

Scaling National Security: The SCALE Program's Role in Growing the Nation's Skilled Microelectronics Workforce

Trusted & Assured Microelectronics
Education & Workforce Development

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A ready workforce is required for the U.S. to lead high-performance microelectronics for decades to come



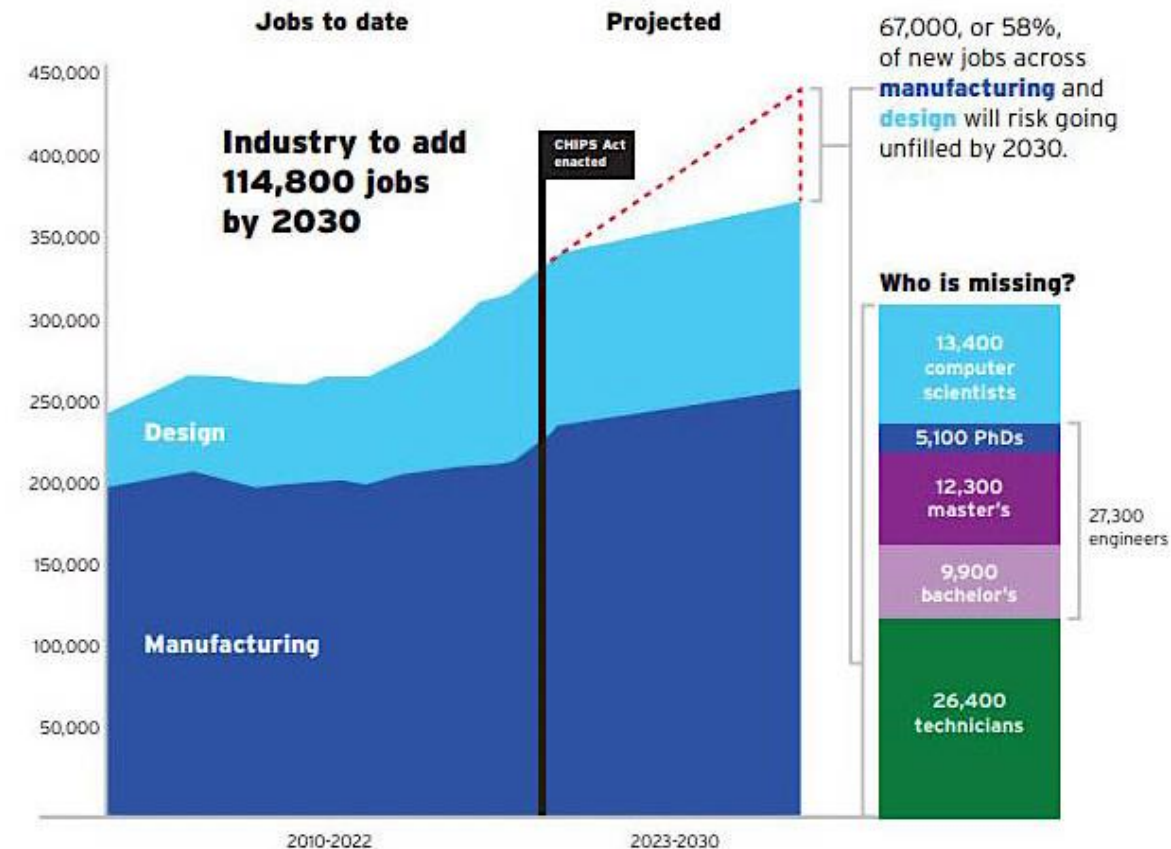
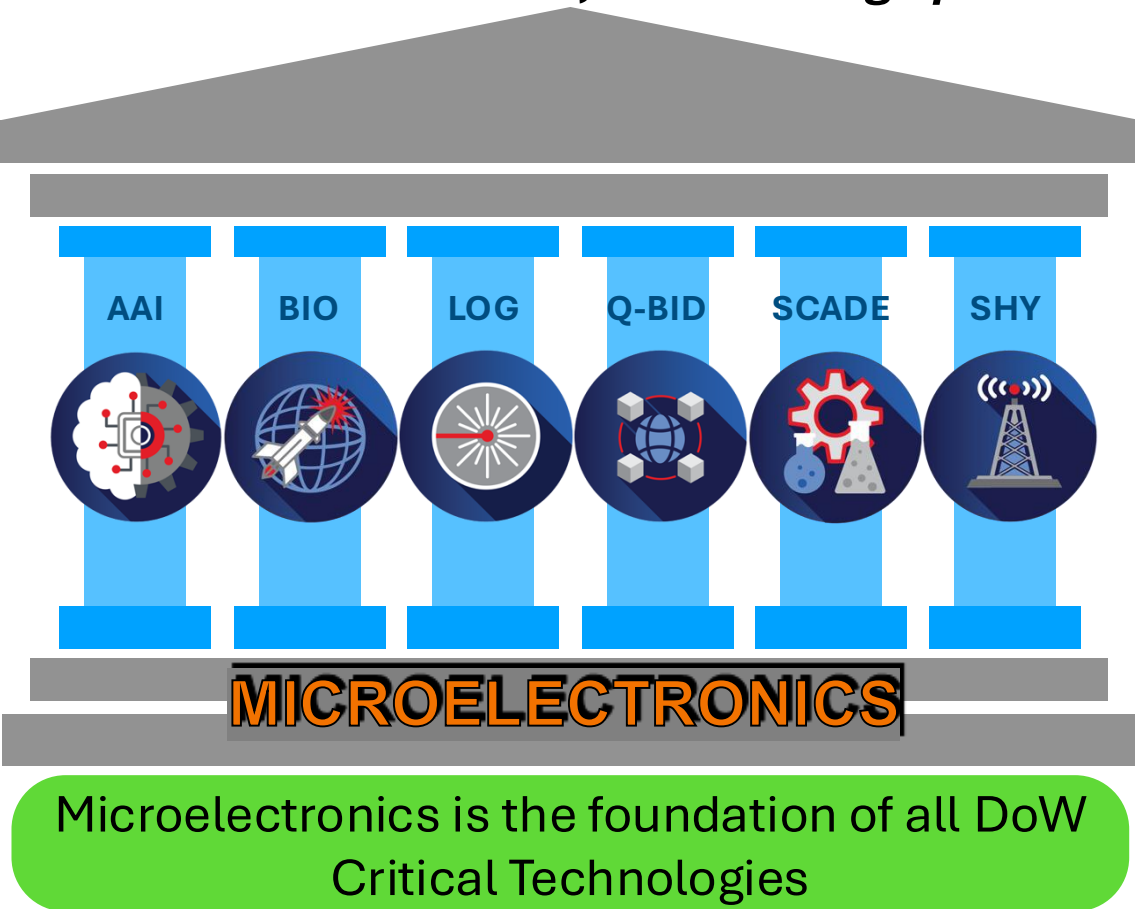


