Research Community for Nanotechnology Convergence

Current Leadership/Key Participants

Jacob Jones
NC State

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Maude Cuchiara
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Phillip Strader
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Elaine Hubal
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Khara Grieger
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NC State

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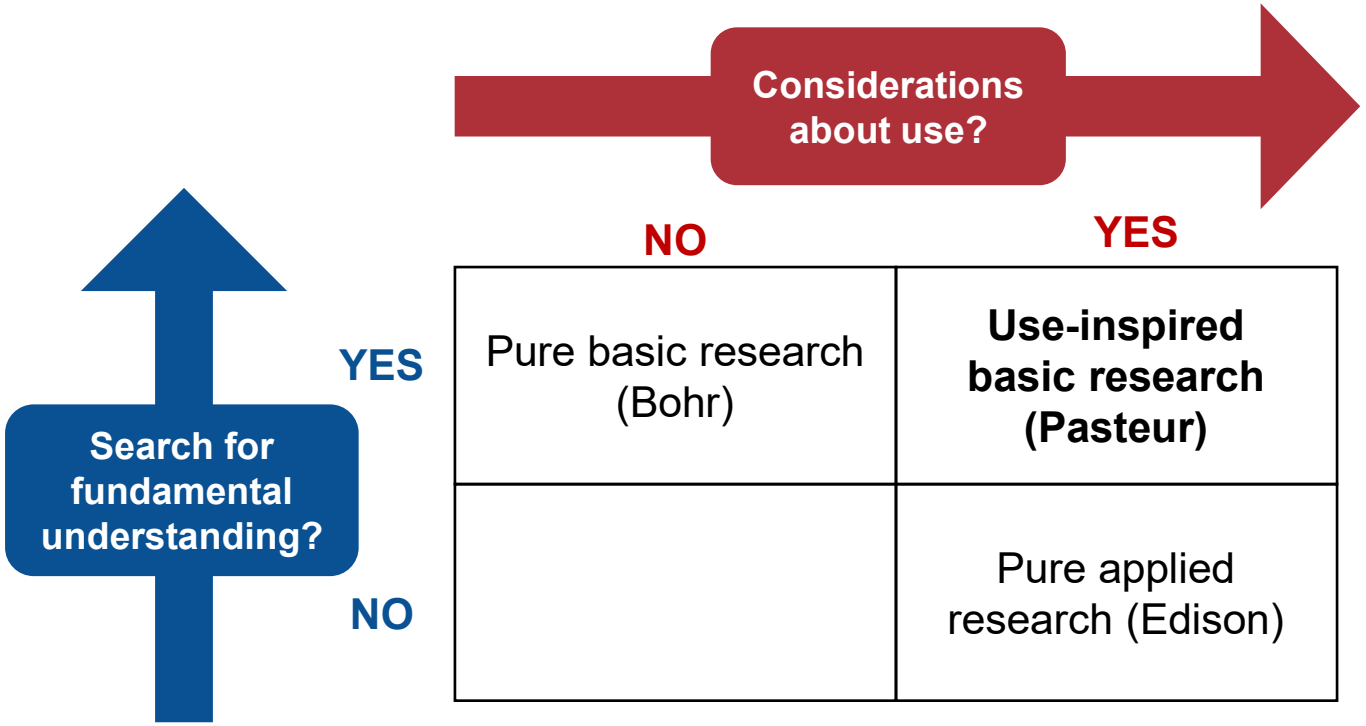
Nanotechnology for What?



Research done within these different quadrants may involve **significantly different reward systems, incentives, and impact metrics**.

