Comments of the

Semiconductor Industry Association (SIA)

Request for Information Regarding

Basic Research Initiative for Microelectronics

84 Fed. Reg. 33248 (July 12, 2019)

Submitted August 30, 2019

The Semiconductor Industry Association (SIA) is the trade association representing leading U.S. companies engaged in the research, design, and manufacture of semiconductors, also known as "microelectronics". Semiconductors are the fundamental enabling technology of modern electronics that has transformed virtually all aspects of our economy, ranging from information technology, telecommunications, health care, transportation, energy, and national defense. The U.S. is the global leader in the semiconductor industry, and continued U.S. leadership in semiconductor technology is essential to America's continued global economic leadership. More information about SIA and the semiconductor industry is available at www.semiconductors.org.

Semiconductors are critical to America's economy, job creation, technology leadership, and national security. For over 50 years, America has led the world in semiconductor innovation, driving transformative advances in nearly every modern technology, from computers to mobile phones to the Internet itself.

Today, semiconductors underpin the most exciting "must-win" technologies of the future, including artificial intelligence to power self-driving cars and other autonomous systems, quantum computing to analyze huge volumes of data and enhance digital encryption, and advanced wireless networks to seamlessly connect people at unprecedented speeds and security. To secure America's leadership in these future technologies for the next 50 years, the United States must continue to lead the world in semiconductor research, design, and manufacturing.

In April 2019, SIA released a report, *Winning the Future: A Blueprint for Sustained Leadership in Semiconductor Technology*[1], that made the following recommendations to policymakers:

- Invest in research that will promote American semiconductor innovation:
  - Triple U.S. investments in semiconductor-specific research across federal scientific agencies from approximately $1.5 billion to $5 billion annually to advance new materials, designs, and architectures that will exponentially increase chip performance.
  - Double U.S. research investments in semiconductor-related fields such as materials science, computer science, engineering, and applied mathematics across federal

[1] https://www.semiconductors.org/winthefuture/

scientific agencies to spur leap-ahead innovations in semiconductor technology that will drive key technologies of the future, including artificial intelligence, quantum computing, and advanced wireless networks.

- Attract and develop a skilled workforce that will ensure U.S. leadership in semiconductor research, design, and manufacturing and in the development and implementation of future growth technologies.

Given the importance of continued U.S. leadership in semiconductor technology and the essential role of federal research investment in fundamental science research in driving innovation in the semiconductor industry, SIA strongly commends the Department of Energy's Office of Science (DOE-SC) for advancing a basic research initiative for microelectronics.

In this document, SIA's recommendations on microelectronics research at DOE-SC are based on bolstering innovation in semiconductor technology and creating a new pipeline of skilled researchers and scientists, which in turn will open the door for a host of applications and technologies that enable and support many sectors of the economy, and ensure America's economic and national security.

DOE-SC Should Fund a Basic Science Resurgence Initiative in Microelectronics

The semiconductor is highly supportive of DOE-SC moving aggressively in supporting and funding basic research in microelectronics. In a recent study[2], the Potomac Institute for Policy Studies found that to develop meaningful long-term fundamental research, public-private R&D collaborations in the semiconductor industry need to be funded at $200-300 M/year and a total budget of $2-3B with a 10-year timeline.

Consequently, we recommend that DOE-SC undertake this effort at funding levels comparable to the Electronics Resurgence Initiative at DARPA, which is scheduled to be funded at $1.5 billion over five years (FY2017-FY2022). A complementary program at DOE-SC funded at $1.5 billion over 5 years would reinvigorate U.S. leadership in technology and electronics, support DOE's scientific and national security missions, and result in significant leadership gains for the U.S. in innovation.

This investment by DOE-SC would be fiscally sound. According to an upcoming report by Nathan and Associates, for every dollar invested in federal semiconductor research, the United States receives a return of at least $40 in value to the economy over the following 5 years.[3] Furthermore, the report found that in the U.S., federal government basic research investments in microelectronics do *not* crowd out private sector investments. Instead, federal investments spur private sector investment, creating a virtuous growth cycle of microelectronic innovation.

