Making a Difference: Effective Execution of Transdisciplinary Research

Organizers: T. Eighmy (Univ. of Tennessee, Knoxville); M. Gautam (Univ. of Nevada, Reno); H. Gobstein (APLU); C. Keane (Washington State Univ.)

APLU Council on Research
August 2, 2016
Morgantown, West Virginia

THE UNIVERSITY OF TENNESSEE KNOXVILLE

ASSOCIATION OF PUBLIC & LAND-GRANT UNIVERSITIES

Office of Science and Technology Policy

WESTVIRGINIA UNIVERSITY

University of Nevada, Reno

University of Colorado Boulder

Our Presenters

Chris Keane, Vice President for Research, Washington State University (Also presenting on behalf of Tom Kalil, Deputy Director for Technology and Innovation, White House Office of Science and Technology Policy)

Dan Carder, Director, Center for Alternative Fuels, Engines and Emissions, West Virginia University

Robert McGrath, Director, Renewable and Sustainable Energy Institute, University of Colorado, Boulder

Taylor Eighmy, Vice Chancellor for Research and Engagement, University of Tennessee, Knoxville

Our Questions

Chris Keane/ Overview and (for Tom Kalil) Federal Perspective: What is a Grand Challenge? What are the challenges facing large and small centers in addressing these complex transdisciplinary problems?

Dan Carder/Small Center Perspective: To be successful, what should small centers in the early phase of development keep in mind?

Robert McGrath/Large Center Perspective: What lessons would a large center director pass on to colleagues desiring to grow smaller centers? What should a VPR or other senior leader look for when selecting a particular smaller center for investment?

Taylor Eighmy/Industrial Perspective: How can a center structure facilitate industrial involvement in university research and advance innovation and entrepreneurship generally? What is the most important thing a center brings to the table other than technical capability? The ability to manage large projects? Other?

Session agenda

- Overview (C. Keane) (10 minutes)
- Federal perspective (C. Keane for T. Kalil) (10 minutes)
- Small Center perspective (D. Carder) (10 minutes)
- Large Center perspective (R. McGrath) (10 minutes)
- Industrial perspective (T. Eighmy) (10 minutes)
- Discussion (25 minutes)

Thank you in advance for your attention and participation!

Making a Difference: Effective Execution of Transdisciplinary Research

Overview: Grand Challenges and Their Pursuit in University Centers

Presented to:
APLU Council on Research
August 2, 2016

Dr. Christopher J. Keane
Vice President for Research
Professor of Physics
Washington State University

This session builds on a "Grand Challenges" session held at the 2015 APLU annual meeting

1:45–3:00 p.m. • White River Ballrooms G–J

Identifying and Solving Research Grand Challenges

What are several leading models of defining research grand challenges? Does this augur a change in how research is undertaken? Are there efficiencies and increased effectiveness in developing new models of institutional collaboration? How do universities benefit by defining research as societal and scientific challenges?

MODERATOR: **Jo Handelsman,** *Associate Director for Science, Office of Science and Technology Policy (OSTP), The White House*

PANELISTS: **Chris A. Kaiser,** *Former Provost, Massachusetts Institute of Technology*

Fred H. Cate, *Vice President, Research, I*

Michelle Popowitz, *Assistant Vice Chan Research, University of California, Los Ang*

1:45–3:00 p.m. • White River Ballroom F

Defining the New Engagement

APLU
CERE

Sunday, N

8:30–10:00 a.m.

A Commu

APLU
ANNUAL
MEETING

DELIVERING THE FUTURE

November 15–17, 2015

Indianapolis, IN | **www.aplu.org**

T. Kalil

The Obama Administration has articulated a number of "Grand Challenges"

https://www.whitehouse.gov/administration/eop/ostp/grar | 21st Century Grand Challen...

21st Century Grand Challenges

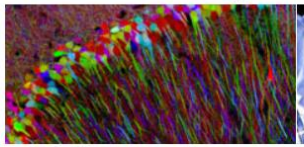
Grand Challenges are ambitious but achievable goals that harness science, technology, and innovation to solve important national or global problems and that have the potential to capture the public's imagination.