The Microelectronics Workforce Challenge



Without sustained workforce development, the U.S. risks losing technological leadership. For the DoW and DIB, this shortage presents a national security risk.

SEMICONDUCTOR WORKFORCE GAP



Source: Semiconductor Industry Association, Chipping Away Report, July 2023



The Defense Workforce Gap



The U.S. Defense microelectronics ecosystem faces a uniquely constrained domestic talent pipeline and insufficient work-ready training capacity, creating a critical shortage of clearable microelectronics talent.

Talent Demand Accelerating

- Defense modernization priority areas – advanced compute, sensing, and autonomous systems – are **driving rapid growth in demand for specialized microelectronics talent**
- Mission-critical technology development/sustainment demands **niche skillsets not produced at scale by commercial talent pipelines**

Domestic Pipeline Constraints

- **Limited domestic participation** in microelectronics degree programs
- **Over-reliance on international graduate students** in key programs
- Insufficient domestic pipeline **eligible for clearance-requisite defense work**

Workforce Readiness Gap

Many graduates **lack hands-on experience** with:

- design tools
- fabrication processes
- reliability testing for extreme environments

Creates need for **extended onboarding and significant post-hire training**

Sufficient pathways lacking for **mid-career reskilling and upskilling** into emerging microelectronics roles.

Aging Workforce

A significant portion of the current workforce is approaching retirement, increasing pressure on already constrained talent pipelines



The SCALE Program



The SCalable Asymmetric Lifecycle Engagement (SCALE) program was created in 2019 to specifically address this challenge.



Equips teachers and schools to provide early exposure to microelectronics (ME) concepts and careers



Connects U.S. citizen students to mission
Provides specialized lifecycle spanning education and work-ready training in defense-sector ME technology areas to U.S. citizen students



Upskills and reskills DoW ME workforce in ME security topic areas and use of state-of-the art microelectronics lifecycle tools

Mission: SCALE is a national consortium working to attract, develop, and sustain a **highly skilled U.S. citizen workforce for defense-related microelectronics careers** through coordinated partnerships across government, industry, and academia.

