Findings from the Report: Sustainable Transportation Networks

ERVA Webinar | May 24, 2023

Presented by
Cathy Choi, ClearFlame and ERVA Standing Council

Erin Santini Bell, University of New Hampshire and ERVA Standing Council

info@ERVAcommunity.org

Disclaimer

The views and opinions, findings, interpretations, conclusions, or recommendations expressed today are those of participants and do not represent the views of the National Science Foundation, ERVA, or ERVA's core partners or their members (UIDP, EPSCoR, and the Big Ten Academic Alliance).
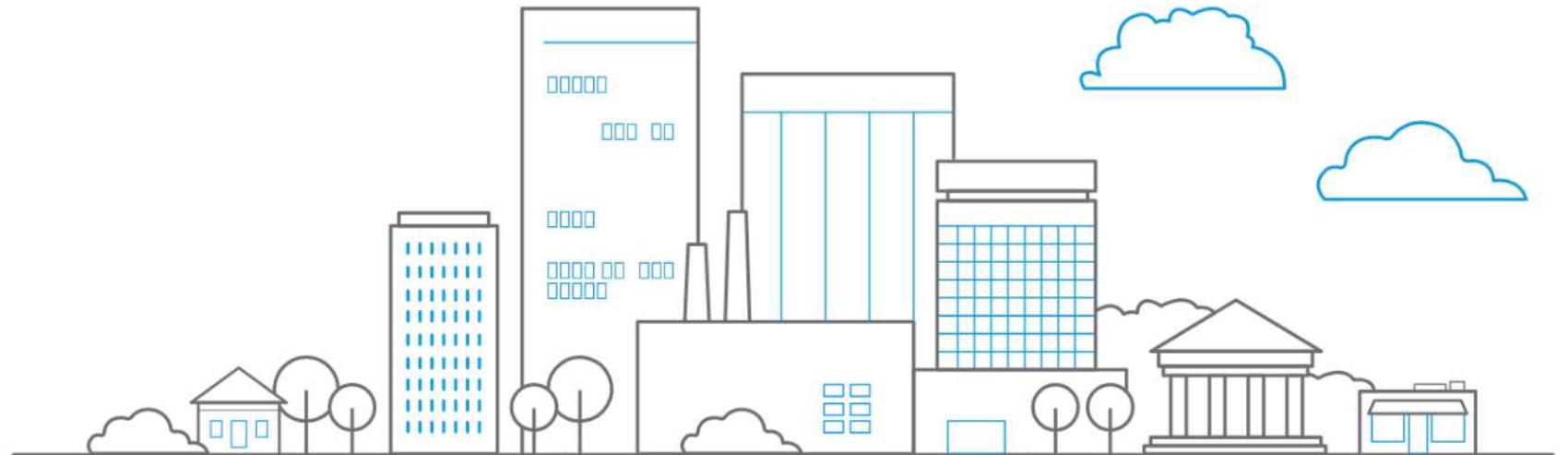
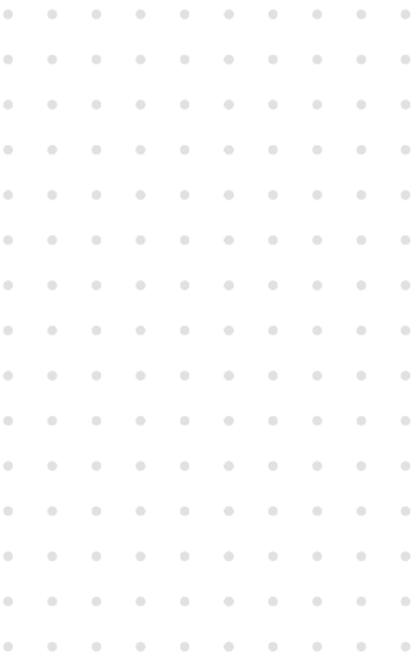erVa | NSF Engineering Research Visioning Alliance

ERVA Background

- Launched in April 2021

- 5-year cooperative agreement funded by NSF

- Awarding Organizations –
BTAA, EPSCoR/IDeA Foundation, UIDP

Mission

To identify and develop bold and transformative new engineering research directions and to catalyze the engineering community's pursuit of innovative, high-impact research that benefits society.

