CONVERSION RESEARCH AND DEVELOPMENT

PROGRAM AREA

INTRODUCTION

CONVERSION R&D SUPPORT OF OFFICE STRATEGIC GOALS

The strategic goal of the Conversion Research and Development (R&D) program is to develop efficient and economical biological and chemical technologies to convert biomass feedstocks into energy-dense liquid transportation fuels, such as renewable gasoline, diesel, and jet fuel, as well as bioproducts, chemical intermediates, and biopower. To achieve this goal, a variety of conversion technologies are being explored that can be combined into pathways from feedstocks to products, including gasoline, diesel, jet fuels, biochemicals, biopower, and other enabling bioproducts.

While Conversion R&D is managed as a single platform, the large number of projects funded by this area could not fit in a single session over the course of a week. Projects were grouped into seven smaller sessions in order to better target reviewers with specific expertise, and to allow the full review to take place in the time allotted. The seven sessions were as follows:

- Agile BioFoundry
- Biochemical Conversion
- Carbon Dioxide Utilization
- Catalytic Upgrading
- Lignin Utilization
- Performance Advantaged Bioproducts and Separations
- Waste-to-Energy.

To the extent possible, projects were grouped with those utilizing similar technologies, though the Bioenergy Technologies Office (BETO) recognizes that many projects contain elements that could fit into multiple sessions. Each project was only reviewed in one session.

CONVERSION R&D SUPPORT OF OFFICE PERFORMANCE GOALS

The overall goal of Conversion R&D is to develop technologies that enable a reduction in the estimated modeled mature technology processing cost of converting algae, lignocellulosic biomass, or waste resources to hydrocarbon fuels and bioproducts, while maximizing the renewable carbon in the desired products. The ultimate aim for all processes is an increase in both carbon and energy efficiency relative to the theoretical maximum. To benchmark technical progress against the barriers to overcome, BETO conducts techno-economic analyses and life cycle assessments of a few representative pathways that link conversion technologies from feedstock to end product. These analyses result in the following Conversion R&D performance goals:

- By 2021, complete the research necessary to verify in 2022 a mature modeled minimum fuel selling price (MFSP) of $3/gasoline gallon equivalent (GGE) or less for a complete technology pathway to hydrocarbon biofuel and, where appropriate, a coproduct, with a minimum 50% reduction in emissions relative to petroleum-derived fuel.
- By 2029, complete the research necessary to verify integrated systems research at engineering scale for hydrocarbon biofuel technologies at a mature modeled MFSP of $2.50/GGE using economically advantaged feedstocks to produce renewable fuels and coproducts.

CONVERSION R&D APPROACH FOR OVERCOMING CHALLENGES

Conversion R&D has identified the following challenges and barriers across the supply chain as key hurdles to achieving the goals outlined above. Some challenges are shared across other platforms.

Pathway-Specific Barriers

- Defining metrics around feedstock quality
- Efficient preprocessing and pretreatment
- Process development for conversion of lignin
- Advanced bioprocess development
- Improving catalyst lifetime
- Increasing the yield from catalytic processes
- Decreasing the time and cost to develop novel industrially relevant catalysts
- Gas fermentation development
- Development of processes capable of processing high-moisture feedstocks in addition to conventional anaerobic digestion
- Identification and evaluation of potential bioproducts
- Developing methods for bioproduct production.

Enabling Research Barriers

- Decreasing development time for industrially relevant microorganisms
- Current reactors not designed to handle harsh conditions inherent to converting biomass feedstocks
- Multiscale computational framework toward accelerating technology development
- Selective separations of organic species
- Selective separations of inorganic contaminants.

The Conversion R&D approach for overcoming these conversion challenges and barriers is being addressed by a combination of specific, pathway-focused projects with industry, universities, and at individual U.S. Department of Energy national laboratories, and by bioenergy consortia that combine the unique capabilities of several national laboratories in collaboration with industry via technical advisory groups and joint projects.