IACMI Wind Technology Area / CoMET Capabilities

IACMI Summer Members Meeting: Salt Lake City, UT

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IACMI Wind TA / CoMET Location: NREL Flatirons Campus

CoMET

The Flatirons Campus hosts the IACMI Composites Manufacturing, Education, and Technology (CoMET) facility leading composite research for renewable energy. The CoMET is:

- Accelerating the manufacture of advanced wind turbine components
- Driving composites science and education
- Demonstrating research for the Manufacturing USA Institute for Advanced Composites Manufacturing Innovation (IACMI)
- Providing a real-world classroom to educate tomorrow's highly trained advanced composites workforce
- Partnering with research universities and industry.

Areas of Expertise

- Rapid prototyping of new blade materials and production methods
- Full-scale blade component tooling and fixtures (root, spar cap, tip, shear web)
- Modeling and manufacturing simulation

CoMET Facility Timeline: Capabilities and Projects

Capabilities

2016

CoMET Facility Established at NREL Flatirons Campus

2017

Cranes, Composite Processing Equipment, Resin Mixing Machines, Wind Blade Tooling

CoMET Team: Composite Engineers and Technicians

2018

Full-Scale Megawatt Blade Components

Eastman Automated Fabric Cutter

2019

DOE AMO/WETO – SNL/ORNL – TPI 3D Printed 13m Blade Mold

Blade Root Drilling System

2020

JR Automation Fanuc Robotic Arm

Advanced Material Validation Load Frames

2021

Kuka Industrial Robot with Gudel Robotic Track

2022

Research Projects

Thermoplastic Resin Systems

Thermal Welding

Vertical Axis Blades: Thermal Forming

Blade Manufacturing Optimization

Pultruded Carbon Fiber Spar Caps

3D Printed Washout Tooling

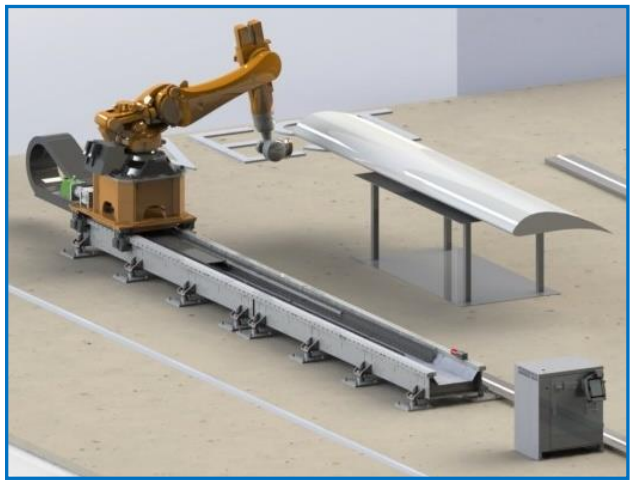
Verdant MHK Blades

Blade Finishing Automation

Bio-Resin Development

AMO FOAs: 3D Printing of Blade Structures

AMO Advanced Automation Research



Advanced Manufacturing and Materials

Exploring the use of innovative materials and manufacturing processes to develop lighter, stronger, more cost-effective wind turbine blades and components that are easier to recycle.

Materials Research and Applications

Exploring materials and techniques that reduce costs and enable advanced designs for renewable power generation and transportation

Manufacturing Processes at Scale

Helping manufacturers find the most energy-efficient and sustainable solutions for their products and processes

Manufacturing Optimization, Onsite and Modular Manufacturing

Enabling onsite manufacturing and lighter blade structures to achieve lower levelized cost of energy (LCOE)

Recycling and Reuse

Developing novel materials that are manufacturable and recyclable by design—and enabling recycling of existing composite structures

Recycling and Reuse

- NREL is researching innovative recycling solutions for composite materials, including for both existing thermoset and future thermoplastic wind turbine blades.
- Employing a thermoplastic resin system, including the use of thermal welding to bond blade components, will enable longer, lower- cost, recyclable wind turbine blades.

Areas of Expertise

- Thermoplastic material system characterization and processing for wind turbine blades at scale
- Industry collaborations across supply chains
- High-impact, circular-economy research initiatives
- Composite processing and structural validation
- Polymer chemistry for composite materials.