Ultimately, nations that recognize the fundamental importance of semiconductor industry and make the investments to lead in basic and applied semiconductor research, will reap critical economic and societal benefits for years to come.

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[2] https://potomacinstitute.org/images/studies/CARTSsm.pdf

[3] Equivalent to 109% annualized return on investment (ROI) and 3900% ROI over 5 years. Draft Report to be Released September 2019, *The Economic Impact of Federal Investments in Semiconductor Research*, 2019.

SEMICONDUCTOR INDUSTRY ASSOCIATION

RFI Question 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?

The U.S. semiconductor industry already invests heavily in its own research and development to stay competitive and maintain its technology leadership. Nearly one-fifth of U.S. semiconductor industry revenue is invested in R&D, amounting to $38.7 billion in 2018.[4] This is among the highest rates of investment of any industry, and most of this research is conducted in the U.S.

The industry's investment is primarily targeted at applied research and product development, not the basic research needed for long-range, fundamental technology breakthroughs. To supplement this private-sector commitment, the U.S. needs to increase government investments at universities, national labs, and other entities to maintain our leadership in this critical industry.

It is vital to undertake critical research in an array of areas beyond existing technology, which is a key role for our nation's largest government institution leading basic research, DOE-SC, therefore SIA recommends DOE-SC take comprehensive approach that considers all aspects of semiconductor technology, including novel materials, new manufacturing techniques, new structures, systems architecture and applications that are driving the 4th industrial revolution.

In the RFI, DOE- SC has identified the following areas of emphasis:

- 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
- 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

The semiconductor industry has historically worked in conjunction with the research community to determine areas where more research is needed. In 2016, SIA, in conjunction with the Semiconductor Research Corporation, convened 72 of the leading semiconductor industry experts for a year-long strategic planning session that produced a roadmap of topics that DOE-SC can use to inform the areas of research emphasis.

These groups released a report in 2017, "Semiconductor Research Opportunities: An Industry Vision and Guide" (Vision Report),[5] that laid out a detailed roadmap of research needs in the semiconductor industry. Because basic research needs to be strongly linked to private sector input in order to achieve eventual commercialization, we encourage DOE-SC to reference the report in detail as they seek to move forward on initiating a new program to bolster U.S. leadership in microelectronics.

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[4] https://www.semiconductors.org/wp-content/uploads/2019/05/2019-SIA-Factbook-FINAL.pdf

[5] https://www.semiconductors.org/wp-content/uploads/2018/06/SIA-SRC-Vision-Report-3.30.17.pdf

In the report, semiconductor industry experts and leaders identified the following 14 research areas for maintaining U.S. leadership in advanced computing systems. Some of these areas overlap with those identified by DOE-SC in the RFI:

- **Advanced Devices, Materials, and Packaging**: Transistors and other semiconductor devices are the fundamental building blocks of computing, data storage, embedded intelligence, etc. As current technologies approach physical limits and novel architectures are developed, new materials and devices as well as advanced packaging solutions are essential. Advances will enable ultimate CMOS technologies, beyond-CMOS applications, and non-von Neumann computing paradigms.

- **Interconnect Technology and Architecture**: Interconnects carry digital information within and between integrated circuits. Limitations of current interconnect technologies are leading to inefficiencies and impacting system performance. Revolutionary advances are needed in interconnect materials, mechanisms, and designs.

- **Intelligent Memory and Storage**: The rapidly growing applications based on data analytics and machine learning will benefit from a paradigm shift in how memory is used and accessed. Advances in memory and storage technologies and architectures will improve system performance, enhance security, and enable intelligent systems.

- **Power Management**: Critical infrastructure, industrial processes and other systems are powered by electricity. Next generation systems depend on innovations in wide-gap materials, active and passive power devices, designs, and packaging to revolutionize how power is switched, converted, controlled, conditioned, and stored efficiently.

