Plastics in use today are predominantly single-use and rarely recycled. The linearity of their lifecycles is not only wasteful from a resource and energy perspective, it has also resulted in >6 billion metric tons of plastic waste discarded in our terrestrial and aquatic ecosystems, where the ensuing environmental stresses have reached a tipping point. The goal of this project is to elucidate design rules by which lifecycles for plastics become circular and therefore sustainable. We will focus our efforts on a new class of dynamic covalent polymer networks, known as vitrimers, which combine the processing and recycling ease of thermoplastics with the performance advantages of thermosets. Vitrimers are readily formulated, compounded, molded, extruded, coated, and blown to yield recyclable adhesives, thermosets, composites, films, coatings, and foams. Vitrimer manufacturing processes typically are conducted ~10-times faster and at ~5-times lower cost than those for conventional thermosetting plastics, e.g., by obviating long-cures in autoclaves. In this project, we will mature our team's unique bio-vitrimer platform from its current baseline of 38% bio-content, 80% recyclable content, and 0% recycled content to end-of-project targets of >75%, 95–100%, and 60–80%, respectively. We aim to commercialize the technology through customer discovery, cooperative research and development agreements, and ultimately licensing agreements with brands that promote UC manufacturing in markets as diverse as environmentally benign packaging for food and beverage, waste-free consumer electronics, ultra-light-weight vehicle and aircraft parts, fast through-cure manufacturing of wind turbine blades, and materials for energy-efficient buildings through regenerative chemistry.