Value Proposition: SCALE focuses on DoW mission needs and building integrated regional ecosystems that produce work-ready microelectronics talent for national security.



Measurable Outcomes and National Impacts



Employer-informed curricula, hands-on training, and direct engagement with government and defense industry partners help ensure SCALE graduates are prepared for mission-critical microelectronics roles.

Impact Metrics:

- **160+** K-12 Educators and **15,000+** K-12 students reached
- Built a **1600+** member workforce pipeline with 520+ program alumni
- **50%+** of active students participating in internships or research
- **52%** of graduates entering the defense sector
- **31%** of graduates pursue graduate education (**WIN**)
 - > 60% of undergraduates pursuing graduate education
- **13,000+** continuing education learners training within existing workforce
- **180+** webinars, modules, courses, and micro-certificates created for continuing education

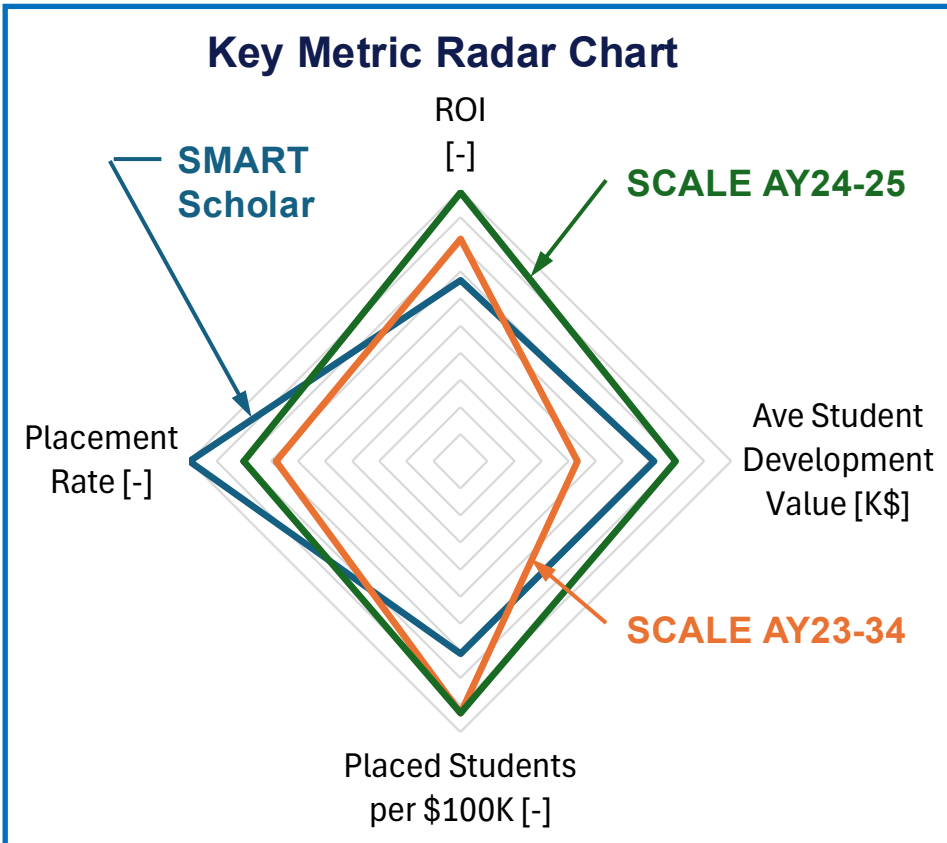
Result:

These outcomes significantly outperform comparable non-SCALE student populations, demonstrating that **SCALE is successfully expanding the national pipeline of highly skilled, clearable microelectronics talent for the defense ecosystem.**



Performance on Key Metrics: ROI

SCALE demonstrates strong workforce outcomes and high return on investment by producing defense-ready microelectronics talent at a highly cost-effective rate.