- **Sensor and Communication Systems**: A key enabler of the information age and the emerging Internet of Things (IoT) is the ubiquitous ability to sense and communicate information seamlessly. Future sensor systems will require energy-efficient devices, circuits, algorithms, and architectures that adaptively sense the environment, extract and process information, and autonomously react. Communications systems must be dynamically adaptive and resilient. Efficient spectrum use and interference mitigation will be required to ensure secure service.

- **Distributed Computing and Networking**: The growing interconnected web of computing capability, as well as the enormous amount of data across the IoT create a challenge and an opportunity for distributed computing. Large scale distributed computing systems, supporting very large numbers of participants and diverse applications, require advances in system scalability and efficiency, communications, and system management optimization, resilience, and architecture.

- **Cognitive Computing**: Cognitive systems that can mimic the human brain, self-learn at scale, perform reasoning, make decisions, solve problems, and interact with humans will have unprecedented social and economic impact. Creating systems with essential cognitive capabilities requires advances in areas including perception, learning, reasoning, predicting, planning, and decision making; efficient algorithms and architectures for supervised and unsupervised learning; seamless human-machine interfaces; networking cognitive sub-systems; and integrating new cognitive systems with existing von Neumann computing systems.

- **Bio-Influenced Computing and Storage**: The convergence of biology and semiconductor technologies has the potential to enable transformational advances in information processing and storage, design and synthesis, and nanofabrication at extreme scale. Examples include DNA-based storage, biosensors, cell-inspired information processing, design automation of biomolecular and hybrid bio-electronic systems, and biology-inspired nanofabrication.

- **Advanced and Nontraditional Architectures and Algorithms**: New applications and advanced computing systems require scalable heterogeneous architectures co-designed with algorithms and hardware to achieve high performance, energy efficiency, resilience, and security. Alternatives to the prevalent von Neumann architecture include approximate computing, stochastic computing, and Shannon-inspired information frameworks can provide significant benefits in energy efficiency, delay, and error rates.

- **Security and Privacy**: The dependence on interconnected, intelligent systems means that security and privacy need to be intrinsic properties of the components, circuits and systems. Design and manufacture of trustworthy and secure hardware will require design for security, security principles and metrics, security verification tools and techniques, understanding threats and vulnerabilities, and authentication strategies.

- **Design Tools, Methodologies, and Test**: Advances in the design and test capabilities are coupled to breakthroughs in materials and architecture, enabling new capabilities to be incorporated in designs and produced at scale. Enormous challenges are posed by growing complexity and the diversity of beyond CMOS technological options.

- **Next-Generation Manufacturing Paradigm**: Advanced manufacturing techniques, including for technologies other than CMOS, as well as tools, and metrologies with high precision and yield, are required to process novel materials, fabricate emerging devices and circuits, and demonstrate functional systems.

- **Environmental Health and Safety Related to Materials and Processes**: The semiconductor industry's reputation, freedom to innovate, and profitability depend on a proactive approach to environmental health and safety issues. In addition to developing EHS understanding of new materials and processes early, currently used materials and processes can be improved.

- **Innovative Metrology and Characterization**: Semiconductor features are measured in nanometers and the trend is toward 3D stacked structures. Innovative characterization and metrology are critical for fundamental material studies, nanoscale fabrication, device testing, and complex system integration and assessment. These key topics clearly illustrate the diversity of challenges for future technology and the importance of a coordinated approach by basic researchers and technical experts in universities, government research agencies, and industry.

On AI/Machine Learning

To be a leader in AI, the US must keep its keep pace with global competitors in semiconductor technologies. SIA recommends that DOE-SC should include precompetitive AI Hardware research as a pillar of their strategy around microelectronics research, and in conjunction with the National AI R&D Strategic Plan[6].

Without advances in semiconductor process technology and chip design, Artificial Intelligence and Machine Learning could not have moved so rapidly from futuristic speculation to present-day reality. Indeed, semiconductors are critical in all three areas of a typical AI process flow: 1) data generation or data source - through smartphones, automobiles, and multiple “Internet of Things” devices; 2) training the AI/deep learning algorithms using graphics processors, microprocessors, or other heavy performance-centric processors; and 3) AI inference in real-world uses.

