Growing the nation’s bioeconomy

ORNL’s bioenergy technologies research brings together experts in agricultural economics and engineering, computational science, environmental science, fuels and engines technology, materials science, and synthetic biology. Researchers work closely with partners in industry, other federal agencies, and academia to ensure analyses and technologies are relevant and scalable to support the nation’s growing bioeconomy. Focus areas include the following:

Quantifying sustainable biomass resources—We lead comprehensive resource assessments known as the Billion Ton studies to inform decision makers about opportunities to advance sustainable use of biomass resources locally, regionally, and nationally. We apply expertise in biomass engineering and logistics to develop national-scale energy crop production strategies that advance best practices and facilitate decarbonization, build rural economies, and strengthen domestic supply chains.

Converting biomass to fuels and products—We develop new catalysts and conversion technologies that increase the efficiency and enhance the economics of producing renewable biofuels and biochemicals. We work with microbes to convert waste carbon sources from biorefineries and other industries into valuable chemicals for use in plastics and a wide variety of consumer products.

Scaling technologies and enabling commercial viability—We apply advanced materials science capabilities to understand causes of wear in production equipment and to evaluate the compatibility of new and existing materials. We collaborate closely with industry, providing computational modeling across scales from the atomic to full-size reactors to optimize processes and boost commercial production.

“We are studying ways to more economically and reliably produce, deliver, and use forest, agricultural, and waste resources to expand the US bioeconomy while preserving ecosystem services.”

—Bioresource Science and Engineering
Group Leader Erin Webb
Recent Impacts

Assessing biomass resources—Leading the fourth in a series of comprehensive national assessments, known as the Billion Ton studies, that provide details on available biomass from a variety of feedstocks, as well as estimated current and future costs as markets grow and promote a robust bioeconomy

Best use of biomass—Developed a new tool to evaluate the best use of national biomass resources to maximize carbon reductions at minimal cost

3D printing with biomaterials—Created biocomposites that have 75% of the strength at 50% of the cost of typical carbon fiber–reinforced plastics used for large-scale additive manufacturing

Studying sustainability—Showed that using less-profitable farmland to grow bioenergy crops such as switchgrass promotes clean energy and boosts biodiversity

Biomass benefits—Quantified and confirmed the significant economic benefits of a thriving bioeconomy on disadvantaged counties in the nation

Converting carbon into chemicals—Engineered microbes in collaboration with LanzaTech and Northwestern University to turn industrial emissions into acetone and isopropanol, chemicals that are the basis of thousands of products, from fuels and solvents to acrylic glass and fabrics

Upcycling plastics—Developed new chemical and biological methods to break down and upcycle mixed plastics into valuable bioproducts

Upgrading ethanol for use in hard-to-electrify sectors—Supported scaling of ORNL-developed technology licensed to Vertimass LLC that converts ethanol into higher-grade hydrocarbons for use in sustainable aviation, marine shipping, and renewable diesel fuels

Addressing industry needs—Leading the DOE Bioenergy Technologies Office’s Consortium for Computational Physics and Chemistry, which leverages modeling and simulation capabilities to help industry optimize processes and resolve technical barriers to deployment

Scaling industrial processes—Provided computational modeling and simulation capabilities, enabling industrial partner Pyran to scale its reactor technology by 1,000 times in a single step

Biobased options for marine shipping—Leading a multi-lab effort to evaluate the use of bio-intermediates as a suitable maritime fuel. Achieved good blend stability of marine fuels when using mixes that contained up to 50% very low sulfur bio-oil

Improving materials—Evaluated biomass processing equipment and developed affordable solutions that decreased equipment wear and provided more consistent feedstock processing