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Goals

Increase coordination among communities

Create process to identify future research priorities

Communicate on nascent opportunities
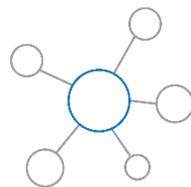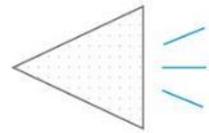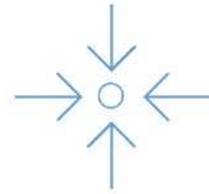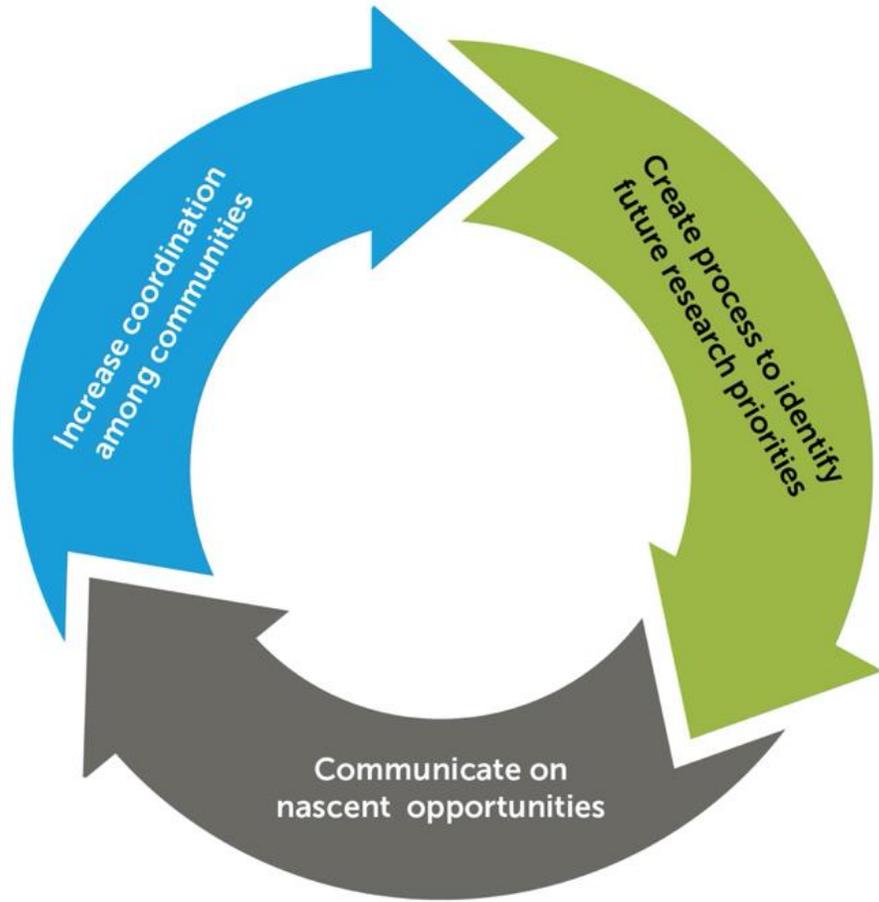
- Facilitate generation of engineering research visions
- Articulate high-impact future research visions
- Enable new opportunities

- Communicate research visions and nascent opportunities

- Synthesize ideas
- Cultivate relationships
- Engage new, diverse voices

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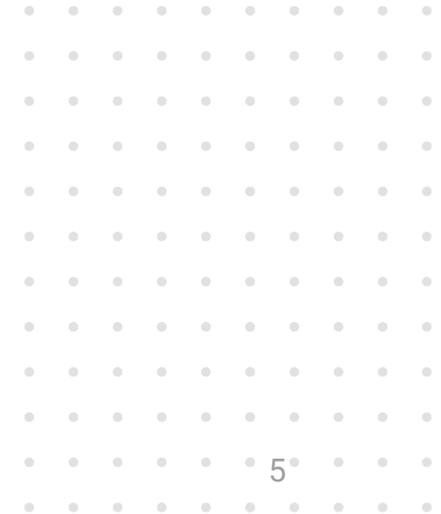
ERVA Distribution Represents all 50 States and the District of Columbia

