Be Part of the Solution: The NSF Convergence Accelerator

USDA ARS Workshop
"Identifying and Prioritizing Research and Programmatic Needs in the Detection, Mitigating, and Remediating PFAS in Agriculture and Food Systems "
September 2024

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Program Director
Technology, Innovation, and Partnerships (TIP) Directorate
National Science Foundation

A Pivotal Moment for the Nation

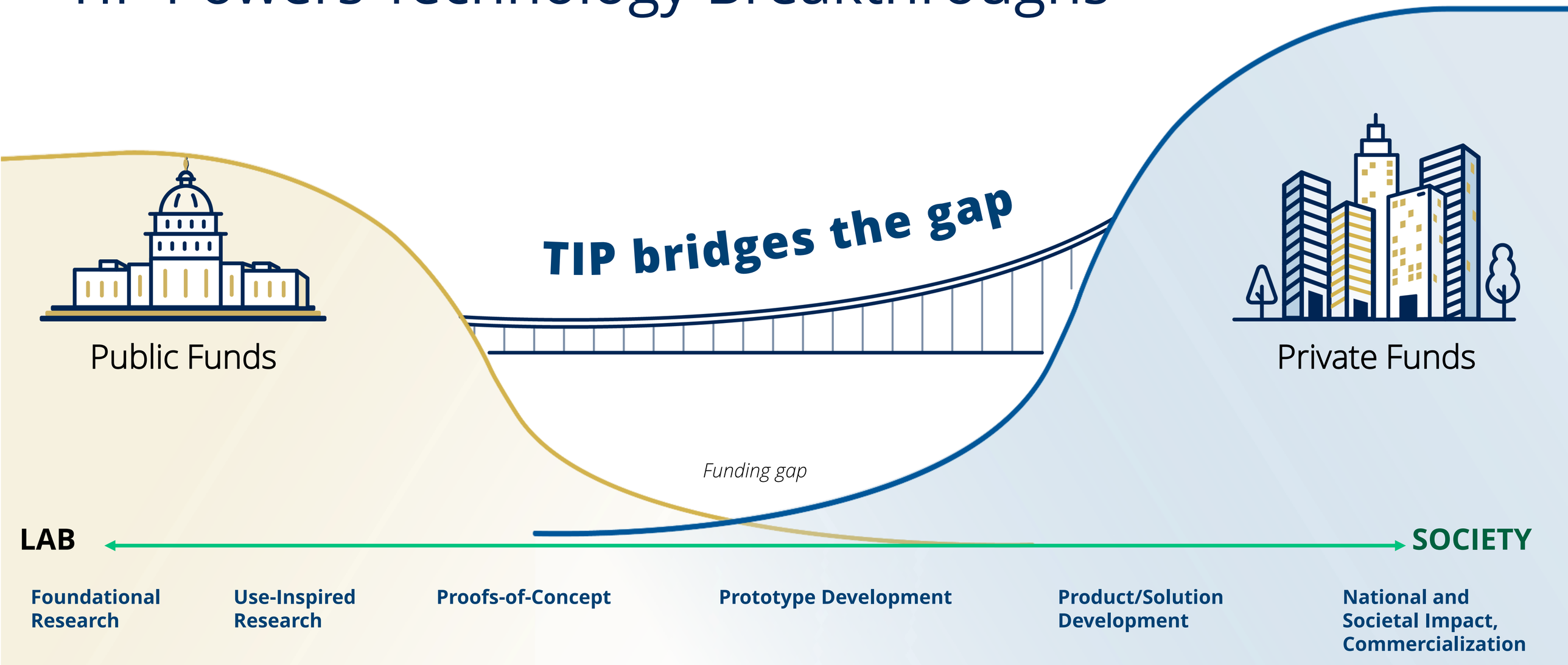
Climate change

Equitable access to education, health care

Critical and resilient infrastructure

A New “Horizontal”: Strengthen, Scale Use-Inspired and Translational Research

TIP Powers Technology Breakthroughs



TIP Programs

- America’s Seed Fund powered by NSF (SBIR/STTR)
- Innovation Corps (I-Corps™)
- Pathways to Enable Open-Source Ecosystems (POSE)
- **Convergence Accelerator**
- Regional Innovation Engines (NSF Engines)
- Partnerships for Innovation (PFI)
- Activate Entrepreneurial Fellows
- ExLENT (Experiential Learning)

NSF Convergence Accelerator funds transdisciplinary teams through convergence research and innovation processes to stimulate innovative idea sharing and development of sustainable solutions to solve societal challenges.

IDEATION (DCL/RFI, WORKSHOPS):

Selected by gathering input from the community. Identified topics must meet a societal need at scale, be built upon foundational research, and be suitable for a multidisciplinary, convergence research approach.

