

Economic Analysis of the Current and Future Bioeconomy

(“Bioeconomy Analysis”)

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**DOE Bioenergy Technologies Office
(BETO) 2017 Project Peer Review**

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ORNL is managed by UT-Battelle
for the US Department of Energy



Goal Statement

Goal: Design and develop novel economic approaches and tools to identify and measure 1) the determinants of demand dynamics of the bioeconomy, 2) interactions among biofuels, biopower, bio-products, and fossil products, and 3) the economic sustainability of the U.S. biofuel industry through integrated modeling using TEA, LCA, and market data.

Outcome: Provide BETO and decision makers across sectors price and economic impact tools to determine the best use of biomass resources, demand drivers, and sustainable commercialization pathways to expand bioeconomy

Quad Chart Overview

Timeline

- Project start date: FY17
- Project end date: FY19
- Percent complete: 15%

Budget

	FY17	Total Planned Funding (FY 17-Project End Date)
	(thousands)	
DOE Funded	\$250	\$750

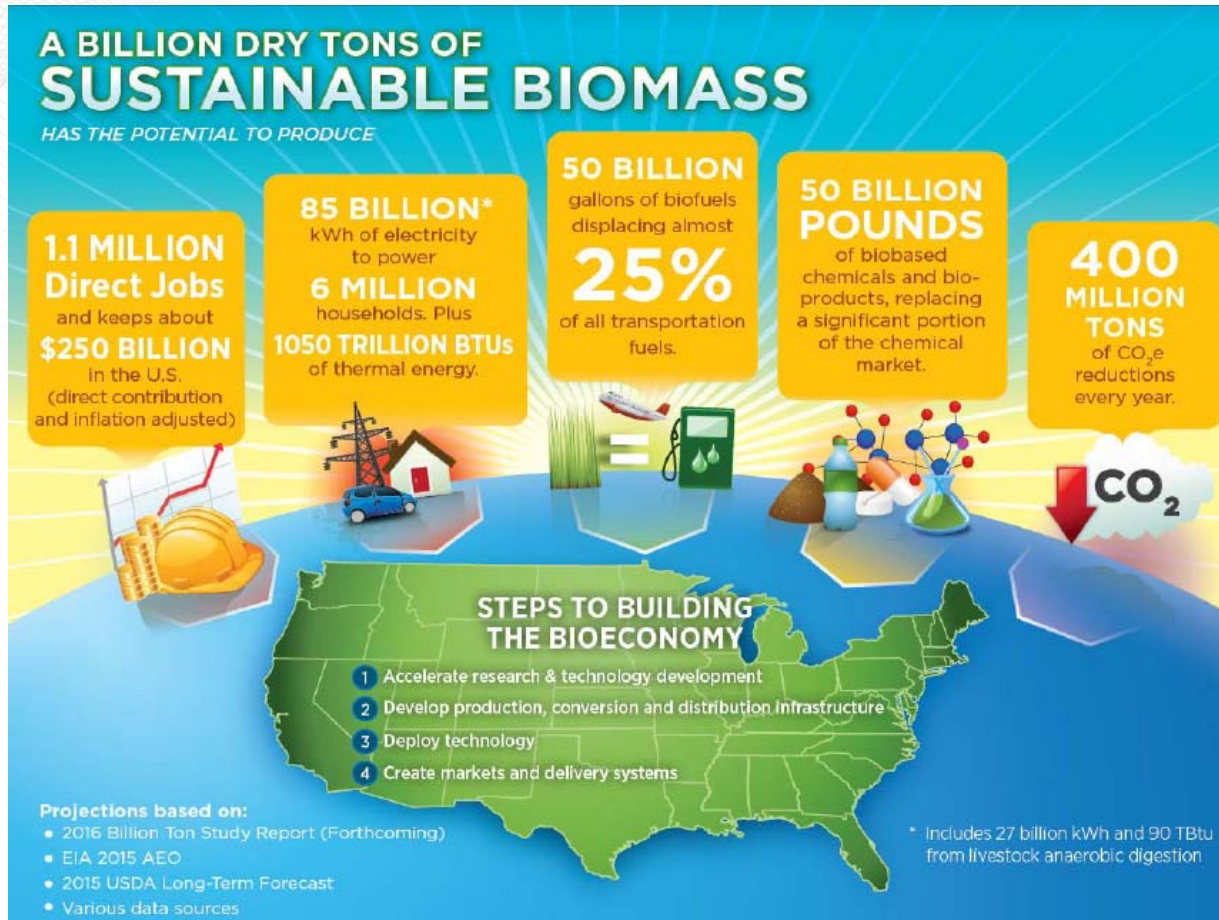
A&S Barriers

- At-A. Comparable, Transparent, and Reproducible Analyses
- At-B. Analytical Tools and Capabilities for System-Level Analysis
- At-C. Data Availability across the Supply Chain:

Partners

- NREL- Strategic Analysis and TEA
- INL- Resource Mobilization
- ANL- GREET modeling team
- PNNL- TEA
- Potential partners- EIA, EPA, BIO organization

1- Project Overview



- Bioeconomy potential involves energy and products, additional bio-based can enable biofuels (biomaterials for manufacturing)
- BT16 verifies resource potential, but market impact difficult to measure
- Interagency effort led by BETO
- Allocation methodologies vary
- Price interactions across markets not well understood

1 - Project Overview

- Identify conversion strategies to maximize economic, environmental, and social value of biomass resources
- Critical questions include:
 - Given market conditions (structure, policy, etc), what are pathways to market maturity for (bioproduct X)?
 - When do we reach market saturation for specific products? How many facilities (bioproduct X), at what capacity?
 - What is demand for bioproducts given current demand for biofuels? How do bioproducts promote advanced biofuels?
- Facilitate integration of data, scenarios, etc. (from TEA, LCA, and market assessment) among BETO projects seeking to understand bioeconomy development
- Evaluate bioeconomy growth strategies within an economic framework

2 – Approach (Management)

- Analysis team holds expertise in energy and agricultural economics, multiple sponsor experience
 - Emerging competency in impact analysis (4.1.2b)
 - Core competency in resource assessment (WBS 1.1.1.1)
- External interactions
 - April 2017: Interagency bioeconomy research collaboration workshop (DOE, EPA, USDA, DOI, NSF, among others)
 - Additional industry review will be identified
- BETO and lab interactions
 - December 2016 kickoff call identified subject matter experts on TEA, LCA and market assessment
 - Bioproducts Working Group (new), continuing discussions as needed
- Participate in monthly Analysis and Sustainability calls and periodic calls with BETO and collaborating labs

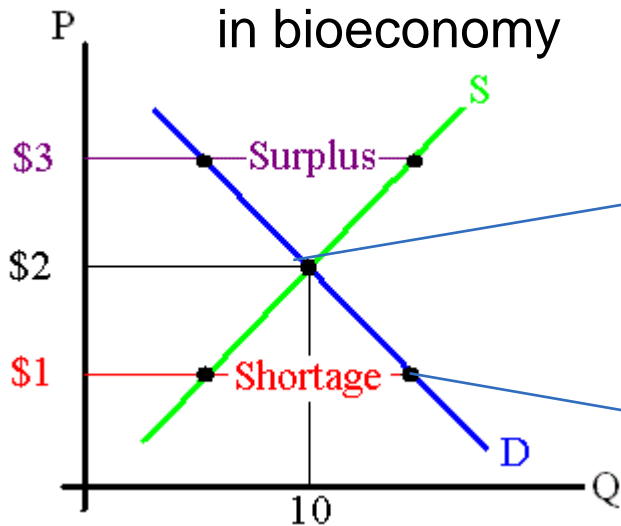
2 – Approach (Technical)

- Develop market structure metrics of biofuels and bioproducts
 - Size, level of gov't support, number of producers/consumers, intermediate vs. final good, domestic vs. international consumption, employment, green certification
- Quantitative analysis of market data
 - Evaluate demand determinants' influence on market prices
 - Quantify/estimate own- and cross-price interactions for candidate bioproducts and biochemicals
 - Incorporate supply curves from BT16 analysis of delivered biomass
 - Integrate demand and supply factors in a Bioeconomy Interactions Tool (BIT)
- Key technical challenges:
 1. Availability of high quality market volume and price behavior for chemicals and products
 2. Providing timely research outputs in highly dynamic global bioeconomy
 3. Integrating useful level of detail within BIT

2 – Approach (Technical)

