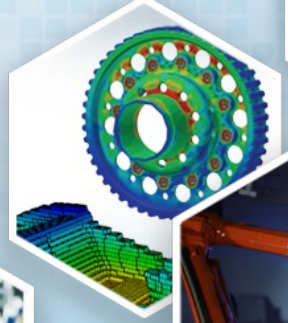
High Rate Aerostructures Fabrication

Meeting Summary

[Brian Rice, Eric Lang, UDRI
Andy Stough, Windlift]

June 21, 2023



THE COMPOSITES iacmi INSTITUTE

High Rate Aerostructures Fabrication Working Group Agenda

10:00 – 10:20	Brian Rice, UDRI Working Group Updates and Review, Project Focus Areas
10:20 – 10:40	Eric Lang, UDRI; Overview of Airborne Wind Energy (AWE)
10:40 – 11:10	Andy Stough, CTO Windlift; Airborne Wind Energy Opportunities and Challenges
11:10 – 11:30	Project discussions with attendees in support of AWE composite structures.

We are always looking for active WG members!
Contact: brian.rice@udri.udayton.edu

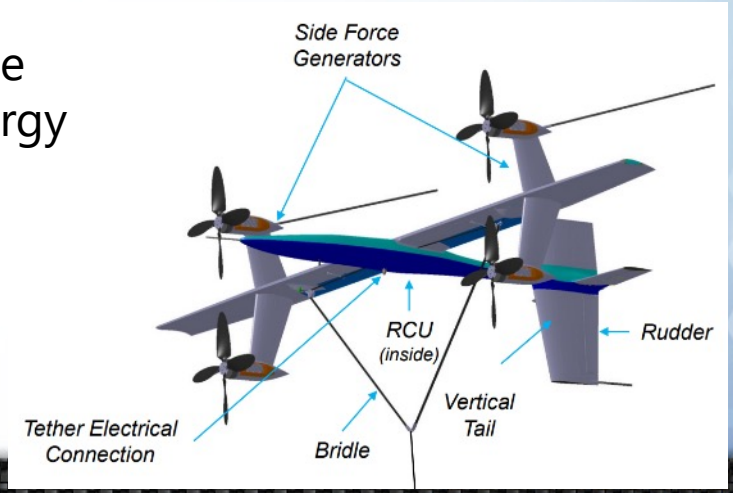
High Rate Aerostructures Application Areas

Build rates of 1000+/year
Leverage common materials
Leverage supply chain
Requires light weight/low cost

Collaborative Combat Aircraft

Advanced Air Mobility

Airborne Wind Energy



House Bill 3560: National Drone and Advanced Air Mobility Research and Development Act

Approximate funding level over 5 year period $1B.

MANUFACTURING USA PROGRAM.—The Director, through the Manufacturing USA Program, shall prioritize research, development, and demonstration activities to enhance and grow the domestic manufacturing capacity of unmanned aircraft systems and components. Such activities may include— (1) rapid-prototyping and reproduction of unmanned aircraft systems structures; (2) additive manufacturing to improve capabilities to produce large tools, dies, and molds for unmanned aircraft systems and components; (3) testing innovative manufacturing processes and manufactured components to improve safety, endurance, and quality of unmanned aircraft systems; (4) development of software to streamline fabrication and integration of manufacturing components, such as sensors for use in unmanned aircraft systems.

House Bill: To provide for a coordinated Federal initiative to accelerate unmanned aircraft systems civilian and advanced air mobility research and development for economic and national security, and for other purposes.

TITLE VI—DEPARTMENT OF ENERGY ACTIVITIES

(D) materials science and engineering; and novel materials, including lightweight and radiation-resistant materials;

(g) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Department to carry out this section—

(1) $50,000,000 for fiscal year 2024;

(2) $52,500,000 for fiscal year 2025;

(3) $55,125,000 for fiscal year 2026;

(4) $57,881,775 for fiscal year 2027; and

(5) $60,775,863 for fiscal year 2028

Advanced Air Mobility Updates

Joby Completes Second stage of eVTOL Certification Process
Joby received $55M purchase order from Air Force for 9 aircraft.

https://www.compositesworld.com/news/joby-completes-second-stage-of-evtol-certification-process

John S. Langford, III; Founder and CEO of Electra.aero
Hybrid-Electric Airplanes with Human, Gas Turbine, and Fusion Power
SAMPE keynote speaker April 2023

Why Airborne Wind Energy - Synergy with AAM

Airborne wind energy (AWE) is “the conversion of wind energy into electricity using tethered flying devices” (Schmehl 2020.)