Grand Challenges are an element of the President's *Strategy for American Innovation* because they help catalyze breakthroughs that advance national priorities. On April 2, 2013, President Obama called on companies, research universities, foundations, and philanthropists to join him in identifying and pursuing the Grand Challenges of the 21st century.

Grand Challenges Can:

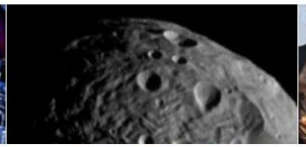
- Help create the industries and jobs of the future;
- Expand the frontiers of human knowledge about ourselves and the world around us;
- Help tackle important problems related to energy, health, education, the environment, national security, and global development; and
- Serve as a "North Star" for collaboration between the public and private sectors.

Current Grand Challenges



NIH, DARPA, and NSF's BRAIN Initiative, to revolutionize our understanding of the human mind and uncover new ways to treat, prevent, and cure brain disorders like Alzheimer's, schizophrenia, autism, epilepsy, and traumatic brain injury

DOE's SunShot Grand Challenge, to make solar energy cost competitive with coal by the end of the decade, and EV Everywhere Grand Challenge, to make electric vehicles that are as affordable as today's gasoline-powered vehicles within the next 10 years.



NASA's Asteroid Grand Challenge, to find all asteroid threats to human populations and know what to do about them.

USAID's Grand Challenges for Development, including **Saving Lives at Birth** that catalyzes groundbreaking prevention and treatment approaches for pregnant women and newborns in poor, low resource communities

What are the attributes of a Grand Challenge?

- Ambitious but achievable
- Requires advances in science, technology, and innovation
- Has the potential to capture the public's imagination
- Has a "Goldilocks" level of specificity. For example, "improving the human condition" is not a Grand Challenge because it is too broad.

See further discussion in new book by B. Shneiderman (Univ. of Md.)

What are some of the potential benefits of a Grand Challenge?

- Help create the industries and jobs of the future
- Expand the frontiers of human knowledge about ourselves and the world around us
- Help tackle important problems related to energy, health, education, the environment, national security, and global development, etc.
- Serve as a "North Star" for collaboration between the public and private sectors, and between researchers in different disciplines
- As science and technology have advanced – the most interesting question is no longer "what can we do" – but "what should we do." Identifying Grand Challenges helps us answer that question.

How are universities getting involved?

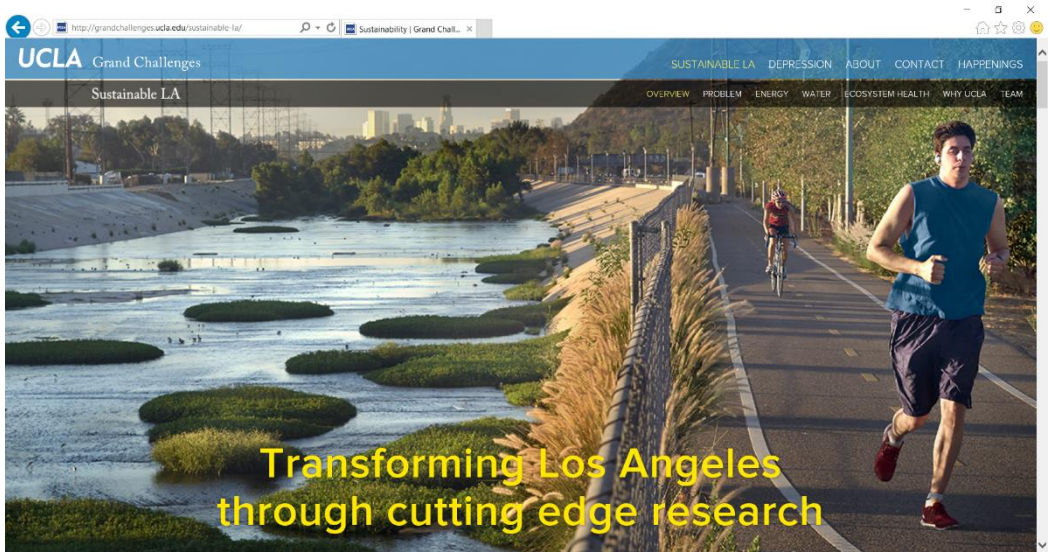
- Identify new Grand Challenges.

