Revitalizing Domestic Semiconductor Manufacturing: Challenges, Opportunities and Emerging Applications

Mark Litecky

SkyWater Technology

Who is SkyWater Technology?

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We streamline the **Concept-to-production** journey.

Technology as a Service

Innovation as a Service + **Manufacturing as a Service**

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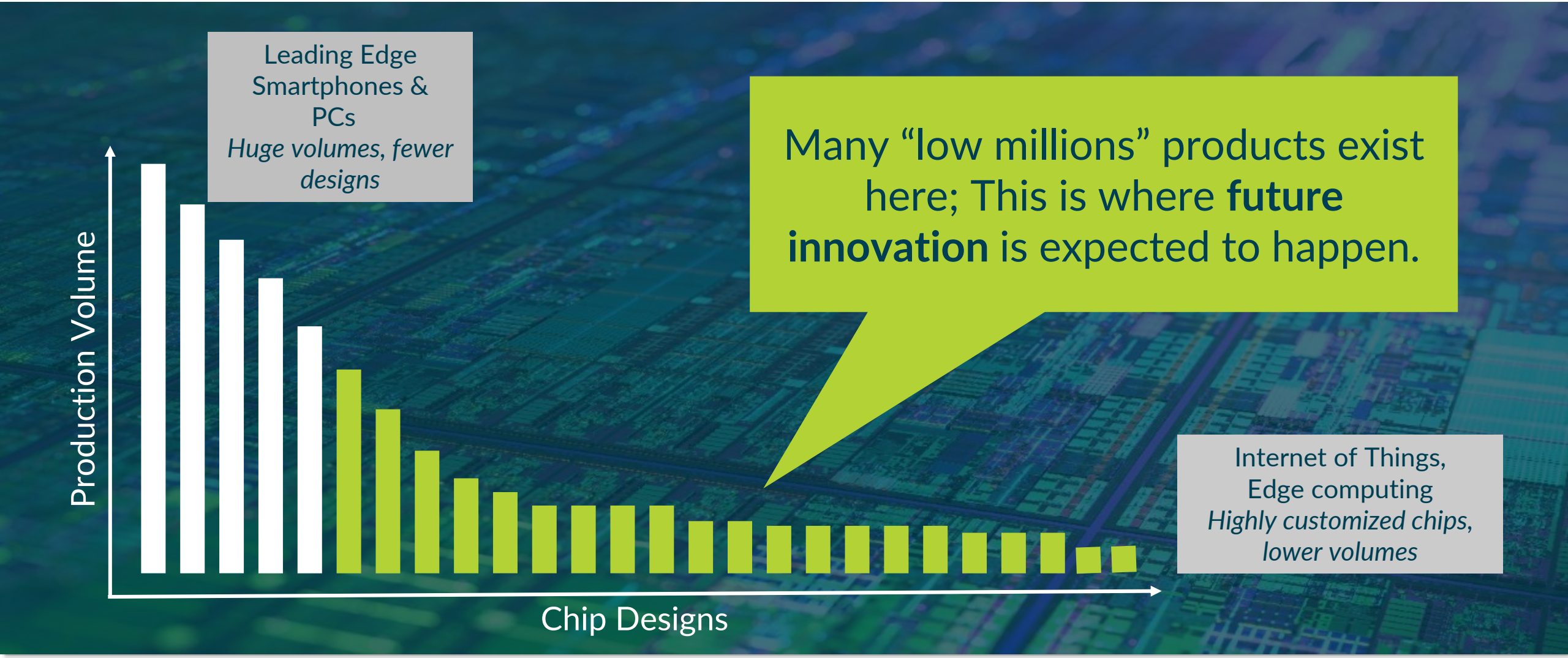
Building the Future in the "Innovation Tail"



