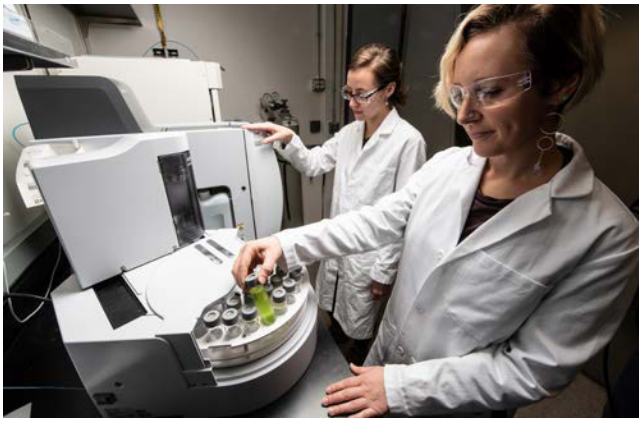
NREL | NATIONAL BIOENERGY CENTER

NREL'S CAPABILITIES IN **ALGAE-BASED CHEMICALS, POLYMERS, AND FUELS**

CORE CAPABILITIES AND APPLICATIONS

NREL is advancing research and development (R&D) to maximize photosynthetic carbon capture into biomass for conversion to a broad portfolio of valuable products. Areas of focus include:

- Carbon capture improvement through photosynthesis engineering
- Biotechnology and genetic toolbox development for broad species portfolio
- Conversion and fractionation of algal biomass to create high-value products and fuels
- Biological seaweed conversion to volatile fatty acids as fuel and product feedstocks
- Novel polyurethane production synthesis from fully renewable algae-based feedstocks
- Advanced analytical characterization of biomass feedstocks
- Process techno-economic and life cycle modeling.



Top Photo by Dennis Schroeder, NREL 60853
Bottom Photo by Dennis Schroeder, NREL 60850

BIOTECHNOLOGY FOR CARBON CAPTURE ENGINEERING

NREL has developed technologies for engineering algae to maximize the conversion of carbon dioxide (CO_2) to chemicals and products. This includes broad host biotechnology engineering capabilities with in-depth support from state-of-the-art genomics, as well as transcriptomics and metabolomics, including metabolic carbon and nitrogen flux analyses.

COMBINED ALGAE PROCESSING FOR BIOPRODUCTS

NREL researchers are developing process-engineering approaches for converting algal biomass into a widening portfolio of high-value products, utilizing all major components of photosynthesis-derived feedstocks.

RENEWABLE POLYMER SYNTHESIS

Research teams at NREL are optimizing the polymerization of algae-based plastic precursors, in particular non-isocyanate polyurethanes and other novel polymers from polyunsaturated lipids. Key performance characterization methods include rheology, thermal analysis, and molecular composition testing.

TECHNO-ECONOMIC AND LIFE CYCLE ANALYSIS

The economic and sustainability implications of the core NREL technologies are continuously assessed through the state-of-the-art computational techno-economic and life cycle analysis models. Major cost-drivers are identified and used as a guide to prioritize future R&D.