Stokes classification of scientific research

NSF view of convergence research aligns with Pasteur's quadrant:

1. **Research Driven by a Specific and Compelling Problem**
2. **Deep Integration Across Disciplines**

Examples: Micro- and nanoplastics in the environment, work beyond mass production, and phosphorus and nitrogen pollution in water resources

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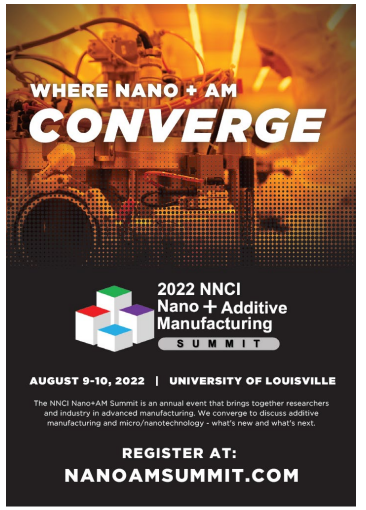
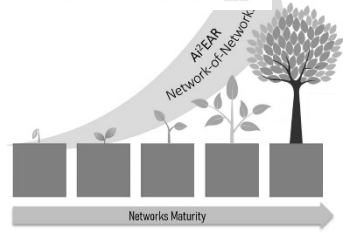
Nanotechnology facilities of the future will play central roles in tackling important **USE-INSPIRED RESEARCH FOR GLOBAL CHALLENGES** and, in many cases, **shared facilities may require MAJOR ADAPTATION to facilitate convergence**

The **GOAL** is to bring together researchers and staff from diverse disciplines and perspectives, facilitate their collaboration, and work toward shared outputs and outcomes

The topic is **DYNAMIC** and introduces a new convergence research area annually:

2021: Convergence in Nanotechnology for Food and Nutrition Security
2022: Convergence in Nanotechnology and Additive Manufacturing
2023: Critical Nanotechnology Opportunities for Addressing Climate Change





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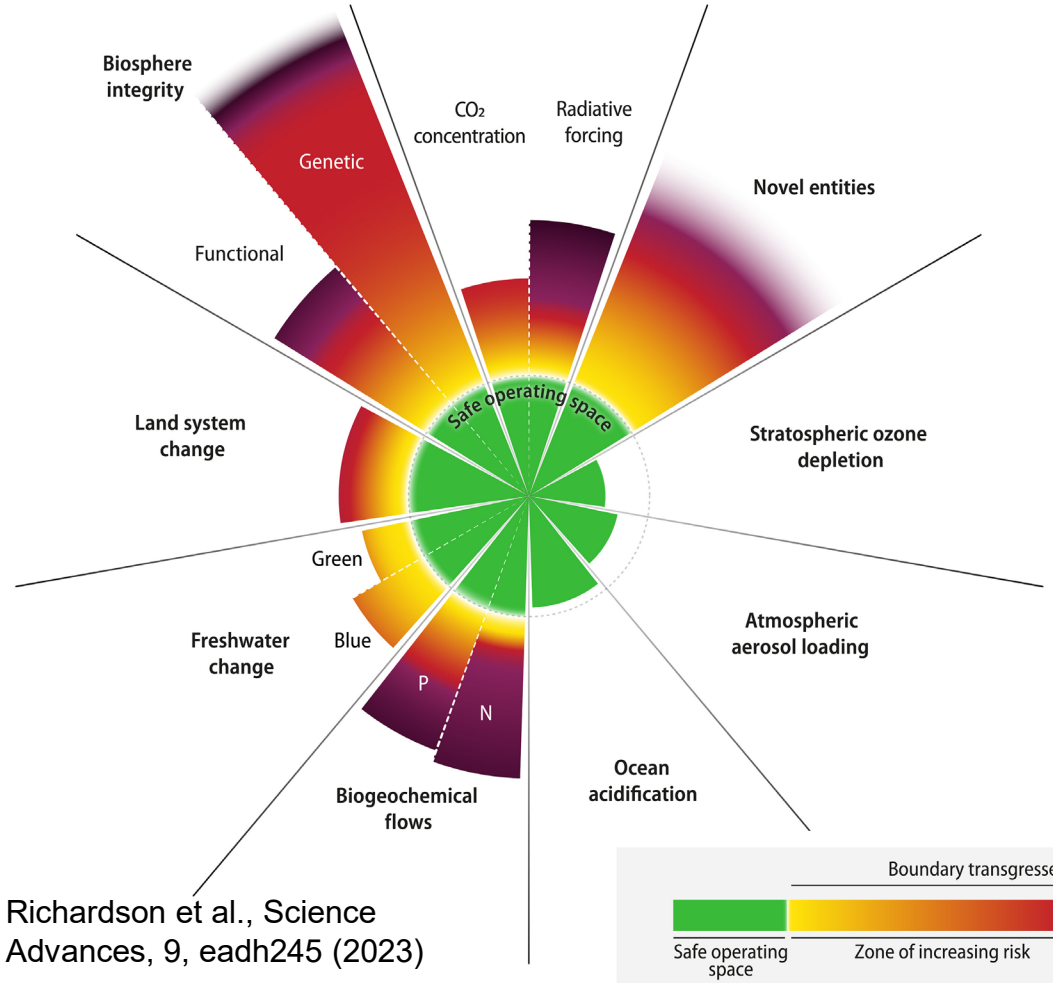
Earth is beyond six of nine planetary boundaries, well outside of safe operating space for humanity.