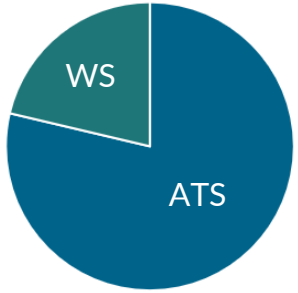
America's Foundry At-a-Glance

$286M
2023 Annual Revenue

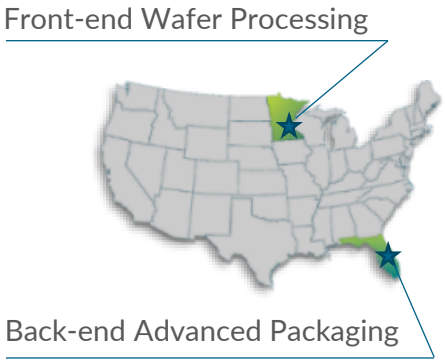
SKYT
Traded on NASDAQ since 2021

750
Total Employees

IATF16949
AS9100
ISO9001
ISO4001
ISO13485
DMEA Cat 1A
Trusted



2023 Revenue by Service



U.S.-based, investor-owned, pure-play foundry

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SkyWater Minnesota

Bloomington, MN

OPERATION

- ~675 employees
- 200 mm equipment
- 91,000 ft² Cleanroom (Class 10 + SMIF)
- 10,000 30 ML CMOS wafers/month or 50,000 MOSFET wafers/month
- 65 nm+ feature geometries

CERTIFICATIONS

- ISO9001 Quality Management System Certified
- ISO9100/IATF16949 Automotive Certified
- ISO13485 Medical Certified
- AS9100 Aviation, Space and Defense Certified
- ISO14001 Environmental Certified
- DMEA Cat 1A Trusted site since 2010
- ITAR and Secure Processing Supported

SkyWater Florida

Kissimmee, FL

OPERATION

- ~60 employees
- 200 mm equipment
- 35,400 ft² Cleanroom (class 1,000 & class 10,000)
- Site added to operation Feb 2021
- Facility will enable custom heterogeneous integration solutions
- Unique Public-Private Partnership (PPP)
  - Osceola County owns site/fab
  - SkyWater operates facility
  - Ecosystem partner with BRIDG (nonprofit)

CERTIFICATIONS

- ISO9001 Quality Management System Certified
- DMEA Cat 1A Trusted – pending

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Trends Influencing the Semiconductor Industry

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Dynamics is Redefining Our Industry

New Product Development Costs are Skyrocketing

IP Security and Supply Chain Risks are Accelerating

Supply Chain Globalization to Improve Transparency

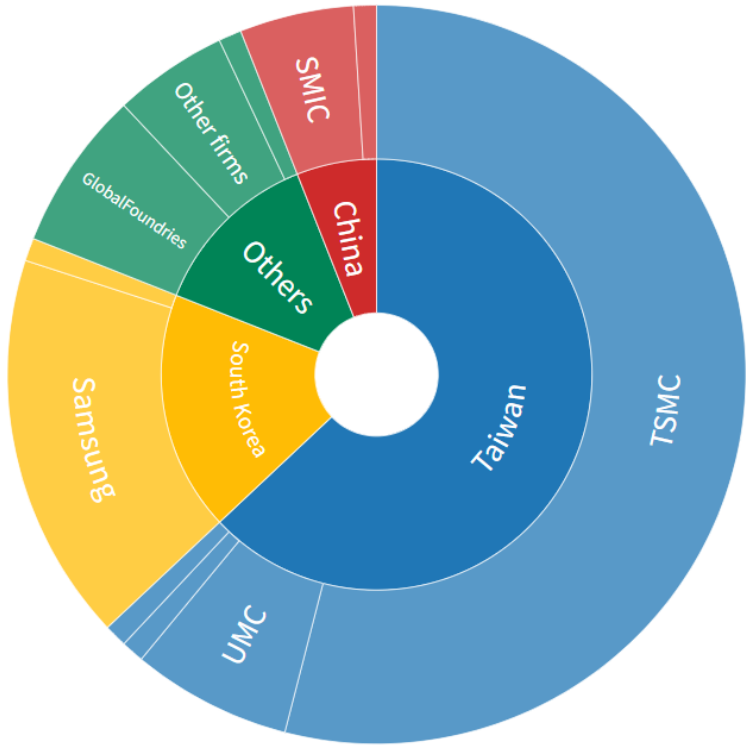
A Need to Revitalize U.S. Manufacturing has Emerged

U.S. share of semiconductor manufacturing has eroded from 37% in 1990 to 12% today[1]

The U.S. share of global packaging capacity, including advanced packaging, is 3%[2]

Semiconductor contract manufacturers by market share

Total foundry revenue stood at $85.13 billion in 2020 [3]



1. 2022 SIA Factbook: https://www.semiconductors.org/the-2022-sia-factbook-your-source-for-semiconductor-industry-data/
2. CSIS Advanced Packaging and the Future of Moore's Law: https://www.csis.org/analysis/advanced-packaging-and-future-moores-law
3. CNBC.com: https://www.cnbc.com/2021/03/16/2-charts-show-how-much-the-world-depends-on-taiwan-for-semiconductors.html

