



The Future of Semiconductors (FuSe) Program: First-Year Reflections

Tony Maciejewski

Division Director, Electrical, Communications, and Cyber Systems
Engineering Directorate
National Science Foundation
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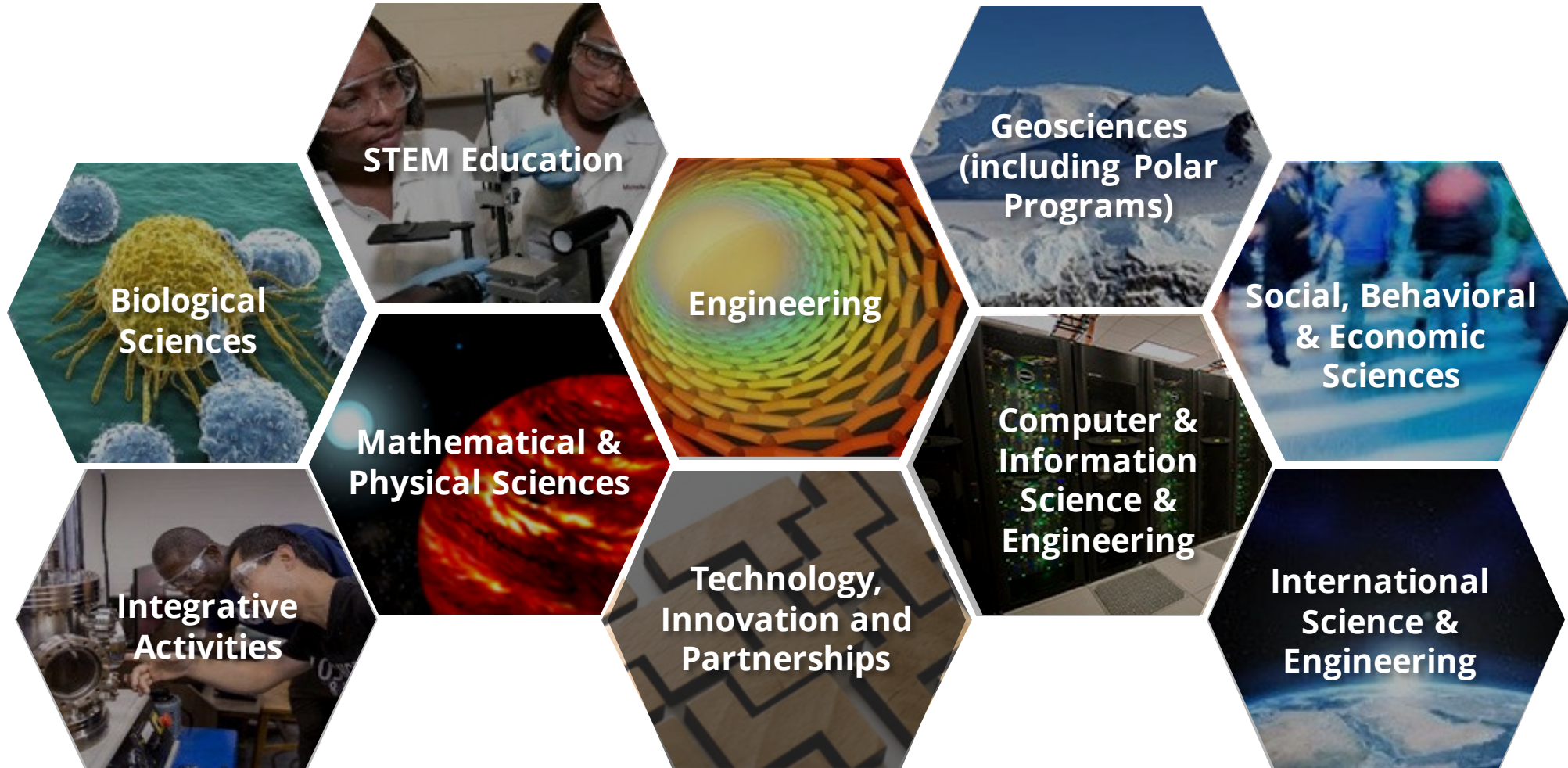
NSF Vision

A nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation.