Affiliate Partners

Deans/AD of engineering

National Laboratory

MSI

Champions

EPSCoR/IDeA FOUNDATION

B1G ACADEMIC ALLIANCE

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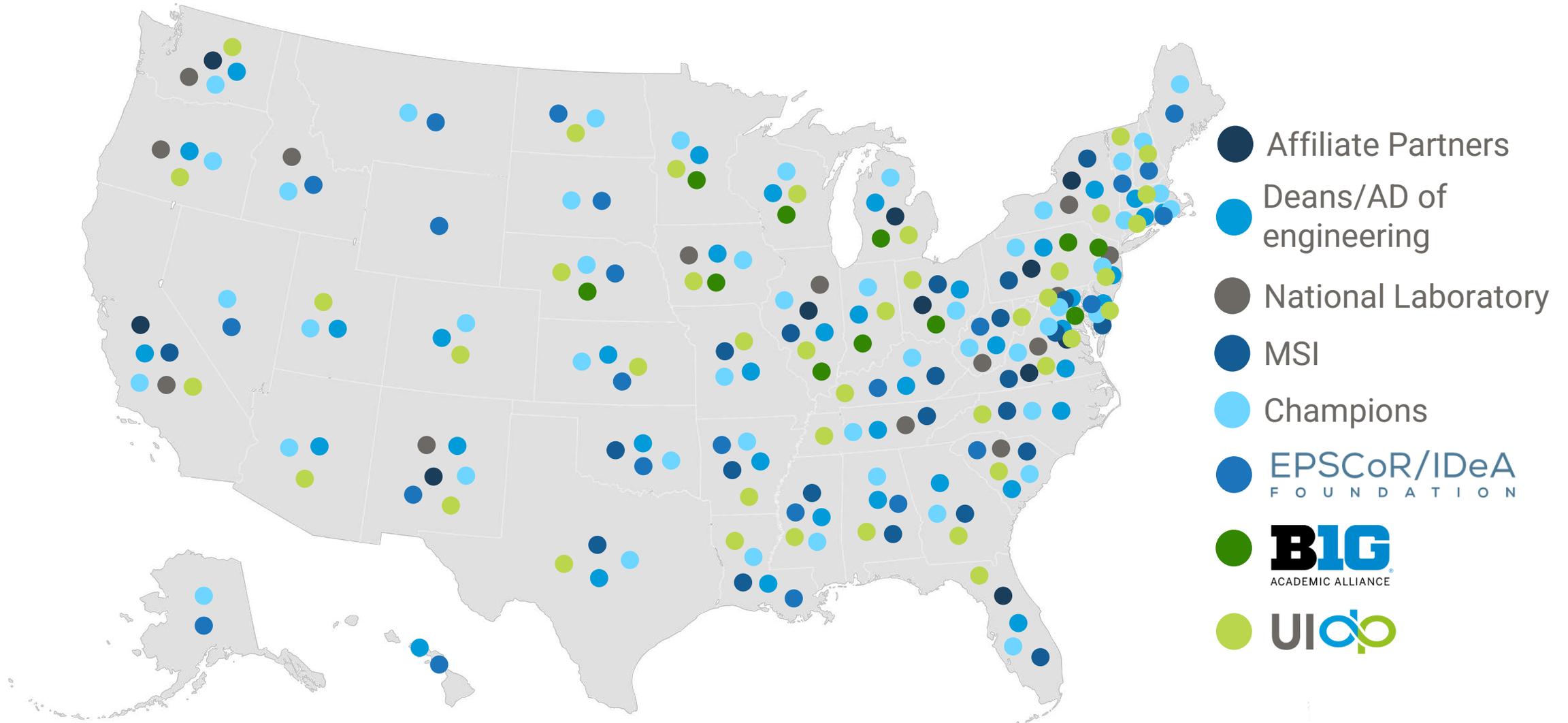
Visioning

Goal: identify specific areas that are nascent or require additional exploration with the potential for the greatest return on investment.

Attendees: cross-sector researchers who can help ERVA identify less-explored, basic, and use-inspired lines of research ripe for engineering community pursuit.

Format: expert, informed discussion and interactive thematic breakout sessions.

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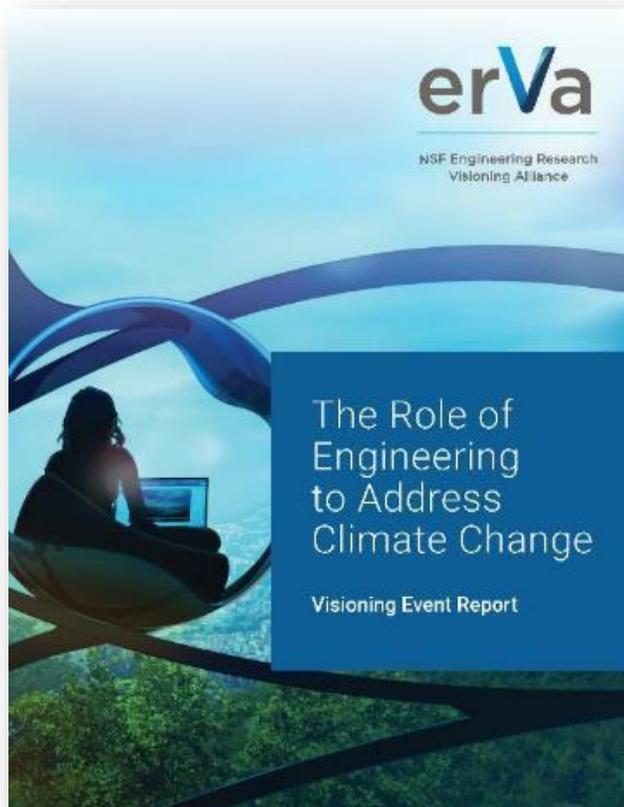
Visioning Reports