Commercial microelectronics hardware currently used to power AI/ML, CPU’s and GPU’s, were not specifically designed with the purpose of running AI/ML algorithms. Although GPUs have been utilized for accelerating Deep Neural Networks (DNNs), there are many other types of AI algorithms for which CPUs and GPUs are not well suited, such as Graph Algorithms and low-precision approximations. Therefore, there is an opportunity to create a research program to explore:

- Theoretical AI/ML algorithm designs closely tied to hardware efficiencies
- How the partitioning of algorithms by microelectronic and semiconductor technology can accelerate AI/ML across heterogeneous processors
- Hardware that can accelerate other classes of AI/ML algorithms in addition to DNNs

As part of the Basic Research Initiative for Microelectronics, DOE-SC could create an aspirational “AI Target” on speed and efficiency of AI/ML processing, like the aspirational targets released on exascale computing[7]. Such a target can be used to track progress toward that objective.

Following this, we hope that DOE-SC will provide expertise to the National Science and Technology Council as they seek to update their 2019 National Artificial Intelligence Research and Development Strategic Plan[8].

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[6] https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf

[7] https://www.investors.com/politics/commentary/from-supercomputing-to-exascale-machines-the-coming-leap-in-computing-power/

[8] https://www.whitehouse.gov/wp-content/uploads/2019/06/National-AI-Research-and-Development-Strategic-Plan-2019-Update-June-2019.pdf

The United States maximizes its unique AI-related advantages, most critically, through its leadership in semiconductor technology. Most of the critical silicon powering AI today is designed by the U.S. semiconductor industry. Yet other countries such as China are investing heavily to close the gap. The U.S. government and industry must deepen their partnership to enable breakthrough innovations that can sustain and strengthen this essential leadership position in AI semiconductor technology.

In conclusion, at the federal level, the federal government should prioritize precompetitive basic research for AI hardware, including at DOE-SC. As various agencies work towards efforts to accelerate innovation in microelectronics, the DOE-SC, the National Labs, and the proposed Science Advisory Board should all prioritize long-term, basic research in AI hardware.

On Quantum and Microelectronics

As DOE plays the lead role in the National Quantum Initiative, industry is ready to partner with DOE-SC on the microelectronic thrust of quantum research. Broadly, industry is interested in research that looks into the microelectronic components that would need to interface with cryo-processors, as well as the performance of CMOS and other materials at the temperatures needed for cryo-processing technology.

This field of research is difficult to accomplish in the private sector and could be accelerated by DOE's quantum initiative. We would expect DOE-SC research leaders and industry to further develop this research thrust in ongoing discussions.

RFI Question 2 - Collaboration, Partnerships, and R&D Performers: What partnership and collaboration models would be most effective in furthering microelectronics R&D in the U.S.? 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?

Recommendations for Partnership Models

One of the goals of DOE-SC should be to leverage private sector interest public-private partnerships with DOE-SC and academia on transformative, pre-competitive microelectronics basic research, and bringing private sector funds and expertise to the table.

Many models have been developed globally for collaborative research between government, industry, non-profits, and academia, and several reports have recently been published to evaluate and compare these models. For example, in May 2019, the Government Accountability Office (GAO) published a report which showed, among other findings, that many of the Manufacturing USA institutes sponsored by DOD, DOE, and Commerce had no long-term viability plan unless they reverted to short-term projects for industry.[9]

The facilities, equipment, and staff at these national resources will allow for fundamental science research that could not be done anywhere else. Finally, academic partners and universities provide

[9] https://www.gao.gov/products/GAO-19-409

creative, intellectual, and lab resources distributed across the country for performing basic research and spawning breakthrough discoveries that open new pathways of science.

Industry can actively provide insights regarding use-cases for the fundamental research and will be able to establish commercialization pathways. In addition, the comprehensive resources of the National Labs will be an important part of the research.