Programmatic Directorates and Offices Support the NSF Mission and Vision



FuSe NSF 23-552 (FY 23)

- ***Research and Development***: Focus on advanced research and development in semiconductor technology, exploring new materials, processes, and designs for future devices and systems.
- ***Education and workforce development***: Provide interdisciplinary education/workforce development to prepare students/participants for careers in the semiconductor industry.
- ***Industry Collaboration***: Collaboration with industry is highly encouraged to address the current and future challenges facing the semiconductor industry.



Future of Semiconductors (FuSe)

PROGRAM SOLICITATION

NSF 23-552

REPLACES DOCUMENT(S):

NSF 22-589



National Science Foundation

Directorate for Engineering
Engineering Education and Centers
Division of Electrical, Communications and Cyber Systems
Division of Civil, Mechanical and Manufacturing Innovation

Directorate for Mathematical and Physical Sciences
Division of Materials Research
Division of Chemistry

Directorate for Computer and Information Science and Engineering

Directorate for Technology, Innovation and Partnerships

Directorate for STEM Education



Intel Corporation



ERICSSON

Ericsson Inc.



IBM Corp.



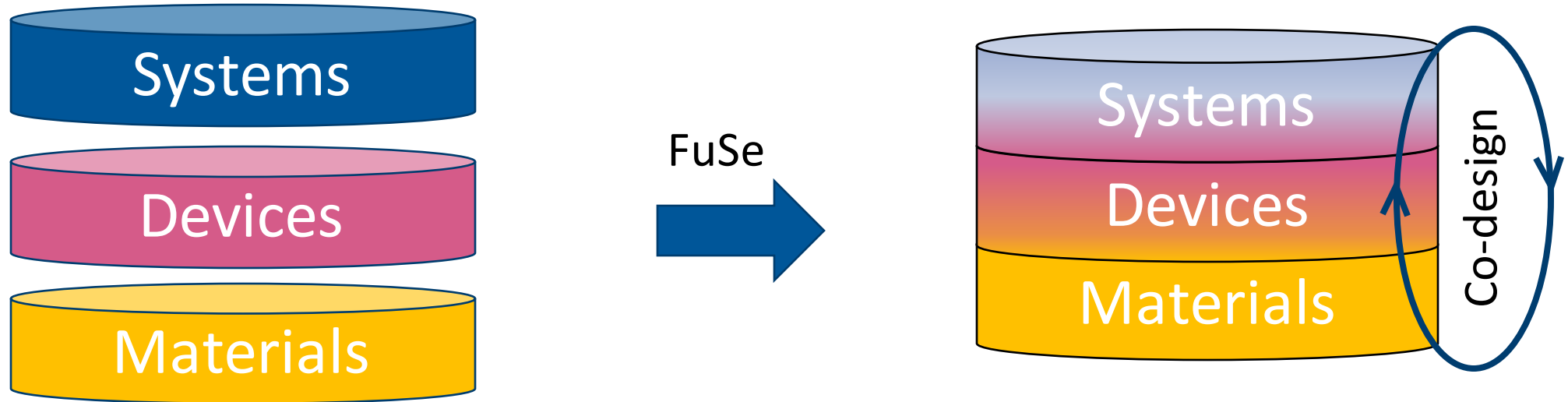
Samsung

Co-funding Industry Partners

- \$45.6M in FY23
- 24 research and education projects, 47 institutions including 8 MSI and 7 EPSCoR