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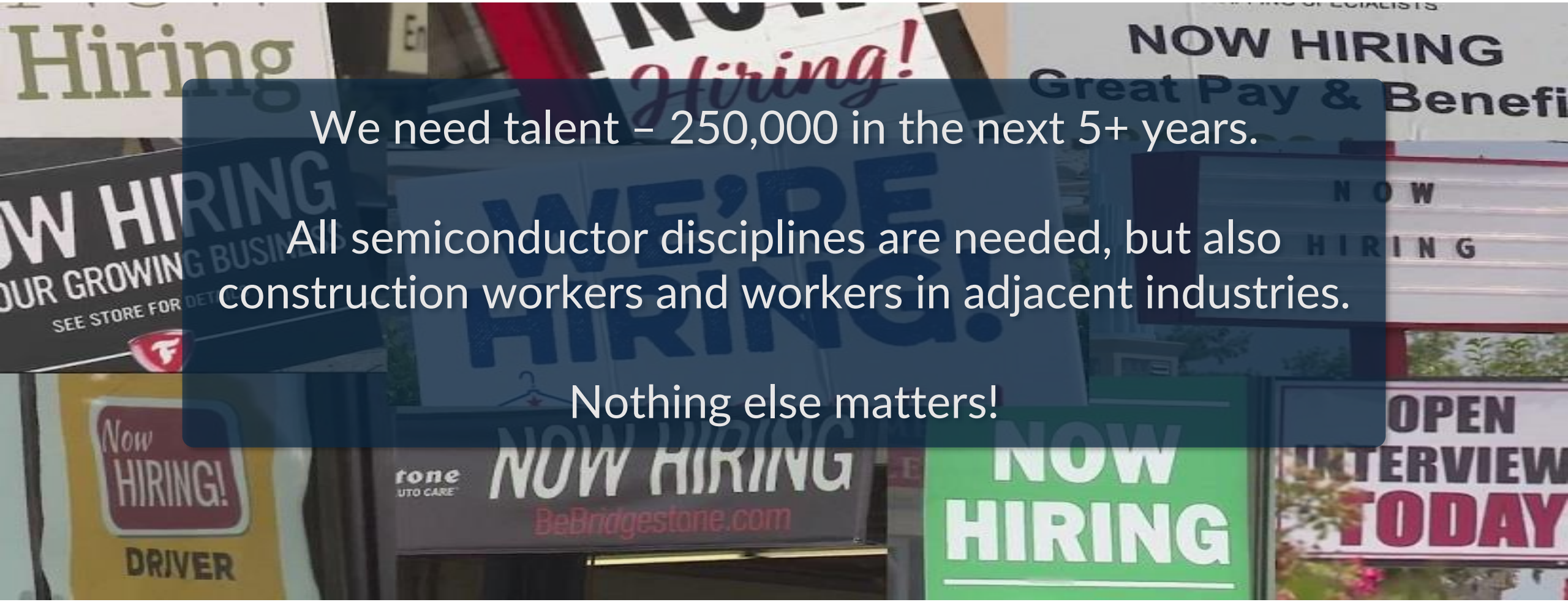
We Need a High-Tech Workforce to be Successful



We need talent – 250,000 in the next 5+ years.

All semiconductor disciplines are needed, but also construction workers and workers in adjacent industries.

Nothing else matters!

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Dynamic Learning Supports Workforce Development

Immersive Learning Approaches	Technicians	Engineers	Business Functions
K-12	← STEM and high-tech education, exposure and opportunities →		
Post Secondary	Scholarships Apprenticeships Re-education Programs Veteran Workforce Transition	Scholarships Internships	Scholarships Internships
Graduate		Rotational Programs	Rotational Programs
Post-Graduate	← Immersive Learning Experiences →		