Consequently, SIA recommends that DOE-SC should select a neutral, 3rd party personnel with experience working with academia, industry and government. This third party should:

- have the right types of organizations involved;
- satisfy a critical need that exists for its public and private members;
- determine a well-defined structure with mechanisms for evolving as needs change;
- be managed by an organization with the experienced, history of success, and credibility within the semiconductor industry and academic research fields; and
- ensure neutrality such that the 3rd party includes full and equal opportunities for participation by industry participants, regardless of their prior involvement with the National Labs, or membership with the organization.

The model developed by the SRC (Semiconductor Research Corporation), is one example of a model that meets these criteria. SRC has been managing and administrating their semiconductor public-private partnership consortia model for basic research in semiconductor technology since 1982. Since then, SRC:

- has managed over $2B of long-term fundamental research in academia funded by over 20 industry members and three government agencies across over 2,000 research projects;
- has sponsored over 12,000 graduate and undergraduate students for the semiconductor workforce; and
- has produced over 600 precompetitive foundational patents upon which member companies have added their own technology development to commercialize.

Examples of technologies funded through the SRC consortium that have become critical to semiconductor technology include the following.

- High K Dielectrics
- Copper interconnects
- FinFET technology
- Scalable FLASH Memory
- EDA design, simulation, and verification tools.

The history of SIA leadership and SRC research provides credibility that the model can be effective, and consequently, SIA endorses SRC an effective potential DOE-SC partner to implement this program.

DOE-SC Should Establish a Government-Industry-Academic Science Advisory Board to Guide Basic Research in Microelectronics

In order to accelerate the speed of the program, SIA recommends that DOE-SC establish a Science Advisory Board – comprised of industry leaders in research, government representatives from DOE-SC and the National Labs, and academia - to oversee the direction of the new Basic Research Initiative in Microelectronics effort at DOE-SC, oversee the partnership with the 3rd party, and recommend adjustments or directions for the duration of the program.

Guidance from a Science Advisory Board is a model with wide acceptance in industry and academia – and has been implemented in DARPA's JUMP program[10], that researches long-term, fundamental basic research, as well as the High Energy Physics Advisory Panel (HEPAP) at DOE. In order to ensure further use of DOE-SC and DOE broader capabilities, SIA also recommends that personnel from the National Labs should sit on the Science Advisory Board.

The goals of the Science Advisory Board would be

- To determine the research agenda that will be undertaken by researchers in industry, academia, and the DOE
- Oversee the trajectory of the DOE-SC 3rd party partnership
- Ensure the participation of key National Labs and the leverage of unique DOE-SC capabilities
- Leverage public-private partnership opportunities in both research funding and design

Timeline

SIA recommends that the timeline for this effort should be five years with a re-alignment at year three.

SIA recommends convening two workshops, to determine scope, timeline, and to select Science Advisory Board members. SIA believes that the call for research can begin in mid-2020, and that selection of research projects can be made in the by the end of 2020.

Intellectual Property Rights

In establishing new government-university-industry collaborations, each new organization has the challenge of negotiating a membership agreement with prospective members. IP rights can be a critical and contentious topic where each party has rigid constraints. SIA recommends that DOE establish IP rights early as a baseline requirement of the program, as it is critical to understand all participants' needs, and determine how all the needs can be met.

One of the most significant factors contributing to the delayed launch of collaborations relates to defining terms and conditions that are acceptable to all prospective members, with IP terms historically being the biggest area of contention. Prospective members from government, industry, and academia

[10] https://www.darpa.mil/news-events/2018-01-17

all typically have different priorities with respect to IP management, but still need to agree to a mutually acceptable set of terms and conditions.

