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MEMORANDUM

H. R. 4346 - The CHIPS and Science Act of 2022

BACKGROUND

The U.S. Congress passed momentous bipartisan legislation that is aimed at strengthening the nation's scientific research enterprise and spur advanced manufacturing. The bill represents a huge win for ASCE, and the science and engineering community.

Most of the media coverage on the bill focuses on the production of leading-edge semiconductors and investing in a STEM workforce. But when you dig deeper, you will see there is so much more to the CHIPS and Science Act than what meets the eye. Looking at the provisions encompassed in this bill, it is no understatement to say this is one of the most important pieces of science and technology legislation in a generation. Here are just a few of the few highlights of how the CHIPS and Science Act would bolster the scientific and engineering community:

- Robust reauthorization of the National Science Foundation
- Movement towards cementing a National Science & Technology Strategy
- Support for the creation of regional technology hubs
- Fortification of R&D in the Departments of Commerce and Energy; National Aeronautics and Space Administration (NASA); and National Institute of Standards and Technology (NIST).

As is often the case, the path to enactment was neither smooth nor quick as provisions of the bill moved through Congress in many forms and shapes over the past several years. Though final approval occurred in the flurry of pre-August break activity, its origins, especially the science provisions, stretch back decades. In 2005, a committee was set up by the National Academy of Science to review the nation's competitiveness. That effort produced *Raising Above the Gathering Storm*, a report which concluded that the prosperity of the United States enjoys is due in no small part to investments the nation has made in research and development at universities, corporations, and national laboratories. However, failures of leadership and investment in the scientific and technological building blocks critical to our economic leadership eroded at a time when many other nations were gathering strength. The report included many recommendations to restore America's preeminence in science. Since that time, and

even before, ASCE has worked with other science and engineering associations, academia, and industry to enact the recommendations in the report.

Over the last two decades that have been numerous efforts to address the issue, however like addressing the Nation's deteriorating infrastructure, these efforts fell short of truly addressing the issue at hand.

Therefore, the CHIPS and Science Act is the result years of legislative efforts to modernize and invest in the nation's R&D enterprise. What started as the Endless Frontier Act became the U.S. Innovation and Competition Act, then the COMPETES Act, the Bipartisan Innovation Act, CHIPS-Plus, and finally, the CHIPS and Science Act. Beginning life as the bipartisan Endless Frontiers Act, legislation that would bolster funding and make reforms at numerous science related agencies, the effort morphed into the Senate's U.S. Innovation and Competition Act (USICA) and the House's America Creating Opportunities for Manufacturing, Pre-Eminence in Technology and Economic Strength (COMPETES) Act. Both of which passed their respective chambers and set the stage for a conference committee to reach a compromise between the two versions earlier this year.

In broad terms, both the House and Senate bills teamed enhancements to the nation's civilian research and development programs with provisions aimed to counter China's growing economic power and focus on expanding the role for the federal government in "strategic sectors" – including semiconductors, drones, wireless broadband, and artificial intelligence – with increased funding, and regulation of various industries. Both bills would have funded domestic semiconductor chip manufacturing, revive several lapsed trade programs, and re-orient the United States' international posture towards competition with China and other foreign competitors.

As negotiations slowly moved forward, it became more apparent that support for the large bill was wanning and Senate leaders would have trouble enacting the entire package. Hoping to savage a legislative victory, Senate Majority Leader Chuck Schumer (D-NY) pulled the provisions focused on semiconductor manufacturing grants and investment tax credits for the chip industry. This measure had broad support and began to pick up momentum, however there was a strong push from a number of members of Congress, as well as ASCE and other science and engineering groups, to include the research and development provisions of USICA/COMPETES. This proved to have bipartisan support and the CHIPS and Science Act, as it was now named, was swiftly approved with bipartisan votes in the Senate 64-33, and the House 243-187 in late July.

BILL SUMMARY - CHIPS and Science Act

Division A or the CHIPS provisions.

ASCE took no position on Division A of the bill. This part of the bill includes actual appropriations for CHIPS and Public Wireless Supply Chain Inventory, totaling $54.2 billion.

Under the measure, CHIPS for America Fund, will receive:

- *Department of Commerce (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.
- *DOC Research and Development (R&D)*: **$11 billion for DOC research and development**, including:
  - 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 Department of Defense (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 to support international information and communications technology security and semiconductor supply chain activities.
- *Public Wireless Supply Chain Innovation Fund*: **$1.5 billion** to spur movement towards open-architecture, software-based wireless technologies, and funding innovative, ‘leap-ahead’ technologies in the **U.S. mobile broadband market.**

Division B or the Science Provisions

ASCE strongly supported the provisions included in Division B of the final legislation, which will significantly increase authorizations for federal science and technology research and development programs. This includes authorizing about **$174 billion through FY 2027 to support the nation's science and technology base.** Authorized funds would go toward interagency programs to boost technological innovation and help translate federally funded research to commercial applications. Since these are authorization levels, Congress will still need to appropriate funds annually during the appropriations cycle. In addition to increases in authorizations, the bill creates new programs and make changes to others. All authorizations are for five-years from fiscal year 2023 through fiscal year2027.