- Participate in existing Grand Challenges. For example, University of Pittsburgh and CMU made commitments of over $100 million to support the BRAIN initiative. See https://www.whitehouse.gov/sites/default/files/microsites/ostp/brain_fact_sheet_9_30_2014_final.pdf

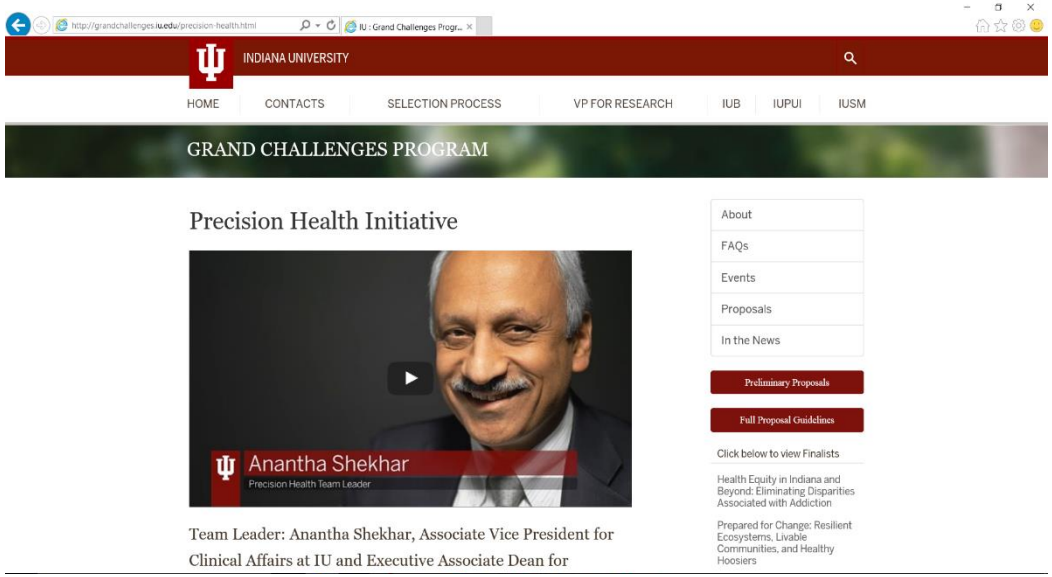
- Participate in programs such as the Grand Challenge Scholars Program. Over 120 Engineering Deans have committed to participate in this program, which allows undergraduates to organize their coursework, research, service-learning, international experiences, and entrepreneurial activities in the pursuit of a Grand Challenge. See http://www.engineeringchallenges.org/14373/15549/15785.aspx

- Establish a process that allows multidisciplinary teams of faculty to identify Grand Challenges. Provide institutional support and include these in capital campaigns.

Examples of University Grand Challenges



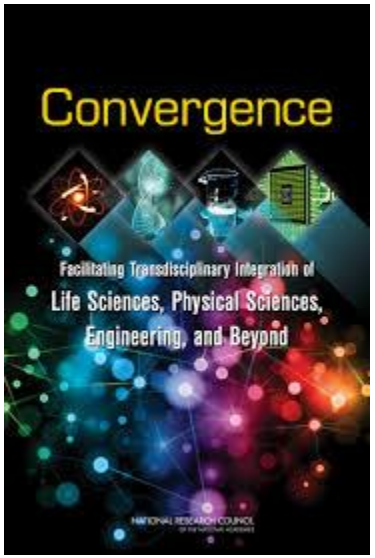
- Transition LA to 100% renewable energy and 100% locally sourced water by 2050



- Cure at least 1 cancer; Develop novel prevention methods for neurodegenerative disease; Cure at least one pediatric disease

NAS 2015 “Convergence” Report defines degrees of disciplinarity (*text below drawn from p. 44-45 of report*)

Category	Distinguishing Features (from NAS "Convergence" report)
Unidisciplinary	Researchers from single discipline address a topic or theme
Multidisciplinary	Two or more disciplines focus on a question or topic. Disciplines remain separate and existing structure of knowledge not questioned. Individuals in different disciplines work separtely, with reports compiled together in encyclopedic fashion and not synthesized.
Interdisciplinary	Key defining concept is integration- a blending of diverse inputs that is greater than the sum of the parts. Research is team-based and introduces social integration into the process, requiring attention to project management and communications dynamics.
Transdisciplinary	Problem oriented research that crosses the boundary of academic, public, and private spheres. Includes learning, joint work, and knowledge aimed at solving "real world" problems. Goes beyond interdisciplinary combinations of existing approaches to foster new worldviews or domains.