Semiconductor Technology Stack

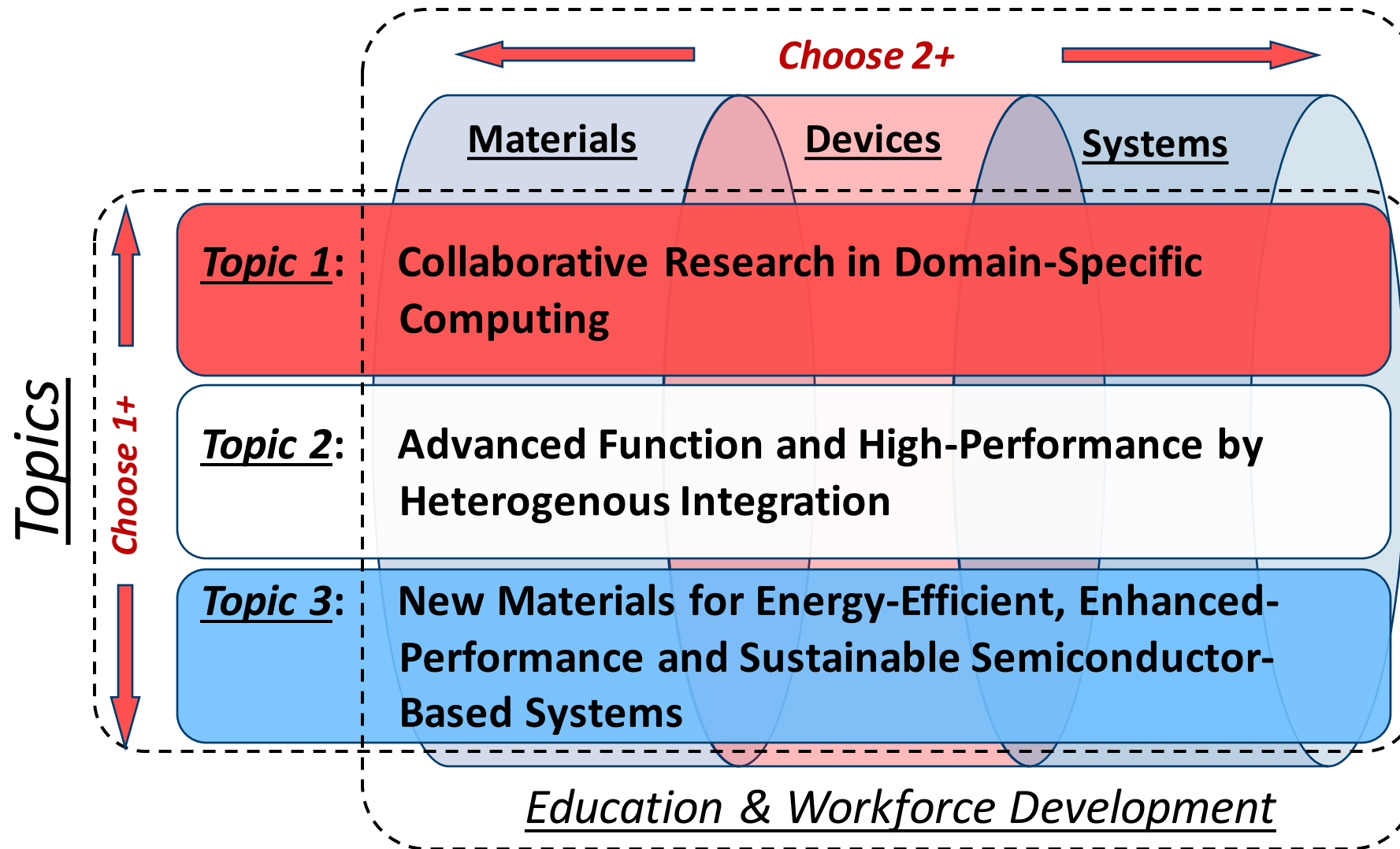


- Ever growing need for materials, devices and system architectures
- Research occurs mostly independent in these areas