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 (NSF) – The measure authorizes **$81 billion for five years**, an increase of $36 billion over the agency's current baseline authorization. Specific highlights and funding within NSF include:

- Authorizes **$20 billion for the first-of-its-kind National Science Foundation ("NSF") Directorate for Technology, Innovation, and Partnerships** ("TIP"),

with the goal of accelerating domestic development of national and economic-security critical technologies such as artificial intelligence, quantum computing, advanced manufacturing, 6G communications, energy, and material science.
- Grows Basic Research by supporting 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.
- Builds the Science-Technology- Engineering-Mathematics (STEM) Workforce by authorizing $13 billion to fund STEM education. Funding would be directed toward scholarships, fellowships, and traineeships to create workers in critical fields, including to establish an artificial intelligence scholarship-for-service program, a national network for microelectronics education, and cybersecurity workforce development programs.
- Builds broad-based research opportunities by funding NSF research activities for universities across the country, including investing in minority serving institutions and emerging research institutions. This includes expanding the uses of the Established Program to Stimulate Competitive Research (EPSCOR) which sets aside money for states that do not receive the majority of the agency's research funding.
- Expands rural STEM Education and provides additional funding 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 (DOC) - The bill authorizes **$11 billion** total, $4 billion over the current baseline over five years for science programs.

- Authorizes $10 billion for 20 geographically distributed "regional technology hubs." These hubs will focus on technology development, job creation, and expanding U.S. innovation capacity.
- Establishes the "Recompete Pilot Program" at $1 billion to support distressed communities with economic development activities.

Also, within the DOC, the **National Institute of Standards and Technology** (NIST) is authorized at **$9 billion** over 5-years, a $4 billion increase over baseline. In addition to increases in on going building research and support for standards activities, the Act:

- 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.

- Advances research and standards development for industries of the future, including quantum information science, artificial intelligence, cybersecurity, advanced communications technologies, and semiconductors.
- Triples funding to $2 billion for the Manufacturing Extension Partnership, to support small- and medium-sized manufacturers with cybersecurity, workforce training, and supply chain resiliency
- Provides $131 million to leverage the Manufacturing Extension Partnership to create a National Supply Chain Database and to assist businesses with supplier scouting and minimizing supply chain disruptions.
- Provides $829 million to support the creation of new competitively awarded manufacturing research institutes with expanded capacity for education and workforce development.

Department of Energy Office of Science – The measure authorizes **$8.9 billion** for FY23, rising to $10.9 billion by FY27. The provisions authorize research and development programs in basic energy sciences, including materials science and engineering, chemical sciences, physical biosciences, geosciences, and other disciplines to provide the foundations for new energy technologies. Among the specific provisions for DOE's Office of Science include:

- Provides a 6% annual increase for each of the Office's core research programs authorizing $2.6 billion in FY 2023 and raising to $3 billion in FY 2027. This includes funding to address climate change by supporting 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.
- 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. Authorizes $550 million per year for FY 2023 through FY 2027 for construction activities to ensure core research is able to grow annually, independent of each project schedule.

In addition, the bill contains provisions for the **National Aeronautics and Space Administration (NASA) but** does not provide an authorized funding level. Furthermore, Title V of the bills is focused on broadening participation in science. This section includes 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. It requires agencies to collect comprehensive demographic data on the merit review process and ion STEM faculty at U.S. universities.

Finally, Title VI includes miscellaneous science and technology Provisions, such as directing the Office of Science and Technology Policy (OSTP) to complete a

comprehensive quadrennial review that would 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.

Conclusion

ASCE has actively supported enhancing the nation's research enterprise for more than 30 years and applauds Congress for passing the CHIPS and Science Act. As we noted in a letter to members of Congress, just as the Infrastructure Investment and Jobs Act (IIJA) targets many of the solutions outlined in ASCE's *2021 Report Card for America's Infrastructure* to raise the grades, the CHIPS and Science Act will help restore the United States' commitment to research and development. ASCE believes that together with the IIJA, a significant investment in R&D will accelerate the development of new and innovative materials and processes, which will cut costs and facilitate sustainable and resilient infrastructure. Therefore, the CHIPS and Science Act is the complement that the IIJA requires to meet future needs and ensure the best possible infrastructure for the 21st century.

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