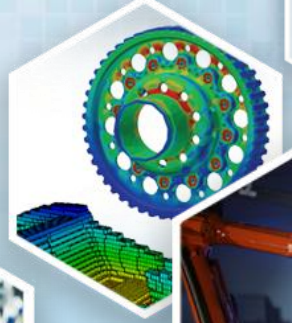
Members Meeting
Summer 2022

June 28-30, 2022



THE COMPOSITES iacmi INSTITUTE

In Partnership With

uammi
UTAH ADVANCED MATERIALS + MANUFACTURING INITIATIVE

Convene. Connect. Catalyze.

Welcome back!

IACMI Vision & Mission Statement

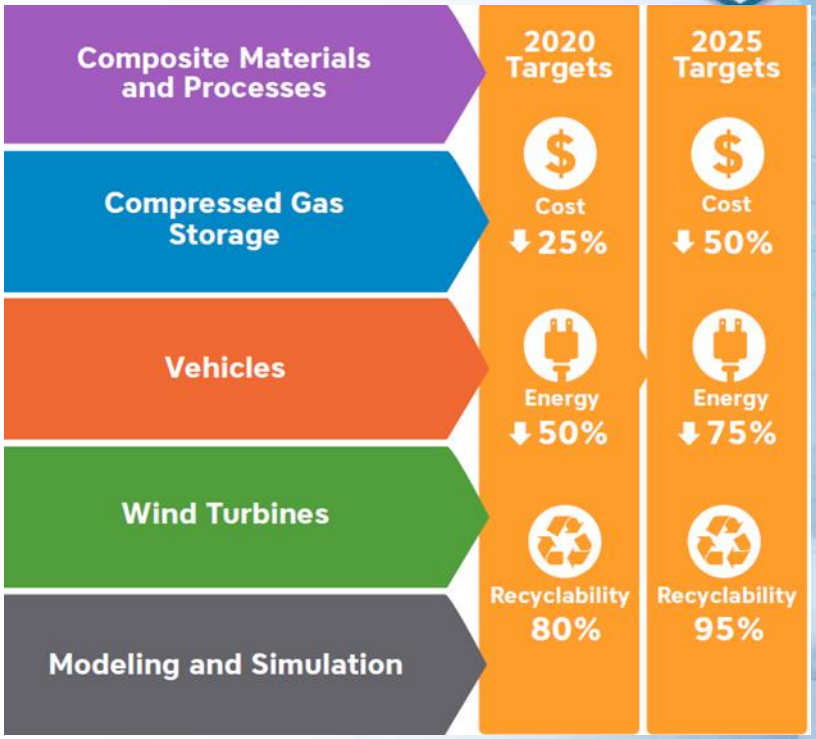
Vision: *Improving everyday lives through the power of composites*

Mission: *Convene, connect and catalyze the composites community to accelerate advanced composites design, manufacturing, technical and workforce solutions to enable a cleaner and more sustainable, more secure and more competitive U.S. economy*

Convene. Connect. Catalyze.

Destination 2020

- Create Institute
  - Membership
  - Capabilities
  - Operational Models
  - Foundation for Knowledge and Learning
- Create and manage portfolio of projects to meet technoeconomic goals in preparation for large-scale deployment
- Increase US Manufacturing Competitiveness



Five years later…

- New world class capabilities for **composites manufacturing**

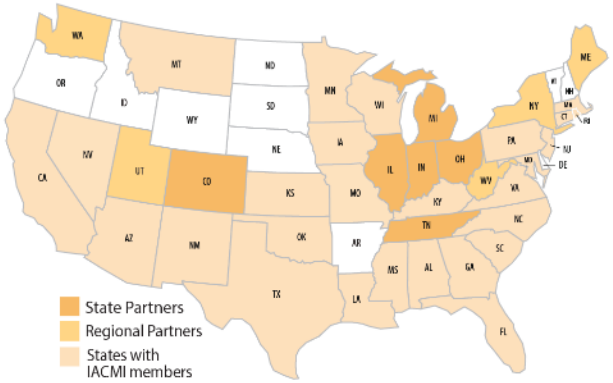
IACMI outcomes to date

Creating an Innovation Network

60+~~50+~~ IACMI technical projects

90+ IACMI members participating in technical projects

$150M+ IACMI's R&D value to date



150+ IACMI Members served

68% of companies are SMEs

Impacting Economic Development Across the U.S.

