CHIPS and Science Act of 2022

Division A Summary - CHIPS and ORAN Investment

Background: In January 2021, as part of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Congress passed into law funding programs from the bipartisan CHIPS for America Act, authorizing Department of Commerce (DOC), Department of Defense (DoD), and Department of State (DOS) activities to develop onshore domestic manufacturing of semiconductors critical to U.S. competitiveness and national security. Only 12% of chips are currently manufactured domestically, compared to 37% in the 1990s, and many foreign competitors, including China, are investing heavily to dominate the industry. The United States also lacks capabilities to produce the most advanced chips at volume. The CHIPS Act of 2022 would provide appropriations needed to implement the currently authorized programs from the bipartisan CHIPS for America Act. To ensure the Congressional goal of promoting domestic competitiveness, the Act would also install safeguards to ensure that recipients of Federal funds from these programs cannot build advanced semiconductor production facilities in countries that present a national security concern.

The CHIPS & Innovation Act of 2022 would also provide appropriations needed to implement the USA Telecom Act that was enacted in the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021. This program would help shore up the global telecommunications supply chain and limit the scope of involvement globally of telecommunication companies with close ties to the Communist Party of China, like Huawei. Funds would be used to capitalize on U.S. software advantages, accelerating development of an open-architecture model (known as OpenRAN) that would allow for alternative vendors to enter the market for specific network components, rather than having to compete with Huawei end-to-end.

$54.2 Billion in Total Appropriations for CHIPS and Public Wireless Supply Chain Innovation (also known as ORAN):

- **CHIPS for America Fund:**
    - **DOC Manufacturing Incentives:** $39 billion in financial assistance to build, expand, or modernize domestic facilities and equipment for semiconductor fabrication, assembly, testing, advanced packaging, or research and development, including $2 billion specifically for mature semiconductors. Within the incentive program, up to $6 billion may be used for the cost of direct loans and loan guarantees.

    - **DOC Research and Development (R&D):** $11 billion for DOC research and development.
        - **DOC National Semiconductor Technology Center (NSTC):** A public-private partnership to conduct advanced semiconductor manufacturing R&D and prototyping; invest in new technologies; and expand workforce training and development opportunities.
        - **DOC National Advanced Packaging Manufacturing Program:** A Federal R&D program to strengthen advanced assembly, test, and packaging (ATP) capabilities, in coordination with the NSTC.

    - **DOC Manufacturing USA Semiconductor Institute:** A partnership between government, industry, and academia to research virtualization of semiconductor machinery, develop ATP capabilities, and design and disseminate training.
    - **DOC Microelectronics Metrology R&D:** A National Institute of Standards and Technology (NIST) research program to advance measurement science, standards, material characterization, instrumentation, testing, and manufacturing capabilities.

- **CHIPS for America Workforce and Education Fund:** $200 million to kick start development of the domestic semiconductor workforce, which faces near-term labor shortages, by leveraging activities of the National Science Foundation.

- **CHIPS for America Defense Fund:** $2 billion for the DoD to implement the Microelectronics Commons, a national network for onshore, university-based prototyping, lab-to-fab transition of semiconductor technologies—including DoD-unique applications—and semiconductor workforce training.

- **CHIPS for America International Technology Security and Innovation Fund:** $500 million for the DOS, in coordination with the U.S. Agency for International Development, the Export-Import Bank, and the U.S. International Development Finance Corporation, to support international information and communications technology security and semiconductor supply chain activities, including supporting the development and adoption of secure and trusted telecommunications technologies, semiconductors, and other emerging technologies.

- **Public Wireless Supply Chain Innovation Fund:** $1.5 billion through the DOC National Telecommunications and Information Administration (NTIA), in coordination with NIST, the Department of Homeland Security, and the Director of National Intelligence, among others, to spur movement towards open-architecture, software-based wireless technologies, and funding innovative, 'leap-ahead' technologies in the U.S. mobile broadband market.