Richardson et al., Science Advances, 9, eadh245 (2023)

It's not enough to act. We must act ***now***.

We must choose ***sustainability*** over instant gratification.

We must wisely intentionally balance ***time and resources*** across:

i) short-term vs. long-term priorities/needs, and

ii) mitigation vs. resilience/adaptation strategies

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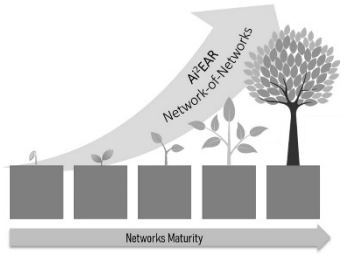
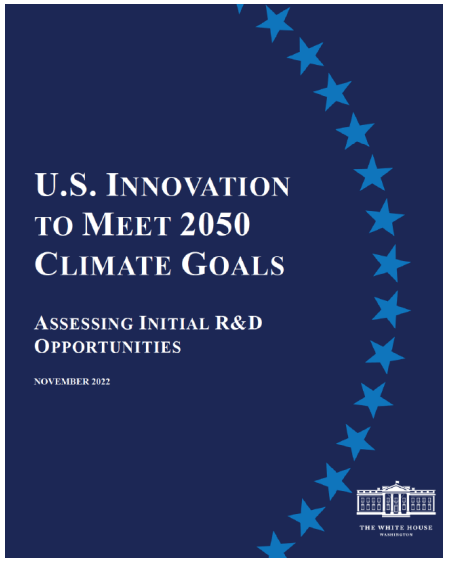
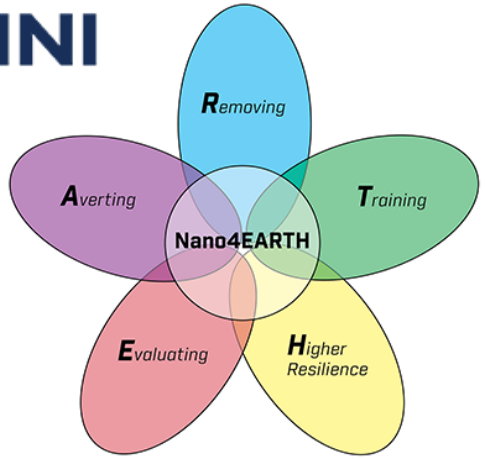


Collective Action in the U.S. Recently Accelerated



"U.S. Innovation to Meet 2050 Climate Goals describes 37 game-changing R&D opportunities… for near-term wins, investments in underserved communities…, and long-term transformation of the energy system."