$400M Investment in 8 states for Scale Up Facilities

3,000 Jobs announced

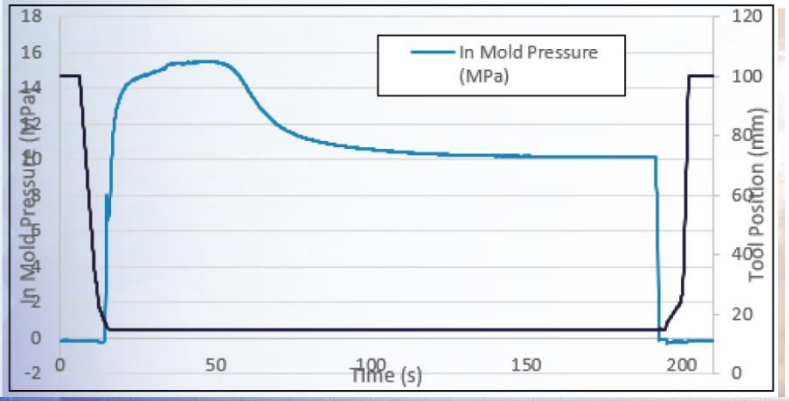
$150M in Research & Development Value

60+~~50+~~ Collaborative and industry-led technical projects

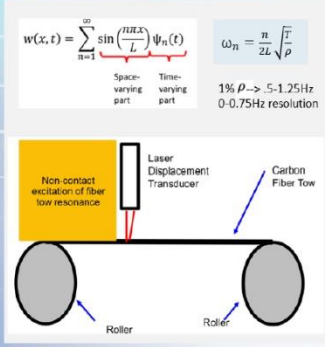
90+ 90+ IACMI members participating on technical projects

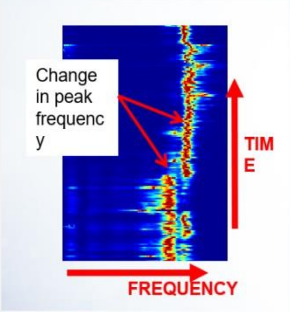
25+ New products commercially available because of IACMI collaboration outcomes

Ford carbon fiber liftgate inner panel

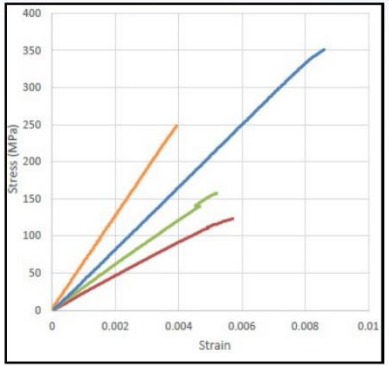


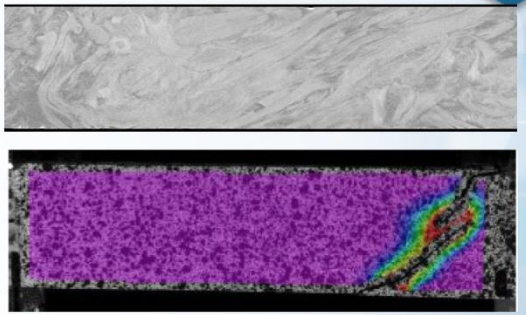
Ford liftgate project



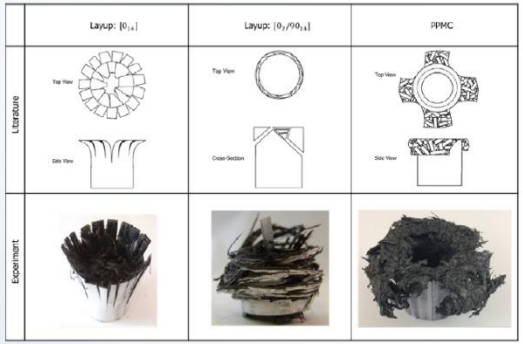


In line non-contact measurement of carbon fiber properties





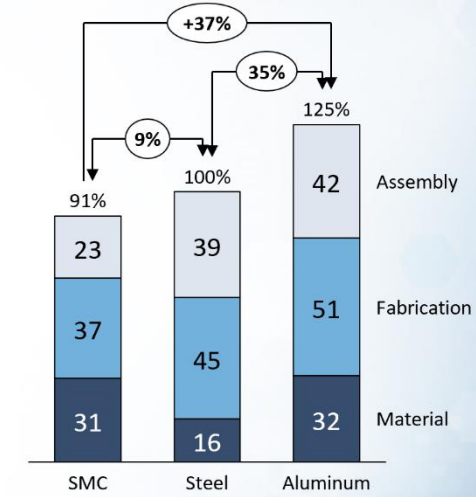
Mechanical strength testing and morphology



Flow simulation and crash performance correlation

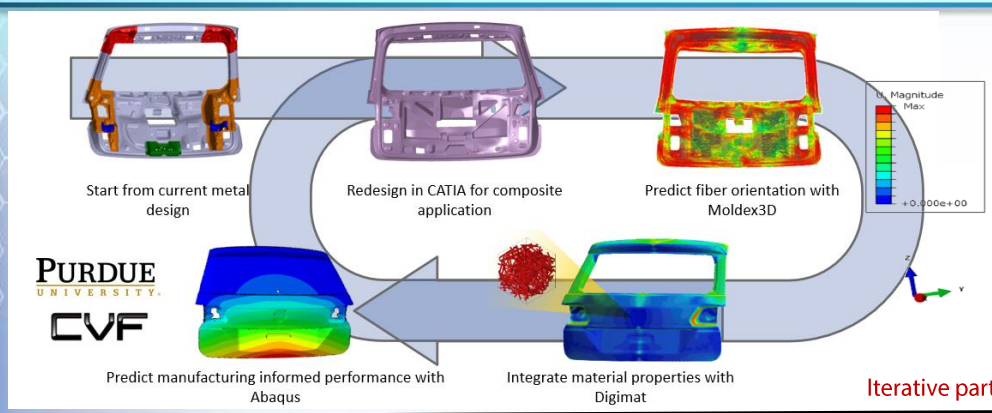
Digital Image Correlation (DIC) for fiber orientation

