TESTIMONY BEFORE THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES, EXAMINING THE STATUS OF INNOVATIVE TECHNOLOGIES IN ADVANCED MANUFACTURING

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SENATE HEARING DATE: APRIL 12, 2016

The Institute for Advanced Composites Manufacturing Innovation (IACMI) is a public-private partnership created to accelerate development of clean energy products, processes, and systems. Specifically, IACMI aims to provide a catalyst to industry, academia, and the public sector, pushing improvements in composites R&D, capitalizing on potential commercial applications, and ensuring continued U.S. leadership in advanced composite manufacturing—a sector that holds significant potential in energy, industry, and American competitiveness.

The IACMI partnership of industry, universities, national laboratories, trade associations, universities, and federal, state and local governments is sharing resources and investing in innovative research nationwide to accelerate development and commercial deployment of advanced fiber reinforced polymer composites. Our growing portfolio of partnerships now gives us members in all 50 states, and our world-class team of leading industrial manufacturers, material suppliers, software developers, government researchers and academics is working toward specific, measurable goals. Specifically, in the next decade, we aim to:

- Lower the cost of advanced composites by 50 percent.
- Reduce the energy used to make composites by 75 percent, and
- Increase the ability to recycle composites by more than 95 percent.

In pursuit of those goals, the Institute is developing new low-cost, high-speed, efficient manufacturing and recycling process technologies and will be training the next generation composite workforce.

The University of Tennessee was selected for negotiations in early 2015 and a cooperative agreement was signed in June of that same year with DOE when IACMI was launched in Knoxville, Tennessee. IACMI is operated by Collaborative Composite Solutions Corporation (CCS Corp.), a wholly-owned not-for-profit subsidiary of the University of Tennessee Research Foundation, and is governed by a board of directors. The institute’s structure reflects industry feedback to the Department of Energy and partner

institutions, placing R&D and scale-up capability in close proximity to manufacturing sites. We selected sites focused on specific areas of technology, based on factors such as RD&D and jobs.

- Michigan's number-one ranking in automotive RD&D spending and jobs solidified the state as the location for our Vehicle Technology Area.

- Ohio was second in those rankings and is home to our Compressed Gas Storage Technology Area.

- Indiana ranks third and comprises the Modeling and Simulation Technology Area.

- Tennessee ranks fourth and is headquarters for the Material and Processing Technology Area.

- Finally, Colorado's strong wind manufacturing ecosystem was the basis for the establishment of the Wind Technology Area.

Key partners in IACMI's five technology areas include:

- Vehicles (Michigan)
    - Michigan State University
- Wind Turbines (Colorado)
    - National Renewable Energy Laboratory
    - Colorado School of Mines
    - Colorado State University
- Compressed Gas Storage (Ohio)
    - University of Dayton Research Institute
- Design Modeling & Simulation (Indiana)
    - Purdue University
- Composite Materials & Processes (Tennessee)
    - University of Tennessee
    - Oak Ridge National Laboratory
    - Vanderbilt University
    - University of Kentucky

The institute began just nine months ago, but early successes have been significant:

- The number of organizations committed to **membership has doubled** since the initial funding

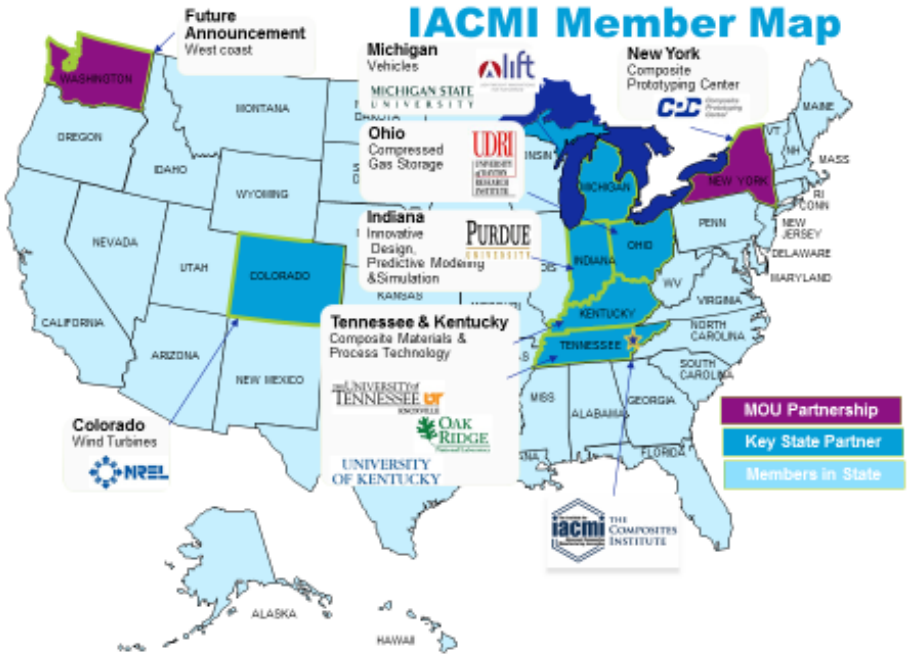
- The geographic footprint and capabilities of IACMI have **expanded through partnerships** including:

- A **co-location announcement with the Lightweight Metals Institute in Michigan.**

- The recent Memorandum of Understanding signed with the **Composite Prototyping Center in New York,** which expands IACMI's capabilities in the Northeast.

