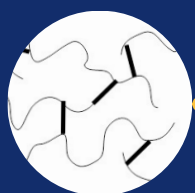


# Wind Turbine Blades

## End-of-life Challenges Pathways to Solutions

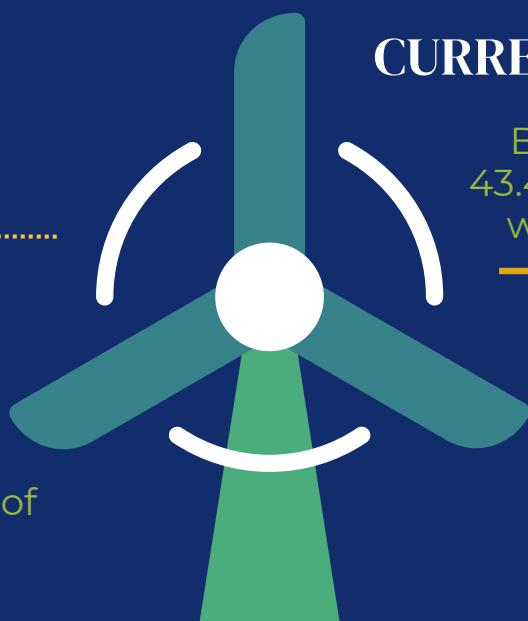
Cross-linked polymer matrix made of **reinforced glass fibers**



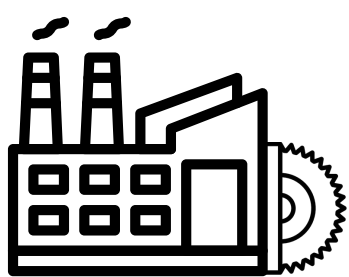
Durable, rigid structures **limit** repurposing and recyclability of turbine polymers

### CURRENT CHALLENGES

By 2050, an estimated 43.4 Mt of turbine blades will be retired globally<sup>1</sup>



### CURRENT RECYCLING SOLUTIONS



#### Mechanical processing

- ✓ Maintains chemical properties
- ✓ Established infrastructure and high technological readiness

- ✗ Small scale
- ✗ Dust pollution

**Applications:**  
Milled wind turbine waste can be made into composite panels



#### Chemical processing

- ✓ Efficient recovery of glass and carbon fibers
- ✓ 90 - 100% recovery of source material<sup>2</sup>
- ✓ ↑ circularity and ↓ carbon solution<sup>2</sup>

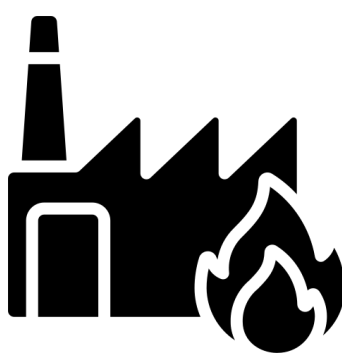
- ✗ High cost
- ✗ Low technological readiness
- ✗ Energy intensive<sup>2</sup>

**Applications:**  
Produce useful chemical and recovery for a circular process

#### Pyrolysis

- ✓ ↓ Damage of glass and carbon fibers
- ✓ High technological readiness

- ✗ Energy intensive
- ✗ Low circularity<sup>3</sup>
- ✗ Low recovery yields<sup>3</sup>



#### Thermal processing

**Applications:**  
Generate fuels for energy and produce valuable fibers

#### Combustion

- ✓ High technological readiness
- ✓ Composites can be turned into energy and fibers<sup>3</sup>

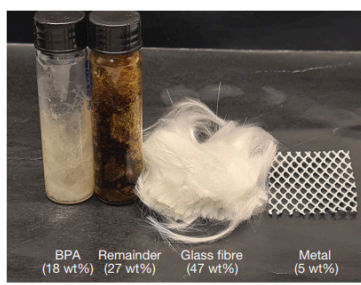
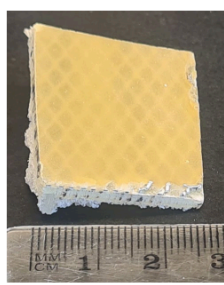
- ✗ Low combustion efficiency
- ✗ Toxic gas emissions

### EMERGING SOLUTIONS -CHEMICAL RECYCLING APPROACH

#### Oxidative Liquefaction<sup>4</sup>



#### Transition Metal-catalyzed Method<sup>5</sup>



Researchers have developed a way to disconnect the bonds between carbon and oxygen to recycle thermoset epoxy resins from wind turbine blade shells.

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### GROUP 10

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