



C3Bio is a U.S. DOE Energy Frontier Research Center

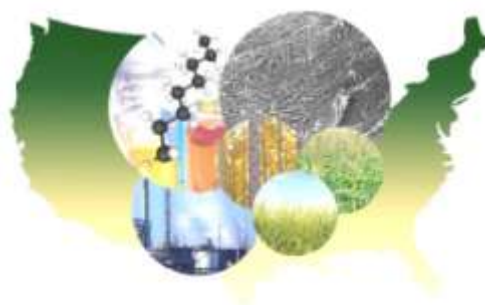


In 2009, the Department of Energy established pioneering Energy Frontier Research Centers to address grand challenges in basic energy sciences. C3Bio develops transformational knowledge and technologies to optimize the energy and carbon efficiencies of conversion of biomass to advanced biofuels, conducting fundamental research for the foundation of a renewable hydrocarbon industry. Our enterprise is integrated among five partner institutions: Purdue University, Argonne National Laboratory, the National Renewable Energy Laboratory, Northeastern University, and the University of Tennessee.

Petroleum Dependence Undermines Economic, Environmental and National Security

Biofuels and bio-products are part of the diverse energy portfolio required to displace current U.S. dependence on foreign and finite sources of oil. Biomass is an annually renewable source of home-grown energy available from U.S. agriculture and forestry. The long-term impact of C3Bio is to enable the replacement of petrochemical refineries with next-generation hydrocarbon biorefineries that:

- utilize any type of plant biomass
- minimize the land area required to grow biomass crops
- make high-value bioproducts and fuels compatible with existing transportation infrastructure



New Science at the Intersection of Disciplines

C3Bio researchers integrate plant genetics and molecular biology, cutting-edge catalytic and analytical chemistry, engineering and nanotechnology to directly convert non-food plant biomass to transportation fuels and other value-added products. Our undergraduate and graduate students, post-doctoral fellows and technicians are cross-trained in a highly interdisciplinary research environment. At this interface, science is transformational.



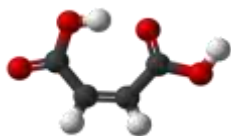
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C3Bio is funded by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, Award Number DE-SC0000997



Technical Research Areas

Thrust 1. Apply new catalytic transformations to biomass and identify highly efficient process pathways.



Rational cell wall deconstruction requires the development of catalytic chemistry with targeted bond-breaking to enable efficient transformations of lignin and polysaccharides into defined high-value products. We are developing catalysts for controlled deconstruction of lignin and polyalcohols derived from cellulose and xylan in intact biomass. We are studying catalytic thermal processes to develop a detailed understanding to increase liquid fuel yields with appropriate catalysts. Development of advanced mass spectrometric tools is enabling rapid molecular-level characterization of complex mixtures of reaction products.

Thrust 2. Achieve an atomic-to-macromolecular scale understanding of the catalysts:biomass interaction.

We are developing structural biosensors, sophisticated imaging technologies and advanced bioanalytical tools to define the chemical structure and physical properties of biomass, its components and genetic variants to provide critical knowledge of how biomass interacts with catalysts. We are developing models for integrated data visualization from Ångström to micron scales, including computational models of cell wall assemblies in various interactions with metallo- and other chemical catalysts.



Thrust 3. Tailor biomass for highly efficient, direct catalytic conversion to high-value fuels and products.



A key to catalyst-substrate interactions is the accessibility of catalysts to the appropriate chemical bonds. The tools of plant genetics and molecular biology enabled a revolution in the ability to produce plants with modified characteristics. We are investigating delivery of metal catalysts throughout the cell wall structure and creation of functionalized sites primed for catalytic transformations. We will design biomass variants to incorporate catalysts, co-catalysts into cell walls as the plant grows, simplifying deconstruction following biomass harvest. Our ability to incorporate plant-generated *Trojan horse* catalysts depends upon a deep understanding of cell wall assembly and the chemical structure and physical properties of the biomass.

C3Bio Investigators

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