



**[6450-01-P]**

**DEPARTMENT OF ENERGY**

**Request for Information: Basic Research Initiative for Microelectronics**

**AGENCY:** Offices of Advanced Scientific Computing Research (ASCR), Basic Energy Sciences (BES), Fusion Energy Science (FES), and High Energy Physics (HEP); Office of Science, Department of Energy (DOE).

**ACTION:** Request for information (RFI).

**SUMMARY:** The DOE Office of Science (DOE-SC) is considering the launch of a multi-program basic research initiative in support of microelectronics and semiconductor sectors. The participating program offices in DOE-SC invite interested parties to provide input on the topical areas, innovation mechanisms, impact, and potential collaborations, including public-private partnerships, that could be implemented under this initiative. DOE-SC is particularly interested in ways in which unique DOE facilities, expertise and capabilities can be leveraged to support US continued global innovation and leadership in this field.

**DATES:** Written comments and information are requested on or before August 30, 2019.

**ADDRESSES:** The DOE Office of Science is using the <http://www.regulations.gov> system for the submission and posting of public comments in this proceeding. All comments in response to this RFI are therefore to be submitted electronically through <http://www.regulations.gov>, via the web form accessed by following the “Submit a Formal Comment” link near the top right of the *Federal Register* web page for this RFI.

**FOR FURTHER INFORMATION CONTACT:** Requests for additional information may be submitted to Dr. Andrew Schwartz, (301) 903-3535, [Microelectronics@science.doe.gov](mailto:Microelectronics@science.doe.gov).

**SUPPLEMENTARY INFORMATION:** For decades DOE-SC has been at the leading edge of microelectronics and semiconductor-based technology innovations, both as a consumer and as an

engine of scientific understanding that has enabled many of the technological breakthroughs adopted by industry. Since the invention of the integrated circuit in 1960, advances in microelectronics have followed Moore's Law and other scaling laws, leading to circuit density and device performance improvements of  $10^9$  over this time period. In turn, strong commercial demand fueled the pace of scaling, and assured that the needs of DOE-SC facilities were met.

Today, the end of Moore's Law, along with the emergence of new computing workloads, new materials and devices, and new models of computation, have resulted in an unprecedented need and opportunity to "redesign" the innovation process. As highlighted in the SC-sponsored *Basic Research Needs for Microelectronics* workshop,<sup>1</sup> to enable continued advances in computing and power technologies, a fundamental rethinking is needed of the science behind the materials and chemistry, physics, synthesis and fabrication technologies, architectures, algorithms, modeling, simulation, and design software tools. Could we replace the historical roadmaps with co-design collaborations among software developers, computer architects, circuit designers, device physicists, materials scientists, and chemists to guide a new R&D strategy? The outcome of such an "end-to-end co-design framework" could fundamentally reshape future high performance computing, sensing, data analytics, artificial intelligence, power conversion and control, and other electronics-intensive applications.

DOE-SC supports robust basic research portfolios and scientific user facilities for chemical, physical, mathematical, computational sciences, and modeling/simulation. DOE-SC is poised at the convergence of these scientific disciplines, in a unique position to play a critical role in the advancement of microelectronic technologies over the coming decades. In addition, the success

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<sup>1</sup> [https://science.osti.gov/-/media/bes/pdf/reports/2018/Microelectronics\\_Brochure.pdf](https://science.osti.gov/-/media/bes/pdf/reports/2018/Microelectronics_Brochure.pdf)

and impact of DOE-SC facilities (e.g. high-performance computers, x-ray and neutron scattering centers, and high energy physics experiments) will be dependent upon the resultant capabilities in computing, sensing, power, and communications.

DOE-SC is considering the launch of a basic research Microelectronics R&D initiative with emphasis on the following broad areas:

- Materials, chemistry, surface science, and plasma science/technology
- Device physics and circuits
- Component integration, architecture, and algorithms
- Next-generation tools for synthesis, fabrication, and characterization

Investments in these areas will provide foundational support for US leadership in key technology growth areas, including the following:

- Memory and Reconfigurable Systems
- Machine Learning and Artificial Intelligence
- Edge Computing, Sensors, and the Internet of Things
- Power Electronics, the Electricity Grid, and Cyber Physical Systems
- Energy Efficiency of Computation and Packaging

*Request for Information:* The objective of this request for information is to gather input about the topical areas, organization, impact, and potential collaborations including public-private partnerships that could be implemented under this initiative. The participating program offices of DOE-SC are specifically interested in receiving input pertaining to any of the following questions:

(1) *Topical Areas and Scope:*

Are the topics identified above appropriate? Do DOE-SC expertise and capabilities in these areas offer unique opportunities? Are there other topical areas that DOE-SC should consider including?

(2) *Collaboration, Partnerships, and R&D Performers:*

What partnership and collaboration models would be most effective in furthering microelectronics R&D in the US? What mechanisms should be used to foster innovation? What types of organizations and institutions should be involved? What are the optimal roles for industry and particularly public-private partnerships in such work? What approaches or concerns with respect to intellectual property rights should be considered?

(3) *National Impact and Unique DOE Role and Contribution:*

How can DOE-SC contribute to advancement of the field in ways that are not possible with other existing or envisioned programs (supported by DOE, other Federal agencies, or non-Federal sources)? How can this initiative effectively complement and expand upon existing research programs and facilities supported by ASCR, BES, HEP, and FES?

(4) *Program Planning and Evaluation:*

What strategic planning inputs and processes might maximize the impact of the DOE-SC investments in microelectronics? How can DOE-SC best review progress and coordinate with other federal agencies funding microelectronics R&D?

(5) *Other:*

What key obstacles, impediments, or bottlenecks to progress should be considered? Are

there other factors, issues, or opportunities, not addressed by the questions above, which should be considered in the establishment of a DOE-SC microelectronics R&D initiative?

The proposed initiative will focus on long-term fundamental R&D and therefore DOE is not interested in receiving input related to near-term incremental improvements to current state-of-the-art commercial CMOS technology nodes. DOE is also not interested in feedback on work that is primarily supported by other US government agencies, such as Fabs and Trusted Microelectronics.

DOE-SC is not announcing an intention or an interest in procuring goods and services for its use. This RFI makes no statement about the possibility that DOE-SC might issue one or more solicitations for either procurement or financial assistance activities in the future. DOE-SC seeks input about how best to create a public benefit through fostering revolutionary advances in the state of the art in this field.

Comments containing references, studies, research, and other empirical data that are not widely published should include copies of the referenced materials. Note that comments will be made publicly available as submitted. Any information that may be confidential and exempt by law from public disclosure should be submitted as described below.

*Confidential Business Information:* Pursuant to 10 CFR 1004.11, any person submitting information he or she believes to be confidential and exempt by law from public disclosure should submit via email: one copy of the document marked “confidential” including all the

information believed to be confidential, and one copy of the document marked “non-confidential” with the information believed to be confidential deleted. DOE will make its own determination about the confidential status of the information and treat it according to its determination. Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) a description of the items, (2) whether and why such items are customarily treated as confidential within the industry, (3) whether the information is generally known by or available from other sources, (4) whether the information has previously been made available to others without obligation concerning confidentiality, (5) an explanation of the competitive injury to the submitting person which would result from public disclosure, (6) when such information might lose its confidential character due to the passage of time, and (7) why disclosure of the information would be contrary to the public interest.

Signed in Washington, DC, on July 3, 2019.

Chris Fall, Director,  
Office of Science.

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