WSU "Grand Challenges" define the university's strategic research agenda and areas for investment opportunity

"Grand Challenges" → *Strategic Reallocation (5% of operating)- Research and Student Success* → *Focused Investments (up to $1M/yr each)*

- Sustaining Health
- Food/Energy/Water Nexus
- Opportunity and Equity
- Smart Systems
- National Security

- Functional Genomics
- Community health analytics
- Health disparities
- Green stormwater
- Nutritional genomics
- Smart Cities

Defined investments areas (and others) operated as centers- how is this best done?

Examples of Small and Large Centers

Small

WSU-ESIC: The Energy Systems Innovation Center is made up of more than 45 members (15 faculty, 20 affiliate faculty, 2 staff, and >8 industry representatives). The center resides within the School of Electrical Engineering and Computer Science. The center bring in ~$3-5M/year in research grants from federal, state and industry resources and has operating costs of ~$300K. ESIC will be the model used for WSU investments funded by the strategic reallocation process.

Large

UT-IACMI (established in 2015): University of Tennessee led Institute for Advanced Composites Manufacturing Innovation is an NNMI consortium with 123 members from 7 institutions. Funding profile - $189 million in funding from partners and $70 million from the Department of Energy (EERE). It is managed by a not-for-profit 501(c)(3) organization established by the UT Research Foundation.

Question for our panel: How should “Centers” or “Institutes” be effectively managed to address transdisciplinary, “Grand Challenge” like research problems?

- Issues for "small" centers
  - Faculty leadership and management expertise
  - Providing sufficient administrative support to get the center launched
  - Incentives: Center vs. departmental grant submission and allocation of F&A
  - Credit reporting
  - Promotion and tenure for interdisciplinary work
- Issues for “large” centers
  - Project management expertise, including more sophisticated administrative support
  - Degree of independence from College/central units
  - F&A arrangements- special incentives
  - Impact on teaching and other faculty responsibilities

Sustainability and effective communication is a key issue for all centers

Comments on university pursuit of "Grand Challenges" via centers

- Sponsor needs to ensure their funding is a significant fraction of the center- otherwise sponsor goals may be lost
- Need to distinguish between faculty who truly want to work together and those who just want to "look good"- i.e. need to distinguish true collaborative proposals from "staple jobs"
- First 3 years of centers are often less productive, as the team gets started- years 4-5 can be more productive
- 3-5 researchers working together with a common funding source that is a significant fraction of the center or laboratory budget is often effective
- Universities can be effective identifying emerging areas where innovation is needed but no sponsor is present

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Transdisciplinary Research and Small Centers

APLU Council on Research
Morgantown, WV
August 2, 2016

Daniel Carder
Center for Alternative Fuels, Engines, and Emissions (CAFEE)
West Virginia University

CAFEE

- Founded in 1989 with US DOE Funding
- Examine the Impact of Alternative-fueled Engine and Vehicle Technology
- 25 Years of Research, Development and Innovation
- > $100 Million in Revenue
- Mix of Federal Government, State Government, and Industrial/Commercial Sponsors
- “Blue-collar” researchers that challenge students to think broader
- Core Faculty (9) and Staff (15), Graduate Students (30-50), Temporary Staff and Undergraduate Students

Keys to (Our) Success- Leadership and Organization

- Sustainability - Very critical. This drives the long term viability. This drives the composition of the group and its symbiotic relationship among the rainmakers (has to be plural) in the Center.
- Even small centers need a dedicated professional(s) (managers of sorts) for operational details.
- Faculty role statements should allow for them to publish in relevant journals; not just the ones that have traditionally been targeted by a specific discipline. The Provost needs to take the lead on this issue. For example, faculty doing cyber security work in Political Science should be given credit for publishing in journals, such as IEEE or any other relevant journal.
- Pool resources.