- Future manufacturing will be empowered by co-design
- Stronger coordination and research
 - A parallel process with constant feedback between the levels in the stack

FuSe NSF 23-552

Technology stack



Education and Workforce Development

- All proposals must address how the *work will contribute to education and workforce development*.
- The proposal must include within the Broader Impact Description a section titled "**Education and Workforce Development Plan**" that clearly articulates:
 - Education and Workforce Development goals,
 - A plan for recruitment, retention, and graduation of students from underrepresented minority groups, and
 - A plan for assessing the effectiveness of the education and workforce development plan,
 - A plan to integrate research and education & workforce development components.
- Engage experts in education, curriculum development or academic assessment, as appropriate.



FuSe

It is the sense of Congress that the leadership of the United States in semiconductor technology and innovation is critical to the economic growth and national security of the United States.

- The CHIPS & Science Act



ENG CISE
MPS EDU

TIP

RAMP OF OPPORTUNITY

Valley of Death



SAMSUNG



LAB

Foundational Research

Use-Inspired Research

Proofs-of-Concept

Prototype Development

Product/Solution Development

SOCIETY

National and Societal Impact, Commercialization



FuSe Industry Partners – Proposal Development

- Proposals may not list or describe any kind of agreed or assumed arrangement to use the contributions or any other collaborative arrangement with this solicitation's industry partners
- Proposers are not restricted from making use of the widely accessible products or services of FuSe industry partners
- Proposers should not directly contact FuSe industry partners with questions pertaining to their company's participation in this solicitation. All questions should be directed to NSF



FuSe Industry Partners – Award Decisions

- FuSe Industry partners will not participate in or observe the review of proposals.
- NSF will share some of the proposals which are under consideration for funding
- Reviews and panel summaries will also be shared
- NSF will take into consideration the input of all FuSe industry partners prior to making final funding decision.
- Proprietary or privileged information provided by the PI in the separate "Single Copy Documents" section of the proposal will not be shared with reviewers or industry partner representatives.
- NSF will retain final authority for making all award decisions.



FuSe Industry Partners – Post Award

- FuSe Industry partners may make available direct **contributions of resources**
 - Example: software (prototypes or products), data sets, computing infrastructure.
 - No awardee will be required to use any industry partner's offered direct contributions
- A FuSe industry partner may also arrange to **fund its own personnel as researchers** to directly participate with awardee project personnel.
 - *These arrangements will be optional and upon the mutual consent of the industry partner and respective awardee institution(s). No awardee will be required to accept an industry partner researcher.*
- NSF will share annual and final project reports with FuSe industry partners after those **reports have been reviewed and accepted by the cognizant NSF Program Officer.**



FuSe Industry Collaboration – Intellectual Property

- *Awardees shall grant to the sponsoring parties a non-exclusive, worldwide, paid-up, non-transferable, irrevocable royalty-free license to all intellectual property rights in any inventions conceived or first reduced to practice in the performance of the Program work under the funding agreement.*
- Awardees shall grant the license to each industry partner named in the award letter unless the industry partner opts to decline the license.
 - Such license **shall not extend to awardees' background intellectual property.**
 - Intel and Samsung will be named as sponsoring parties for all awards.
 - Ericsson and IBM will be named as sponsoring parties in a partial set.



Key NSF Education and Workforce Development Programs

Experiential Learning in Emerging and Novel Technologies (ExLENT)

- Invests in practical experiences, including for the current workforce looking to reskill in emerging technologies.
- Anticipated to touch 1,000 students beginning this year.