Preventing CHIPS Funding Recipients from Expanding Certain Chip Manufacturing in China and Other Countries of Concern:

- **Technology leadership and supply chain security.** To ensure that the manufacturing incentives advance U.S. technology leadership and supply chain security, the Act would require recipients of Federal financial assistance to join an agreement prohibiting certain material expansions of semiconductor manufacturing in the People's Republic of China or in other countries of concern. These restrictions would apply to any new facility, unless the facility produces "legacy semiconductors" predominantly for that country's market, but not to existing facilities for manufacturing legacy semiconductors. The restrictions would apply for ten years after the receipt of financial assistance, ensuring that semiconductor manufacturers focus their next cycle of investment in the United States and in partner nations. The Secretary of Commerce would be required, in consultation with the Secretary of Defense and Director of National Intelligence, to consider updates to the technology threshold for prohibitions on manufacturing in countries of concern, considering consistency with export controls as well as technology advancements. The Secretary of Commerce, in consultation with the Secretary of Defense and the Director of National Intelligence, would define restricted process capability thresholds for memory and packaging, as well as which semiconductors are critical to national security.

- **Notification requirements.** Companies that receive federal financial assistance through the CHIPS program would also be required to notify the DOC of planned transactions in countries of concern subject to their agreement with the Secretary. If DOC determines that the planned transaction would violate the agreement, the company would have an opportunity to remedy the potential violation; otherwise, DOC could recover the full amount of Federal financial assistance provided. The provision gives the DOC the authority to request any records necessary to review compliance with the agreement, while ensuring such records remain confidential.

Background on the Advanced Manufacturing Investment Tax Credit:

The United States, which developed and pioneered semiconductor ("chips") technology, finds itself too reliant on foreign producers of semiconductors. While American companies still dominate the global semiconductor industry, accounting for nearly half of all revenues, the share of global production in the U.S. has dropped from 37 percent in 1990 to just 12 percent today. This is a national and economic security threat.

Semiconductor production is increasingly concentrated overseas, with 75 percent of global production now occurring in East Asia. Foreign government subsidies drive as much as 70 percent of the cost difference for producing semiconductors overseas. Combined with other factors, the result is a 25 to 40 percent cost advantage for overseas semiconductor production, as compared to the United States.

These dynamics must change if the United States is to remain at the forefront of technological development in this vital industry and retain these high-skill, high-wage jobs. The CHIPS grants, while substantial, will generally not fully make up for the foreign cost differential without additional support, either through a tax credit, or state or local support.

The advanced manufacturing investment tax credit (ITC), is based on a bipartisan bill (H.R. 7104/S. 2107, the Facilitating American Built Semiconductors Act; also known as the FABS Act) that would counteract these trends by providing reasonable, targeted incentives for American semiconductor manufacturing here at home.

The ITC provides a 25 percent investment tax credit for investments in semiconductor manufacturing. The credit covers both manufacturing equipment as well as the construction of semiconductor manufacturing facilities. It also includes incentives for the manufacturing of the specialized tooling equipment required in the semiconductor manufacturing process.

The ITC erases the difference with foreign subsidy regimes, and, when paired with the CHIPS grant funding, would completely erase the 40 percent cost difference for leading-edge semiconductor production. The ITC provides a baseline incentive for reshoring chip making, allowing the grant funding to be focused on those leading edge semiconductor technologies that are particularly critical to our economic and national security.

The ITC also includes safeguards similar to CHIPS funding to ensure that recipients of the ITC cannot build advanced semiconductor production facilities in countries that present a national security concern, including the People's Republic of China.

Division B Summary – Research and Innovation (NSF, DOC, NIST, NASA, and DOE)

Background: Scientific research and development (R&D) is critical to economic development, public health, and national defense, with as much as 85 percent of U.S. productivity growth in the first half of the 20th century resulting from technological advances. Partnerships and technology hand-offs between the Federal Government and the private sector have contributed to this success. For instance, Federally-funded, curiosity-driven research created the knowledge underlying the global positioning system (GPS), atomic clocks, cancer drugs, web browsers, barcodes, speech recognition technology, and 3D printing. Use-inspired and translational research, often prioritized at agencies such as the Defense Advanced Research Projects Agency (DARPA) and National Aeronautics and Space Association (NASA) but also practiced at agencies such as the National Science Foundation (NSF) and Department of Energy (DOE) have also delivered technology-based solutions to national, societal, or geostrategic challenges. Increasing global technology competition, however, has surfaced economic and national security concerns, with other nations announcing plans to assume global leadership in key economic and national security technologies such as artificial intelligence and microelectronics. Meanwhile, U.S. Federal R&D spending as a percentage of GDP is near its lowest point in over 60 years and total U.S. R&D spending as a percentage of GDP has fallen from 4th place in the 1990s to 9th place today, behind advanced economies like South Korea, Japan, and Germany.