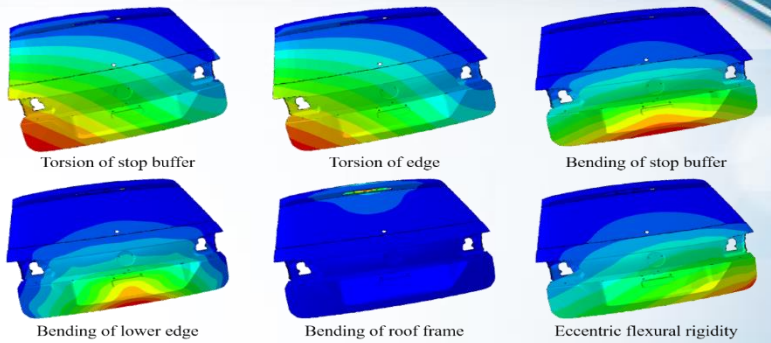
VW SMC liftgate project



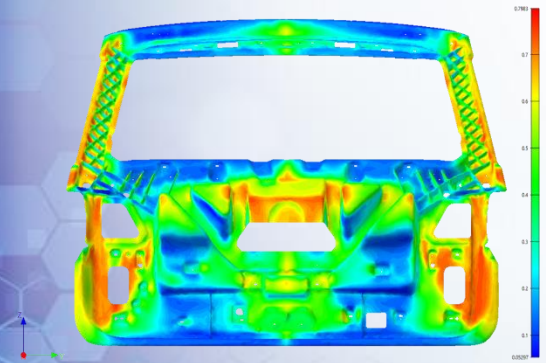
Recurring cost comparison (performed by VW)

VW liftgate project





Iterative part design and load case structural modeling



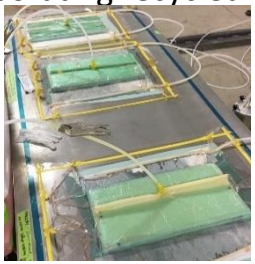
Fiber orientation prediction and measurement using Digital Image Correlation (DIC)

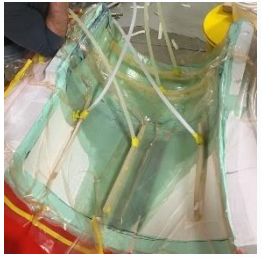
9 meter blade demonstration (November 2016 -January 2017)

Purpose: Early scale demonstration of novel technologies focused on thermoplastic matrix

Outcome: Fabricated largest infused part to date with Elium thermoplastic resin, pultruded textile carbon fiber spar caps with polyurethane resin, and incorporating recycled PET foam cores

Textile PAN Carbon fiber ➡ Spar Cap Pultrusion





Panel and Root End Infusion Trials

Mold Prep/Gel Coat

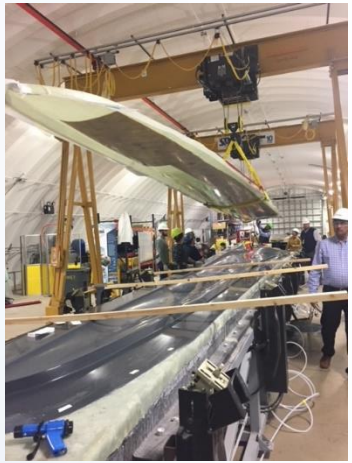
Blade Layup ➡ Resin Infusion ➡ Molded Shell ➡ Bonding ➡ Finished 9m Blade

13 meter blade fabrication

Purpose: Scale Technology to 13m and validate against baseline 13m epoxy blade

Outcome: 13m blade successfully fabricated and structural test completed (bending and fatigue), with results comparable to epoxy baseline. Technoeconomic modeling shows advantages for TP blade.