Some additional concerns include:

- A well accepted consortium practice is that background, solely developed IP (i.e., IP developed outside the consortium) is solely owned, while jointly developed IP (i.e., IP developed within the consortium) is jointly owned. Consortium-developed IP is typically licensed to consortium participants and their subsidiaries under Non-exclusive royalty free (NERF) terms, and to others under reasonable and non-discriminatory (RAND) and reciprocal terms. Typically, no sublicense rights are granted. Given the variability that exists between federal collaborations, some variation in IP management plans between collaborations is reasonable. However, collaboration members expect access to collaboration-created IP to be commensurate with their respective level of investment and membership tier.
- A current consortium best practice is to grant a perpetual, worldwide, NERF or RAND license for all consortium-developed IP and project results to all top tier consortium members, with lower tier members being granted a similar license to institute-developed IP and project results for only those projects they directly support.
- Some collaborations have explored implementing a clause in the membership agreement that immediately suspends access and rights to all institute project results and IP upon termination of institute membership. Although the motivation behind this clause may be to incentivize continued membership in the collaboration for existing members, prospective member organizations typically view this as a “deal breaker” since it reduces the long-term value proposition of membership. When a collaborative member contributes resources to a joint project, they typically have the very reasonable expectation that they will retain access to all project data and IP that they invested in, and to which they rightfully obtained access to, from the duration of their membership.

For this effort, SIA recommends using NERF or RAND licensing models for consortium-developed IP as appropriate for specific projects. Participants would be able to develop their own IP in order to move this fundamental research to commercialization.

Clear IP terms are essential to industry participation so that industry can commercialize, can protect their follow-on investment in research, and ultimately differentiate themselves with products.

RFI Question 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?***

Academic research and national lab facilities are a tremendous resource for generating and testing new ideas and making breakthrough discoveries in semiconductor technology. Non-federal sources in industry and university labs distributed across the country have the talent and creativity to identify new research directions and disruptive technologies that will become the next generation of how we sense, process, store, and transmit information. National labs and their staff have large scale equipment, metrology, and facilities have scale that can only be installed at a few distributed locations across the country.

Harnessing these resources for industry and government members can provide new trajectories for competitiveness and provide a strategic advantage. Discoveries within these universities and national labs within the field of microelectronics will not only help members achieve technical leadership, but when applied to medical, automotive, communications, and national security applications have a direct impact on society by dramatically improving our health, safety, security, and quality of life.

DOE-SC has unique opportunities and assets that are un-replicable in the private sector. These benefits include:

- The National Labs: the world's largest array of major scientific user facilities that includes particle colliders, powerful X-ray light sources, and delicate sensors and optics[11]
- Highly specialized and unique technical expertise and equipment that are not available elsewhere in the U.S.
- Research and development (R&D) interactions between DOE laboratories and industry
- Experts from different fields whose collaboration uncovers synergies and multidisciplinary solutions not otherwise evident

Furthermore, DOE has played a fundamental role in advancing semiconductor technology. Over the years, these efforts have included:

- Support of Materials Genome Initiative
- Support of PowerAmerica
- Los Alamos National Lab Exascale Computing Project
- Brookhaven National Lab Light Source used to study semiconductors
- Sandia National Lab modeling and fabrications of compound semiconductor devices
- CRADA between SRC and Sandia National Lab on device modeling

Government participants will provide critical knowledge for the operation and management of the program in addition to funding to partially support the program. DOE-SC participants can prioritize the needs of national interest, and provide insights regarding how the program should be directed to fit in with complimentary government programs. They will supply information regarding national security, technical leadership, and economic growth.

Government participants will also be instrumental in helping the consortium gain access to complementary government agencies like the National Nuclear Security Administration (NNSA), the National Institutes of Standards and Technology, and the National Science Foundation.

[11] https://www.energy.gov/science/about-office-science

RFI Question 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?

We recommended that when DOE-SC begins broad-call planning workshops with industry and academia, the workshops should consider input and linkages in microelectronics research across the government, including with the National Quantum Initiative, National Strategic Computing Initiative, the National Nanotechnology Initiative, and the work of the NNSA.

DOE-SC can be a leader in microelectronics research policy setting and should seek a vocal and key role in pushing forward the microelectronics R&D strategy. One mechanism to do that is to utilize the cross-agency mechanisms, like the National Nanotechnology Initiative, to issue strategic research plans and goals across the 5- and 10-year horizons.