Released: August 17, 2022
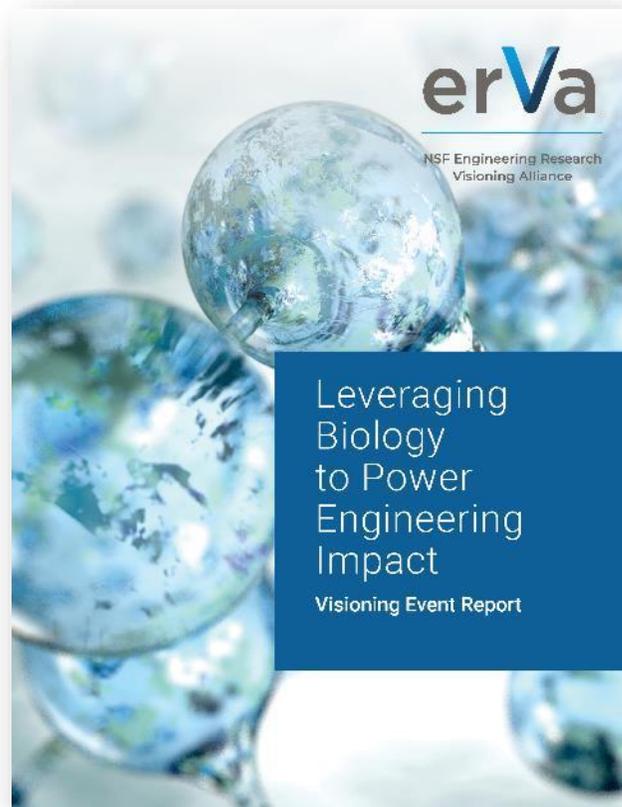
Release: October 27, 2022
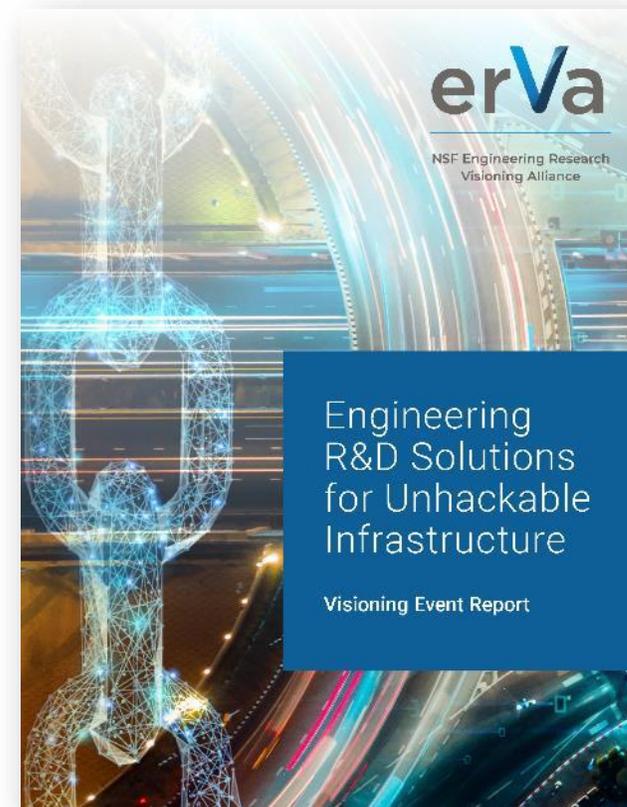
Release: February 16, 2023