To reverse these trends, the [Act] would authorize, in dollar terms, the largest five-year investment in public R&D in the nation's history. This investment would grow both curiosity-driven and translational research, ensuring both the creation of new ideas and the ability of those ideas to create new innovations, products, companies, and jobs in the United States. Aside from dramatically increasing research funding, the Act would build new technology hubs across the country, increasing the participation of underrepresented populations and geographies in innovation, and combat the illicit foreign absorption or theft of U.S. research products. These represent critical steps to regaining U.S. strength and reducing long-term supply chain vulnerabilities in critical areas such as advanced manufacturing, next-generation communications, computer hardware, and pharmaceuticals.

Key Programs	Five-Year Authorization	Increase over Baseline
National Science Foundation (NSF)	**$81 billion**	**$36 billion**
• NSF Tech Directorate	$20 billion	$20 billion
• NSF Core Activities	$61 billion	$16 billion
Department of Commerce (DOC)	**$11 billion**	**$11 billion**
• Regional Technology Hubs	$10 billion	$10 billion
• RECOMPETE Pilot	$1 billion	$1 billion
National Institute of Standards and Technology (NIST)	**$10 billion**	**$5 billion**
• NIST Research	$6.9 billion	$2.8 billion
• Manufacturing USA	$829 million	$744 million
• Manufacturing Extension Partnership	$2.3 billion	$1.5 billion
Department of Energy (DOE)*	**$67.9 billion**	**$30.5 billion**
• DOE Office of Science	$50.3 billion	$12.9 billion
• Additional DOE Science and Innovation	$17.6 billion	$17.6 billion
Total	**$169.9 billion**	**$82.5 billion**

*Across all the DOE sections, there is:

- A total of $14.7 billion for infrastructure, equipment, and instrumentation across 17 DOE National Laboratories.
- A total of$16.5 billion in new or above baseline authorizations for research in the 10 technology areas identified in USICA across the Office of Science and DOE's applied R&D offices in advanced energy and industrial efficiency technologies, artificial intelligence and machine learning, advanced manufacturing, cybersecurity, biotechnology, high performance computing, advanced materials, and quantum information science.

- **National Science Foundation Authorization** ($81 billion total over 5 years; +$36 billion over baseline)
    - **Invest in Strategic Translational Science.** Authorizes $20 billion for the first-of-its-kind National Science Foundation ("NSF") Directorate for Technology, Innovation, and Partnerships ("TIP"), which will accelerate domestic development of national and economic-security critical technologies such as artificial intelligence, quantum computing, advanced manufacturing, 6G communications, energy, and material science. ($20 billion total)
    - **Grow Basic Research.** Supports early-stage research that will create revolutionary new ideas, including in areas such as the food-energy-water system, sustainable chemistry, risk and resilience, clean water systems, technology and behavioral health, critical minerals, precision agriculture, and the impact of satellite constellations on NSF-funded science.
    - **Build the STEM Workforce.** Authorizes funding for STEM education, including scholarships, fellowships, and traineeships to create workers in critical fields, including to establishing an artificial intelligence scholarship-for-service program, a national network for microelectronics education, and cybersecurity workforce development programs. ($13 billion total)
    - **Building Broad-based Research Opportunities**. Grows funding for NSF research activities for universities across the country, including investment in minority serving institutions and emerging research institutions, and by placing EPSCoR jurisdictions on a path to receive 20% of funding in key accounts by FY2029.

- **Expand Rural STEM Education.** 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.