Keys to (Our) Success- Resources

- Quality is trumps everything. Quality people - faculty, scientists/engineers, administration support, technicians, students. Students need to be hand-picked from a world-wide pool.
- While it is important for the institution to provide resources through reprogrammed IDC recovery (one example), this support can never form the backbone. It is simply a supplement. Continual inflow of grants/contracts is the best guarantee if sustainability.
- Funding support should be a portfolio; no different than our own investment portfolio. Federal (big money) , state, industry, Foundations, philanthropy.
- Use your uniqueness to your advantage, small is nimble (not limited)….
- Stimulate participation through provided services

Keys to (Our) Success- Communications

- Comradery and respect for the fact that no one person can do it alone...shorty-term center, yes; long-term sustainable center, no.
- Everyone must have a voice – this is critical to ownership.
- Unite from bottom upward – “lower-level” commitment will largely determine success
- External communication (industry/program managers) – don’t always talk, be willing to listen.

Keys to Success

"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." - Margaret Mead

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Making a Difference:

Effective Execution of Transdisciplinary Research

Association of Public & Land-grant Universities

Presented to:
APLU Council on Research
August 2, 2016

Dr. Robert McGrath
Renewable & Sustainable Energy Institute
University of Colorado

Large University Centers & Institutes

- Can provide vision and focus for particular R&D themes
- Can foster teamwork, provide infrastructure to address large scale or grand challenge level problem.
- Can facilitate development of large, multi-investigator, multi-institution proposals and award execution.
- Can provide comprehensive R&D programs for particular federal agencies or industry sectors.
- If partnered well with appropriate academic colleges and departments, large R&D institutes can contribute greatly to
  - Educational opportunities for undergraduate & graduate students
  - Recruitment and retention of outstanding faculty
- Strategic investments can help small/medium sized centers grow into larger, more productive institutes with sustained research impact and continued reputation enhancement for the University

Administrative Considerations for Large Research Centers & Institutes

- If a federal agency says it's a Center or Institute, then it is! Examples:
  - NSF Science & Engineering Centers
  - NIH Cancer Centers and Comprehensive Cancer Institutes, focused awards (e.g. P50s, P30s, . . .)
  - DOE Research Hubs, Bioscience Engr. Centers, IACMI . . .
  - FFRDCs & UARCs

- In establishing any Center or Institute, be sure to clearly define
  - The University's annual budgetary commitments from the Central Administration, Colleges, Departments and any other internal unit and the duration of those financial commitments
  - An annual review process
  - Provisions for sun-setting the Institute
  - Provisions under which the Institute may persist in occupying University research space (e.g. define the academic, educational, scientific & financial mission objectives and associated metrics)

Administration & Management Structures for Large Centers & Institutes

- Most academic Research Centers and Institutes function very effectively under OMB Circular A-21 financial compliance guidelines that typically are applied to all other R&D at the University.
- Some large center have found it advantageous to operate as a 501(c) 3 with not-for-profit designation under FAR 31.2.
- Because research execution, financial management, industry partnerships and technology transfer have not gone well on a few large federally sponsored R&D Institutes, some federal agencies are requiring formation of a 501 (c) 3 as a precondition for selected large proposals and awards.
- Note that "not-for-profit" designation does not prohibit annual revenues in excess of expenditures.
- Many University Research Foundations function as 501 (c) 3 units
- Clear objectives should be defined before additional 501 (c) 3 research units are established.
  - A Caution: "not for profit" designation generally requires a significant amount of additional administrative burden.
  - However, with sustained success, such units often become donors!