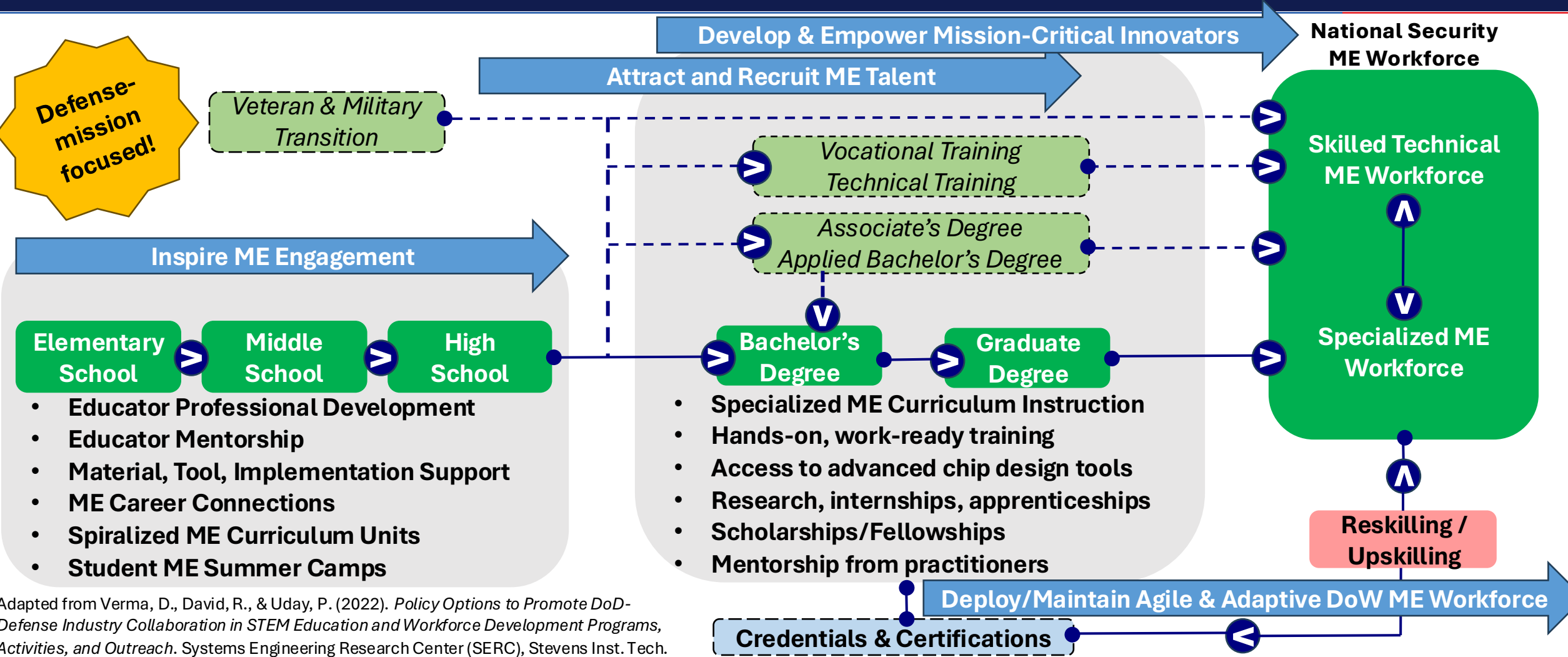


Key Metric (Higher is Better)	SMART Scholar*	SCALE AY23-24	SCALE AY24-25	Comment
Return on Investment (ROI) [-]	3.34	4.10	4.96	Measures value on funding
Ave Student Development Value [K\$]	\$143	\$86	\$159	Measures development before entering workforce
Placed Students per \$100K [-]	0.71	0.93	0.93	Measures cost effectiveness
Placement Rate [-]	100%	68%	80%	Measures success in placing graduates

* = with same degree mix as SCALE



Building the National Security Microelectronics Workforce



Adapted from Verma, D., David, R., & Uday, P. (2022). *Policy Options to Promote DoD-Defense Industry Collaboration in STEM Education and Workforce Development Programs, Activities, and Outreach*. Systems Engineering Research Center (SERC), Stevens Inst. Tech.

Outcome: A clearable, highly skilled U.S. microelectronics workforce supporting national security innovation.



SCALE Microelectronics Technical Areas



SCALE educates and trains students in mission-critical microelectronics technologies supporting defense systems.

Mission-Critical Technical Areas include:

- System-on-Chip Design
- AI Hardware and Secure Systems
- Radiation-Hardened Microelectronics
- Advanced Packaging and Heterogeneous Integration
- Secure Edge and IoT Systems
- Emerging Technologies (Quantum, 5G/6G)

SCALE technical areas, curricula, and training pathways are developed in collaboration with government laboratories and defense industry partners to ensure students acquire the knowledge, skills, and abilities needed for mission-critical microelectronics roles.