PHASE I (PLANNING)

9 months
Up to **$750,000**

PHASE II (IMPLEMENTATION)

24 months
Up to **$5 Million**

Opportunity available to:

- Academia
- Business & Industry
- Governments
- Nonprofits

NSF Convergence Accelerator Portfolio

Track A

Open
Knowledge Networks

Track B

AI and the Future
of Work

Track C

Quantum
Technology

Track D

AI-Innovation
Data Sharing & Modeling

Track E

Networked
Blue Economy

Track F

Trust & Authenticity in
Communication Systems

2019 COHORT
Complete

2020 COHORT
Phase 2

2021 COHORT
Phase 2

Track G

Securely Operating
Through 5G
Infrastructure

Track H

Enhancing
Opportunities for
Persons with
Disabilities

Track I

Sustainable Materials
for Global Challenges

Track J

Food & Nutrition
Security

Track K

Equitable Water
Solutions

Track L

Real-World Chemical
Sensing Applications

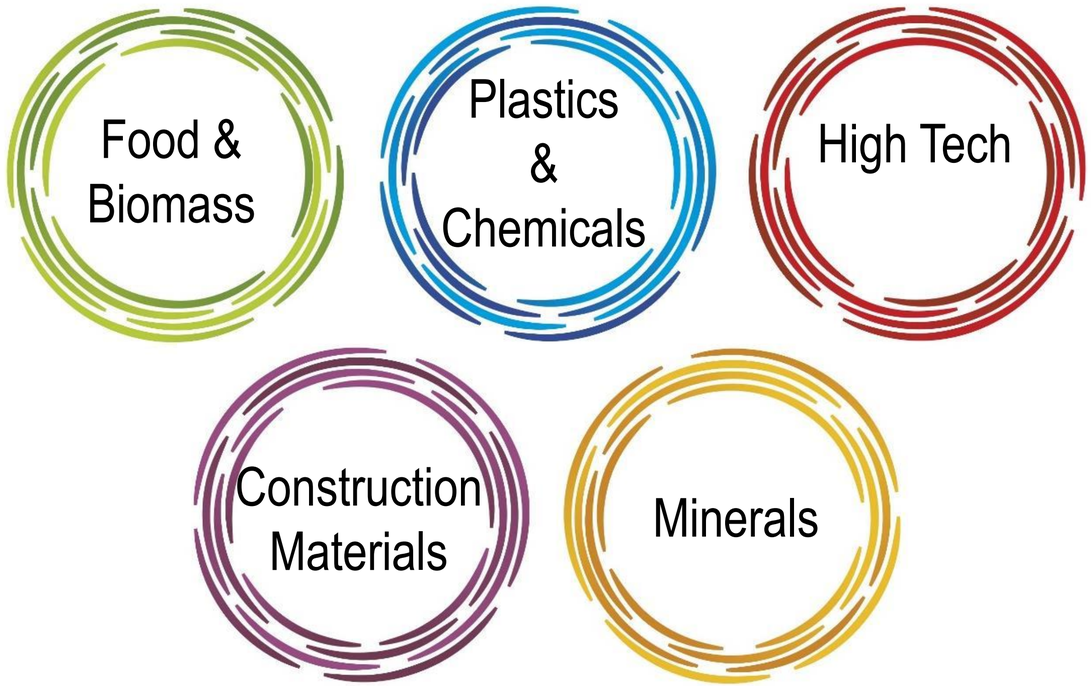
Track M

Bio-Inspired Design
Innovations

2022 COHORT
Phase 1

2023 COHORT
Phase 1

Our systems are half-built…



Keeping atoms and molecules inside the economy, producing value

Why is this topic so important?

- https://www.nationalgeographic.com/environment/article/human-made-materials-now-equal-weight-of-all-life-on-earth, December 9, 2020.
- Elhacham, E., Ben-Uri, L., Grozovski, J. *et al.* Global human-made mass exceeds all living biomass. *Nature* **588**, 442–444 (2020). https://doi.org/10.1038/s41586-020-3010-5

- The fundamental links between climate change and marine plastic pollution – ScienceDirect, Ford et al. Science of the Total Environment, Volume 806, Part 1, 1 February 2022, 150392, "The fundamental links between climate change and marine plastic pollution."

Why is this topic so important NOW?

Nairobi, 02 March 2022 – Heads of State, Ministers of environment and other representatives from UN Member States endorsed a historic resolution at the UN Environment Assembly (UNEA-5) today in Nairobi to End Plastic Pollution and forge an international legally binding agreement by 2024. The resolution addresses the full lifecycle of plastic, including its production, design and disposal.

NSF's Convergence Accelerator

TRACK I: Sustainable Materials for Global Challenges, NSF 22-583

This track will converge advances in fundamental materials science with materials design and manufacturing methods with the goal to couple their end-use and full life-cycle considerations for environmentally and economically sustainable materials and products that address global challenges.