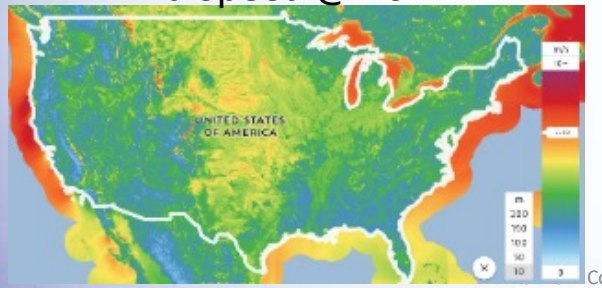
Technical Report NREL/TP-5000-79992 August 2021

- Near-Term – Years 1 to 4: Initiate Fundamental Research and Plan for Commercialization
- Midterm – Years 3 to 10: Evaluation Campaigns and Research To Accelerate Technology
- Long Term – Years 6 to 10: Technology Advancement and Fundamental Research

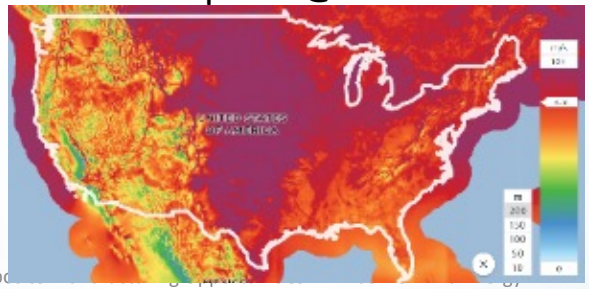
Wind Turbine Composites Market and Technical Drivers

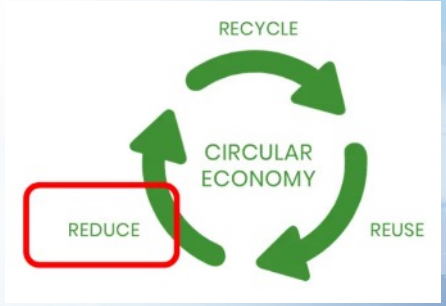
- The global wind turbine composite materials market is expected to be valued at **USD 12 Billion** in 2022 and secure **USD 25.4 Billion** by 2032.
- The projected market growth is **7.14%** during the forecast period from 2022 to 2032.
- The growing application of **carbon fiber** is expected to act as a significant market driver during the forecast period.
- **Airborne wind energy is forecast to follow a similar and more rapid growth trend**
  - No tower and little foundation yet higher altitude with more wind for lower cost of energy
  - Much smaller blade without sacrificing swept area for more energy production

Wind Speed @ 10m



Wind Speed @ 200m





A NEW APPROACH TO OFFSHORE WIND

Windlift

Relative to Conventional Fixed Bottom Offshore Wind:

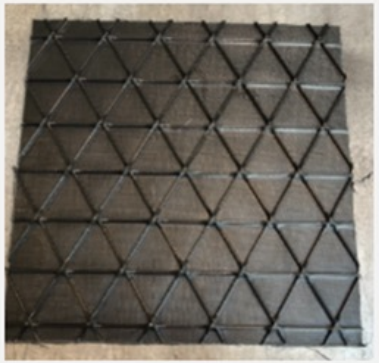
- 50% reduction in LCOE at maturity
- 90% less steel
- 93% less carbon fiber
- 96% less rare earths
- All components transportable in 40-ft containers

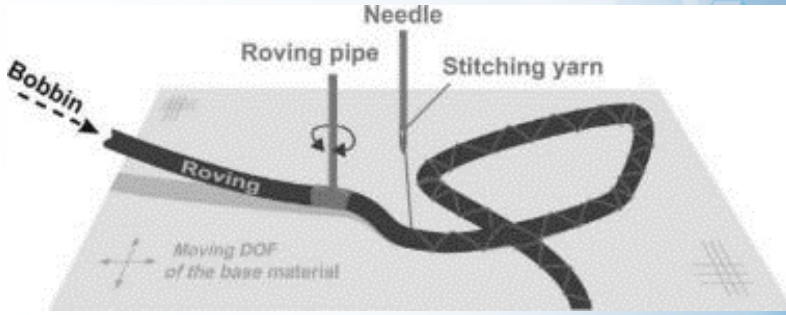
Composites for Airborne Wind – Parts and Technologies