NNI

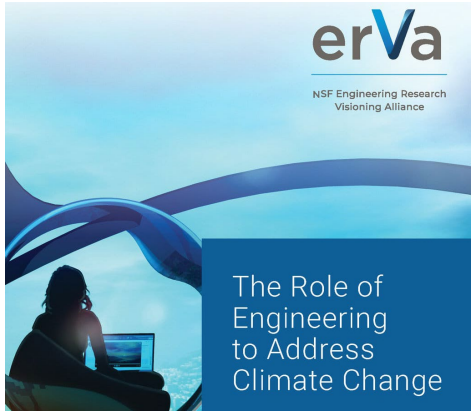


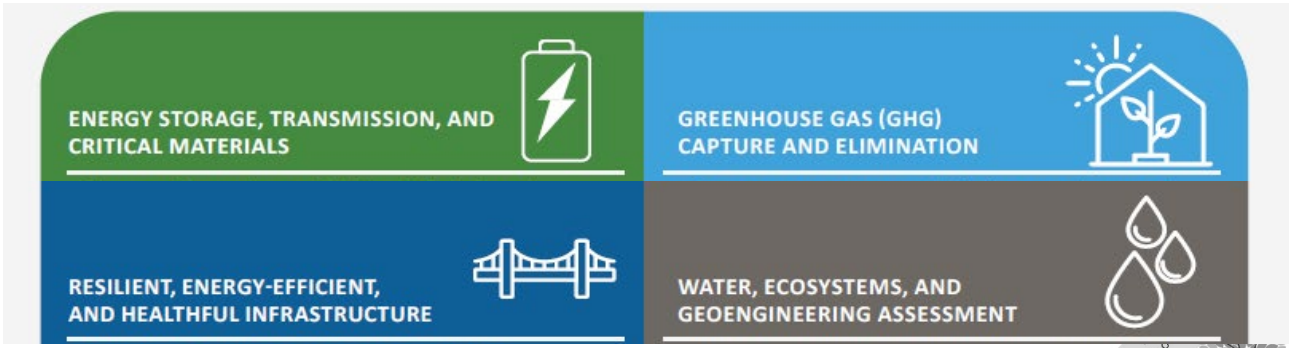
Nano4EARTH is a "National Nanotechnology Challenge to develop technologies and industries that advance the… Administration's commitment to tackling the climate crisis" – White House OSTP (Jan. 26, 2023)

ENERGY earthshots
U.S. DEPARTMENT OF ENERGY

"The climate crisis calls for a different kind of moonshot."

"The goal of this event was to identify specific areas that are nascent or require additional exploration with the potential for the greatest return on investment."





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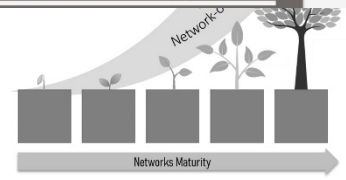
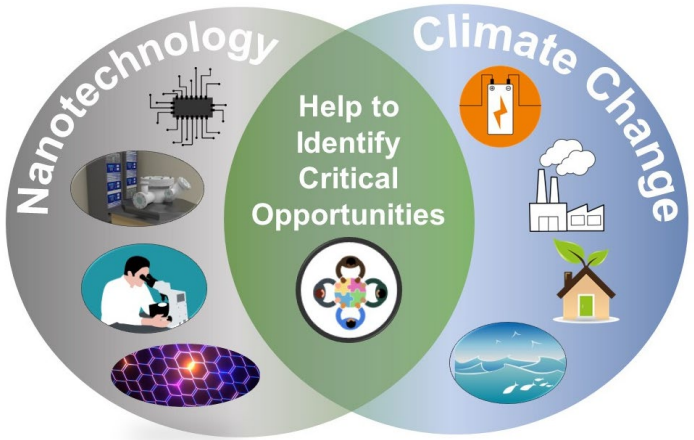


The Research Community's Virtual Event 2023



Goal: Seeking to identify, prioritize, and disseminate the:

1. Underpinning **nanotechnology basic science research areas** in both short-term and long-term,
2. Necessary characteristics of the **research process**, e.g. aspects of converging disciplines and stakeholders, and
3. Capabilities and expertise in **open-access nanotechnology research facilities**.

