IEEE★USA

POSITION STATEMENT

FEDERAL SUPPORT FOR ADVANCED MICROELECTRONICS MANUFACTURING RESEARCH & DEVELOPMENT

Adopted by the IEEE-USA Board of Directors (November 2024)

IEEE-USA recommends that the government work with industry, universities, national laboratories, and other research institutions to increase federal investment in support of advanced microelectronics manufacturing, research, and development, including technology transfer of research to domestic manufacturing.

The microelectronics industry has become a major driver of the world economy, and our country must reestablish its global leadership position, especially in manufacturing. Dependence on other countries in the manufacturing of leading-edge microelectronic components compromises our national security and imposes major financial and economic risks to the United States. It is important to our country's future that the U.S. Government facilitates the economic environment and national security measures required to support and fortify the domestic infrastructure for advanced microelectronics research, development and manufacturing.

IEEE-USA recommends that Congress and the Administration:

1. Establish domestic industrial microelectronic research centers to support both basic and applied research in electronics and computer systems, including new materials, technologies, and systems.

2. Establish consortia jointly funded by government and industry, with state-of-the-art development and domestic manufacturing facilities aimed specifically at technology transfer to produce next generation microelectronic technology in the United States.

3. Provide funding to colleges and universities specifically aimed at encouraging American students to pursue careers in microelectronics and related fields.

4. Establish federal incentives, including additional tax incentives, for building new microelectronics manufacturing facilities in the U.S.

5. Incentivize small businesses to develop innovative solutions for the microelectronic supply chain to operate in the U.S.

6. Support domestic sourcing of critical microelectronics technology for national defense, space exploration, and other strategic endeavors.

7. Enact trade policies to counter mercantilist practices of some foreign competitors.

8. Maintain strong intellectual property protections to domestic microelectronics industries.

BACKGROUND

The Semiconductor Industry Association (SIA) has shown that every dollar invested in semiconductor research results in $16.5 in economic growth. Current plans for growth in semiconductor manufacturing across several countries suggest that nearly all of this growth will take place in East Asia. As currently positioned, the United States stands to largely miss the economic benefits of this critical technology sector. We find the consequences of such a growth model for the semiconductor industry as extremely limiting for the future of U.S. industrial and educational research establishments.

With the migration of the leading-edge microelectronic manufacturing off-shore, America's industrial research infrastructure in this technology area has been devastated. This includes former world-leading research laboratories such as Bell Labs, IBM Watson Microelectronic Research, RCA Research Lab, Xerox Palo Alto Research Center, HP Labs, Fairchild Research, and Motorola Research. These labs invented the 21st century, yet no longer exist in any of their former glory. They fulfilled the role of technology transfer from the academic research laboratories to the industrial production floors. The microelectronic industry is still benefitting from the research conducted at these labs, but the industry is at a crossroads, when it comes to the next generation of microelectronic technology development.

Semiconductor technology was invented and perfected in the United States. Early innovators of this discipline realized that products made with this technology could be smaller, more functional, and faster with modest incremental cost. Executed on a carefully preplanned timetable, semiconductor technology enabled unprecedented growth across the economy and quality of life improvements across society. Moreover, semiconductors introduced the concept of innovation on a predefined time scale, which created an entirely new economic model. For decades, our country enjoyed the privilege of being unchallenged at the leading edge of the semiconductor technology and made technological innovation the defining feature of the late 20th century.

Over time, the success of America's semiconductor industry invited competition. Semiconductor companies were formed all over the world, many with direct financial and regulatory support from their respective governments. This unbalanced competition drove manufacturing out of the United States to such an extent that, today, only a few leading-edge semiconductor manufacturing facilities remain here. Americans still do cutting-edge work designing new semiconductor chips, but the lucrative work in manufacturing them is almost always done elsewhere. Ancillary industries and the technology supply chain have gone with the manufacturers, further diminishing economic opportunities in the United States. A vivid illustration of the dependence on other countries for the leading-edge microelectronic components has come under spotlight during this year (2021) which has limited the production of leading-edge automobiles and other electronic components and depressed the economic growth of the United States.