Infusion and Cure

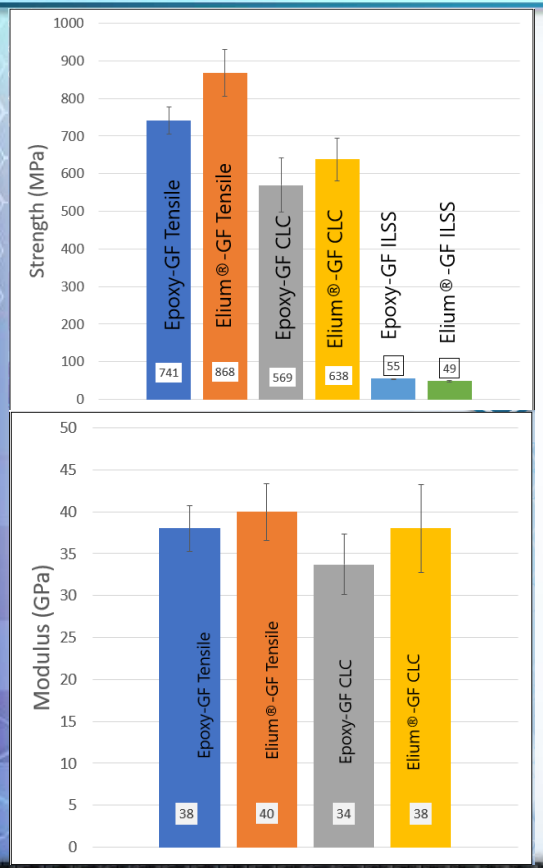


Demolding

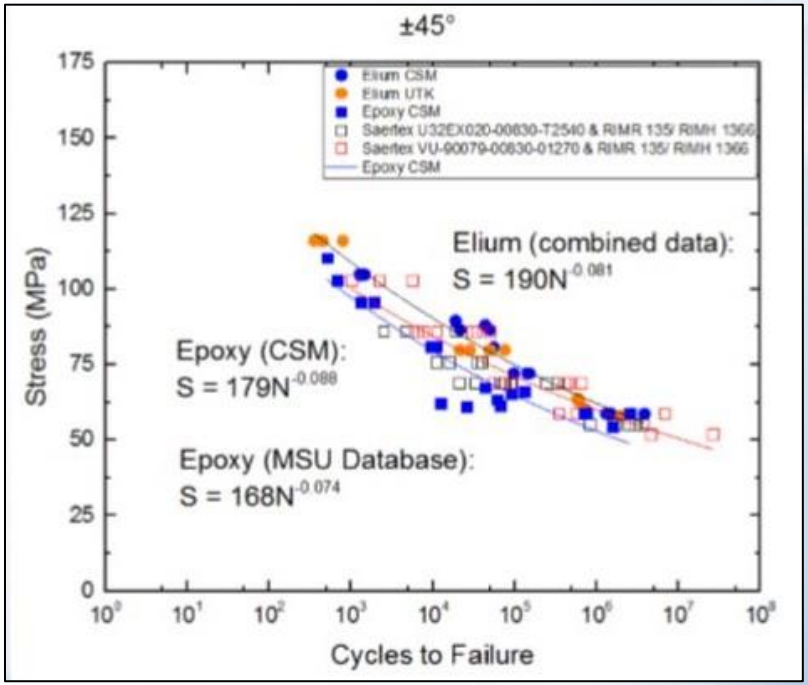
Bonding

Blade Prep for Testing

13m blade project



Mechanical property testing compared to baseline



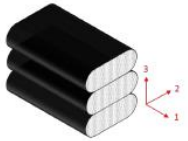
Fatigue testing

Wide range of large scale 3D printed structures

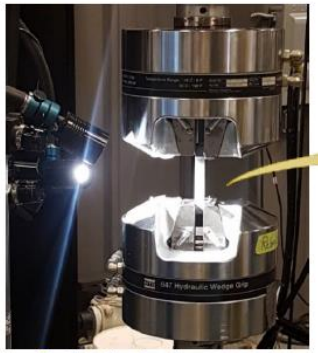
OAK RIDGE National Laboratory

Advancing the science of large-scale 3D printing

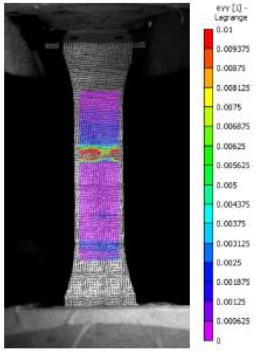
TENSILE PROPERTIES CHARACTERIZED FOR 25% CF- PESU PRINTED IN CAMRI



	Tensile modulus (GPa)			Ultimate strength (MPa)		
	Print (E_1)	Transverse (E_2)	Stacking (E_3)	Print (X_1^u)	Transverse (X_2^u)	Stacking (X_3^u)
AVG	16.44	**5.06**	4.07	151.82	**19.69**	41.60
SD	0.97	0.47	0.18	5.19	3.28	2.30



Tensile testing of specimens prepared from panels printed in CAMRI system



Strain field developed after failure of specimen under tension.