- ✓ Current production and use of materials is not sustainable for human or planet health
- ✓ Urgent need for circular economy principles, standards, tools, and metrics across all levels of the supply chain
- ✓ Urgent need to educate and train current and future generations of scientists and engineers on circular design

Reimagine and transform how we design across all levels – from molecules to materials products, and to the built environment and envision the end-of-life and/or re-use from the cradle to the grave using systems tools to guide the design.

Potential for positive societal impact by mitigating and preventing climate change due to materials production in areas of highest unmet need (e.g., health, energy, transportation, infrastructure, technology).

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NSF Convergence Accelerator

Part of an Integrated Approach to Achieving a Circular Economy that Encourages both Economic Development and Environmental Protection and Justice

NSF ADVANCES THE CIRCULAR ECONOMY

Creating sustainable materials and products critical to our future.

- $12.25 million investment
- 17 Phase 1 convergent teams
- Australia's CSIRO has partnered with NSF and is funding Australian researchers on two U.S. projects

https://beta.nsf.gov/news/nsf-advances-sustainable-materials-solutions

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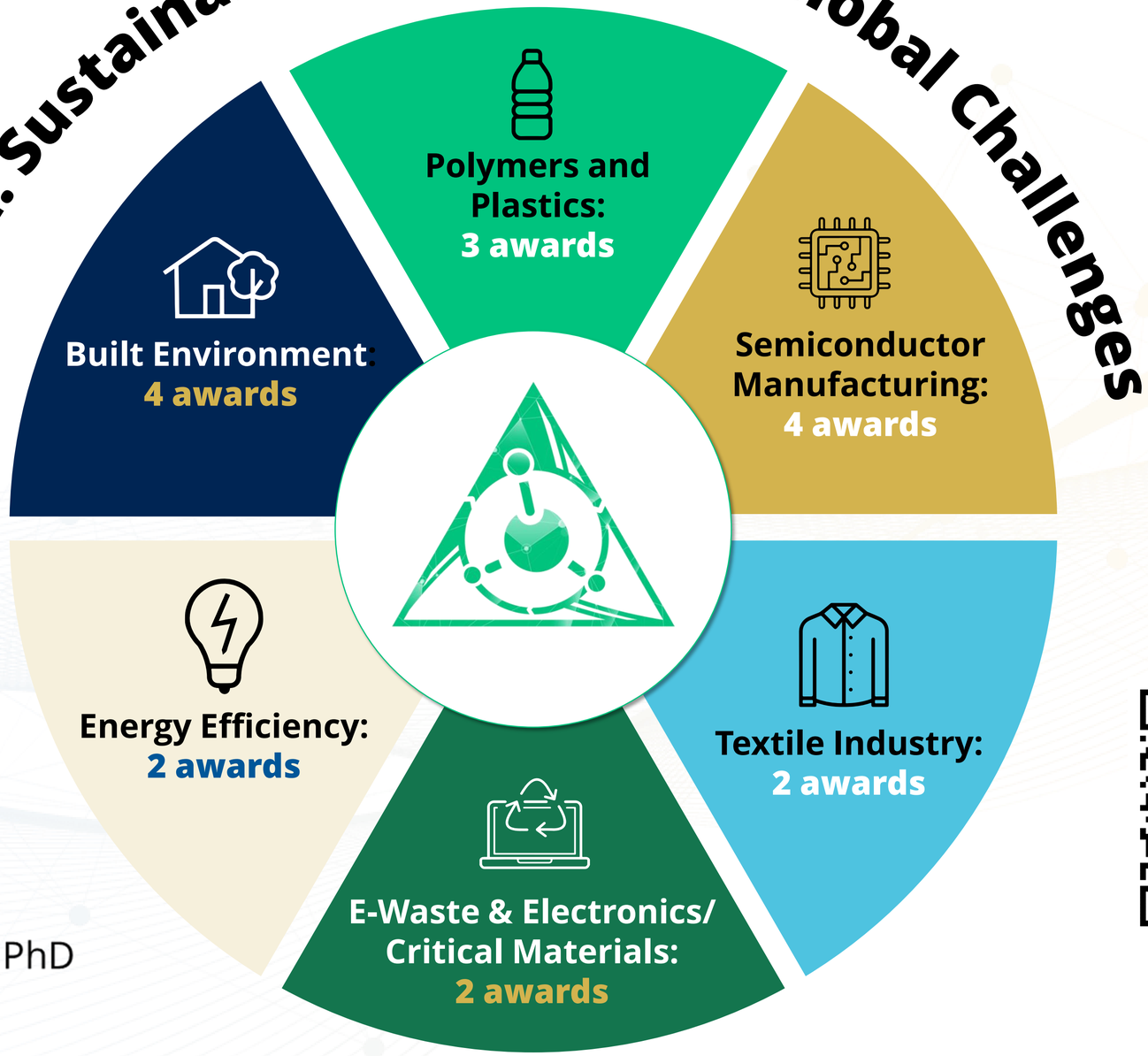
Track I: Sustainable Materials for Global Challenges