- **Department of Commerce Technology Hubs** ($11 billion total over 5 years; +$11 billion over baseline)
  - **Build Regional Innovation.** Directs the Department to create 20 geographically-distributed "regional technology hubs". These hubs will focus on technology development, job creation, and expanding U.S. innovation capacity. ($10 billion total)
  - **Revitalize Communities.** Establishes the "Recompete Pilot Program," to support persistently distressed communities with economic development activities ($1 billion total)

- **National Institute of Standards and Technology Authorization (**$9 billion total, +$4 billion over baseline)
  - **Support Critical Technology Research and Standards.** Advances research and standards development for industries of the future, including quantum information science, artificial intelligence, cybersecurity, advanced communications technologies, and semiconductors.
  - **Strengthen Small Manufacturers.** Triples funding for Manufacturing Extension Partnership, to support small- and medium-sized manufacturers with cybersecurity, workforce training, and supply chain resiliency ($2 billion total)
  - **Combat Supply Chain Disruption.** Leverages the Manufacturing Extension Partnership to creates a National Supply Chain Database, to assist the businesses with supplier scouting and minimizing supply chain disruptions ($131 million total)
  - **Grow Manufacturing USA.** Supports the creation of new competitively-awarded manufacturing research institutes with expanded capacity for education and workforce development ($829 million total)
  - **Promote 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.

- **National Aeronautics and Space Administration Authorization** (no authorization funding levels)
  - **Authorize the Artemis Moon Program.** Authorizes the Moon-to-Mars Exploration Campaign, including the Artemis program to return America to the Moon, including the first woman and person of color.
  - **Maintain the International Space Station.** Extends authorization for the International Space Station through 2030 and establishes priorities for research, as required to bring Americans to Mars.
  - **Extend NASA Enhanced Use Lease Authority.** Enables NASA to lease underutilized properties through 2032, and to use lease revenues to address facility maintenance while reducing taxpayer costs.
  - **Support NASA Science Priorities.** Expresses support for a balanced science portfolio, including Earth science observations and the search for life beyond Earth. Supports

continued development of the Nancy Grace Roman Space Telescope and requires quarterly progress reports to Congress.
    - **Advance U.S. Aeronautics Leadership**. Requires NASA to continue research efforts in aeronautics, including with the use of experimental aircraft, to advance supersonic flight, aircraft efficiency, and advanced materials manufacturing.
    - **Enhance NASA Technology, Infrastructure, and Workforce.** Directs NASA to invest in testing infrastructure and capabilities, supports space nuclear power and propulsion research and technology maturation activities (with an in-space demonstration of a nuclear propulsion systems) and requires a study and planning on the industrial base and NASA workforce. Codifies the Office of STEM Engagement to promote STEM literacy and workforce development.
    - **Ensure Planetary Defense.** Codifies the Planetary Defense Coordination Office and requires NASA to continue efforts to protect Earth from asteroids and comets, including a dedicated Near-Earth Object Surveyor telescope.

- **Research Security to Protect Federal Investments in the U.S. R&D Enterprise**
    - **Empower NSF Research Security**. Requires the NSF to maintain a Research Security and Policy Office to identify potential security risks, conduct outreach and education to the research community, establish procedures and policies on research security for the Foundation, and conduct risk assessments of applications and disclosures.
    - **Train Researchers on Best Practices.** Creates an online resource for institutions and researchers to receive NSF guidance and information on security risks and best practices and requires covered individuals seeking funding from Federal research agencies to complete annual training on research security. Creates a Research Security and Integrity Information Sharing Organization that would serve as a clearinghouse for institutions and researchers to identify improper and illegal efforts to compromise research security.
    - **Prohibit Foreign Recruitment Programs.** Requires the Office of Science and Technology Policy to promulgate guidance to all Federal research agencies that would:
        - Prohibit Federal research agency personnel from participating in foreign talent recruitment programs
        - Required covered individuals on applications (e.g., Principal Investigators) to disclose participation in foreign talent recruitment programs
        - Prohibit awards in cases where covered individuals are participating in malign foreign talent recruitment programs
    - **Ensure Transparency.** Requires annual disclosures for NSF award recipients regarding foreign financial arrangements. Institutions receiving NSF funds would have to disclose financial support for foreign countries of concern (China, Russia, North Korea, Iran) and allows NSF to reduce, suspend, or terminate funding under certain circumstances. Provides Federal research agencies with authority to request contracts and documents related to foreign appointments and employment with foreign entities for applicants.