Appendix

SIA Endorses SRC Model to Accelerate Public-Private Partnership and Innovation

An opportunity for DOE-SC is to partner with a longstanding semiconductor industry organization that can facilitate public-private-academic partnerships. SRC staff are uniquely experienced in that they have experience in both creating government-industry-academia partnerships within government and managing the partnerships at a non-profit. SRC staff have experience working with national labs and have set up a model for leveraging national lab resources through the INNOVATE program sponsored by DARPA to fund research fellows at the Cyclotron Road organization at LBNL through a non-profit called Activate.

This experience, coupled with the initial success and additional funding for expansion, provide credibility that this can work. SRC will also be able to leverage additional resources that have been managing government-industry-academia semiconductor partnerships.

SRC's model has several key steps which are described as follows.

Understand sponsor's needs: SRC works with government sponsors to understand their technical and operational needs, the objectives of what they want to accomplish, their mission and how the objectives support their mission, and their constraints. Fully comprehending this information helps establish a constructive relationship that builds a foundation for the success of the program.

Recruit members: The SRC model requires that all members involved in the program are aligned with the objectives and will actively contribute to the program's success. This could be done through some combination of existing relationships and a series of workshops.

Establish governance and operational structure: SRC will develop an effective management and governance structure providing appropriate authority to each member and establish an operational model that is within scope of the program. For example, the operational model will establish the duration, size, and management requirements of performer contracts, establish the proposal review and selection process, and develop a method for reviewing program performance.

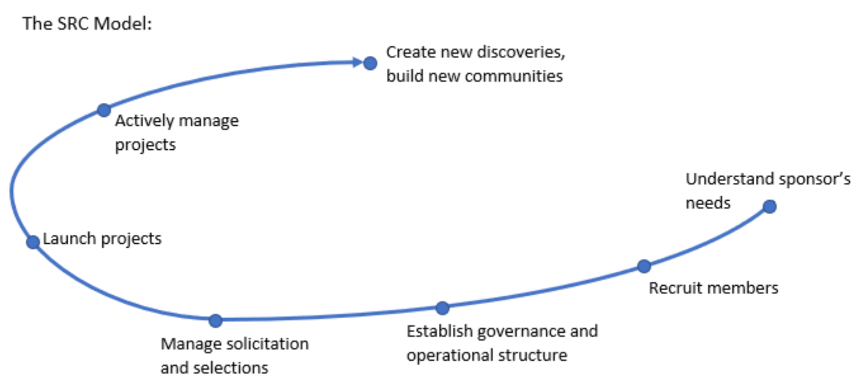
Manage solicitation and selections: SRC will manage the research topic selection process by determining which technologies areas will be studied, determining how much funding and how many projects can be selected, writing the solicitations, broadcasting the solicitations, collecting proposals, managing the proposal review, selection, and leveraging SRC's in-house contracting staff to quickly get all documents signed. A key part of this is recruiting exceptional performers in academia and at national labs to perform the research within the projects.

Launch projects: Once the selected proposals are contracted, SRC will begin a series of project launches to establish expectations of performers, clarify any questions about contracts, and to being establishing cohorts within each of the research topics selected.

Actively manage projects: SRC staff will lead the review and management of the research being performed to ensure Principle Investigators are meeting their contractual obligations, understanding the progress being made, distribute the technical findings to members, and to pivot the research in different trajectories as appropriate based on the findings.

Create new discoveries: Through the execution of SRC's model over the past several decades it is clear that new discoveries in fundamental research will be established. These discoveries will spawn new communities of researchers that will further refine the science beyond the scope of this program.

A key for establishing a successful research model is to periodically review the program performance and make refinements to the model to ensure alignment with participants' needs. SIA recommends that the timeline for this oversight effort should be five years with a re-alignment at year three, with the Science Advisory Board leading review in partnership with SRC and DOE.



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SIA appreciates the opportunity to provide these comments.