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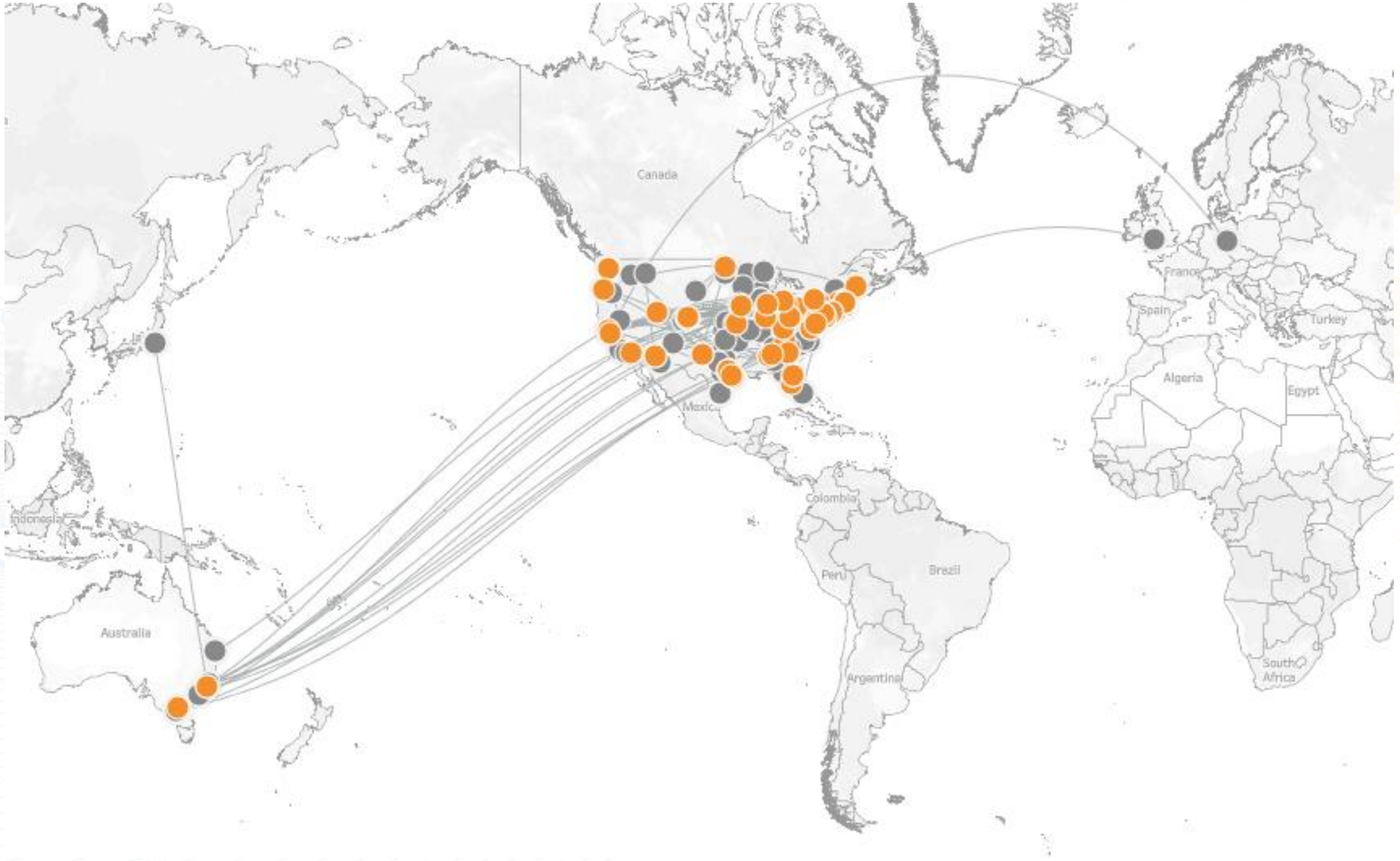
Track I Phase 1 Awards



2022 Cohort, Track I: Sustainable Materials for Global Challenges – Phase 2 Teams

FUTUR-IC	pfacts	ReCreateIt
Led by Massachusetts Institute of Technology	Led by IBM Corporation's Almaden Research Center	Led by re:3D Inc.
SOLAR	SPHERICITY	Topological electric
Led by Battelle Memorial Institute	Led by University of Georgia	Led by Massachusetts Institute of Technology