Investments in Domestic Manufacturing

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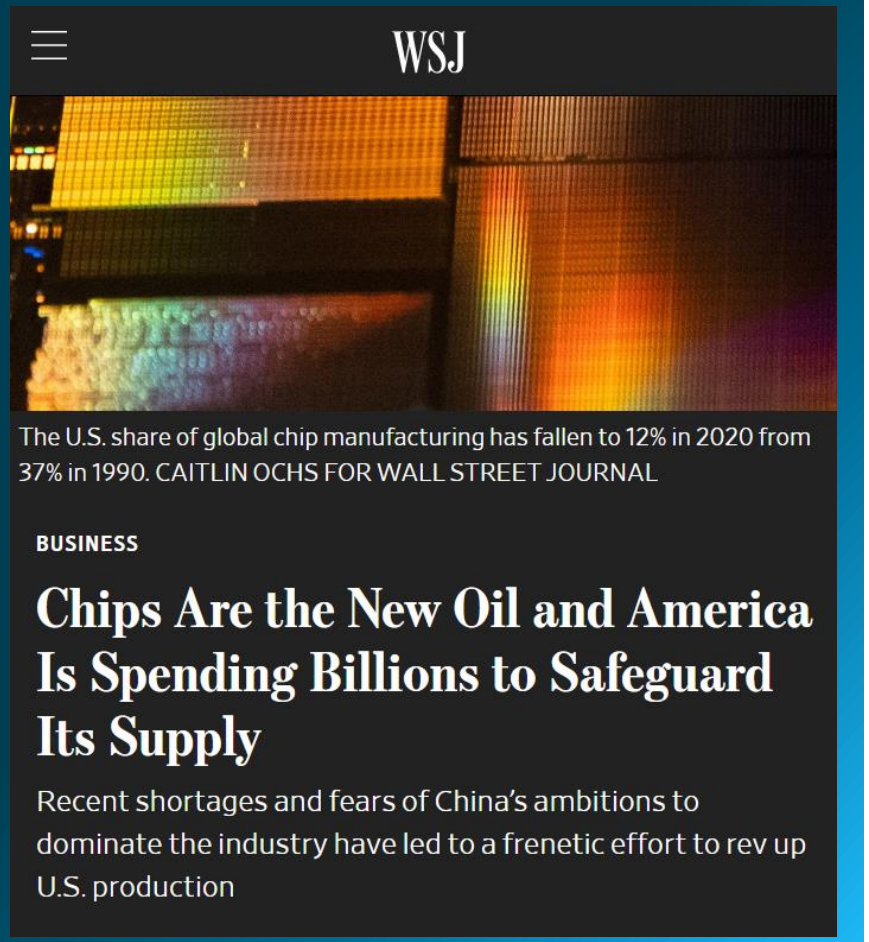
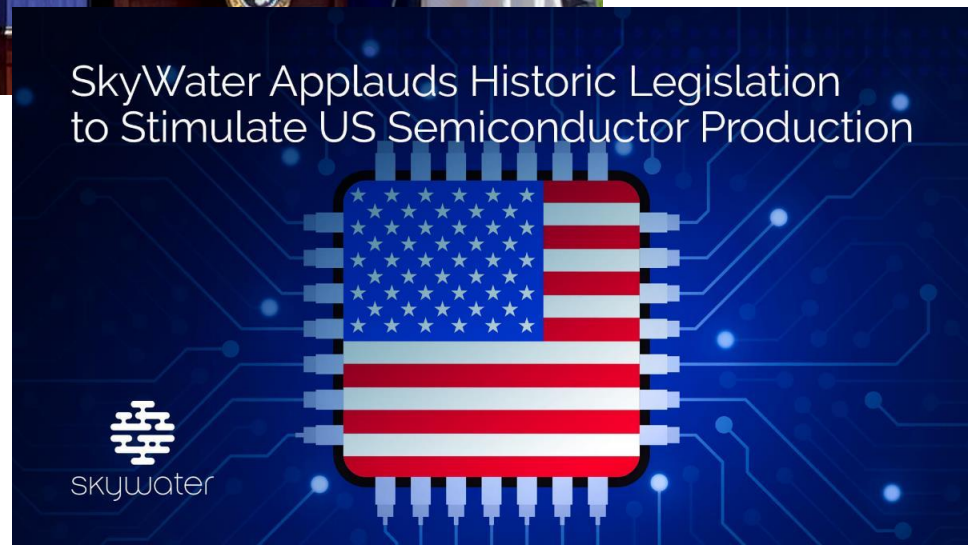
Investment Needed for Both Leading Edge and Legacy Nodes

- 60% of microelectronics devices will be on 65 nm or higher platforms through 2030*
- Investments are concentrated at the leading edge
- Mature nodes offer a base on which advanced emerging technologies can be layered
- Advanced Packaging is an opportunity to advance the leading edge of semiconductor technology

*McKinsey Presentation at SEMI Industry Strategy Symposium, Jan 8-11, 2023, Half Moon Bay, CA



President Biden Signs the CHIPS & Science Act of 2022



From President Biden holding up a SkyWater wafer at the virtual Chip Summit last year to the signing of the CHIPS & Science Act of 2022, SkyWater has supported this critical initiative.

