LEWIS–BURKE ASSOCIATES LLC

Federal Microelectronics Overview – September 2021

Lewis-Burke Associates LLC – September 9, 2021

Microelectronics research and manufacturing is a priority across federal agencies, Congress, and the Administration. U.S. leadership in emerging technologies like microelectronics continues to be key to national security. Issues identified in the White House's 100-day supply chain review have confirmed critical gaps in semiconductor production and research.[1]

Budget requests for fiscal year (FY) 2022 included many microelectronics research and manufacturing investments across multiple agencies. Pathways to specific funding opportunities, however, remain murky due to the confluence of legislation Congress is currently considering in September 2021. *Lewis-Burke recommends direct engagement with agencies known to currently or in the future hold responsibility for executing funding from key microelectronics legislation from FY 2021 and 2022*.

Updated ongressional and federal agency activity related to microelectronics and semiconductors follows.

Congressional Overview

In December 2020, the *Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Act* was signed into law when it was included in the *FY 2021 National Defense Authorization Act (NDAA)*. The CHIPS Act authorizes expanded and/or new research and development efforts at the Department of Defense (DOD), the Department of Energy (DOE), and the National Science Foundation (NSF) to ensure U.S. leadership in semiconductor technology and innovation.

While the NDAA authorizes funding levels and sets policy and program priorities for DOD, funding is appropriated through a separate Defense Appropriations bill. The CHIPS Act, while authorized, was not funded with FY 2021 appropriations. It has instead been appended as mandatory directed funding in the FY 2022 *U.S. Innovation and Competition Act (USICA)*, a mammoth Senate bill passed in May that authorizes funding for a variety of innovation, science, research, and national security programs aimed at improving the U.S.'s competition with China and other near-peer competitors. USICA has since stalled in Congress as the House has addressed its version in a variety of separate, smaller bills like the *NSF for the Fut*ure and *DOE Science for the Acts*, neither of which contain direct provisions for emergency funding of CHIPS for America.

In Section 276 of the FY 2021 NDAA titled "Microelectronics and National Security," Congress urges the continuing production of cutting-edge "microelectronics for national security needs, including access to state-of-of the-art node sizes through commercial manufacturing, heterogenous integration, advantaged sensor manufacturing, boutique chip designs, and variable volume production capabilities."

[1] The 100-Day Review, entitled "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth" can be found here.

CHIPS for America would provide $52 billion to onshore a cutting edge, domestic microelectronics industry in, by, and for the U.S. Funding is directed at expanded or new research and development (R&D) efforts at DOD, NSF, and DOE. Key provisions in CHIPS include:

- $49.5 billion over 5 years for a Department of Commerce (DOC)-led microelectronics fund including:
    - $39 billion appropriated upfront and allocated over 5 years, of which $19 billion will be appropriated for FY 2022 and $5 billion per year for FY 2023-2026.
    - $10.5 billion for DOC microelectronics R&D programs, including the National Semiconductor Technology Center (NSTC). This funding would appropriate $5 billion in FY 2022 for:
        - Standup and operating costs of the NSTC ($2 billion)
        - Advanced packaging manufacturing ($2.5 billion)
        - Microelectronics R&D ($500 million)
- $2 billion ($400 million/year for 5 years) for CHIPS for America's Defense, aimed at DOD and Intelligence Community R&D, testing, workforce development, and other activities (including additional funds for the Defense Advanced Research Projects Agency's (DARPA) Electronics Resurgence Initiative and a new National Network for Microelectronics Research and Development).
- $500 million for a CHIPS for America International Technology Security and Innovation Fund ($100 million/year for 5 years), managed by the Department of State (DOS) to coordinate common international supply chain security and consistency in the global semiconductor industry.
- DOD assessment on the need of establishing a national laboratory with a commercial incubator "exclusively focused on the research and development of microelectronics to serve as a center for Federal Government expertise in high-performing, trusted microelectronics and as a hub for Federal Government research into breakthrough micro-electronics technologies."
- Establish a new manufacturing institute focused on microelectronics via the National Institute of Standards and Technology's (NIST) Manufacturing USA program.
- An investment tax credit of 40% for semiconductor equipment or facility costs through 2024, tapering down to zero by 2027.

On September 8, 2021, the House Science, Space, and Technology subcommittee passed its markup in compliance with the House Budget Committee's FY 2022 reconciliation instructions for. This bill included an amendment providing $150,000,000 for a new Manufacturing USA Institute focused on semiconductors. As amended, the bill must now be passed by the full House and conferenced with the Senate as a complete reconciliation package.