Non-Academic Research Internships for Graduate Students (INTERN)

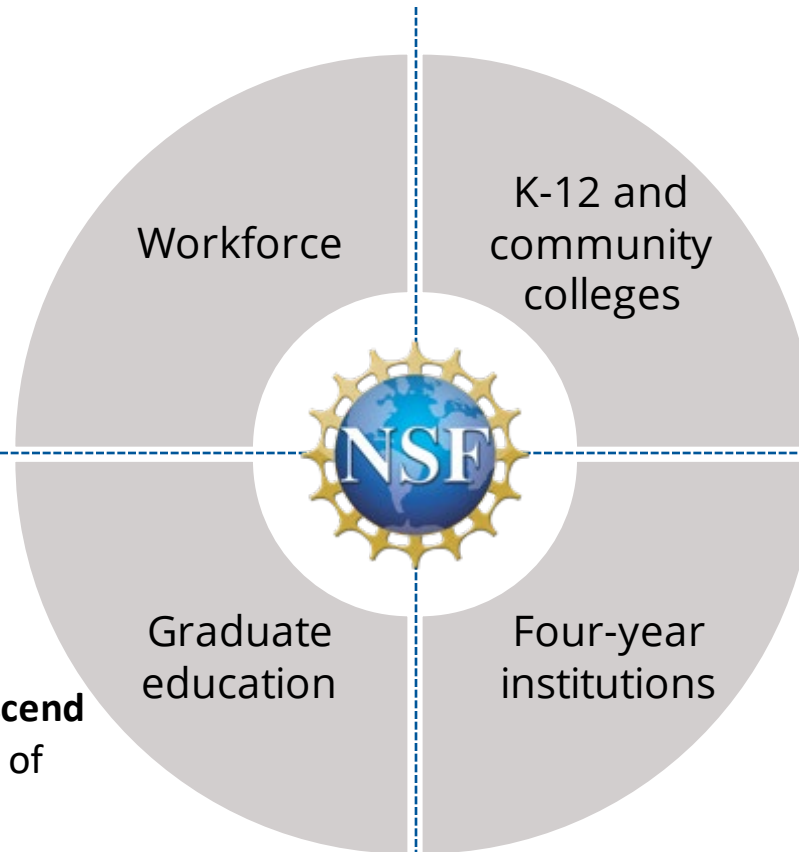
- Internships for NSF-funded graduate students.
- Supports more than 300 students each year.

CSGrad4US Fellowships, eFellows, and MPS-Ascend

- Invests in increasing the number and diversity of advanced degree students and post-docs.

Supplements for Access to Semiconductor Fabrication

- Provides funding to enable access to semiconductor fabrication for research and education.



Advanced Technological Education (ATE)

- Invests in advanced technician training.
- Touches nearly 40,000 students, 9,000 teachers annually.

Research Experiences for Teachers (RET)

NSF Scholarships in STEM (S-STEM)

- Invests in low-income students.
- Has touched more than 100,000 students in nearly every state, plus PR and USVI, since 2006.

Research Experiences for Undergraduates (REU)

- Supports more than 6,000 students annually to conduct research and receive mentoring.



Advanced Chip Engineering Design and Fabrication (ACED Fab)

NSF Directorate for Engineering and Taiwan NSTC Department of Engineering and Technology Collaborative Research Opportunities

PROGRAM SOLICITATION

NSF 22-636



National Science Foundation

Directorate for Engineering

Division of Electrical, Communications and Cyber Systems

Division of Chemical, Bioengineering, Environmental and Transport Systems

Division of Civil, Mechanical and Manufacturing Innovation

Engineering Education and Centers

Office of International Science and Engineering



National Science and Technology Council, Taiwan

Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):

January 17, 2023

A Research Concept Outline (RCO) must be submitted to nsf-acedfab@nsf.gov no later than December 13, 2022. Please see Special Instructions for RCO submission in the full text of this solicitation.