- An agreement confirmed with the **Composite Recycling Technology Center in Port Angeles, Washington** that will be announced in the very near future.

- A partnership with an industry association, **ACMA** (American Composites Manufacturers Association), which expands IACMI's presence from 32 states with members to 50 states.

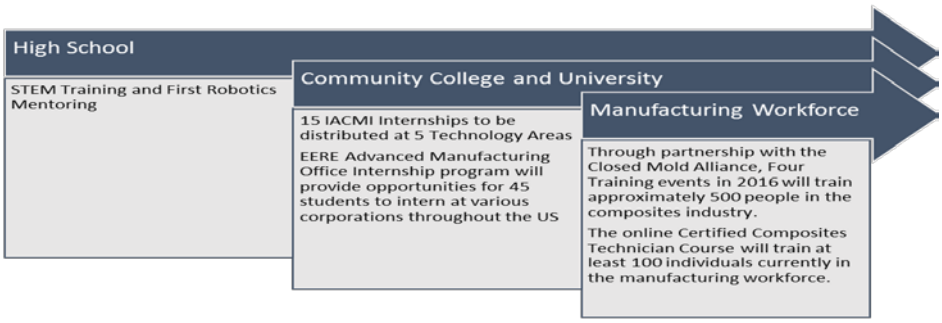


- The announcement and construction of a $50 million facility to advance energy-saving technologies at Purdue University.

- A call for proposals announced within the four months of institute funding.

- A licensing opportunity announced by partner Oak Ridge National Laboratory that will significantly lower carbon fiber production costs and enable commercialization of the innovative technology.

- Workforce development initiatives that include STEM training for high school students, ORAU managed internship opportunities for fifteen college students and at least four workforce training events that will provide training to over 400 composite industry professionals.



- Job creation with a specific focus on IACMI's partner states. With technological leadership and diverse membership spanning the supply chain, a new reason has been created for companies to locate jobs and investment in their regions and in the United States.

- Leisure Pools, parent company of Orion Composites and a composite pool manufacturer originally from Australia, has relocated its facilities to Knoxville, Tennessee to be near IACMI as it reinvents itself as a sophisticated producer of a range of carbon fiber and advanced composite materials. It is expected to add 240 jobs almost immediately and up to 1,000 over the next five years.

- In Colorado, Vestas Wind is hiring 400-plus composite technicians in 2016.

- In Indiana, Wabash National Corporation is spending more than $2 million to expand operations for its composites business that will create more than 100 jobs in the next five years.

By coupling basic to applied science, we are expanding potential applications for advanced composites

Advanced fiber-reinforced polymer composites, which combine strong fibers with tough plastics, are lighter and stronger than steel. Advanced composites are used for select purposes now—such as aircraft,

military vehicles, satellites and luxury cars— but if they can be produced at a lower cost, these materials could help manufacturers deliver more advanced and affordable products with much broader availability and impact, including:

- Lightweight vehicles with record-breaking fuel economy.
- Lighter and longer wind turbine blades.
- High pressure tanks for natural gas-fueled cars.

Lightweighting is directly tied to energy efficiency. With just a 10-percent weight reduction, fuel efficiency rises by 6-8 percent for internal combustion engine vehicles. For battery-electric vehicles, that 10 percent weight reduction increases vehicular range by 10 percent.

In automotive applications, advanced composites could reduce the weight of a passenger car by 50 percent and improve its fuel efficiency by about 35 percent without compromising performance or safety—helping to save American families thousands of dollars in fuel costs over the car's lifetime.

In the wind energy industry, advances in low-cost composite materials will help manufacturers build longer, lighter, and stronger blades to create more energy. In fact, doubling the length of a turbine blade can quadruple the amount of electricity generated.

OPERATIONS

IACMI's network enables industry-driven R&D along the full spectrum from laboratory to full-scale demonstration, aligned with a technology roadmap for the objectives of the Institute.

IACMI issues call for proposals from its membership to identify and prioritize resources to solve technical challenges that can lead to commercialization opportunities.

IACMI has a variety of mechanisms that aim to maximize options for industry, including short-term projects with industry (known as Technical Collaborations), longer-term collaborative R&D efforts with large potential impacts (Enterprise Projects), and partnerships to address challenges that can benefit the entire composites community (Topic Specific Projects).

There are four levels of membership (Consortium, Resource, Premium and Charter) with increasing levels of involvement and benefits. Consortium memberships are available at $5,000 for small- and medium-sized companies, government and not-for-profit organizations and $10,000 per year for large companies.

IACMI aims to be financial self-sufficient by the end of the Cooperative Agreement with DOE.

IMPACT AND GOALS

As the institute works towards its five/ten year technical goals, it is anticipated there will be other benefits to society and the economy:

1. A 25- to 50 percent reduction in the cost of carbon fiber-reinforced polymer (CFRP).

2. A 50- to 75-percent reduction in CFRP embodied energy.

3. 80/95% composite recycling into useful products

4. Demonstration of materials with energy and cost of glass with carbon fiber composite performance

IACMI projects will result in enhanced energy productivity, reduced lifecycle energy consumption, increased domestic production capacity, job growth and economic development.