New Visioning Report

Download the report
at ervacommunity.org
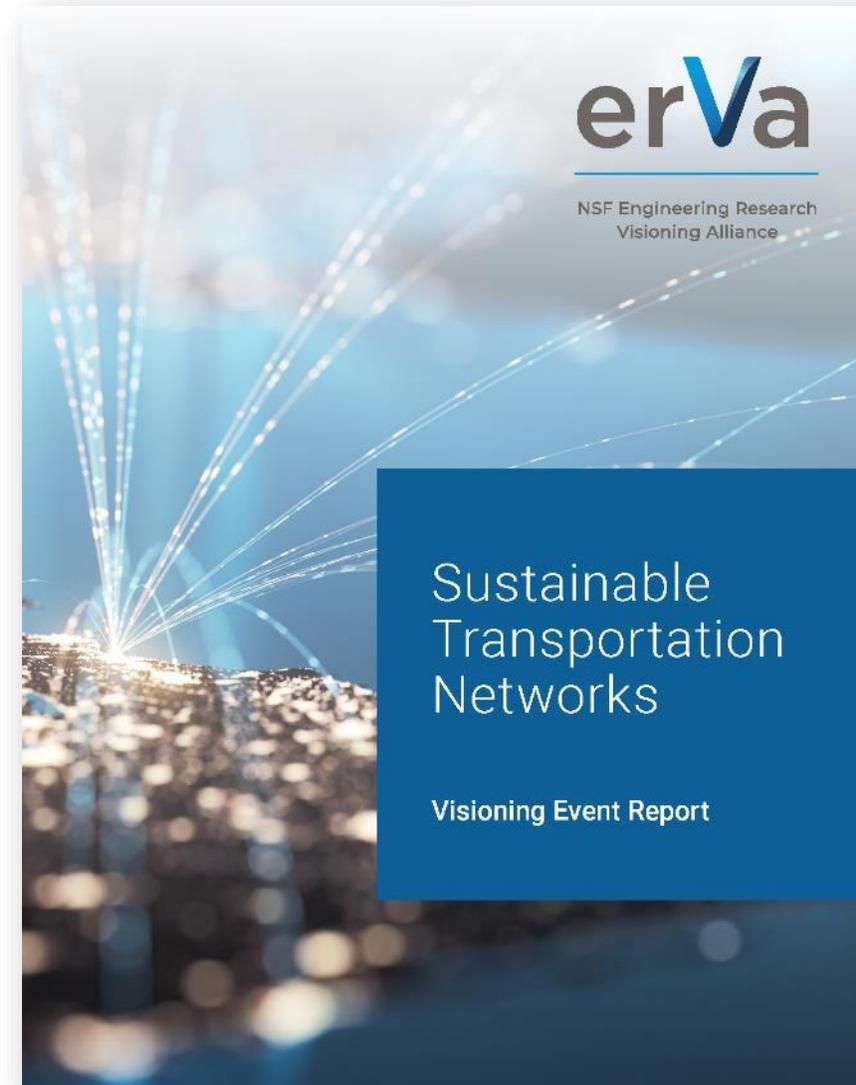
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Today's Speakers

Cathy Choi, Co-Chair, ERVA Thematic Task Force
Chief Sustainability Officer and VP of Engineering
ClearFlame

Erin Santini Bell, Co-Chair, ERVA Thematic Task Force
Professor and Chair, Civil and Environmental
Engineering University of New Hampshire

Setting The Stage

Thematic Task Force: 13 leading voices in sustainable transportation research

- Frame the event—select 4 subtopics and the questions that will drive the discussion toward goal

Participants: 93 selected, based on their research and expertise (engineering and other disciplines). From academia, industry, and government.

Co-Hosted: Event was co-hosted by ION and the Michigan URC

Charge: Identify specific areas that require exploration → greatest ROI potential.

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THEME: Sustainable Transportation

Key question: *What could tomorrow's "sustainable transportation" look like with **non-incremental** advances in engineering R&D?*

"Sustainable"

- Efficient energy use

- Low/no emissions

- Alternative construction materials

"Transportation Networks"

- Enhance efficiency of freight and logistics

- Appropriate automation and connectivity

- Optimize multimodal transportation by land, sea, and air.

…and prioritize and balance safety, affordability, diversity, equity, inclusion, and accessibility in mobility

Four Themes Explored

#1 **Infrastructure**

#2 **Vehicles and Transportation Modes**

#3 **Data**

#4 **Our People and Community**

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#1 Infrastructure

Sampling of engineering research opportunities:

- Low-cost, embeddable and scalable **sensors for data collection**.

- **Adaptive AI t**hat can anticipate failure modes and connect those with diagnostics proactively

- **Self-healing** bioengineering infrastructure **materials**

- **Models** that can support both **system performance** (e.g., traffic flow) and **design and materials performance** (e.g., road and bridge structure).

- Progress to using **digital twins** as planning tools.

- Ability to **integrate transportation modeling** with other infrastructure.