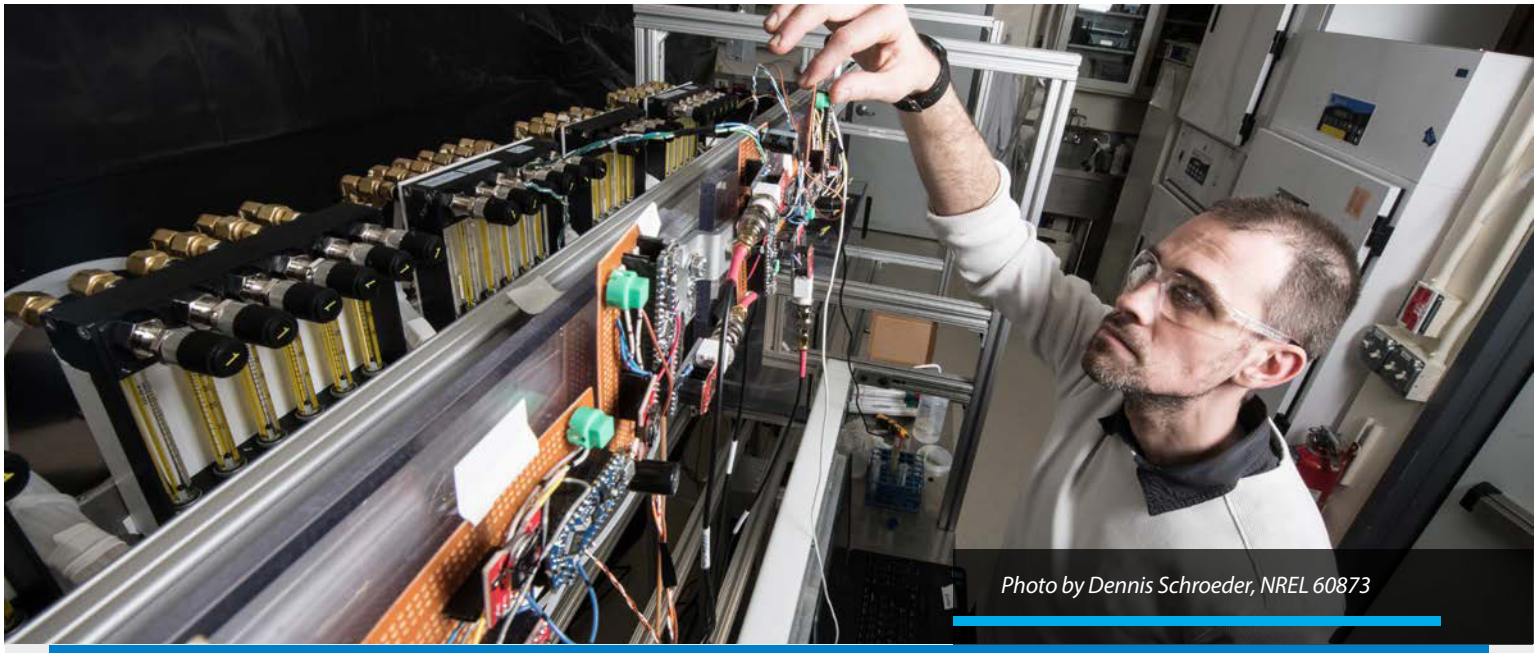


Photo by Dennis Schroeder, NREL 60873

RECENT SUCCESSES

KEY RESULTS

- NREL's algae team has recently demonstrated the production of non-isocyanate polyurethane polymers, foams, and coatings, with highly tunable properties based on fatty acid derivatization chemistry with similar performance compared to fossil-derived materials.
- NREL has demonstrated the engineering of highly efficient algae cultivars capable of assimilating twice the CO_2 per acre compared with terrestrial crops and demonstrated biomass value exceeding production value of process-compatible bioproducts.

Highlighted Publications

Dong, T., et al. "Renewable Polymers and Resins and Methods of Making the Same." U.S. Patent Application No. 62/482238.

Knoshaug, E. P., et al. "Open Pond Algal Cultivation Datasets of the Algae Testbed Public-Private Partnership: The Unified Field Studies as the Benchmark for Innovative Algae Agronomics." *Nature Scientific Data.* DOI: 10.1038/sdata.2018.267.

Laurens L. M. L., et al. "Development of Algae Biorefinery Concepts for Biofuels and Bioproducts; A Perspective on the Molecular Identification of Process-Compatible Bioproducts and Impact on Cost-Reduction." *Energy & Environmental Science.* DOI: 10.1039/C7EE01306J.

Dahlin, L. R., et al. "Development of a High-Productivity, Halophilic, Thermotolerant Microalga *Picochlorum renovo*." *Nature Communications Biology.* DOI: 10.1038/s42003-019-0620-2.

Find Out More

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NREL's algae research is supported by the U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy (EERE), Bioenergy Technologies Office (BETO).

NREL

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NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

NREL/FS-5100-75883 • September 2020

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