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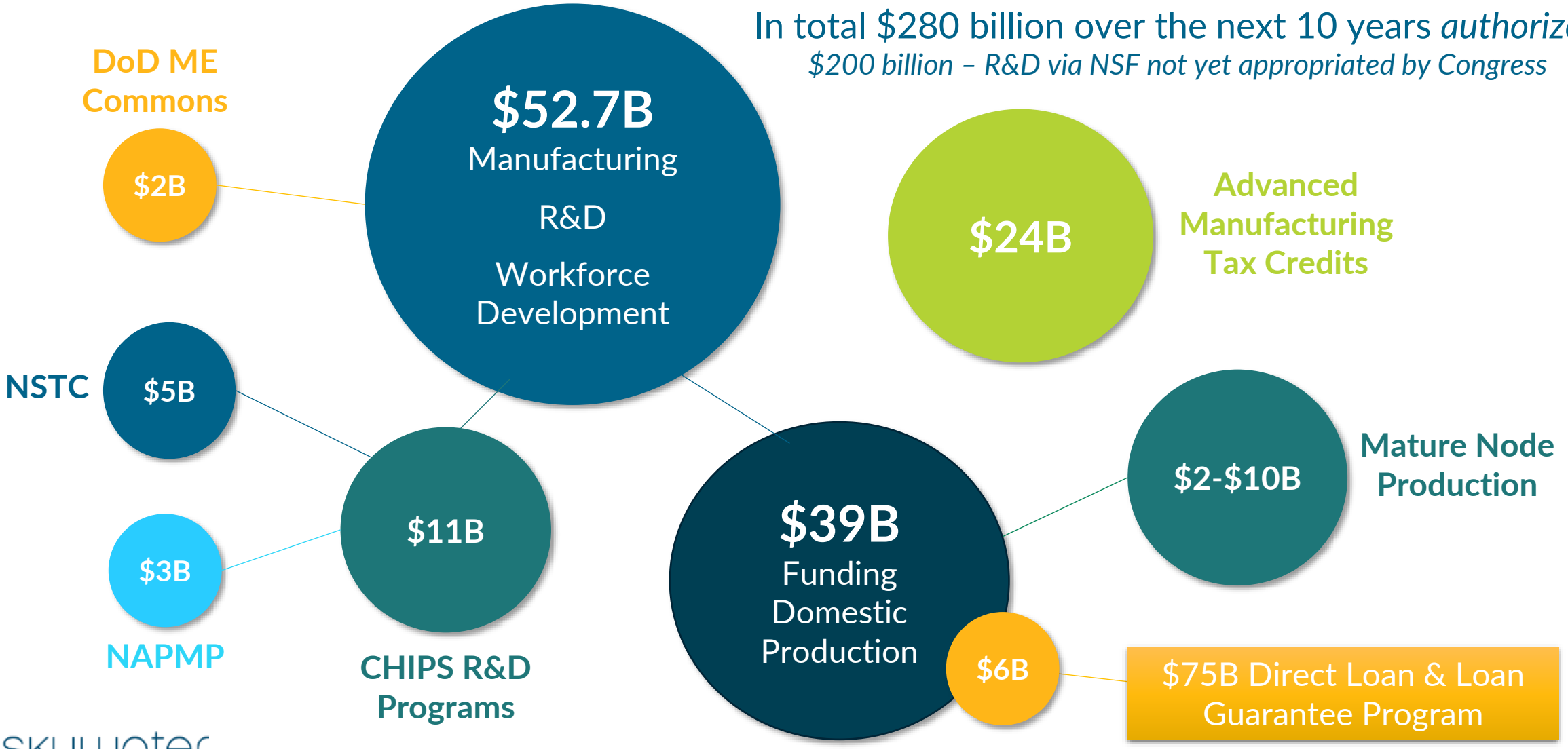
CHIPS & Science Act Funding



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$1.6 Billion in CHIPS Awards