COMET
JLG

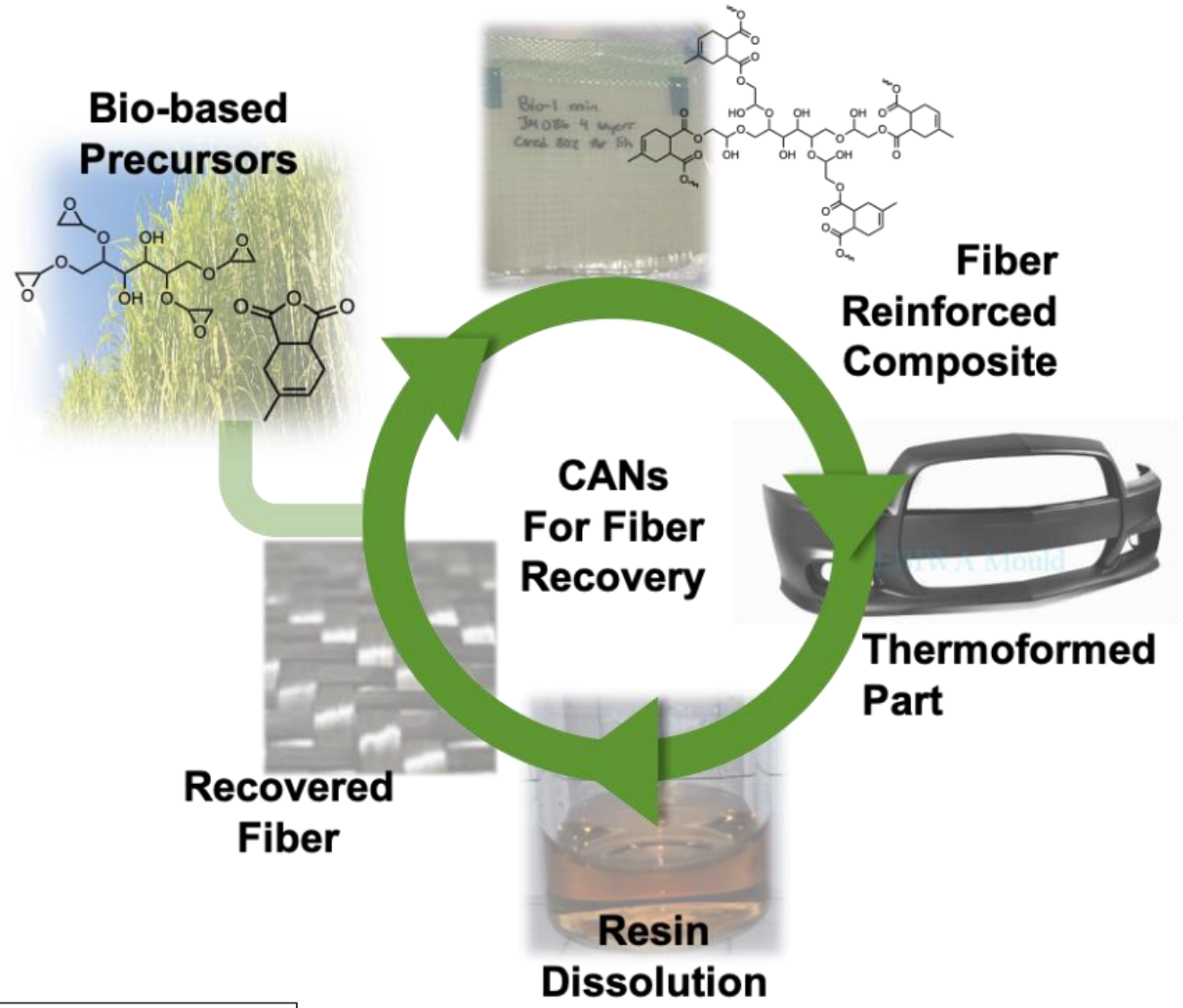
Resins to Enable Decarbonization and Recycling

Impact

- CFRCs can light-weight vehicle parts up to 60%–70%, but the cost of carbon fiber (CF) remains very high and CFRCs can undergo mechanical failure due to brittleness.
- By developing resins that can undergo exchange reactions, CFs can be recycled, and thermomechanical properties can be modulated.
- By leveraging bio-based starting blocks, this work has the potential to decarbonize the processes associated with vehicle part manufacture, especially in the second life of materials and beyond.