It is not just the economy that has suffered. Over the years, our universities and educators have made tremendous contributions to the growth of the semiconductor industry. But university researchers are now struggling to justify research in an industry that has mostly moved overseas.

A number of policy initiatives have been proposed to enhance our chip manufacturing, including manufacturing initiatives by the Semiconductor Industry Association (SIA) and university research initiatives by the Semiconductor Research Corporation (SRC). Federal investments in semiconductor research and manufacturing can play a significant role in reestablishing the U.S. in a leadership position in microelectronics manufacturing.

Microelectronics Consortia and Research Centers

Consortia that engage universities, industries, and national laboratories have proven effective in building needed collaborations and generating critical mass in research and development, leading to innovations in materials, manufacturing processes and production of leading-edge components, and ultimately to a larger and more innovative industrial base. These consortia bring together industry, government, national labs, and academia to develop and execute a common roadmap to drive innovations in next-generation microelectronics manufacturing.

Additionally, the high cost of semiconductor manufacturing equipment drives the need for collaboration and leveraging of assets. One way to do so is to use federal funds to match state and local government incentives for the creation of advanced microelectronic development facilities.

The proposed consortia and development/fabrication facilities will complement similar research facilities described in a recent Congressional Research Service (CRS) report and will allow a much-needed upgrade to the laboratory infrastructure in the United States to enable efficient technology transfer guided by the Heterogeneous Integration Roadmap.

To accelerate the adoption of new research and development discoveries into the commercial marketplace, these consortia should encourage collaborative research and technology transfer while maintaining respect for intellectual property protection for the discovery participants. In addition to leveraging the significant expertise in allied countries, these consortia should encourage U.S. allies to participate in manufacturing in the United States, while disseminating the message that the research outcomes lead to increased manufacturing market share in the United States.

Growing and Sustaining High-Wage Jobs in the U.S.

Semiconductor manufacturing requires a large workforce of skilled professionals, both for the industry itself and for the ancillary businesses required to support it. These jobs include not only PhD engineers and scientists, but also skilled machinists, programmers, lab technicians and others, many of whom will need only a two-year diploma or an undergraduate college degree to earn a solid middle-class wage.

On-shoring of semiconductor manufacturing and associated migration of the supply chain to the USA will lead to a significant creation of well-paid U.S. jobs. According to a

IEEE-USA | 2001 L Street, N.W., Suite 700, Washington, D.C. 200036-4928 USA
Office: +1 202 785 0017 | Fax: +1 202 785 0835 | E-mail: ieeeusa.org | Web: https://www.ieeeusa.org

recent CRS report5, semiconductor manufacturing jobs in the U.S. currently employ 184,600 workers earning an average salary of $166,400, as compared to an average salary for the U.S. workforce of $69,928. These are the kinds of jobs the U.S. needs in order to protect our economic and national security.

To compete effectively on the world stage as a leader in microelectronics, the U.S. needs to develop and sustain a talented workforce in this important area and safeguard the fruits of domestic R&D by maintaining strong intellectual property protections. IP safeguards should include avoiding issuing exceptions to U.S. International Trade Commission exclusion orders under Section 337. The federal government should provide funding to our nation's colleges and universities specifically aimed at encouraging American students to pursue careers in microelectronics and related fields. This funding should in part direct community college students towards semiconductor jobs with proper training and pathways to higher level education. This funding also should be used to link professors to industry and laboratories through partnerships for research and student internships.

American students have shifted away from this critical field. The graduate student body studying advanced microelectronics at academic programs in the United States is overwhelmingly foreign-born. And, since most microelectronics jobs are outside the U.S., many foreign students with advanced degree are returning to their home country after completion of their education. America is losing in the global competition for talent in this critical field. The proposed centers and consortia will attract and engage U.S. students into this important field, and increased investment in U.S. microelectronics manufacturing and innovation will provide greater opportunities for U.S. trained students to pursue careers in the U.S. Such centers and consortia will be a major resource for reversing the erosion of the U.S. talent pool in the microelectronics field.

It should be noted that the various recommendations in this document have strong dependencies and might require further adjustments during implementation.

This statement was developed by the IEEE-USA R&D Policy Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the over 180,000 engineering, computing and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE, or its other organizational units.