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Scaling Recyclable and Dynamic Thermosets: From Beaker to Wind blade and Beyond

Today's composite materials are necessary to continue our renewable energy transition. From the composites used for wind turbines to those used in lightweight vehicles, these materials are robust, lightweight, and easy to manufacture.

Despite their prolific use, these materials often use intensive chemical intermediates, may use cost prohibitive carbon fiber, and often are unable to be recycled. Taken together, these materials contribute to growing energy, climate, and waste concerns; thus, it is necessary to redesign these materials to come from sustainable feedstocks and to be recyclable. However, just implementing recyclable and bio derivable materials is not enough, the manufacturing and performance requirements of these materials must be considered at multiple scales.

This work will focus on the key requirements of implementing bio derivable and recyclable materials, namely epoxy-anhydride chemistries referred to as polyester covalently adaptable networks (PECANS), into multiple applications. Furthermore, TEA and LCA analysis will demonstrate the tremendous opportunities in this approach while providing information for future directions.