1:10 – 1:25 PM – **Review of NNI's Nano4Earth Kick-Off Workshop** by *Dr. Matthew Hull, Director, Nanoscale Characterization and Fabrication Laboratory (Virginia Tech)*

1:25 – 1:40 PM – **Introduction to the NSF Engineering Research Visioning Alliance (ERVA) Report, "The Role of Engineering to Address Climate Change"** by *Professor Khara Grieger, Ph.D., Environmental Health and Risk Assessment (NC State)*

1:45 – 2:30 PM – Breakout sessions with Guiding Questions

1. **Energy storage, transmission, and critical materials**
   Facilitator: Nina Balke; Notetaker: Jacob Jones
2. **Greenhouse gas capture and elimination**
   Facilitator: Mark Spitler; Notetaker: James Custer
3. **Resilient, energy-efficient, and healthful infrastructure**
   Facilitator: Nicky Cates; Notetaker: Phillip Strader
4. **Water, ecosystems, and geoengineering assessment**
   Facilitator: Taylor Moot; Notetaker: Maude Cuchiara

2:30 – 3:00 PM – **Report outs, closing, and call to action**

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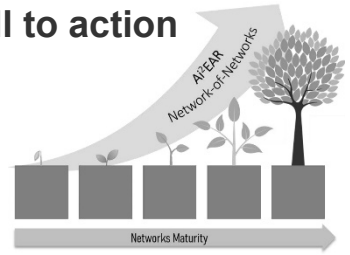
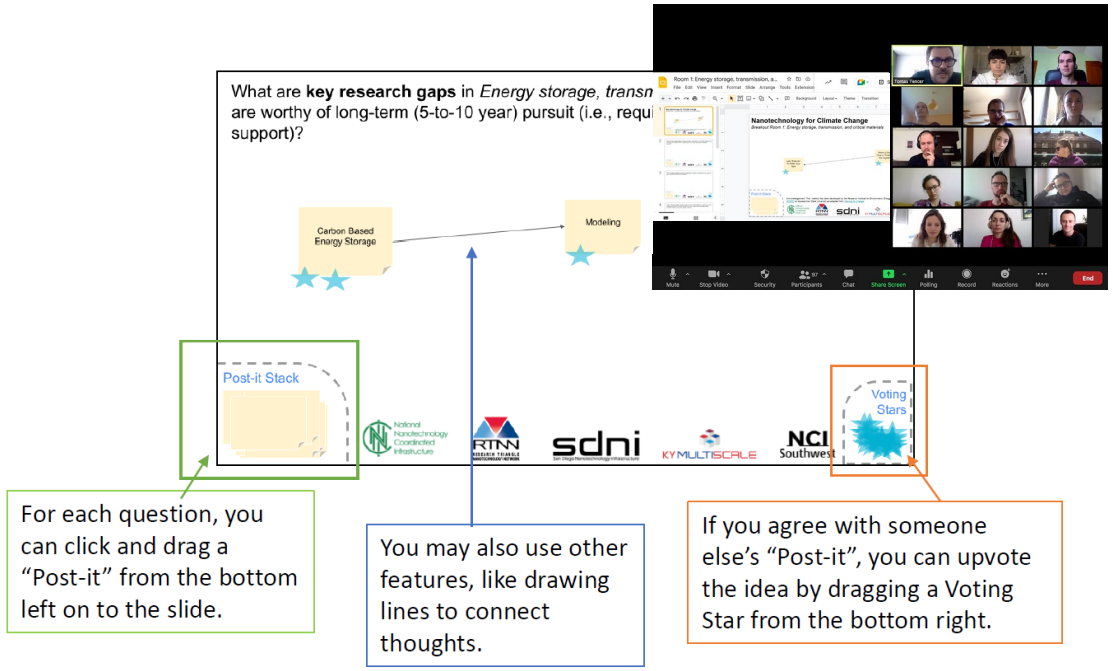