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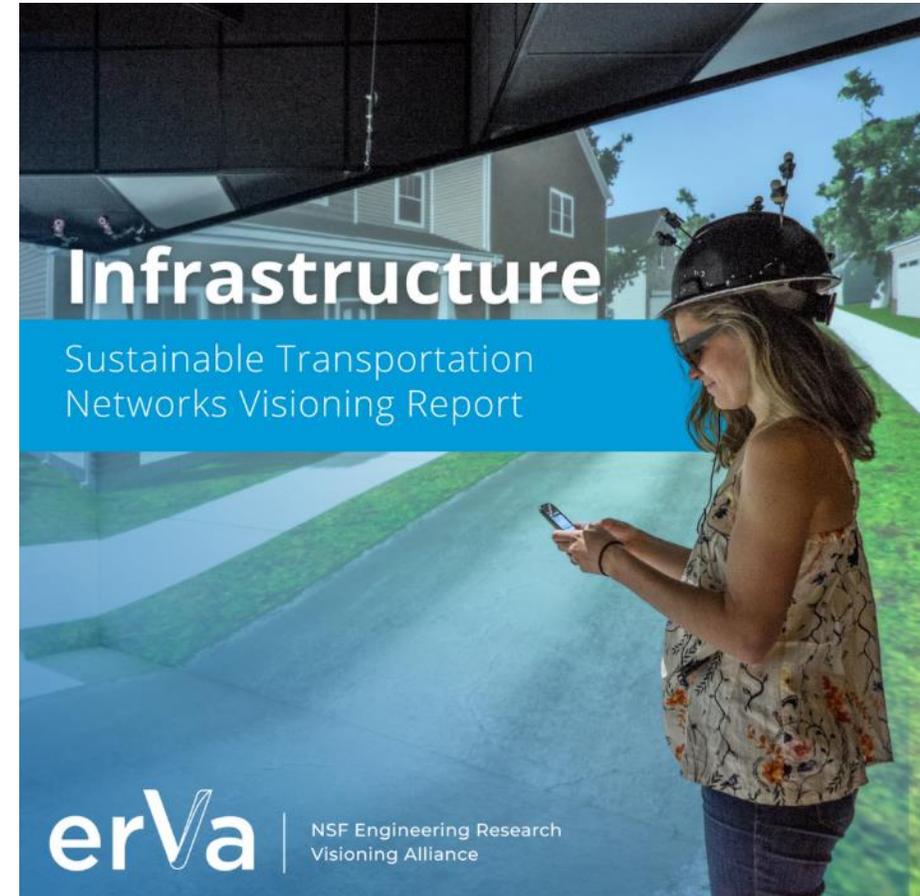
#1 Infrastructure

- **Locally-sourced, high-quality, resilient,** and **recyclable** infrastructure **materials**.

- **Replacements for sand/gravel** that deliver similar quality.

- **Transportation Infrastructure Index** for measuring overall lifecycle costs and other impacts.

- **Modular construction techniques** (Industry 4.0).

- Evolve **3-D printing** technology for **large-scale** use.

- Sustainable, performance-based **design standards** and integrate into codes.

Infrastructure
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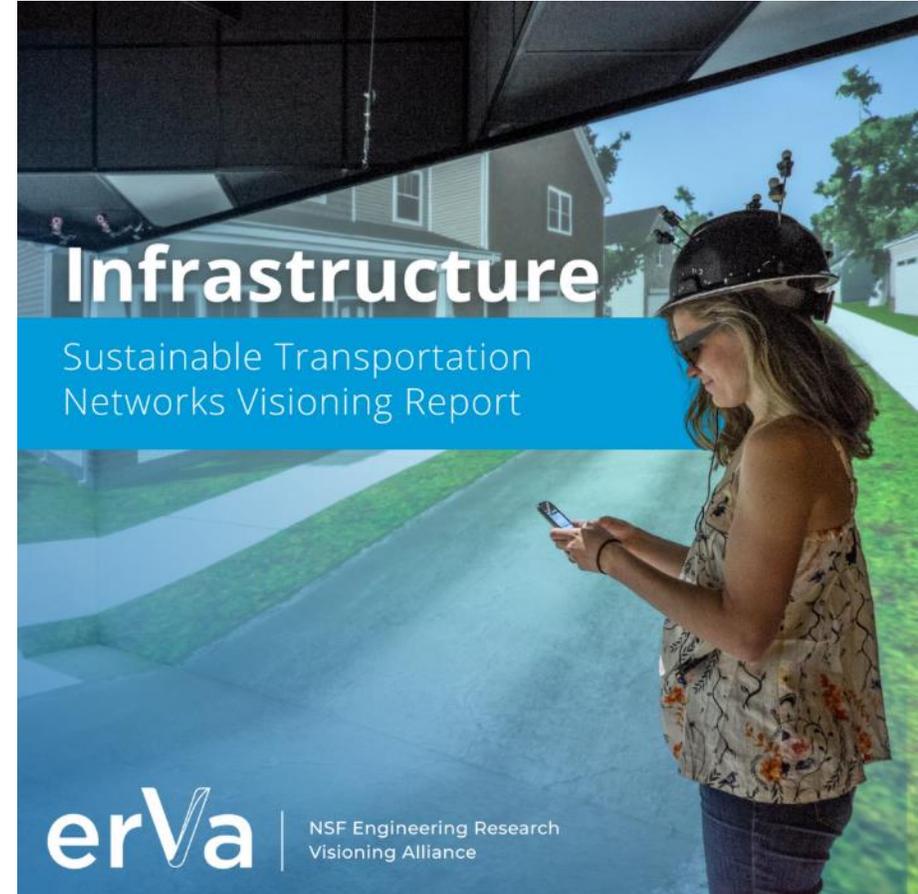
#2 Vehicles and Transportation Modes

- **Universal battery charging** stations.

- **Battery safety** in hazardous environments (e.g., floods).

- Devices/vehicles for different mobility use cases.