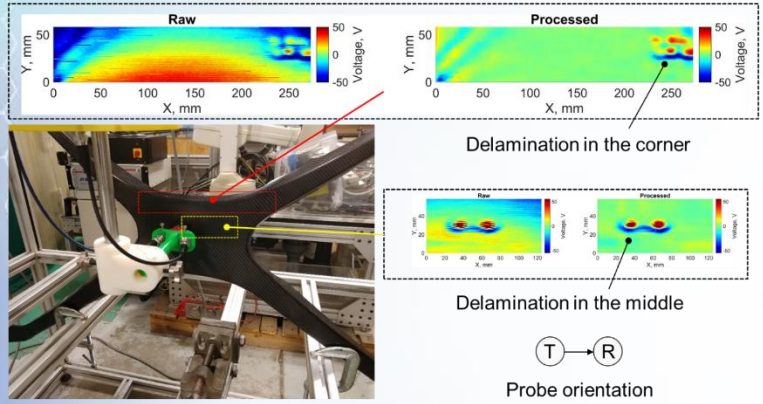
Status Characterization Material Card

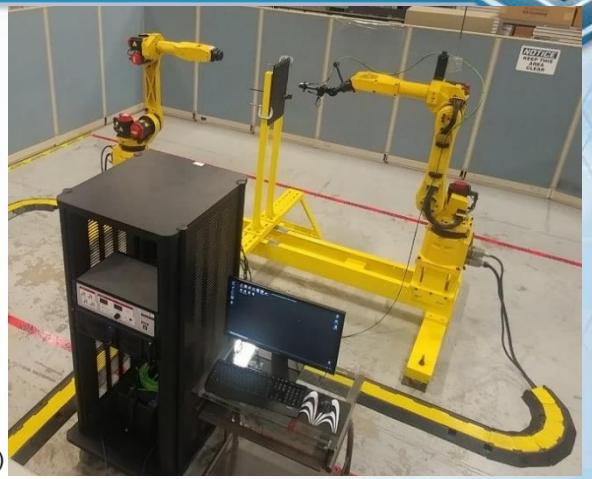
Completed [ ]
Pending [ ]

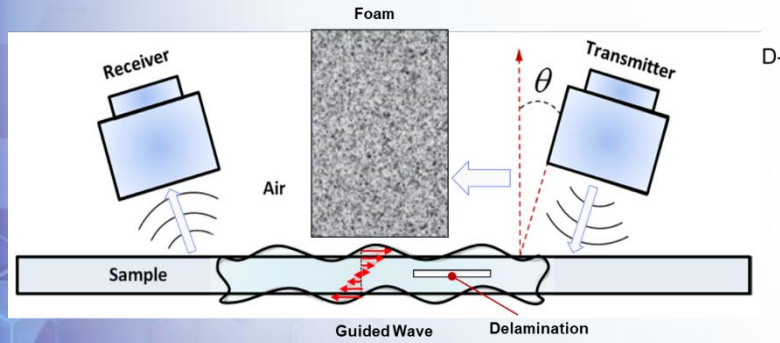
Property / Material Descriptor	Characterization Method	Relevant Standard	ASTM links	Number of repetitions per material direction or condition	Characterization Level	Group to deliver data
Tg	DMA	ASTM D7028	https://www.astm.org/Standards/D7028.htm	1	bulk	UTK – Mat Group
Tg	DSC	ASTM D3418	https://compass.astm.org/download/D3418.37472.pdf	1	bulk	UTK – Mat Group
Fiber orientation distribution	Optical Microscopy or CT scan			3	bead	Local Motors
Void content	Optical Microscopy or CT scan			3	bulk	Local Motors
Elastic modulus - E1, Poisson's ratio - ν13, Tensile strength - X1	Tensile test and DIC	ASTM D3039	https://www.astm.org/Standards/D3039	10	bead	Local Motors
Elastic modulus - E2, Poisson's ratio - ν12, Tensile strength - X2	Tensile test and DIC	ASTM D3039	https://www.astm.org/Standards/D3039	10	bead	Local Motors
Elastic modulus - E3, Poisson's ratio - ν13, Tensile strength - X3	Tensile test and DIC	ASTM D3039	https://www.astm.org/Standards/D3039	10	bead	Local Motors
Shear moduli - G12, G13, Shear Strength X12, X13	V-Notched beam method	ASTM D5379	https://www.astm.org/Standards/D5379	10	bead	Local Motors
Coefficient of thermal expansion as a function of temperature - α1 (T), α2 (T), α3 (T)	Thermomechanical analysis (TMA) or DIC method	ASTM E831	https://www.astm.org/Standards/E831.htm	3	bead	UTK – Mat Group
Relaxation curves for E1(t,T), E2(t,T), E3(t,T) at multiple temperatures	Stress relaxation experiments - DMA equipped with 3-point bending fixture		-	3	bead	Local Motors
Thermal conductivity as a function of temperature - K1(T), K2(T), K3(T)	Flash method	ASTM E1461 &	https://www.astm.org/Standards/E1461.htm	2	bead	Local Motors
Heat capacity as a function of temperature - Cp(T)	Differential Scanning Calorimetry (DSC)	ASTM E1269	https://www.astm.org/Standards/E1269.htm	3	bulk	Local Motors

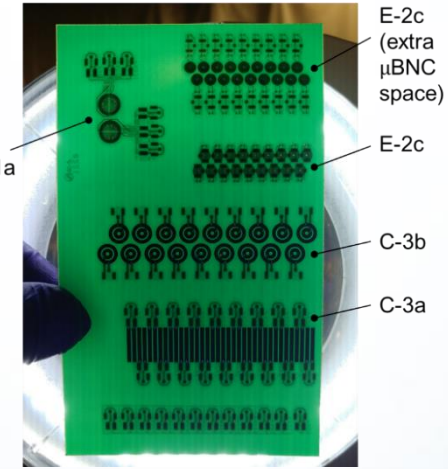
Material card generation. Methodology for developing test specimens and measuring properties completed, and material cards for many commercial systems now available. Physical properties, including thermal conductivity and rheology are also measured and included in process simulation.