REUTERS World Business Markets Sustainability More

Technology

US plans $35 million award to BAE to boost chip supply for F-35

By David Shepardson

December 11, 2023 4:16 AM CST · Updated 3 months ago

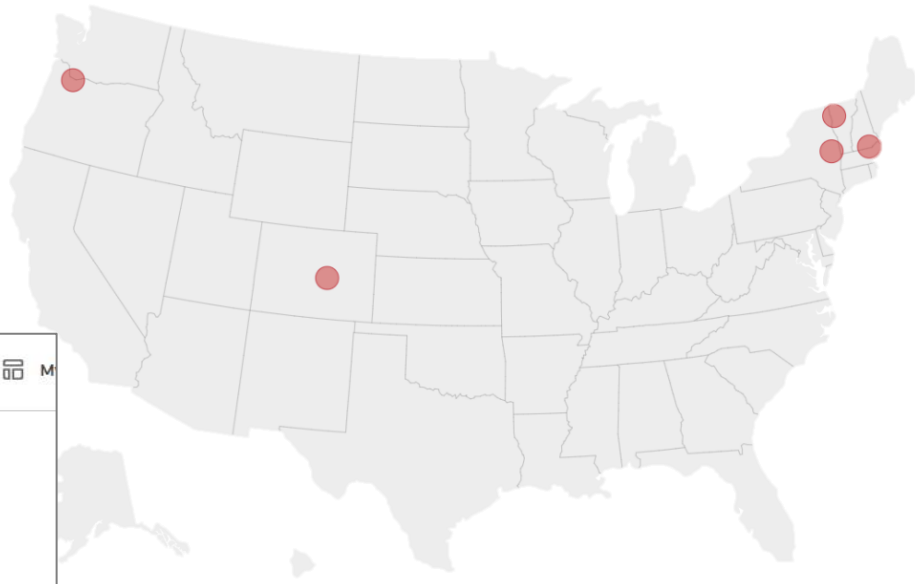
REUTERS World Business Markets Sustainability More

Technology

US plans $162 million award to Microchip Technology to boost production

By David Shepardson

January 4, 2024 10:45 AM CST · Updated 2 months ago



AP WORLD U.S. ELECTION 2024 POLITICS SPORTS ENTERTAINMENT BUSINESS SCIENCE FACT CHECK ODDITIES NEWSLETTERS VIDEO

Israel-Hamas war · Russia begins voting · McDonald's outage · Keenan Allen to Bears · James Crumbley

WASHINGTON NEWS

Biden admin providing $1.5 billion to GlobalFoundries to make computer chips in New York and Vermont

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Microelectronics Commons Addresses the Valley of Death

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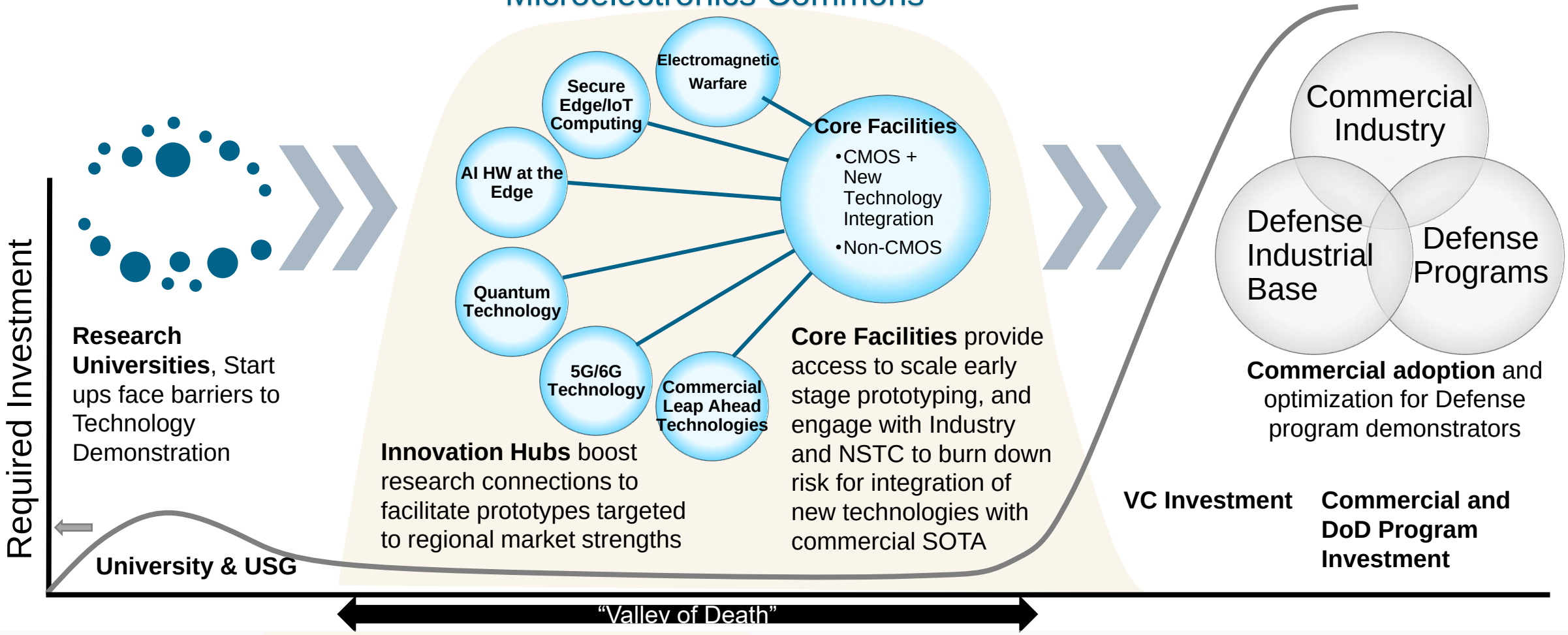
Microelectronics Commons



