialization of energy and other Department-supported technologies. Funding would be awarded based on the technical and commercialization merits of the proposed project, and funded entities would be subject to a cost-share requirement. The subtitle authorizes the Foundation to work with the Department to leverage the technical capabilities and expertise of the National Laboratories to augment technology commercialization activities. The Foundation would also be able to support training and education programs relevant to its stated purpose, maturation funding to move a technology from the prototype stage to commercialization, and other stakeholder engagement activities. The Foundation would be required to provide support to and coordinate with National Laboratory-Associated Foundations.

The Foundation would be charged with meeting several oversight requirements, including the submission of a strategic plan and annual reports to relevant Congressional Committees. In addition, the Foundation would be subject to an evaluation by the Comptroller General of the United States and annual financial audits.

This introduced bill served as a counterpart to an amendment that passed as part of the Senate's *United States Innovation and Competition Act of 2021*. While H.R. 4863 was nearly identical to the Senate text, the conference version includes House language that would mandate the establishment of an intellectual property policy, foster efforts to broaden participation in energy technology R&D among historically underrepresented communities and regions, and strengthen guardrails between the Foundation and the Department's Office of Technology Transitions.

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Subtitle J: Energizing Technology Transfer

Rep. Ross (D-NC) introduced **H.R. 4606, the Energizing Technology Transfer Act** on July 21st on behalf of herself and Rep. Meijer (R-MI).

This subtitle authorizes a series of activities related to clean energy technology commercialization nationally and at the national laboratories, as well as reforms for DOE management and administration of demonstration projects and prize competitions, among other activities.

Part 1 of the subtitle authorizes a series of programs to enhance commercialization of clean energy technologies across the nation. This includes authorization of: $15 million annually for 5 years for a national clean energy technology incubator program; $1 million annually for 5 years for university prize competitions, and $3 million annually for 5 years for coordination of technology transfer programs and activities.

Part 2 of the subtitle would authorize programs to support the commercialization of technologies developed at the national laboratories and facilitate partnerships with the national laboratories. This includes authorizing a total of $3.7 million annually for 3 years for a Lab Partnering Service Pilot Program. It would also authorize: $25 million annually for five years for a program to bring entrepreneurial researchers into the national laboratories; $25 million annually for five years for a program to provide small businesses with greater access to national laboratory facilities and expertise; and entrepreneurial leave and consulting opportunities for national lab employees.

Part 3 of the subtitle authorizes programs to modernize activities at DOE pertaining to its management and funding of technology development, demonstration, and commercialization. This includes authorization of: $20 million for each of fiscal years 2023 through 2027 to carry out the authorized activities of DOE's Office of Technology Transitions; substantial oversight mechanisms for demonstration projects stewarded by the Department; extension of a cost-share waiver program for universities and non-profits by 2-years; special hiring authority; and consolidated and updated reporting requirements.

The CHIPS and Science Act

Subtitle K: Micro Act

Representative Paul Tonko (D-NY) introduced **H.R. 6291, the Microelectronics Research for Energy Innovation Act (Micro Act)** on December 14, 2021 on behalf of himself and Representative Jake Ellzey (R-TX).

The Micro Act subtitle directs the Secretary of Energy to carry out a crosscutting initiative in microelectronics research, development, and demonstration (RD&D). This includes research activities aimed at driving progress in the scientific areas underpinning microelectronics, as well as a mechanism for supporting large-scale efforts focused on addressing specific challenges.

The impetus for this legislation lays in the need to authorize the Department of Energy's (DOE) role in the broader microelectronics RD&D enterprise. DOE's unique technical expertise and user facilities, as well as the external research community that engages regularly with the Department, render it well-positioned to accelerate transformational research in microelectronics that are essential to meeting future mission needs and bolstering the competitiveness of the domestic microelectronics industry. Research supported under the new initiative would leverage the Department's assets to focus on a broad array of topics including materials science, plasma sciences, fabrication, device architecture, energy efficient computing, and grid optimization, among many others. The subtitle also includes language intended to ensure funding awarded through this program aligns with the explicit scope of the legislation and does not duplicate microelectronics research activities funded elsewhere.

The subtitle also authorizes the establishment of up to four Microelectronics Science Research Centers (MSRCs). These large-scale centers would conduct mission-driven research to address foundational challenges in the design, development, and fabrication of microelectronics. The MSRCs would be multi-institutional endeavors involving National Laboratories, universities, and private sector partners, and will seek to advance high-impact research, facilitate technology transfer, and generate new intellectual property. They would also contribute to the future microelectronics workforce through student engagement, technical training programs, and public outreach.

The Micro Act complements the *Creating Helpful Incentives to Produce Semiconductors Act* (CHIPS Act). The CHIPS Act, which was enacted into law in late 2020, includes authorization of a new National Semiconductor Technology Center (NSTC) focused on research and prototyping of advanced semiconductor concepts in partnership with the private sector. The MSRCs mentioned above would accelerate early-stage research that could then feed into the NSTC, which would focus on more downstream technology development. The Micro Act includes language directing DOE to ensure that the MSRCs and the broader research program are coordinated with the NSTC and other research activities authorized in CHIPS, as well as other microelectronics research activities occurring both within and outside of the Federal Government, to prevent duplication of activities.

The CHIPS and Science Act

Subtitle L: National Nuclear University Research Infrastructure Reinvestment

Rep. Gonzalez (R-OH) introduced the National Nuclear University Research Infrastructure Reinvestment Act of 2021 on July 29th. Original co-sponsors include Reps. Casten (D-IL), Meijer (R-MI), and Foster (D-IL). Chairwoman Johnson is also a co-sponsor of the bill.