- Ability for existing roads to **dynamically charge vehicles** and other adaptations for electrification

- Improve **vehicles and power grid communication** for dynamic adjustment to need.

- **Maritime** applications of **advanced nuclear technology** (port power),

- **Synthetic photosynthesis** for scaling **fuel production** from hydrogen and carbon dioxide.

- **Greenhouse gas-optimized transportation modes** in all categories.

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Vehicles and Transportation Modes

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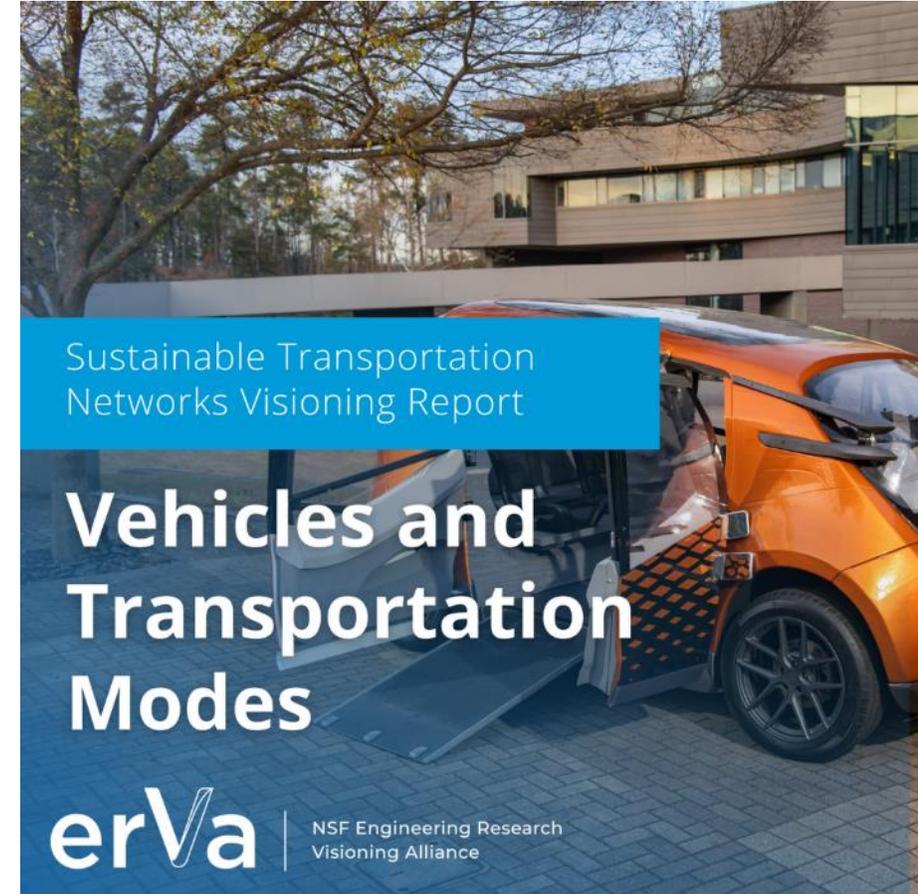
Vehicles and Transportation Modes

- **Dedicated "roads"** for personal mobility vehicles.

- Better **transportation prediction systems** for barge/shipping, rail.

- **Plan for design and replacement** of current urban mobile systems.

- **Preferred routing** for pedestrians, personal mobility devices, roadways.

- **Data standardization** for modes; power management algorithms.

- Real-time reservation of micromobility and public transportation.

- **Green cyber-infrastructure/communication network** for all users.

- **Quantum computing** for maximum-speed decision-making.

- **Smart city infrastructure** with all systems cross-linked.

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Vehicles and Transportation Modes