STATE OF PLAY ACROSS FEDERAL AGENCIES

DEPARTMENT OF DEFENSE (DOD)

DARPA – DARPA is focused on starting the next phase of the Electronics Resurgence Initiative (ERI), an effort begun in 2017 to shore up the microelectronics sector. DARPA will conduct an ERI Summit in October 2021 to detail its progress and presolicit topics for a new open competition in microelectronics innovations. Defense R&D in microelectronics will play out in a convergence-type fashion for FY 2022 and beyond, where innovations in new types of semiconductors and microlectronic components can support other emerging technology developments in artificial intelligence (AI), quantum information science (QIS), and energy. DARPA's Microsystems Technology Office (MTO) is primarily responsible for

oversight and program management of microelectronics/semiconductor research, although other offices can participate.

- MTO leadership: https://www.darpa.mil/about-us/offices/mto/staff-list
- Open MTO funding opportunities: https://www.darpa.mil/about-us/offices/mto/staff-list

Defense Microelectronics Activity (DMEA) – The DMEA is a program office in the Office of the Under Secretary of Defense for Research & Engineering (OUSD(R&E)) under the Director of Defense Research & Engineering for Research and Technology (DDR&E(R&T)). The DMEA is dedicated to establishing new trusted sources of microelectronics components and supporting technology. DMEA operates several rapid contracting capabilities to surge semiconductor production to operational units in the field using labs and trusted foundries. Its Advanced Technology Support Program IV (ASTP-IV) provided over $5 billion in task orders in 2020. DMEA also runs a trusted supplier program aimed accrediting manufacturers of semiconductors and fabrication methods.

- Acting Director: Jerry Tucker, Jerome.r.tucker2.civ@mail.mil

Service Laboratories:

- Air Force Office of Scientific Research (AFOSR):
  - Basic research areas (including those in semiconductors and microelectronics) can be found in AFOSR's annual Broad Agency Announcement (BAA) here.
  - AFOSR's program staff most relevant to microelectronics can be found in its Physical Sciences division here.
- Air Force Research Laboratory (AFRL)
  - Materials and Manufacturing Directorate, Nanoelectronic Materials Branch
    - Acting Director: Dr. Charles H. Ward https://www.afrl.af.mil/About-Us/Biographies/Display/Article/2620932/dr-charles-h-ward/
  - Sensors Directorate open BAA for Assured and Trusted Microelectronics Solutions (ATMS): https://sam.gov/opp/a5054bd69214fb84020db195a0e8e2a4/view
    - Director: Ms. Amanda Gentry (SES) https://www.afrl.af.mil/About-Us/Biographies/Display/Article/2707037/amanda-gentry-director-afrlry/
- Office of Naval Research (ONR):
  - Electronics, RF Semiconductors & Amplifiers: program/POC information available here.
  - Nanoscale Computing Devices & Systems: program/POC information available here.
- Army Research Office (ARO):
  - Computational Architectures technical area, program and contact information available in its open BAA on page 34.

Multidisciplinary University Research Initiatives (MURI) Program – DOD's MURI program provides $1.25-1.5 million over a three-year award period to research topics of interest to the Services. Research topics vary by year and are submitted by the Services' research offices. The last several years have seen microelectronics topics, and various DOD leadership has indicated that this will continue. The next MURI competition is expected to be issued in March 2022. More information here: https://www.onr.navy.mil/en/work-with-us/funding-opportunities/announcements

INTELLIGENCE COMMUNITY

Intelligence Advanced Research Projects Agency (IARPA) – IARPA is a DARPA-like organization supporting the IC through the Office of the Director of National Intelligence (ODNI). Like DARPA, IARPA

invests in high-risk, high-payoff research but tailored to use cases in the intelligence world. IARPA has long been interested in R&D, applications, economics, and practical employment of various microelectronic solutions, to include secure semiconductor fabrication capabilities. A full list of IARPA PMs and their contact info can be found here: https://www.iarpa.gov/index.php/our-program-managers.

- Director, Office of Analysis Research: Robert Rahmer, Robert.rahmer@iarpa.gov
- IARPA Request for Information: Biologically Templated Nanofabrication - https://sam.gov/opp/3e018e953b8747e3b2738b82eac2f25b/view

Defense Intelligence Agency (DIA) – DIA sometimes procures new and emerging technologies through its NeedipeDIA process, which involves proposing short white papers to DIA's need areas. Proposers are encouraged to read through the current need areas in detail to ensure their concept matches an existing requirement. While a Defense organization, DIA is funded through the National Intelligence Program and associated appropriations, which enables different pots of money from which to fund research.