The subtitle improves Department of Energy's nuclear energy university programs by ensuring adequate support for upgrades and revitalization of existing nuclear science and engineering infrastructure. This provision builds off of language and activities authorized in the Energy Act of 2020. The provision authorizes $55 million annually for five years for these activities.

This subtitle also directs the Secretary of Energy to carry out a subprogram to establish not more than four new research reactors, along with nuclear science and engineering facilities, to address research demand and infrastructure gaps. This subprogram supports nuclear energy workforce development by establishing or enhancing nuclear science and engineering capabilities at traditionally underrepresented institutions including historically Black colleges and universities, Tribal colleges or universities, minority-serving institutions, EPSCoR universities, and junior or community colleges. The provision authorizes a total of $390M over five years for these activities.

The subtitle also adds nontechnical nuclear research to the scope of the Department of Energy's University Nuclear Leadership Program, and increases authorization of appropriations for the program by $15M annually through 2025.

The CHIPS and Science Act

Subtitle M: Steel Upgrading Partnerships and Emissions Reduction

Rep. Gonzalez (R-OH) introduced the "Steel Upgrading Partnerships and Emissions Reduction Act", or "SUPER Act of 2021", on July 21st on behalf of himself and Rep. Lamb (D-PA).

This provision directs the Secretary of Energy to establish a program of research, development, demonstration, and commercial application of advanced tools, technologies, and methods for low-emissions steel manufacturing in order to increase the competitiveness of U.S. industry and achieve significant reductions in emissions from both advanced and commercially available steelmaking processes.

The subtitle directs the Secretary, in carrying out this program, to focus on a range of key technology areas, including heat generation, carbon capture, smart manufacturing, resource efficiency, alternative materials, and high performance computing, and to leverage the research infrastructure of the Department as practicable. It requires the Secretary to carry out this work in coordination with relevant programs of the Department, other federal agencies including NIST, and with relevant programs and activities authorized in the Energy Act of 2020.

The CHIPS and Science Act

Subtitle N: Applied Laboratories Infrastructure Restoration and Modernization

This subtitle authorizes $800 million in total funding for deferred maintenance, critical infrastructure needs, and modernization activities across seven National Laboratories for each of fiscal years 2023 through 2027. Various mechanisms and approaches may be used for carrying out these activities, including alternative financing arrangements that can significantly accelerate the completion and reduce the total cost of infrastructure projects by making funding more readily available up front.

Specific priorities include upgrades to research laboratories, administrative and support buildings, utilities, roads, power plants, and other critical infrastructure. In addition, this subtitle authorizes projects that would enable National Laboratory user facilities and computing capabilities to meet the specialized requirements of existing and emerging science missions, and to maintain safe, efficient, reliable, and environmentally responsible operations. The latter includes pilot projects to demonstrate net-zero emissions with resilient operations.

The subtitle specifies that the Department of Energy's seven applied laboratories are the intended recipients of this funding. This includes the National Renewable Energy Laboratory, National Energy Technology Laboratory, Idaho National Laboratory, Savannah River National Laboratory, Sandia National Laboratories, Los Alamos National Laboratory, and Lawrence Livermore National Laboratory. Infrastructure construction, restoration, and modernization projects for the National Laboratories stewarded by the Department's Office of Science are authorized in Title I.

The CHIPS and Science Act

Subtitle O: Department of Energy Research, Development, and Demonstration Activities

This section authorizes $11,200,852,898 for research, development, and demonstration (RD&D) activities aligned with the 10 technology areas in the applied energy offices. This section authorizes appropriations for building technologies, sustainable transportation, advanced manufacturing, industrial emissions reduction technology, advanced materials, and renewable power (RD&D) within the Office of Energy Efficiency and Renewable Energy.

It also authorizes appropriations for grid modernization RD&D within the Office of Electricity. This section authorizes appropriations for advanced materials RD&D within the Office of Nuclear Energy. It also authorizes appropriations for RD&D carried out by the Office of Environmental Management, including relating to artificial intelligence and information technologies. This section also authorizes appropriations for clean industrial technologies, alternative fuels, and carbon removal RD&D within the Office of Fossil Energy and Carbon Management. In addition, it authorizes appropriations for the Advanced Research Projects Agency—Energy.

The CHIPS and Science Act

Subtitle P: Fission for the Future

This provision directs the Secretary to establish a program to provide Federal financial assistance to eligible entities to support the research, development, and demonstration of advanced nuclear reactors. It also directs the Secretary to use a competitive, merit-based review process.

In carrying out this program, the Secretary shall prioritize projects that would be located in communities that have retired or retiring fossil fuel electric generation facilities, as well as projects that would support nonelectric applications, such as heating, hydrogen production, or industrial processes.

The provision authorizes $800,000,000 to be appropriated to the Secretary to carry out the program for the fiscal years 2023-2027.

The CHIPS and Science Act

National Aeronautics and Space Administration Authorization Act

- This provision directs policy to ensure that NASA continues to advance and lead in challenging and inspiring missions across its science, space technology, aeronautics, and human exploration portfolio.
- The provision provides important direction to support the nation's goals for sending humans back to the Moon in preparation for the first human mission to Mars
- It supports a robust science program, including as related to planetary defense.
- It authorizes the extension of the International Space Station through 2030
- The provision supports a robust aeronautics program, including experimental aircraft demonstration projects, and a sustainable aviation initiative to ensure the United States continues to lead in cleaner and quieter aviation
- Provides important policy direction on research and development to advance space nuclear propulsion
- Authorizes NASA's STEM activities, and provides direction to ensure NASA has the workforce, infrastructure, and facilities to continue to carry out ambitious, cutting-edge missions and achieve its goals
- Provides stability to NASA's ability to lease non-excess property by extending NASA's enhanced-use lease authority for ten years