CONVERSION R&D

PROGRAM AREA

INTRODUCTION

The Bioenergy Technologies Office's (BETO's or the Office's) Conversion Research and Development (R&D) Program focuses on deconstructing feedstock into intermediate streams (sugars, intermediate chemical building blocks, bio-oils, and gaseous mixtures), followed by upgrading these intermediates into fuels and chemicals. Historically, R&D in this area has been divided between thermochemical and biological conversion. BETO recognizes, however, that these divisions are no longer as clear-cut as they once were and that many promising pathways to achieving the Conversion R&D Program's goals require a hybrid approach. The full integration of these two areas has taken place since the 2015 Project Peer Review.

While Conversion R&D is now managed as a single program, the large number of projects this area funds could not be reviewed in a single session over the course of a week. Because of time constraints, projects were grouped into the following three sessions: Thermochemical Conversion, Biochemical Conversion, and Waste to Energy. To the extent possible, projects were grouped with those utilizing similar technologies, though BETO recognizes that many projects contain elements that could fit into multiple sessions. Each project was only reviewed in one session.

CONVERSION R&D OVERVIEW

Conversion R&D Support of Office Strategic Goals

Conversion R&D's strategic goal is to develop commercially viable technologies for converting biomass feedstocks (via biological and chemical routes) into energy-dense, fungible, finished liquid transportation fuels, bioproducts or chemical intermediates, and biopower. To achieve this goal, BETO and its partners are exploring a variety of conversion technologies that can be combined into pathways from feedstock to product.

Conversion R&D Support of Office Performance Goals

Conversion R&D's overall performance goal is to develop technologies that reduce the estimated mature technology processing cost of converting algae or lignocellulosic biomass into hydrocarbon fuels, while maximizing the renewable carbon in the desired products. There are many different combinations of unit operations that could result in a successful conversion strategy. To track the maturity of these processes and evaluate the R&D hurdles for each, several design cases (with cost targets and technical goals) outline how Conversion R&D might achieve its performance goals via continued R&D over the near, medium, and long term. To benchmark the progress of a few representative pathways that link conversion technologies, the Office funds R&D to overcome barriers to support the following cost goals:

- By 2017, validate an nth-plant modeled minimum fuel selling price of $3/gasoline gallon equivalent ($2014) via a conversion pathway to hydrocarbon biofuel with a greenhouse gas emissions reduction of 50% or more compared to petroleum-derived fuel.
- By 2022, validate an nth-plant modeled minimum fuel selling price of $3/gasoline gallon equivalent ($2014) for two additional conversion pathways to hydrocarbon biofuel with a greenhouse gas emission reduction of 50% or more compared to petroleum-derived fuel.

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.

- ***Deconstruction and Fractionation Challenges***
  - Feedstock variability
  - Reactor feed introduction
  - Efficient preprocessing
  - Efficient pretreatment
  - Efficient low-temperature deconstruction
  - Efficient high-temperature deconstruction to intermediates
- ***Separations, Cleanup, and Conditioning Challenges***
  - Efficient intermediate cleanup and conditioning
- ***Synthesis and Upgrading Challenges***
  - Efficient catalytic upgrading of sugars/aromatics, gaseous and bio-oil intermediates to fuels and chemicals
  - Product finishing acceptability and performance
- ***Integration and Intensification Challenges***
  - Process integration
  - Petroleum refinery integration of intermediates
  - Aqueous-phase utilization and wastewater treatment
- ***Crosscutting Challenges***
  - Cost-effective hydrogen production and utilization
  - Materials compatibility and reactor design and optimization

To address these challenges, Conversion R&D organizes activities into six broad groupings: Analysis and Sustainability, Deconstruction and Fractionation, Synthesis of Intermediates and Upgrading, Integration and Intensification, Enabling Technologies, and Oversight and Support. Technical challenges in each of these areas are identified through technology road mapping, techno-economic analyses, stakeholder meetings, industry lessons learned from demonstration and market transformation activities, and active project management of historical and existing projects.