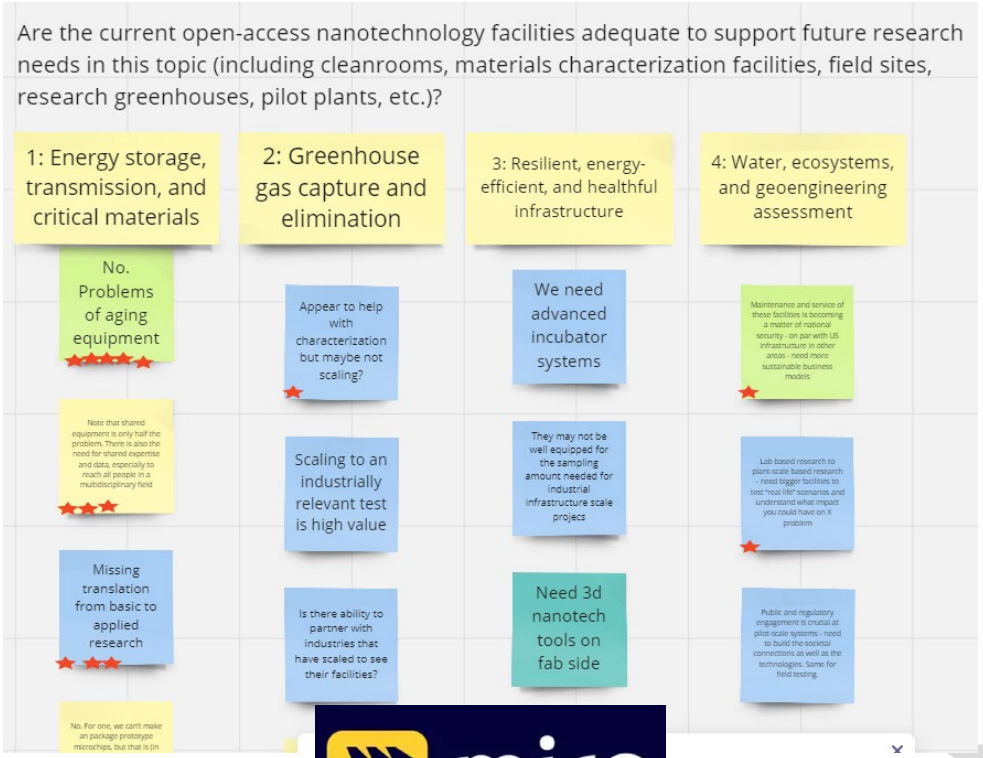
The Process

To promote engagement and efficiency:

- Seven guiding questions,
- Use of facilitators and notetakers
- Shared Google Slide document for each breakout room to lower the barriers for engagement and upvote individual ideas



To distill contributions across topics/rooms, the organizers then used "miro" to identify common and important observations and themes:



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Key Take-Aways; Manuscript in Development; Input Welcome

Systems

Systems-level thinking and approaches need to guide prioritization of research and solutions.

We need to better integrate techno-economics with human and ecological well-being, e.g. through environmental economics, cultural economics, or responsible innovation.

More early-stage sustainability assessment is needed early in the innovation/research stage to avoid unwanted or unintended effects on health, environment, and society, e.g. pre-emptive life cycle analysis (LCA), risk screening, and scalability analysis.

People

The immediacy of addressing climate change needs to be elevated in the research community and supported by stakeholder engagement in research.

Nanotechnology solutions need to be coupled with strategies to ensure inclusive and equitable societies, which will require inclusive stakeholder and community engagement.

We need to better integrate key stakeholders in the research process to prioritize short- vs. long-term needs and mitigation vs. resilience/adaptation strategies.

Infrastructure

The value proposition of existing nanotechnology infrastructure is not sufficiently clear to prospective users in the climate change solutions space – we need to continue promote awareness, democratize access to our facilities, provide seed funding, etc. *(Does NanoEarth offer a good model for supporting use-inspired basic research? Could Topical Networks do the same?)*

Infrastructure could significantly help in demonstrating the scaling of technologies from bench scale to the environmental scale.

We need more use-inspired educational and outreach activities at the intersection of nanotechnology and climate change.

(How could these be incentivized in future infrastructure programs?)

How could NNCI and NNCI-like programs be more responsive to the immediacy of the problem and the quickly changing landscape, e.g. through rapid response funding to study emergent ecosystem events?

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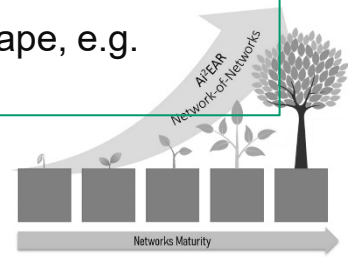

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