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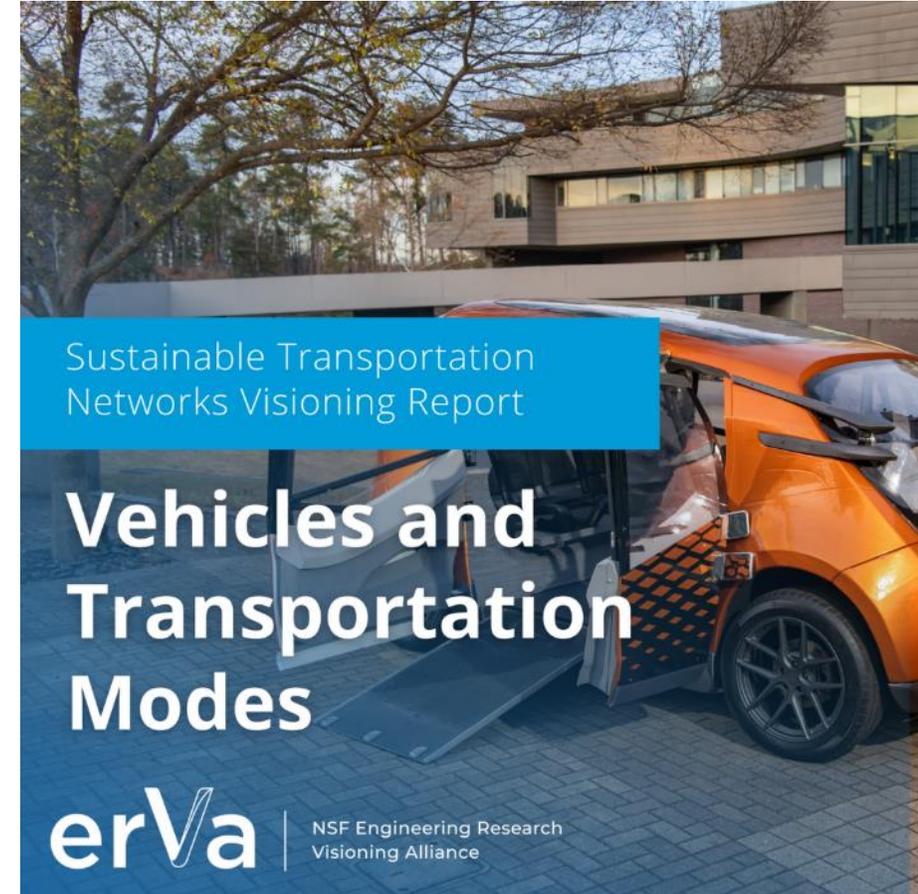
#3 Data

- **Incentivize data standardization and sharing** across sectors.
- **Automatically curate** unstructured and poorly structured **data**.
- **Data-informed** basis for **transportation planning**.
- Low-cost, low-power **sensors** for data collection.
- **Quantum secure** cryptography **protocols**.
- **Real-time** and **adaptive data fusion** and **architectures**.
- **Data-designed** (but not data-reliant) **systems that can function** when real-time data can't be collected.
- Strategies for **continuous operations** under intermittent network resource access.

Data

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#3 Data

- Large-scale, **deep learning methods** using multi-source integrated data sets.

- **Sustainability-driven metrics** and **inputs**.

- **Data coordination** at the network and interagency levels.

- **Dynamic** transportation/urban **planning**.

- **Performance-based infrastructure designs** based on usage data.

- Make **smartphones personal digital twins**.

Data
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#4 Our People and Community

- **Leverage expertise** in mechanical, materials and electrical engineering, along with urban planning to explore the concept of self-sustaining microgrids.

- **Design safe** and sustainable transportation models that leverage and respond to local needs and capacities of each community.

- **Improving and leveraging** data-informed operations in transportation systems.

- **Carbon-Neutral** transportation and **communities.**

- **Improving equity and accessibility** for humans through integrated design of mobility devices and services.

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Our People and Community

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Q&A

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ERVA: Call to Action

Share

- **Share** ERVA reports broadly to anyone interested in the future of engineering.

ervacommunity.org/ visioning reports

Leverage

- **Align** report priorities and insights with your research goals.
- **Pursue** aligned research directions.

Engage

- **Engage** in ERVA ideation and visioning events.
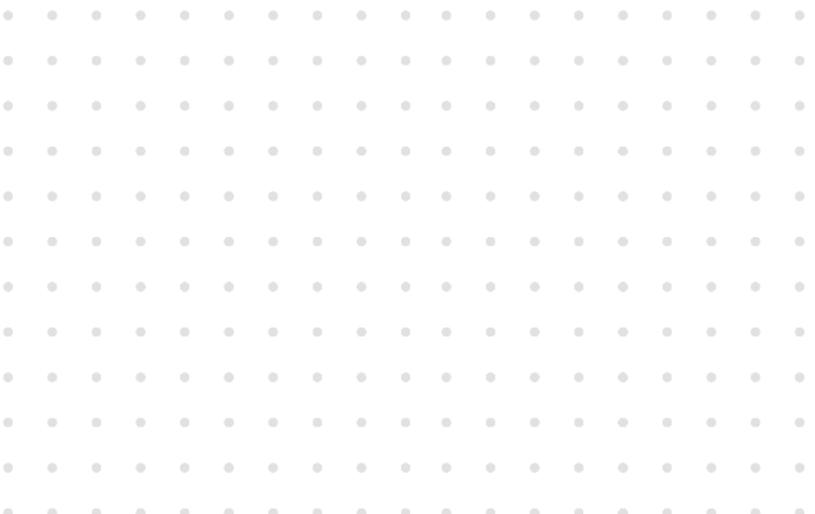- **July 25-26:** *Engineering Materials for a Sustainable Future*
- --Nominate attendees

Got Ideas?

Submit your visioning theme ideas!

Please share!

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JOIN US!

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Thank you!

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