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Microelectronics Commons Awardees

https://microelectronicscommons.org

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The responses to the RFS represented the innovation of a combined membership network of 642 unique organizations

Applied Research Institute *Silicon Crossroads Microelectronics Commons (SCMC) Hub*	**Arizona Board of Regents on behalf of Arizona State University** *Southwest Advanced Prototyping (SWAP) Hub*	**The Board of Trustees of the Leland Stanford Junior University** *California-Pacific-Northwest AI Hardware Hub (Northwest-AI-Hub)*	**Massachusetts Technology Collaborative** *Northeast Microelectronics Coalition (NEMC) Hub*
Midwest Microelectronics Consortium *Midwest Microelectronics Consortium (MMEC) Hub*	**North Carolina State University** *Commercial Leap Ahead for Wide-bandgap Semiconductors (CLAWS) Hub*	**The Research Foundation for SUNY, acting on behalf of SUNY Polytechnic Institute** *Northeast Regional Defense Technology Hub (NORDTECH)*	**University of Southern California** *California Defense Ready Electronics and Microdevices Superhub (California DREAMS)*

DOD Industrial Base and Sustainment Program (IBAS)

- IBAS ensures DOD is positioned to address industrial base issues and support National Security innovation base
- IBAS Advanced Packaging focus is known as RESHAPE (**R**eshore **E**cosystemfor **S**ecure **H**eterogeneous **A**dvanced **P**ackaging **E**lectronics).

- NeoCity in Osceola County, Florida launched its Cornerstone collaboration in January.
- **establishing Fan Out Capability in the United States (eFOCUS)** 5-year contract awarded with a spending ceiling of $120 million and options for an additional $169 million, potentially resulting in a total award of $289 million.

Strengthening Domestic Advanced Packaging Technologies

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Heterogeneous Integration (HI) and SWAP Benefits

Why HI?

- Modular approach vs. Monolithic approach
- Not every logic function (IP) needs to be designed in the same process node (HI)
- Leveraging IP in the form of chiplets
- Current industry trend has led to chiplets on silicon interposers
- Includes latest IC packaging 2.5D, 3D, FOWLP technologies
- Optimize nodes required for ideal performance and cost

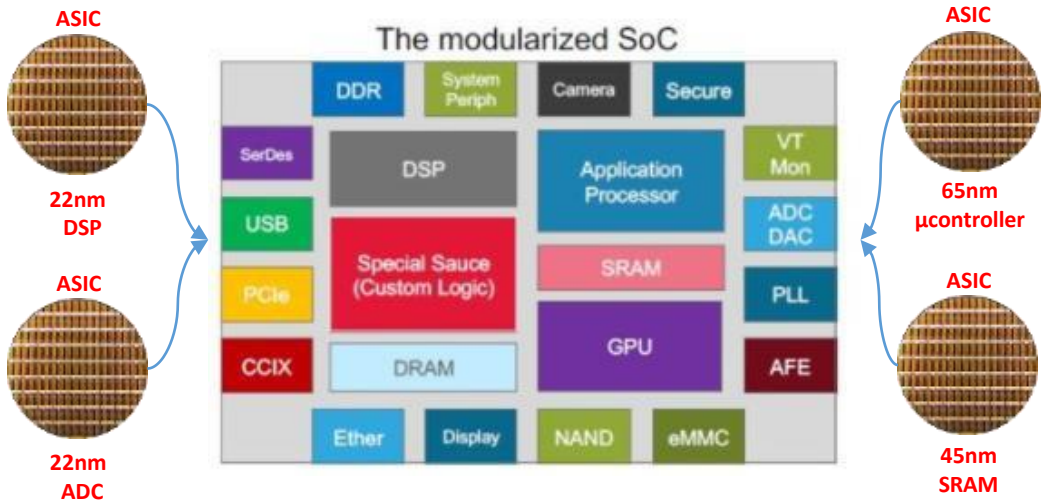
SHIP is leveraging commercial HI solutions to improve SWAP savings and system performance