Objective

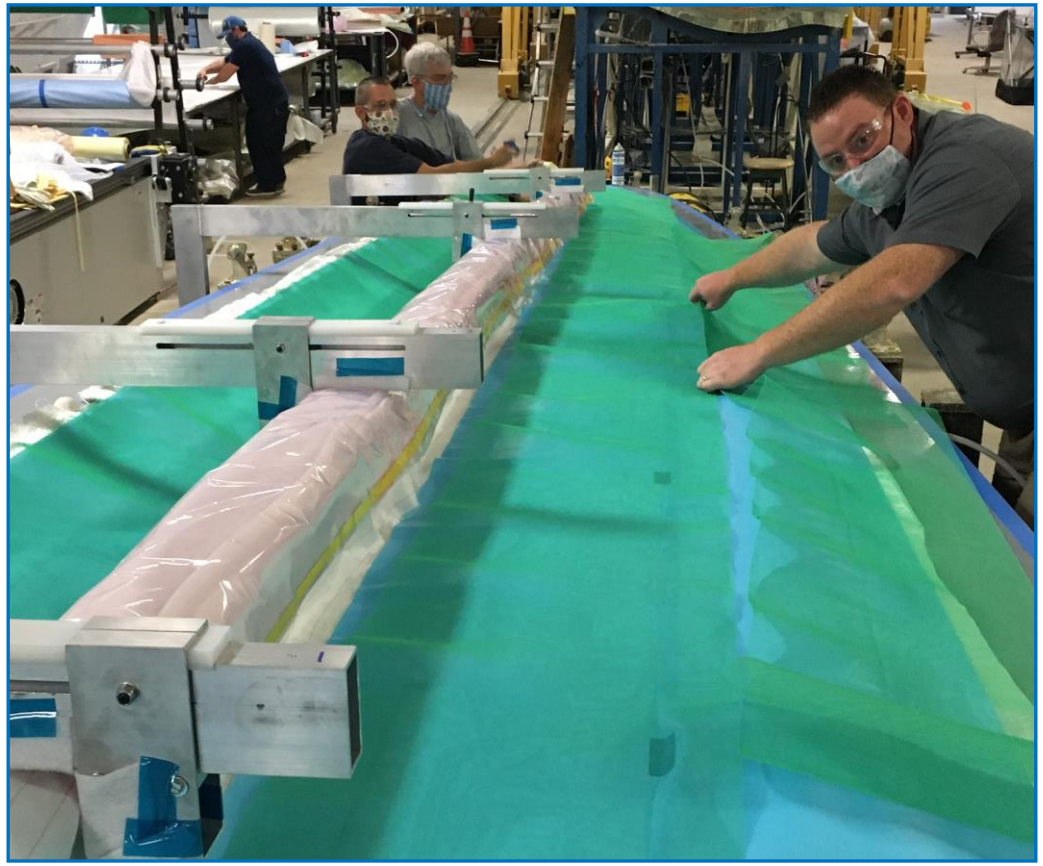
- This work aims to produce recyclable-by-design CFRCs that leverage a bio-derivable epoxy-anhydride covalently adaptable network (CAN) for better material and environmental performance.



Slide from Nicholas Rorrer: 2022 DOE Vehicle Technologies Office Annual Merit Review
Bio-Based, Inherently Recyclable Epoxy Resins to Enable Facile Carbon-Fiber-Reinforced Composites Recycling

Wind Blade Manufacturing: Opportunities for Cost Improvements

- DOE AMO / IACMI funded research to develop techno-economic modeling of wind turbine blade manufacturing to identify innovation design for cost improvements
- Advanced blade design and manufacturing: shear web and blade skin co-infusion
- Reduced cycle time and blade manufacturing costs
- Demonstrated repeatability of process and shear web bond quality



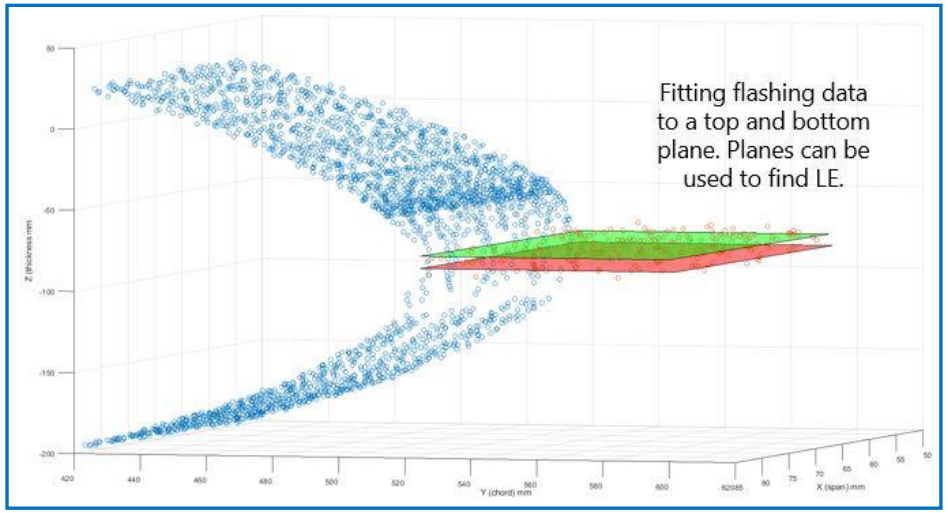
Source: NREL

Manufactured three GE 56.9-meter blade tips at NREL's COMET facility

Automated Composite Finishing Research at the CoMET

Innovative research at the CoMET is appealing to industry partners because it offers a safe way for at-scale research in factory-like conditions without impacting production operations