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Government-University-Industry-National Lab Grand Challenge Collaborations

(Public-Private Partnerships Driving Economic Development)

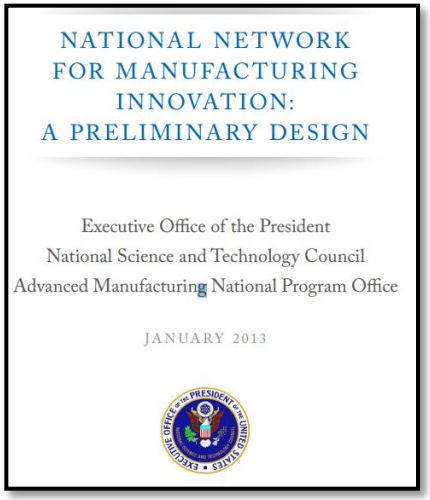
Dr. Taylor Eighmy

APLU 2016 CoR Summer Meeting

THE UNIVERSITY OF
TENNESSEE
KNOXVILLE

Innovation Ecosystem:

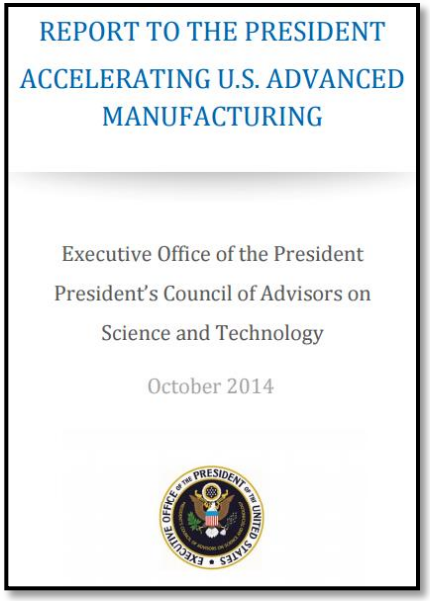
- "A Preliminary Design" Published January 2013 (NSTC, PCAST)
- The Composite Materials and Structures FOA issued 2/25/2014
- RAMI Bill passed 9/15/2014
- AMP2.0 was issued October 2014
- Administration wants 15 IMI (Institutes for Manufacturing Innovation) by the end of 2016



NATIONAL NETWORK FOR MANUFACTURING INNOVATION: A PRELIMINARY DESIGN

Executive Office of the President
National Science and Technology Council
Advanced Manufacturing National Program Office

JANUARY 2013



REPORT TO THE PRESIDENT

ACCELERATING U.S. ADVANCED MANUFACTURING

Executive Office of the President
President's Council of Advisors on Science and Technology

October 2014

Innovation Ecosystem:

National Network for Manufacturing Innovation (NNMI) Model:

Government Investment
- Federal
- State

Industry Investment
- OEMS and their supply chains
- SMEs

Manufacturing Innovation Ecosystem Driven by Industry Need
- Co-investment/Co-creation
- Sustainable business model
- Jobs

University and Federal Laboratory Researchers
- Discovery
- Workforce

Innovation Ecosystem:

Department of Energy (DOE)

- Modular chemical processes intensification
- Reduced embodied energy and decreasing emissions

Department of Defense (DOD)