National Workforce Network

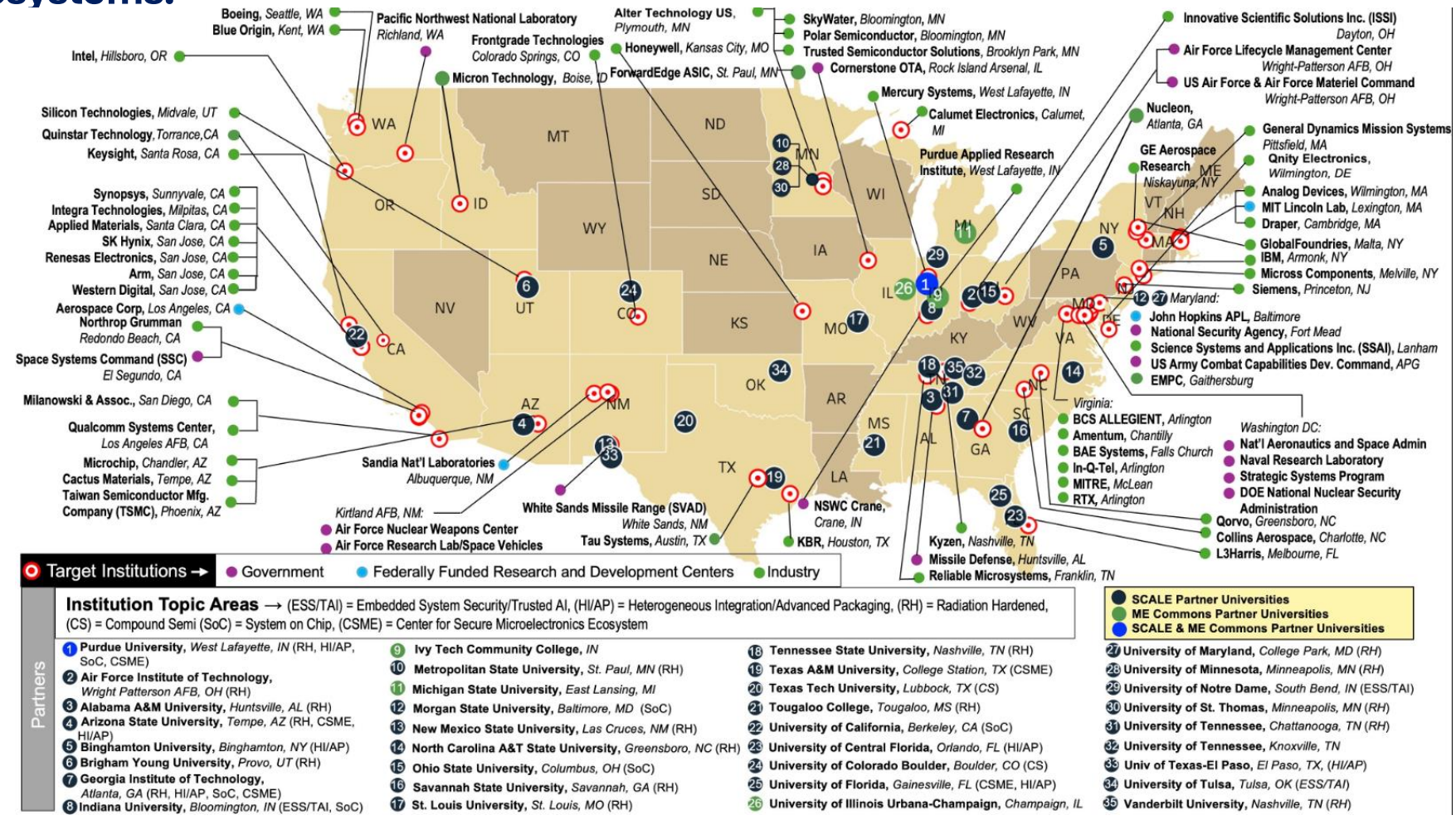


This nationally coordinated but regionally executed model allows SCALE to grow workforce pipelines aligned with local defense innovation ecosystems.