NATIONAL SCIENCE FOUNDATION (NSF)

The Engineering Directorate (ENG) leads NSF basic research in semiconductors and microelectronics, with the Division of Materials Research (DMR) also funding related projects. ENG programs and staff can be found here. DMR programs and staff can be found here. NSF publishes various funding opportunities throughout the year that may intersect with new semiconductor/microelectronics advances including those in artificial intelligence and quantum information science.

DEPARTMENT OF ENERGY (DOE)

In FY 2020 and FY 2021, DOE allocated about $5 million for microelectronics R&D, but that is expected to grow to $45 million in FY 2022 and more than $100 million in the next few years. DOE has identified next generation microelectronics as critical requirements for future computing, sensors, and detectors in energy, the environment, and national security. Led by Basic Energy Sciences (BES), but in partnership with Advanced Scientific Computing Research (ASCR), High Energy Physics (HEP), and Fusion Energy Sciences (FES), DOE has taken a multidisciplinary approach to microelectronics research to accelerate the advancement of technologies in a co-design innovation ecosystem. BES' priorities include materials, chemistry, and fundamental device science for microelectronics.

Of the requested $45 million, about $10 million would support single Principal Investigator and small group awards focused on materials, chemistry, and fundamental device science. The remaining $35 million would be for multidisciplinary, co-design centers within the Office of Science. DOE is aware that computing systems encompassing new materials, devices, architectures, algorithms, and software are needed to maintain the continued upward trajectory in performance that Moore's law scaling has historically provided. Optimization must occur at every level of computing and power microelectronics systems. Among the challenges is discovery science that can lead to microelectronics for exascale computers and beyond with a small footprint and low power utilization. Such high-performance computation will be necessary for analyzing and managing the vast amount of data that will be generated by future Office of Science facilities to enable new discoveries. Furthermore, transforming power electronics and the electricity grid into a modern, agile, resilient, and energy-efficient system requires advances in new microelectronics materials, and their integration within a co-design framework. The microelectronics research centers are intended to address this broad range of issues.

Energy Frontier Research Centers (EFRCs) – DOE currently funds two EFRCs focused on microelectronics first awarded in 2020. DOE has not yet announced the topic areas for the next EFRC competition expected in November 2021, but microelectronics will likely be included consistent with the priority research directions in the Basic Research Needs for Microelectronics report from earlier in 2021. The 2021 competition will recompete and award up to 42 centers. DOE usually funds up to 15 new EFRCs while the rest tend to be renewals. The awards will range from $2 million to $4 million per year for each center over four years with a total of $100 million budgeted.

FY 2022 Office of Science Graduate Student Research Program: BES will participate in the second 2021 solicitation, which is currently open (applications due November 10). The program will provide supplemental awards to qualified graduate students to spend three to 12 months conducting part of their doctoral thesis/dissertation research at a host DOE national laboratory/facility in collaboration with a DOE laboratory scientist. BES priority research topics related to semiconductors include Microelectronics, Quantum Information Science, and Convergence (Accelerators; Data Science; Microelectronics).

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST is the focal point for FY 2022 White House investments in microelectronics manufacturing and workforce development. The Endless Frontier Act, the American Jobs Plan, and many other key 2021 legislative initiatives center microelectronics funding through NIST and it higher headquarters, the Commerce Department (DOC). An overview of current research and programming at NIST for semiconductors and microelectronics can be found here: https://www.nist.gov/semiconductors

Key DOC and NIST POCs:

- Dr. James K. Olthoff, performing the duties of the Under Secretary for Standards & Technology and Director, NIST
- Dr. Charles Romine, Acting Chief of Staff and Director, Information Technology Laboratory
- Dr. Joannie W. Chin, Acting Director, Engineering Laboratory
- Mojdeh Bahar, Associate Director for Innovation and Industry Services
- Mike Molnar, Director of the Office of Advanced Manufacturing (OAM) and DOC Lead for the Manufacturing USA Program
- B. Robert Ilic, Acting Manager of the Center for Nanoscale Science & Technology (NanoFab)
- Jessie Zhang, Assistant Manager of the Center for Nanoscale Science & Technology (NanoFab)
- James Alexander Liddle, Division Chief, Microsystems and Nanotechnology Division, Physical Measurements Laboratory
- James G. Kushmerick, Director, Physical Measurements Laboratory
- Carl J. Williams, Deputy Director, Physical Measurements Laboratory