The Microchip Manufacturing Conundrum

Microchips enable modern life

> 1 trillion
semiconductor chips sold in 2023

70%
Demand from 2021-2030 is up for Computers, Communications, Networks

3 million
Workforce by 2030 growing it from 2 million today

Microchips pollute our environment

150 PWh
Electricity consumed in 2021

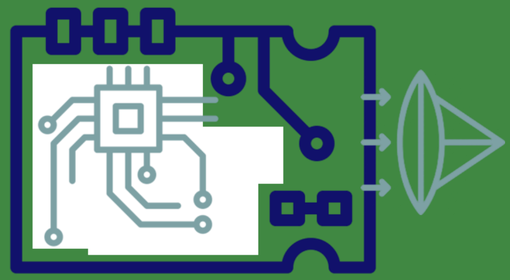
800 million
cubic meters of Water consumed in 2021

500 Megatonnes
CO2-eq lifetime emissions in 2021

How to increase production and efficiency? & **How to improve environmental performance?**

FUTUR-IC: Alliance to make the Semiconductor Supply Chain Sustainable by co-optimizing across Technology, Ecology, and Workforce

Technology



Repairable Technology Demonstrator

Ecology

Life Cycle Analysis

Workforce

Educate using Green Innovation Tool Kit

FUTUR-IC

NSF Convergence Accelerator Track I: Award Number ITE-2236093 and Award Number ITE-2345076

FUTUR-IC deep dive: Technology Advance Within Sustainability Constraints

Technology:

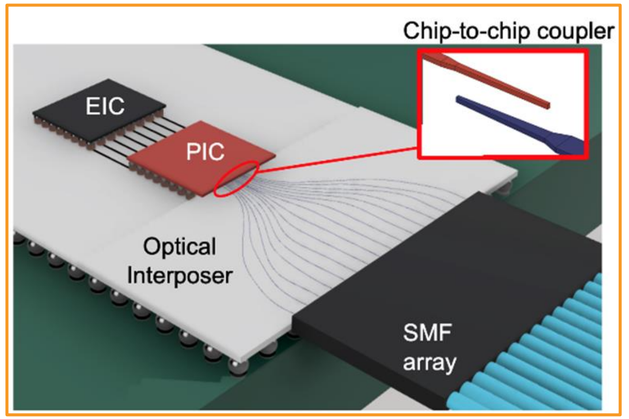
High performance with low energy consumption

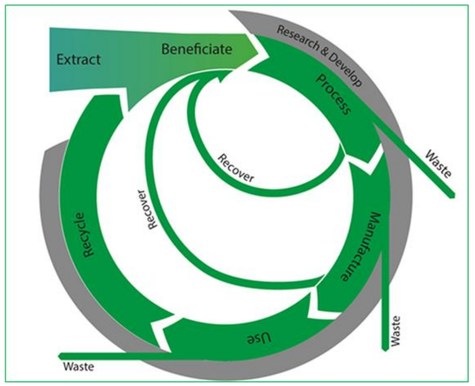
More chiplets/ package and pluggability:

Modular Electronic-Photonic Packaging with Design for Upgrade and Repair

PFAS remediation

Performance metric: BW/Energy density/Cost & Benign/Toxic chemical use





Ecology:

LCA – Circularity

E-waste (Re-use)

Critical Materials

Energy

Water

GHGs

Performance Metric: Footprint and Handprint

Workforce:

Green literacy STEM- and semiconductor skilling for technology scaling;