Expected SWAP Savings:
8x relative to current solution

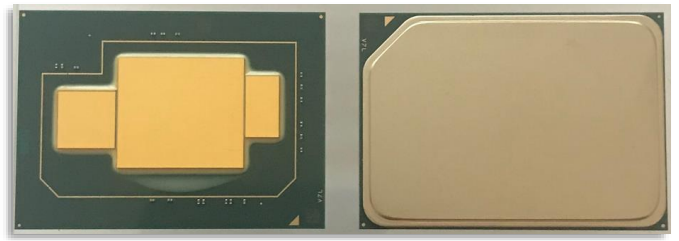
Through HI enabled SWAP savings, MCP-1 will deliver:

- ✓ Unprecedented spectral agility
- ✓ Enhanced signal processing
- ✓ Lower power consumption
- ✓ Improved thermal management

Notional HI MCP



SHIP-D functional parts have been delivered to lead DIB partner to prove SWAP benefits



MCP-1 consisting of two chiplets integrated with an FPGA

MCP-1 finished package

Heterogeneous Integration is the Path Forward

Many variations of HI exist; all are striving to increase interconnect and electronic module density to improve size, weight, power and performance.

- Silicon Interposer — imec
- Wafer Bonding — adeia
- Fan-Out Wafer Level Packaging — DECA

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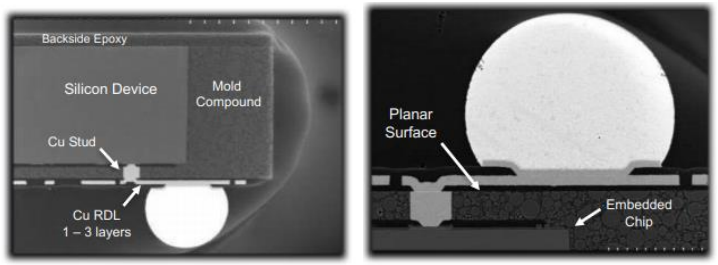
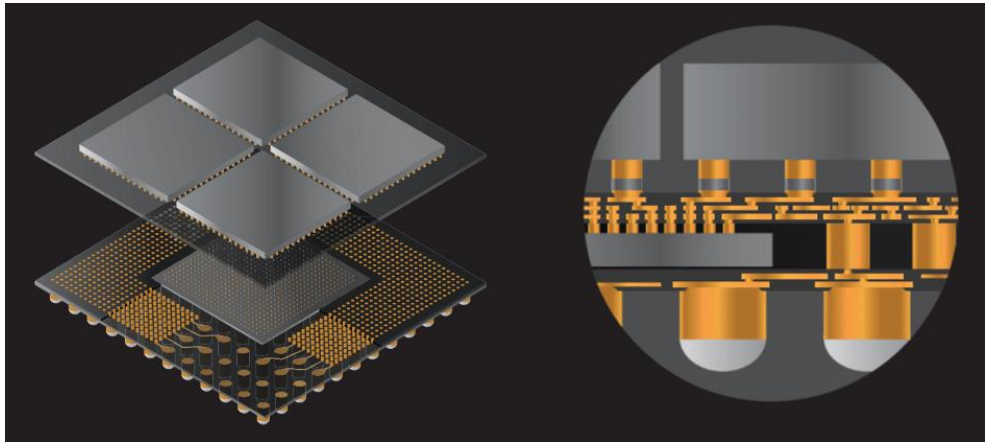
Fan-Out Wafer Level Packaging

DECA

$120M Cornerstone RESHAPE program award to establish Fan Out capability in the U.S. (eFOCUS) awarded to SkyWater/Osceola County

- Complete fab tool install with test vehicle build and characterization
- Deca Technology is SkyWater's FOWLP technology partner, under license agreement.





Deca FOWLP Technology Benefits:

- Highest volume FOWLP technology deployed today, with superior reliability and yield
- Supports multiple die integration in a single package
- Gen 2 capabilities will incorporate additional RDL layers, smaller RDL line/space dimensions, and 20um I/O pitch die
- Supports multiple package architectures and applications

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Successful Collaboration will ensure US Semiconductor Leadership for Years to Come

Revitalize Domestic Manufacturing

Develop the Workforce

Strengthen Partnerships

Accelerate Technologies of the Future


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