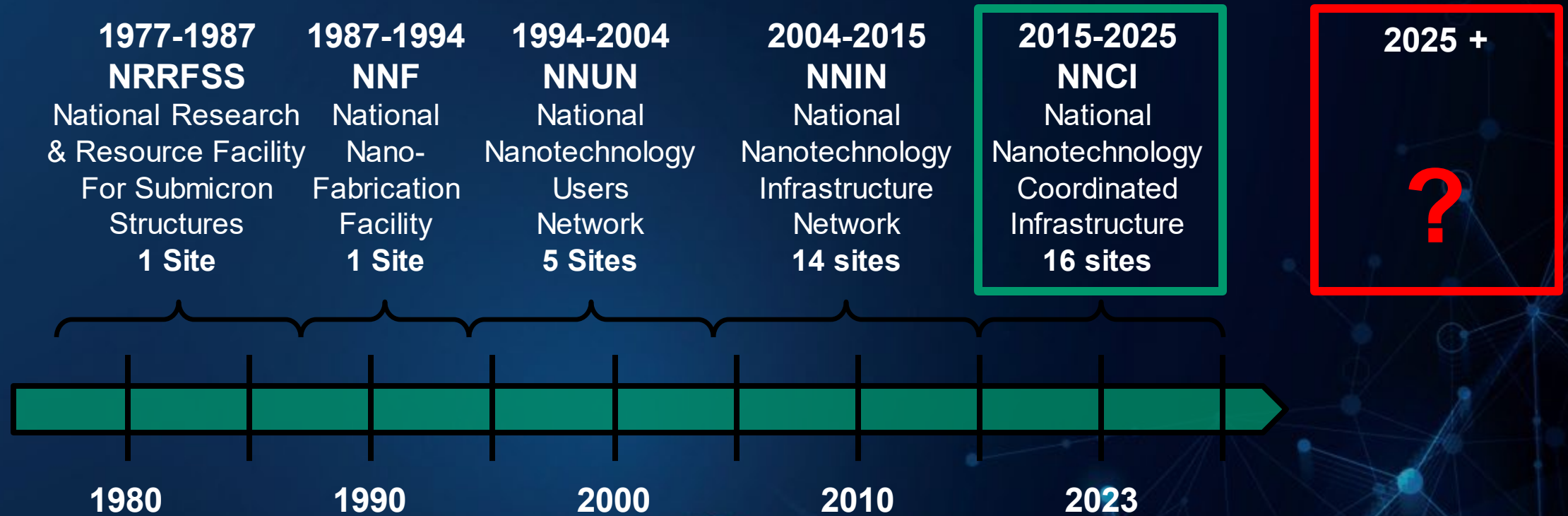


Advanced Chip Engineering Design and Fabrication

- Supports collaborations between US and Taiwan on innovative semiconductor chip design and fabrication projects that utilize advanced technologies in Taiwan's semiconductor foundries (TSMC) with significantly reduced cost (80% discount).
- A single collaborative grant proposal submitted to and reviewed by NSF is jointly funded by NSF and NSTC.
- \$6M in FY23 for six projects
- Three themes:
 - AI/ML Chips
 - Heterogeneous Integration of Novel Devices
 - Low-Power High-performance RF/Wireless Communication and Sensing Chips



40+ Years NSF-Funded Nano Infrastructure



Cornell, 1983

2000 NNI
National
Nanotechnology
Initiative

2003
21st Century
Research and
Development Act



Cornell, CNF 2023

NNCI by the Numbers

	NNCI Year 7 10/2021 – 09/2022
Unique Facility Users	13,348
Unique External Users	3,381 (25.3%)
Average Monthly Users	5,112
New Users Trained	5,151
Facility Hours	1,072,332
External Facilities Hours	253,667 (23.7%)

External users represent (Year 7 data)

- 233 academic institutions (49 states plus Puerto Rico) incl. 75 (32%) serving under-represented populations
- 562 small companies
- 189 large companies
- 17 government organizations



Questions and Contact Information

Tony Maciejewski

Division Director
Electrical, Communications, and Cyber Systems
Directorate of Engineering
National Science Foundation
Email: amacieje@nsf.gov