Sustainability awareness

Performance Metric: Number of microchip green literate workers/year

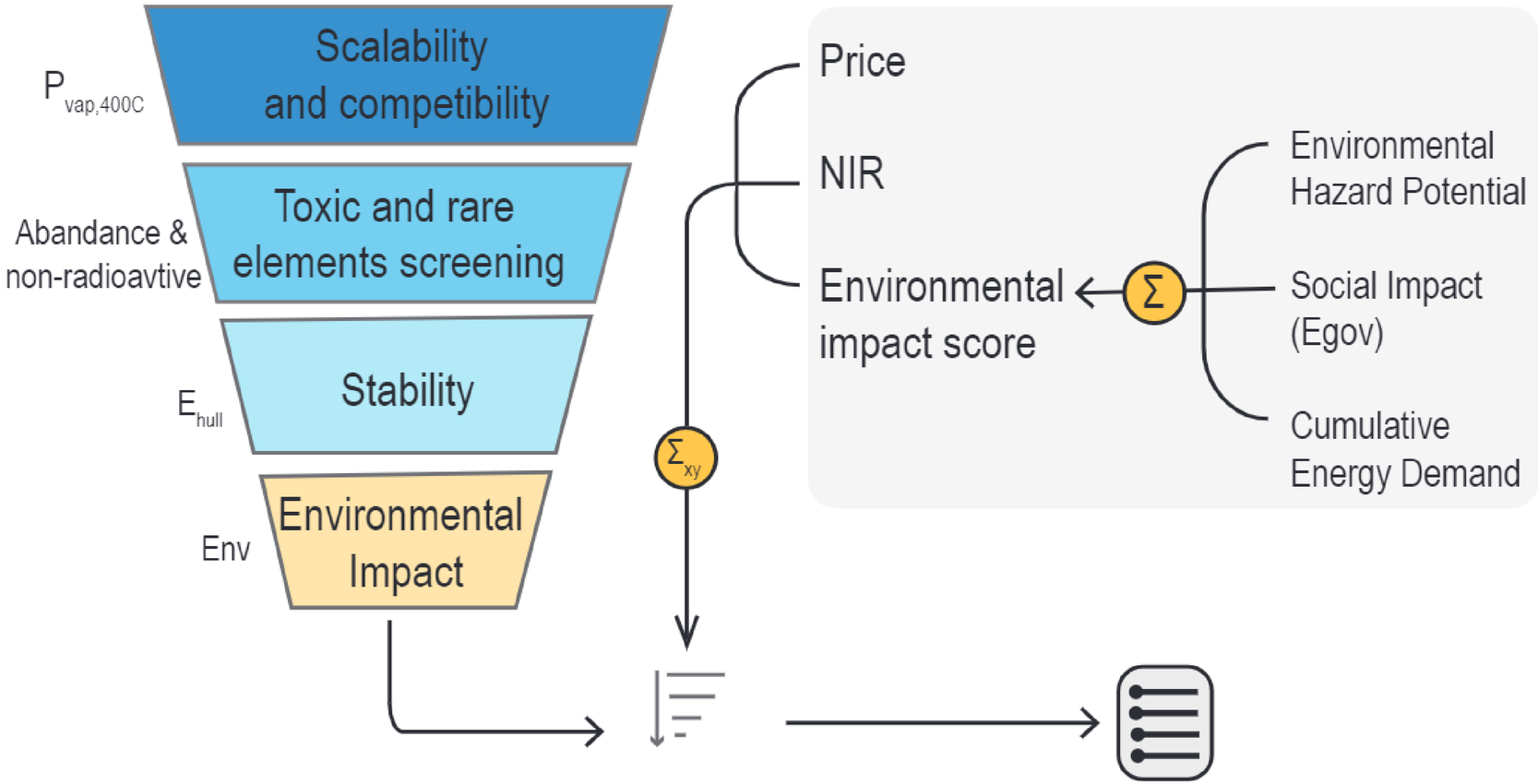
Handprint is a measure of what we can do individually, and together, to restore the balance between consumption and the planet's carrying capacity

- **FUTUR-IC is an alliance that offers (i) inter-disciplinary expertise for innovative and interconnected solutions co-optimized in TEW [Technology (T), Ecology (E), & Workforce (W)], and (ii) a neutral ground for meeting, learning, and roadmapping;**

Importance of sustainability aspects for future functional and quantum materials

PI: Mingda Li, MIT
NSF Award #2345084

- Hierarchical down-selection for 20,000 topological materials
- Scoring at the end including the price, net import resilience (NIR), and environmental impact (ENV)



arXiv:2308.09526, "**Sustainability-Driven Exploration of Topological Materials**"