- Funded by DOE AMO, developed foundation of automated solutions for composite finishing processes
- Application for large structural composites, including wind turbine blades, marine-hydrokinetic devices, vehicles, aerospace, etc.
- Research and development has targeted flash trimming, surface grinding and sanding, non-destructive inspection (NDI), and coating application
- New technology will reduce costs and embodied energy for very large composite structures, including wind blades up to and over 100 meters in length
- CoMET capabilities enable broad range of future industry-connected automation research for composites manufacturing



GE Renewable Energy

LM WIND POWER
a GE Renewable Energy business

JR AUTOMATION

The Composites iacmi Institute

NREL
National Renewable Energy Laboratory

OEDIT CO COLORADO
Office of Economic Development & International Trade

Structural Research Facilities

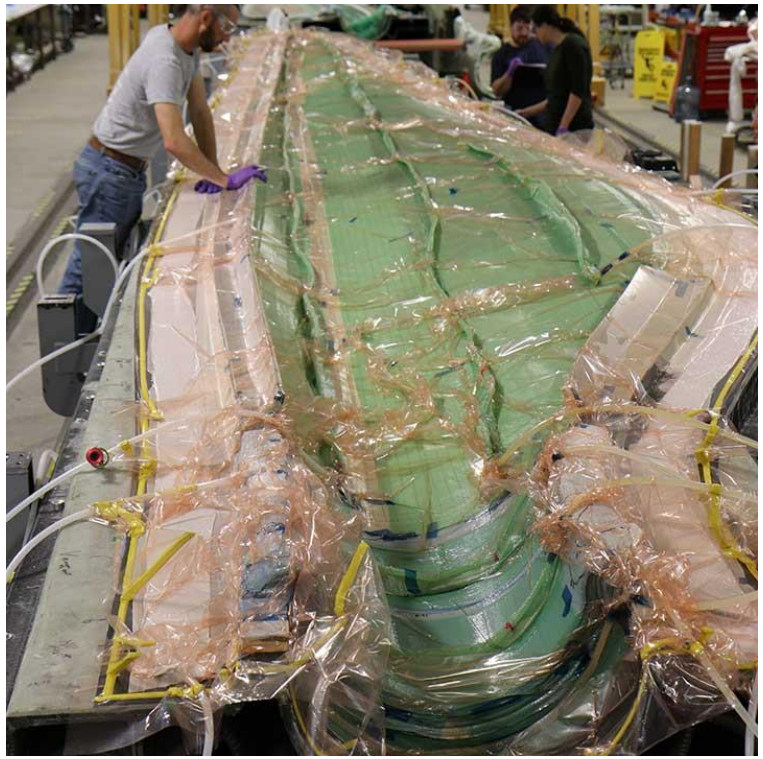
- NREL helps verify and improve new component designs, analyze structural properties, and improve manufacturing processes.
- State-of-the-art equipment and data acquisition systems are capable of validating blades and components from 1 meter to 50+ meters in length.
- Three structural research facilities offer 1,800 square meters of laboratory space that share servo-hydraulic control and actuation equipment.
- Accredited to IEC 61400-23 for wind turbine blade research.
- NREL combines custom data acquisition software tailored for static strength and fatigue validation with a data acquisition system capable of recording hundreds of data channels.

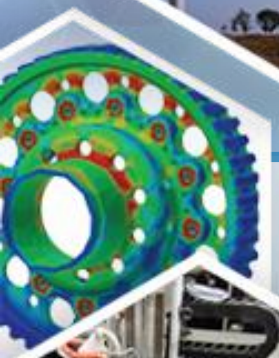
Areas of Expertise

- Experimental design and performance for material and structural validation
- Composite multiscale validations
- Composite performance characterization.

13-meter Thermoplastic Blade Validation at NREL

- Existing 13m blade design, 13m blade mold set, validation data on 13m epoxy blade
- Compare 13m thermoplastic blade to identical geometry thermoset epoxy blade




Thank you

IACMI Wind Technology Area

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