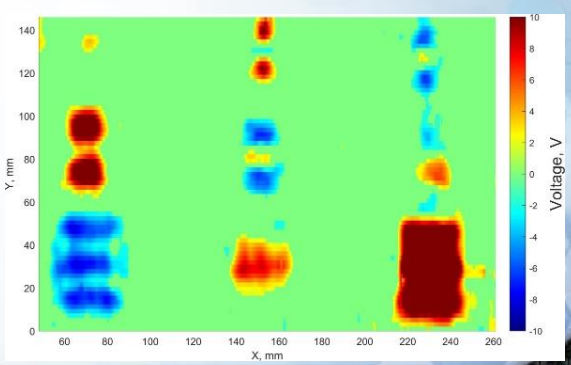
High Speed NDE of Carbon Fiber Composites











Seven Years of IACMI Recycling Innovation

2016

Composite Recycling Technology Center Port Angeles, WA opening and MOU signing ceremony

2016-2017-2018

IACMI Composite Recycling Roadmapping Workshops

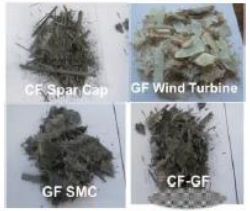
2015 →2020

Participate conference panels, support various CAMX, SAMPE, ACMA, Sustainability Coalition 2015-2020

2015 →2020

Published journal papers and selected for cover page of "Recycling" journal for June 2019

2015 →2020



8 IACMI Recycling Projects with total of 30 industrial collaborators

2015

IACMI and ACMA have entered into a partnership agreement.

2016

Manufacturing Thermoplastic Wind Turbine Blade
Wind Technology Center-NREL

2015 →2020

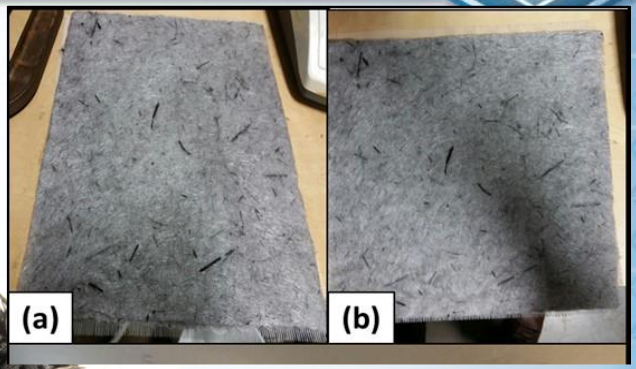
Numerous engineer interns trained in composite recycling

2019

IACMI SURF Facility injection molded the *automotive fender using recycled carbon fiber reinforced PA6*

Related industrial partners

Seven Years of IACMI Recycling Innovation

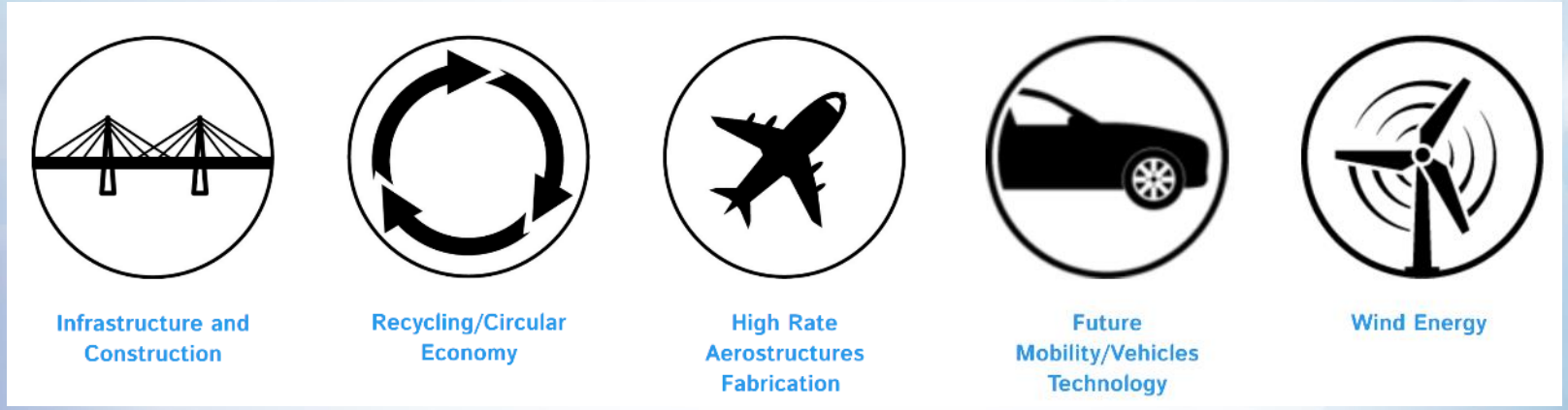


April 27, 2021

Braskem Launches Carbon Fiber Reinforced Polypropylene Filament for Additive Manufacturing