PFACTS

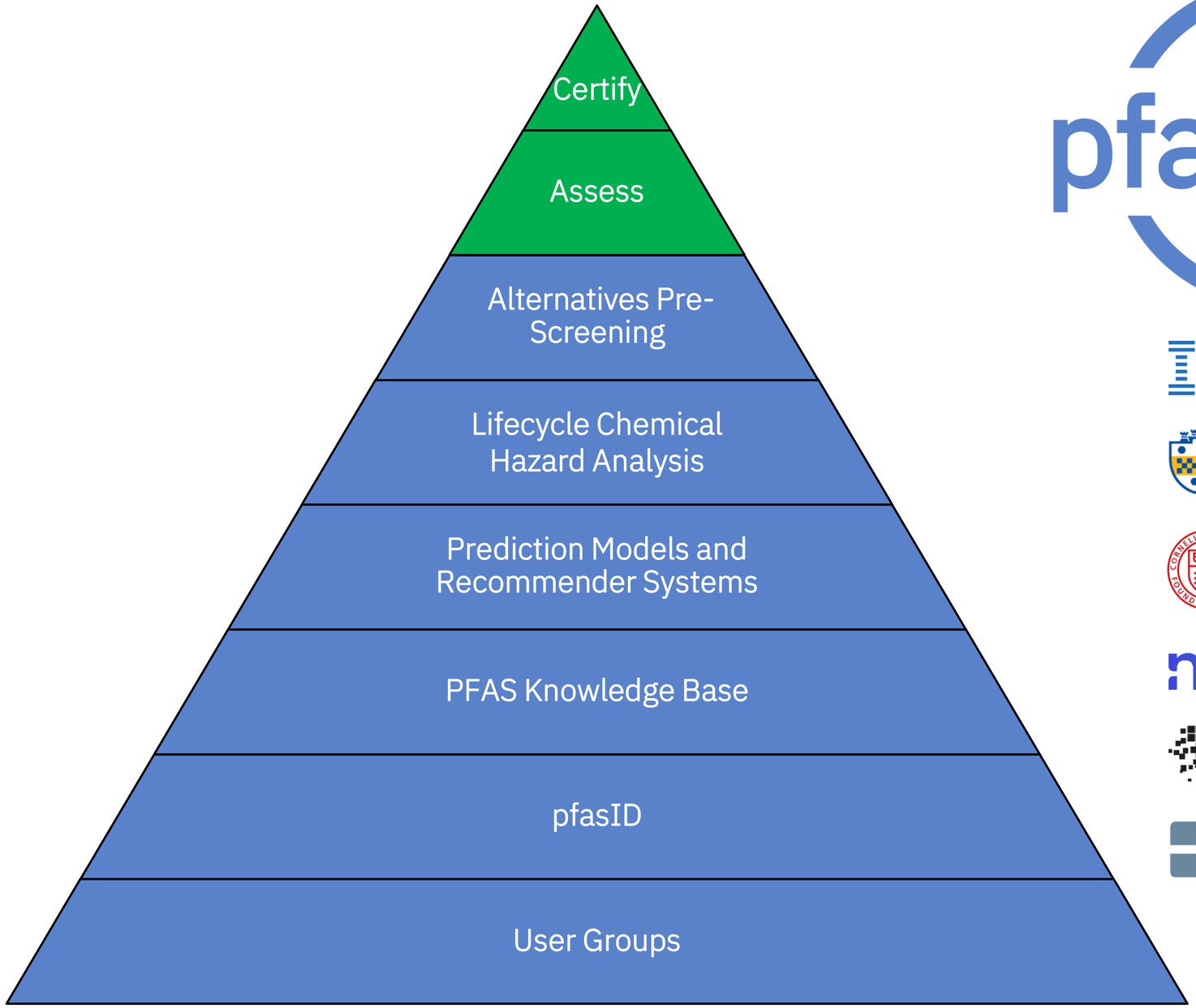
Faster Solutions for Forever Chemicals

Award 49100424C0005

Identifying PFAS & Assessing Lifecycle Chemical Hazards
AI models for hazard and transformation prediction

Avoiding Regrettable Substitutions
AI-assisted alternatives pre-screening

Preventing Release into the Environment
Capture material recommenders



NSF Convergence Accelerator

Non-funded Collaborators: SIA PFAS Consortium, SEMI, Apple, Google, HP, Sonos, Assoc. for the Adv. of Alternatives Assessment (A4)

NSF Convergence Accelerator

Track K: Equitable Water Solutions

This track will converge foundational knowledge and advancements in environmental sciences, geosciences, engineering, computing, social and behavioral sciences, as well as other disciplines to develop solutions for water quality, quantity, and equity issues.

- ✓ Fresh water is critical for future ecosystems, human health, and national security thereby enabling thriving communities.
- ✓ While water needs are ubiquitous, there is not a one-size-fits-all approach.
- ✓ Over 90% of natural disasters and climate impacts are water related (Source: UN Environment Programme).

Real-world solutions are needed to address sustainable water supply systems and utilization of continual watershed planning for equitable access to safe water supplies. This includes a whole-of-society approach with direct community engagement and co-design for addressing water resilience.