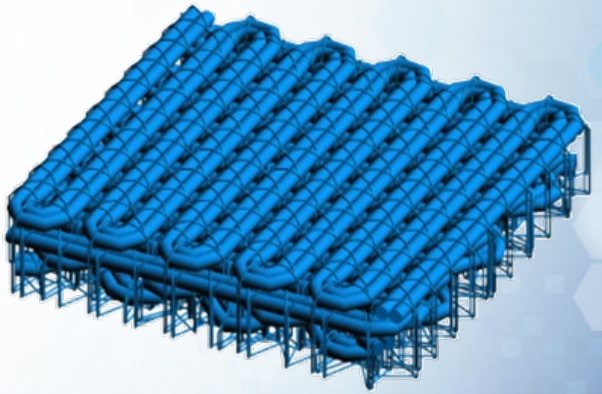
- Demonstrate technologies applicable to drones and eVTOL on a potentially much larger market!
  - Advanced prepreg systems
  - Snap cure epoxy resin systems
  - Recyclable thermoplastic resin systems
  - Ultrasonic forming, bonding, repair
  - Tailored fiber placement
  - Low-cost tooling
  - Advance resin infusion technology
  - Advanced design methods
  - Materials recycling technologies
  - RapidClave®

Capability: Advanced/Agile Manufacturing

Tailored Fiber Placement



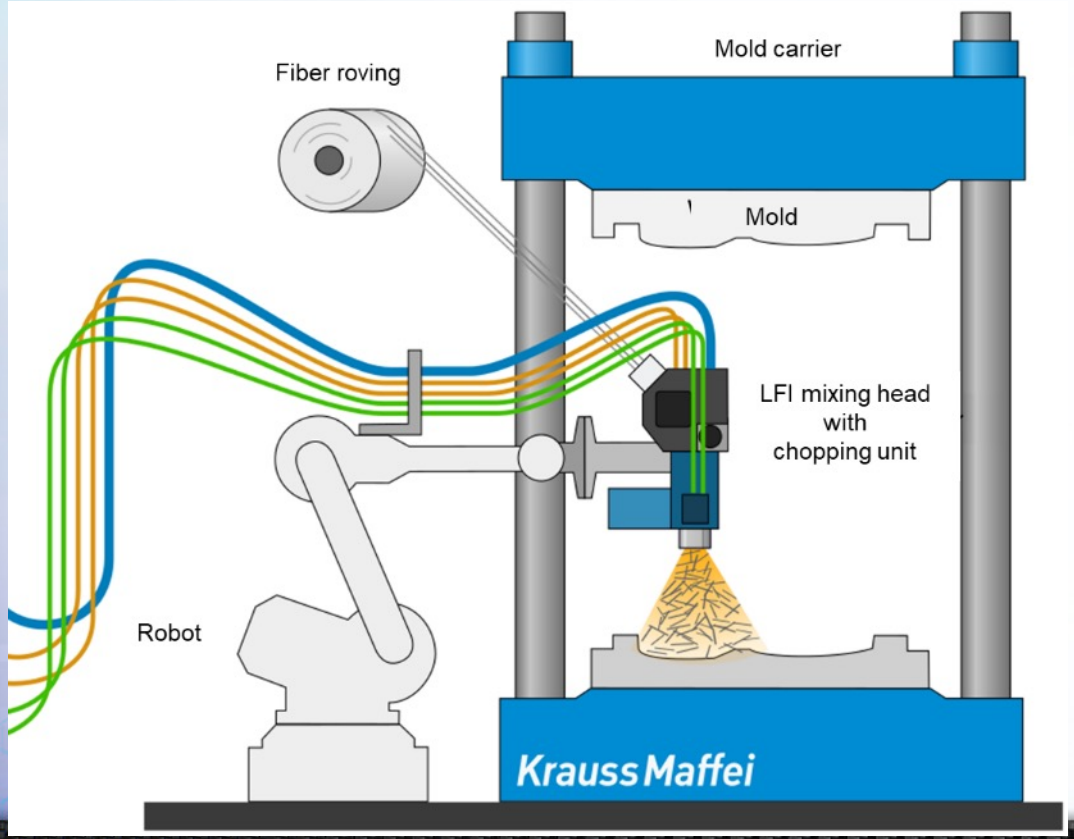




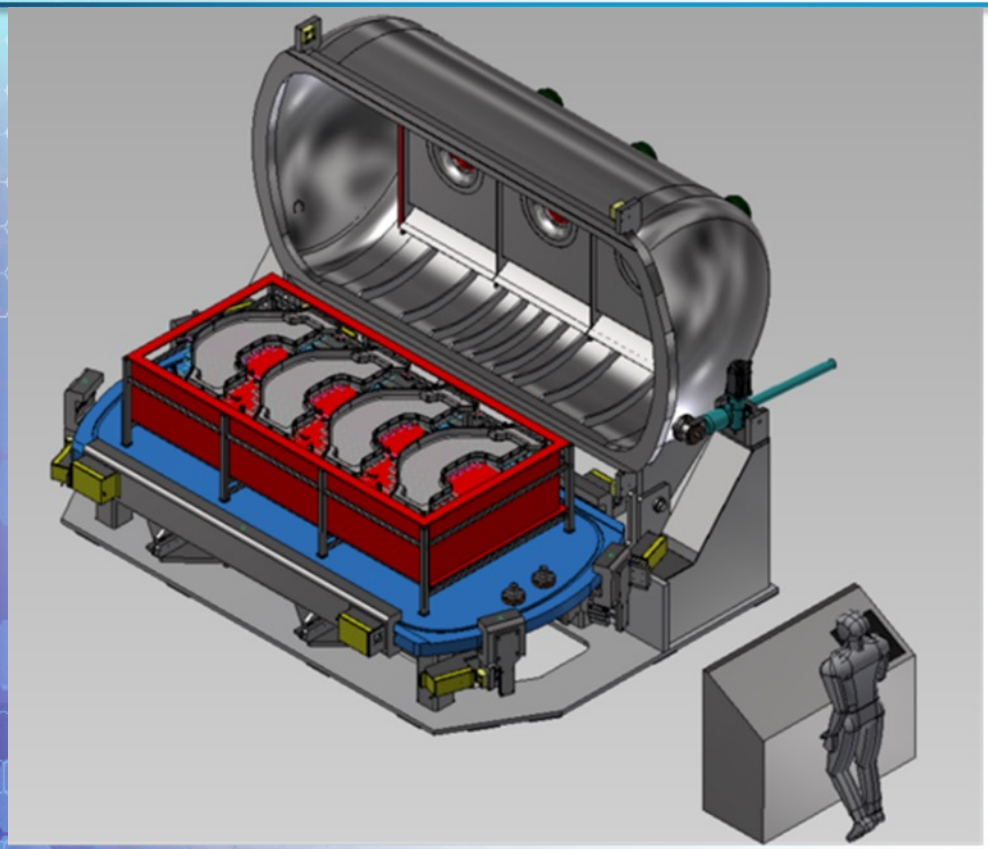
LFI Technology – Long Fiber Injection

Krauss Maffei technology

*Coming soon to DCC