- Growth to 80 Gov/DIB partners
- >100 faculty across >35 universities

NATIONALLY COORDINATED, REGIONALLY EXECUTED

https://www.scale4me.org/s/Dynamic-map_jan_2026.jpg





Future Expansion



With continued support from DoW, Government, and Industry Partners, SCALE will expand to:

- additional universities
- apprenticeship pathways
- veteran workforce programs
- expanded industry partnerships
- building out regional ecosystems

These efforts will further strengthen the national pipeline of microelectronics engineers.



Conclusion



Maintaining U.S. leadership in microelectronics requires intentional and sustained investment in workforce development.

SCALE is the nation's only workforce program specifically designed to produce clearable microelectronics talent for the defense ecosystem.

The SCALE program provides:

- a national pipeline of clearable microelectronics talent
- strong partnerships across government, industry, and academia
- measurable workforce outcomes supporting defense modernization

Expanding programs like SCALE will be essential to ensuring the United States retains leadership in advanced microelectronics.



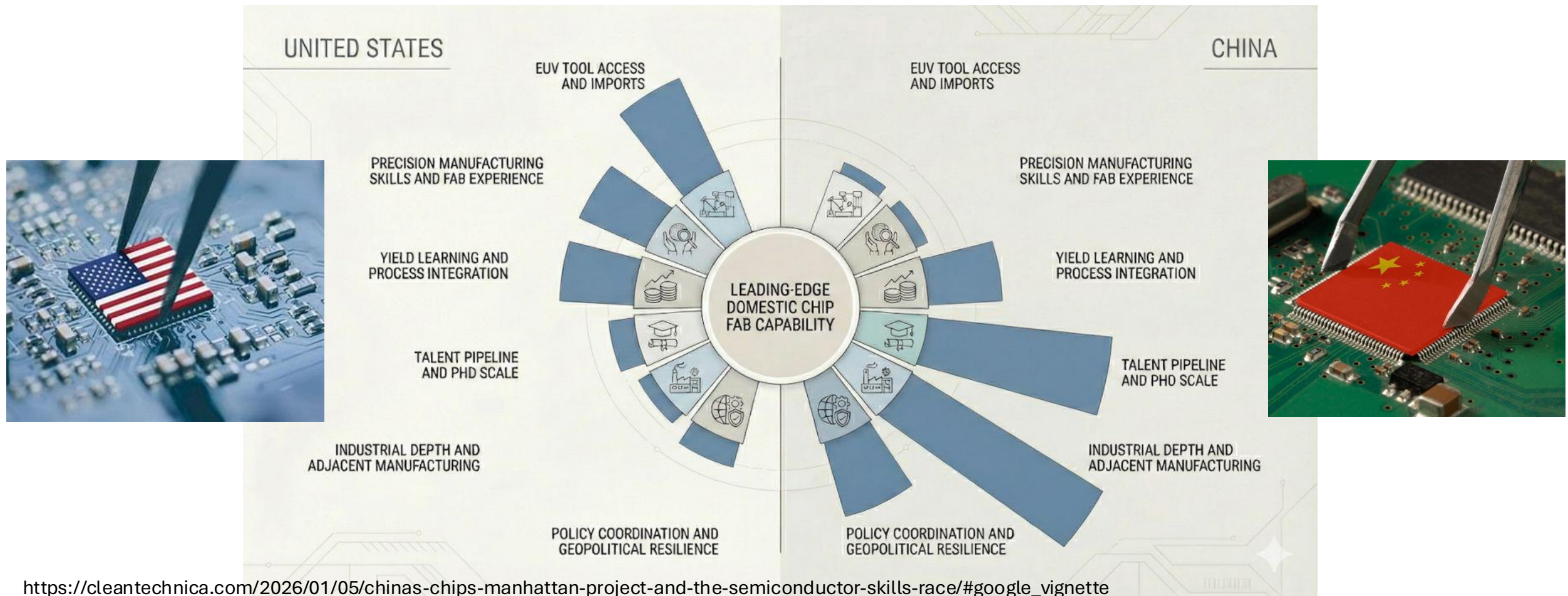
BACKUP



Microelectronics Workforce Critical to Geopolitical Chip Landscape



“The semiconductor race is not just about subsidies or factories. It is about who can patiently build and retain the people needed to run the most complex manufacturing systems on earth.” – Michael Barnard, Climate Futurist





Defense Microelectronics Lifecycle Needs



Defense priorities in design, fabrication, packaging, testing, and sustainment are driving **increased demand for specialized engineering and technical roles.**