- **Department of Energy Office of Science** ($50.3 billion total, +$12.9 billion over baseline)
    - **Reauthorizes fundamental research and development activities** performed by scientists at the Department of Energy, the National Laboratories, universities, and private companies to advance our understanding of the atom, the cell, the Earth's systems, and the universe.
    - **Basic energy sciences:** Authorizes basic energy science research programs, covering materials sciences, chemical sciences, physical bioscience, geosciences, and any

additional disciplines to advance energy technologies. Programs will support research in artificial photosynthesis, energy storage, nuclear matter, and carbon materials and sequestration.
    - **Biological and environmental research:** Authorizes new biological, environmental, and climate research and development programs relevant to the development of new energy technologies.
    - **Scientific computing:** Authorizes scientific computing research programs for applied mathematics, computational science, and quantum computing.
    - **Fusion:** Expands existing authorizations for fusion research and development programs, which includes the establishment of research teams to develop a pilot fusion plant and a high-performance computation center for fusion.
    - **High-energy physics:** Authorizes a high energy physics program to improve the understanding of the universe and for the construction of major facilities.
    - **Nuclear physics:** Authorizes a nuclear physics program to advance the research of various forms of nuclear matter and for the construction of the Electron-Ion Collider.
    - **Science laboratory infrastructure:** Authorizes funding for improvements to critical science laboratory infrastructure for DOE's science national laboratories.
    - **Advanced particle accelerator:** Authorizes and advanced particle accelerator technology research, development, demonstration, and commercialization program.
    - **Isotopes:** Authorizes programs to spur the research, development, and production of isotopes that are essential to medical, industrial, research, and related purposes.
    - **Science workforce:** Authorizes the development of a scientific workforce through programs that foster collaboration between K-12 students, university students, early-career researchers, faculty, and national laboratories.
    - **High-intensity laser initiative:** Authorizes the establishment of a high intensity laser research initiative.
    - **Helium conservation:** Authorizes a helium conservation program that encourages helium recycling and reuse.
    - **Biological threat preparedness:** Authorizes a biological threat preparedness research initiative to aid efforts to prevent, prepare for, predict, and respond to natural and anthropogenic biological threats to national security.
    - **Midscale instrumentation:** Authorizes a program to develop, acquire, and commercialize midscale instrumentation and research equipment.
    - **EPSCoR:** Authorizes the expansion of DOE's Established Program to Stimulate Competitive Research (EPSCoR) to improve its research capabilities at universities in EPSCoR states.
    - **Office of Science research security:** Authorizes development of tools and processes to manage and mitigate research security risks associated with research, development, demonstration, and deployment activities of the Office of Science.

- **Additional Department of Energy Science and Innovation Provisions** ($17.6 billion total, +$17.6 billion over baseline)
    - **Foundation for energy security:** Establishes a Foundation for Energy Security and Innovation at the Department of Energy to foster partnerships between government, industry, startups, and outside funding organizations to increase funding opportunities from the private sector, accelerate commercialization of technologies, and provide workforce training in energy security and innovation fields.
    - **Energizing technology transfer:** Authorizes new clean energy technology transfer programs that expand and enhance the activities of the Office of Technology Transitions, including a national incubator program, a university clean energy technology prize

competition, and programs to increase entrepreneurship and innovation and the national laboratories.

- **Microelectronics:** Establishes two new programs within DOE that focus on the development and research of microelectronics (MICRO Act).
- **University nuclear infrastructure:** Expansion of university research programs to improve the nuclear research capabilities of U.S. universities.
- **Advanced nuclear technologies:** Authorizes a program to support the deployment of advanced nuclear reactors in communities affected by retiring coal facilities. (Fission for the Future)
- **Low-emission steel:** Authorizes a low-emissions steel manufacturing technology research and development program focusing on key technology areas like heat generation, carbon capture, resource efficiency, and high-performance computing. (SUPER Act)
- **Applied laboratory infrastructure:** Authorizes funding to address deferred maintenance and modernization of facilities across the applied national laboratories.
- **Applied energy research and development:** Authorizes funding for new research and development activities in the applied energy offices to align with the 10 technology areas authorized in the NSF authorization.