Morgan County Composite Bridge

IACMI Working Groups



In-person Working Group meetings this week, attendance of approximately 100 at each meeting

Innovation Insights Monthly Webinar Series

- Monthly engagement webinars highlighting new products, services & innovations from IACMI industry members and core R&D partners

Next edition Monday July 18

IACMI's Workforce Development

Serving Workforce Needs

100+ Internships with industry collaboration

2,000 Composites training participants

9,000+ K-12 Students engaged in composites training & STEM outreach

100% IACMI interns who graduated with a job offer in industry or acceptance into a graduate program

accp™ BY IACMI — Advanced Composite Career Pathways

SkillCrafters™ BY IACMI

ACE — AMERICA'S CUTTING EDGE

LinkedIn LIVE
COMPOSITES TECH TALKS
Powered by Composites One & IACMI

ACE Talks — ace America's Cutting Edge

iacmi INSTITUTE | RAPID™ Transforming Process Industries | REMADE INSTITUTE

CAREERS IN CLEAN ENERGY INNOVATION:

COMPOSITES ONE®

ClosedMold Alliance
Composites One • MVP
RTM North Technologies

iacmi INSTITUTE

MVP
MAGNUM VENUS PRODUCTS

Building the Future

Hayley Coughlin

Orbital Composites
Marketing Specialist

2018 and 2019 IACMI Intern

Andrew Muno

Cabot Microelectronics
Research Associate

2017 IACMI Intern

Jordan Langness

Northrop Grumman
Engineer

2018 IACMI Intern

William Henken

Univ of TN, Knoxville
2020 Volkswagen Fellow

2016, 2018, & 2019
IACMI Intern

Casey Nichols

National Renewable Energy Lab
Research Engineer

2018, & 2019
IACMI Intern

Over 100 intern appointments and 100% placement rate within 6 months of graduation!

Revitalizing American Manufacturing

- In 2020, **DoD established a national testbed for ACE** for research, technology advancement, training and workforce development
- Combines scientific expertise of **Oak Ridge National Laboratory**, the research and teaching expertise of **The University of Tennessee**, Knoxville, and the workforce development leadership of **IACMI**

Conducts research to:

- **Increase efficiency** of existing machine tools
- **Develop skills & training** for next generation machine tools for composites and metals
- **Establish tools to rapidly train** the next generation of machine tool designers and operators

Revitalizing U.S. Manufacturing

- **IACMI-managed ACE training addressing critical workforce skills gab**

ACE
AMERICA'S CUTTING EDGE

Reestablishing U.S. leadership in machine tool industry

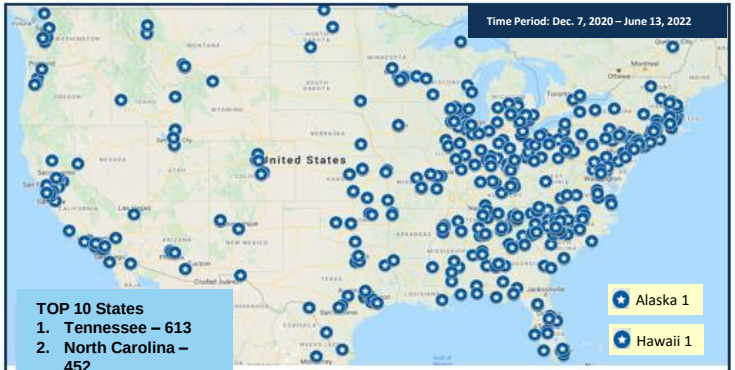
IBAS
Industrial Base Analysis and Sustainment Program

THE COMPOSITES iacmi INSTITUTE

OAK RIDGE National Laboratory

THE UNIVERSITY OF TENNESSEE KNOXVILLE

ACE CNC Machining Training – Online Registration

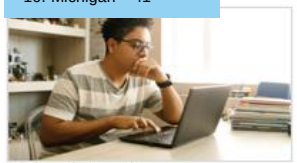


TOP 10 States
1. **Tennessee – 613**
2. **North Carolina – 452**
3. **Ohio - 87**
4. Florida – 69
5. Alabama – 63
6. Texas – 57
7. Illinois – 55
8. California – 52
9. Pennsylvania – 52
10. Michigan – 41

Since December 2020:

2471 ONLINE PARTICIPANTS

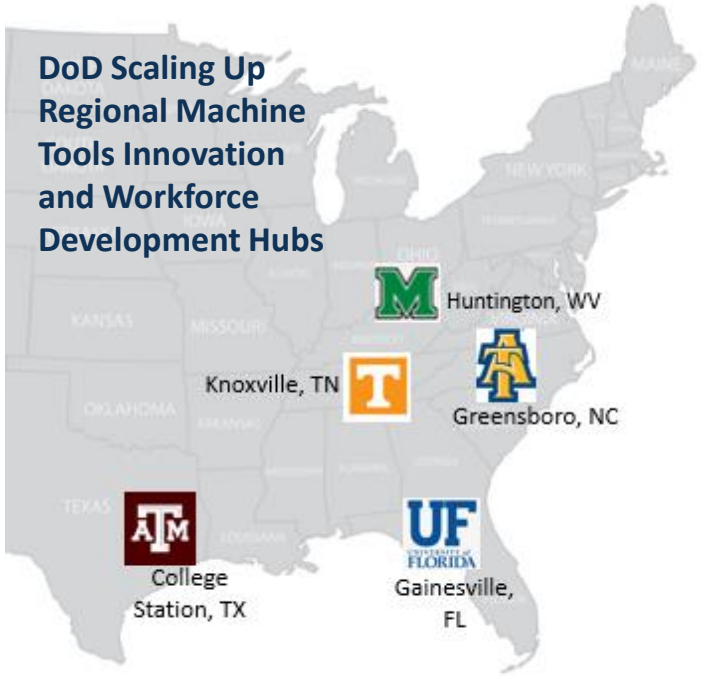
IN **50** STATES



Launched 12/7/2020

Emerging National Network of ACE Training Centers

DoD Scaling Up Regional Machine Tools Innovation and Workforce Development Hubs



Since the last Members Meeting…

- Completed all project work under original DOE Cooperative Agreement
- Added 15 new members to the IACMI Consortium (5 of them presenting today in the SME session)
- Opened a new funding stream from the Resource Pool using a portion of member dues
- Returned to promoting IACMI at in-person events, including CAMX, CW Carbon Fiber, DMC, SAMPE Executive Forum, ACMA Thermoplastics Forum, JEC World, SAMPE Charlotte
- Restarted in-person workshops with Composites One and the Closed Molding Alliance
- Expanded the ACENet project to NC A&T and Texas A&M, and added spokes to the existing UTK hub. Now expanding to two additional hubs.

What Comes Next?

- IACMI has completed our original DOE Cooperative Agreement , meeting and exceeding the original targets.
- We have won other contracts with DOE, DOD and NASA that take advantage of IACMI's vast network of core partner assets, expertise and talented workforce development team.
- Facilities and expertise have been and continue to be used for privately funded projects.
- Since 2015, many aspects of the marketplace have changed. As of June 1, IACMI has been invited by DOE to start the process for renewed large-scale funding of the Institute, focused on today's clean energy and decarbonization priorities.

Featured Speakers

Adele Ratcliff
DOD, IBAS Director

Domestic Manufacturing as a Matter of National Security

Dr. Diana Bauer
DOE, Acting Deputy Director AMO, EERE

DOE Priorities in Clean Energy, Decarbonization, Energy Justice and DEI

Dr. Zachary Valdez
NIST Manufacturing USA

Coordinating DEI at All Levels, Government, Industry & Academia

Jeff Sloan, Editor
CompositesWorld

Opportunity & Challenge – Sustainability in Composite Materials and Processes

Marcy Offner, Director Marketing Communications Composites One

Women in Composites Panel: *Providing Resources to Women in All Stages of Their Career*

Diversity, Equity and Inclusion in Our Industry

Marcy Offner
Composites One & Co-founder of Women in the Composites Industry

2:00 pm

Discussion Leader:
Women in Composites
Panelists:

- Dr. Merlin Theodore, ORNL
- Dana Swan, Arkema
- Rani Richardson, Dassault Systémes

As co-founder of *Women in the Composites Industry*, Marcy is giving voice to women that are breaking the mold and making an impact as leaders, researchers and plant managers in the composites industry.

Dr. Merlin Theodore
Oak Ridge National Laboratory

Dana Swan
Arkema

Rani Richardson
Dassault Systémes

Networking Reception @ Natural History Museum of Utah

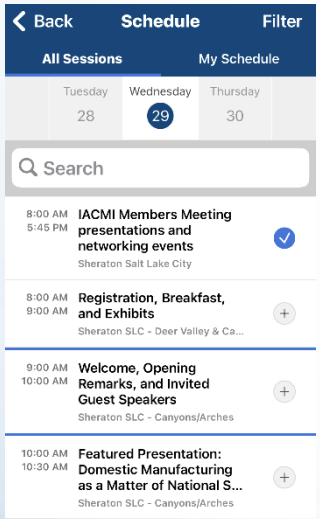
Wednesday, June 29 | 6:30 – 9:00 pm

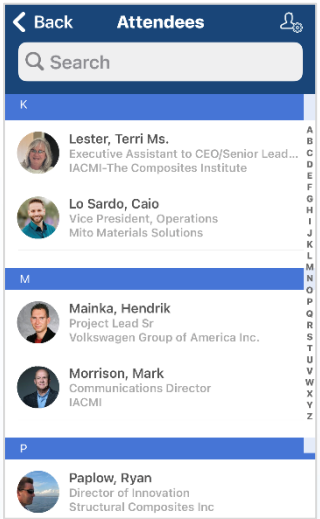
View of South Terraces

Sky Terrace

Tap The App

Make the most of your Members Meeting experience and download the "IACMI" app from your app store.
https://crowd.cc/iacmism22





Thank You to Our Partner & Sponsors!