NSF 23-590

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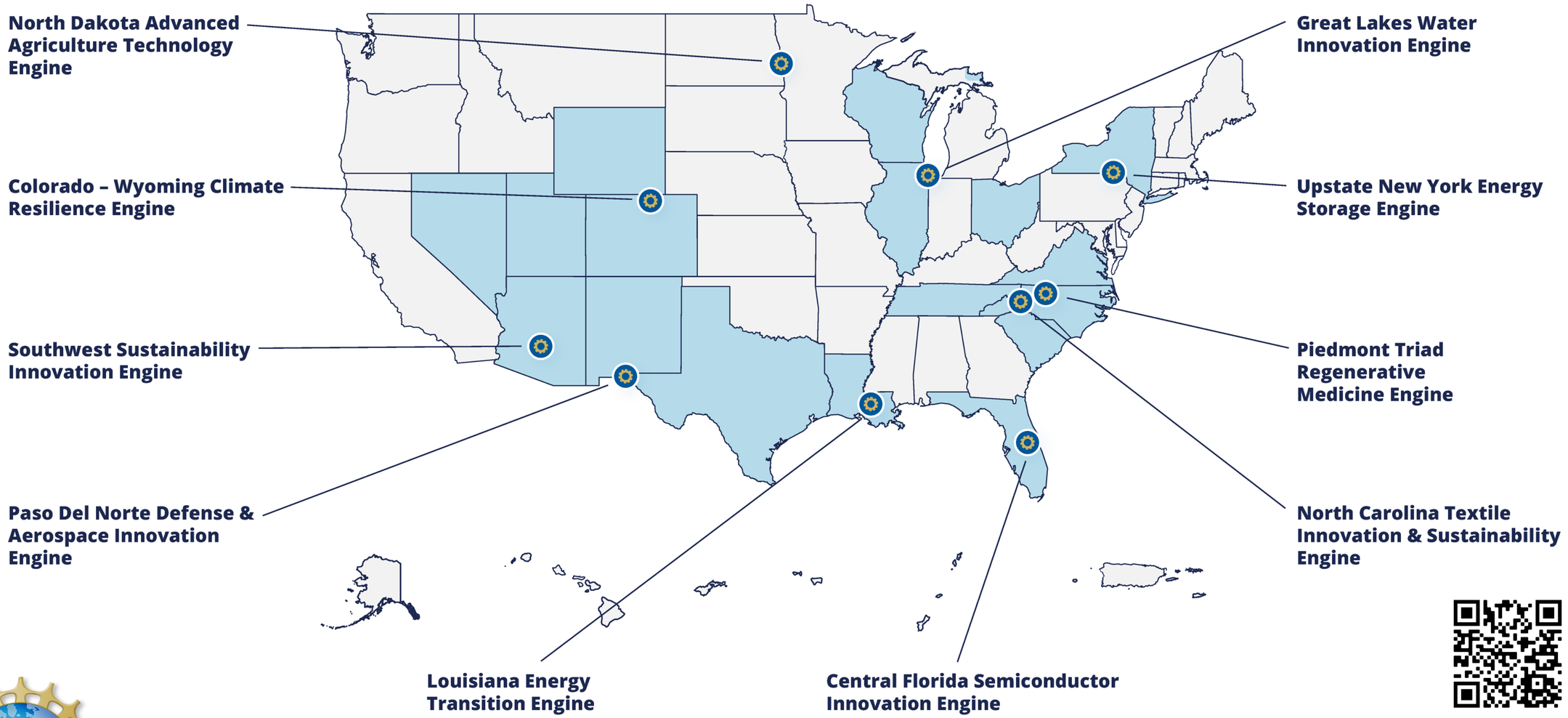
https://new.nsf.gov/news/nsf-invests-9-8m-advance-equitable-water-solutions

10 Inaugural NSF Engines



Synergistic Events Driving Circular Economy Adoption

December 8, 2021, EO 14057, Greening Government Initiative, https://www.sustainability.gov/ggi/, EO 14008.

Nairobi, 02 March 2022 –historic resolution at the UN Environment Assembly (UNEA-5) in to End Plastic Pollution and forge an international legally binding agreement by 2024.

October 2022 US-EU JCG - Circular Economy topic added to agenda; included in March 2024

November 2022 US Net Zero Game Changers Group – https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/04/fact-sheet-biden-harris-administration-makes-historic-investment-in-americas-national-labs-announces-net-zero-game-changers-initiative/, Industrial CE is top 5

December 19, 2022, Convergence Accelerator Circular Economy Track launched, https://new.nsf.gov/news/nsf-advances-sustainable-materials-solutions

January 2023, https://www.whitehouse.gov/ostp/news-updates/2023/01/19/fact-sheet-biden-harris-administration-releases-national-strategy-to-put-nature-on-the-nations-balance-sheet/

April 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/21/fact-sheet-president-biden-signs-executive-order-to-revitalize-our-nations-commitment-to-environmental-justice-for-all/

Synergistic Events Driving Sustainable Semiconductor Development

2021: S3 – The Startups for Sustainable Semiconductors Initiative

November 2022 - SEMI Climate Consortium (SCC)

December 20, 2022, Announcement by 3M to phase out PFAS manufacturing by 2025

June 22, 2023, "3M reaches $10.3 billion settlement over contamination of water systems with "forever chemicals," AP news.

April 2024, EPA issued first-sever national, legally enforceable drinking water standard to protect communities from harmful PFAS.

EU – regulation for over ten years under the EU's Persistent Organic Pollutants (POPs) Regulation

February 2024, SEMI International Policy Summit (SIPS), Brussels

April 18, 2024, AI/AE for Sustainable Materials Innovation - Rroundtable by the White House Office of Science and Technology Policy (OSTP

June 13, 2024. White House Conference on AI Aspirations for Public Missions – topic on Sustainable Materials

May 2024 – "Building Critical International Partnerships for US Leadership in the Global Transition to a Circular Economy (CE): An Embassy Science Fellow for Embassy Dublin, Berlin, the Hague, Brussels, and Helsinki"


GORDON RESEARCH CONFERENCE
New England College (1)
ENVIRONMENTALLY BENIGN ORGANIC SYNTHESIS
Paul T. Anastas, chairperson
Stephen Devito, vice-chairperson
July 21-26, 1996
Achber Studio, Laconia, NH