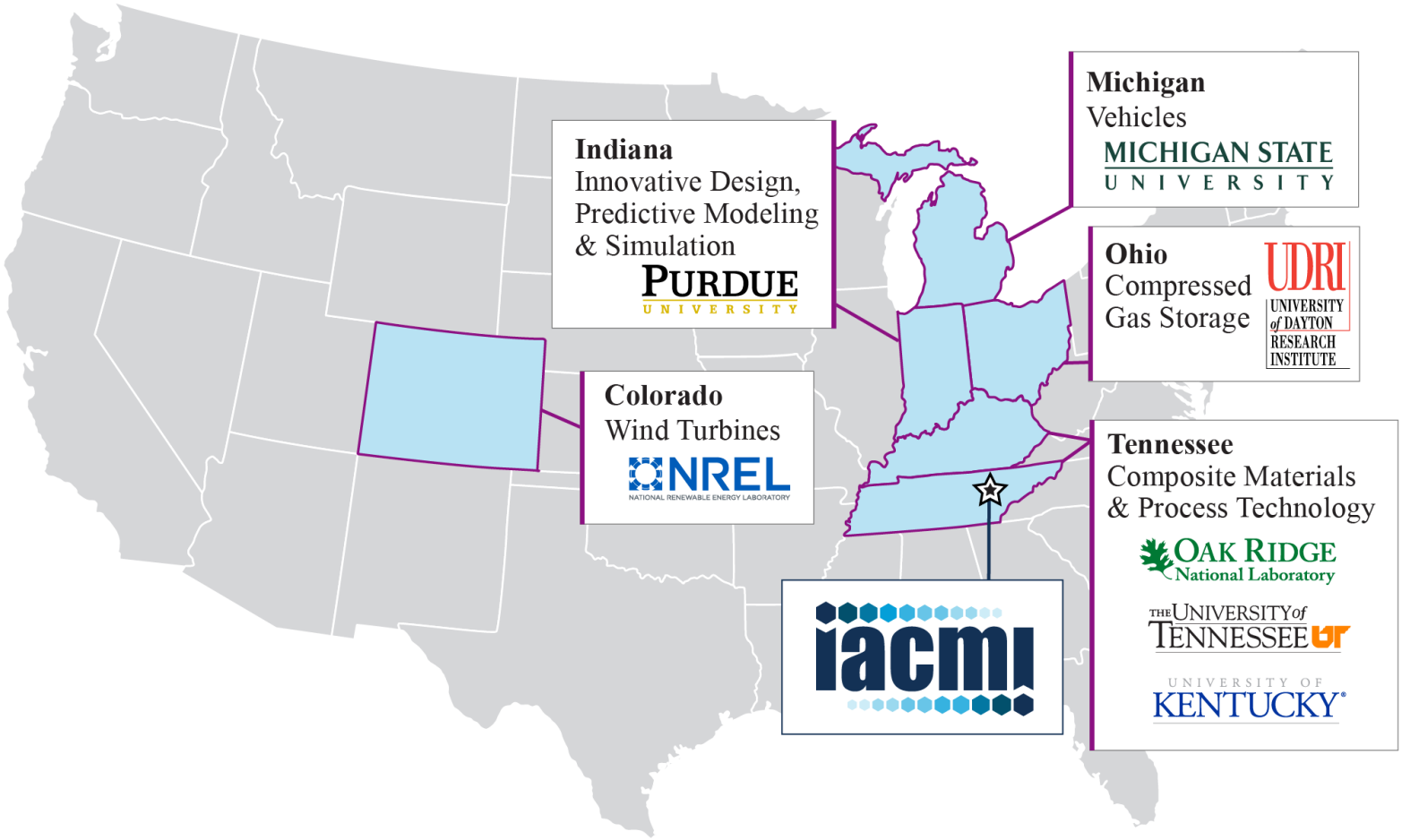
National Institute of Standards and Technology (NIST)

- One or more open topics

Innovation Ecosystem:

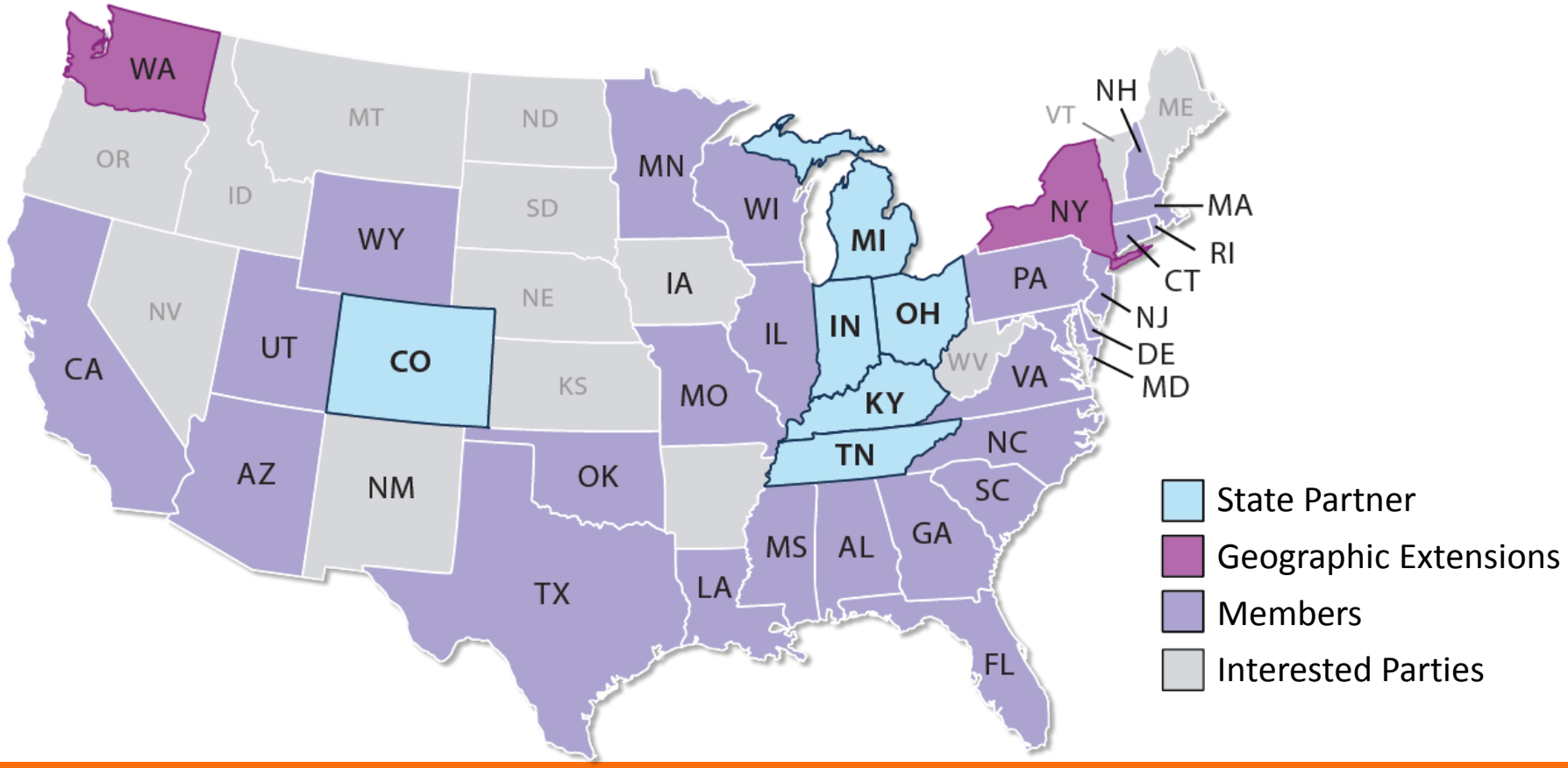
- $259M over five years (2015-2019)
- $70M from DOE
- $189M in cost share from partners (including $100M in new cash)
- Operated by CCS Corp., an independent not-for-profit 501c3
- Governed by a board of directors
- A wholly owned subsidiary of the University of Tennessee Research Foundation (UTRF)
- Incorporated in the State of Tennessee
- Headquartered in Knoxville, Tennessee

Innovation Ecosystem:



Innovation Ecosystem:

- The 150 members are public and private and represent 32 states.
- IACMI has partnered with ACMA, the premiere composites industry association and Composites One for workforce training capabilities.



Innovation Ecosystem:

Industry, Academia and Government Stakeholders

A partnership of world-class companies and their supply chains:

- Local Motors
- Ford
- BASF The Chemical Company
- Dassault Systemes
- DowAksa
- Boeing
- Lockheed Martin
- Dow
- GE
- DuPont

A partnership of outstanding small and medium sized organizations:

- Techmer PM Polymer Modifiers
- Toho Tenax
- TRD Design
- MVP Magnum Venus Products
- Cincinnati Cincinnati Incorporated

Top universities:

- The University of Tennessee UT Research Foundation
- Vanderbilt University
- Michigan State
- Illinois State
- School of Mines 1874 Colorado
- UK
- UDRI University of Dayton Research Institute
- Purdue University
- Colorado State University

Innovation Ecosystem:

- Procurement-style cooperative agreement (budget periods/SOPO/milestones)
- Industry-driven higher level (TRL 4-7) applied R&D: OEMs and their supply chains
- 5 Year technical goals: 25% lower cost CF, 50% reduction embodied energy, 80% recylability
- Impact goals: energy productivity, reduced life cycle energy consumption, domestic production, job & economic growth
- Goals →road mapping→white papers→TAB→BOD/DOE→projects
- Sustainability plan for life after the five year federal investment
- IP management plan
- Work force development plan

Questions?

Please feel free to contact me:

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(865)974-8701 (office)
(806)252-6444 (cell)

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