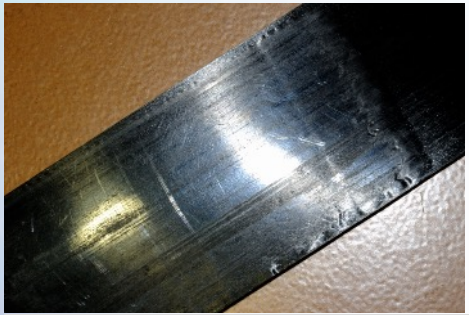
RapidClave® Processing



New RapidClave® with enhanced thermal control, energy saving features, and 5’ x 10’ size to be installed at UDRI spring 2024. Sponsored by Air Force under TARMACS program. Equipment available for industrial projects.

Adaptable Ambient Joining Systems for Tape, Braid & Preform TP's

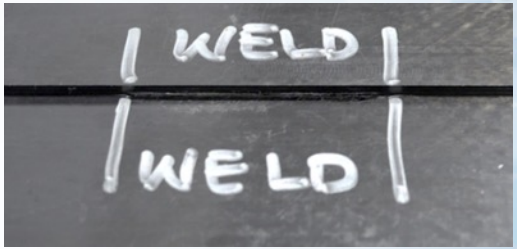
Ply By Ply Consolidation

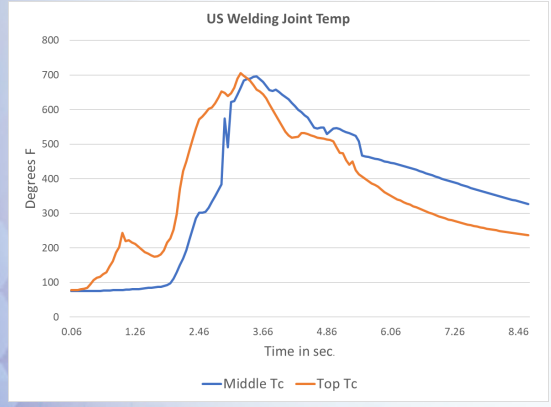


Braid Consolidation

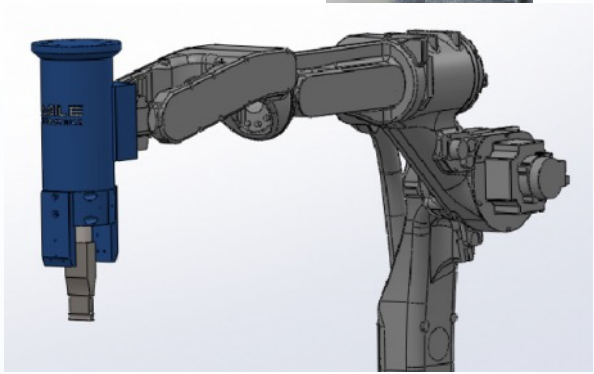
Butt Weld

Joining Preform Components





Through Thickness Temperature Control



Robotic Head

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