Economic framework of BIT

Value-added supply-demand
in bioeconomy



Feasible Set of
Alternative
Outcomes

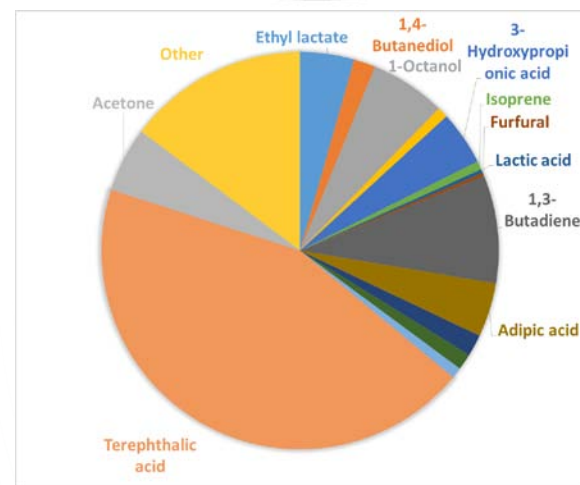
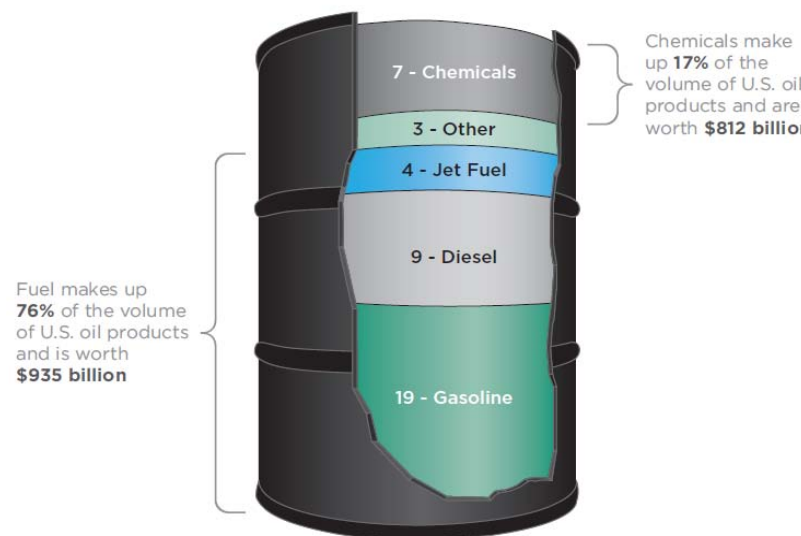
Demand factors: substitution, market structure of consumers, new uses of biomaterials, international trade, etc

Supply factors: market structure of resource producers, technology maturity, cost of feedstock production, international trade, etc

Demand and supply shifts may occur in both input and output markets

3 – Technical Accomplishments/Progress/Results

- Kick-off call with lab partners, FY17 Q1 identified synergies and gaps
- Areas underexplored
 - Approach needed to measure interactions of markets where outputs of one process are inputs of another
 - Examine qualitative aspects of jobs
- Participated in BETO quarterly January 2017
 - EERE management request for analysis of bioproducts to support economics of biorefineries
 - Need for economics to play larger role in targeting markets for bioproducts (e.g. succinic acid market example)



Likely “bioadvantaged” chemicals
Source: Fitzgerald, 2017

4 – Relevance- Supporting Bioenergy Value Proposition

BETO MYPP (2.4.2.4)

Strategic analysis goal: to provide context and justification for decisions at all levels by establishing the basis of quantitative metrics, tracking progress toward goals, and informing portfolio planning and management. (MYPP, 2016, page 2-130)

Project provides biomass value and market growth metrics to support R&D decisions by BETO via market and impact analysis to identify feasible sets of bioeconomy expansion.

Strategic Goal for BETO

Develop and demonstrate innovative and integrated value chains for biofuels, bioproducts, and biopower that can respond with agility to market factors while providing economic, environmental, and societal benefits. (Strategic Plan, p. 11)

Supports bioenergy value proposition through detailed market interactions and industry growth metrics.

5 – Future work (FY 17)

Task 1: Update empirical data on fossil and bio-based products, including market size and structure, costs, and technologies that are most relevant to the biofuel industry.

Deliverable: Bioeconomy markets structure analysis and data gap findings in presentation to BETO (quarterly progress milestone)

Task 2: Preliminary estimates of the impacts of bio-products on the competitiveness of advanced biofuel technologies, and cost of meeting the biofuel policy targets. The impacts evaluated will be based on preliminary simulations of the working version of the Bioeconomy Interaction Tool (BIT)

Deliverable: Provide documentation of the design and scope of the Bioeconomy Interactions Tool (BIT), its implementation within a spreadsheet framework, and discuss test results. (quarterly progress measure)

5 – Future work (FY17, continued)

Task 3: Preliminary estimates of the economy-wide impacts of bioproducts

Employ a multi-market input-output (I-O) model of the U.S. economy based on detailed data for a recent year to explore how changes induced by the interaction between biofuels and bio-products affect economic output in the rest of the economy.

Deliverable: Report documenting the outcomes of FY16 tasks on the empirical market analysis of non-biofuel bio-products, and preliminary simulations to assess interactions between biofuels and other bio-products using the BIT, focusing on the impacts of exogenously specified bio-products and biopower demand scenarios on biofuel markets.

5 – Future work (FY18, continued)

Go/no-go Deliverable: Compare preliminary results from the BIT simulations to available historical data on the development of biofuels, bio-products and bio-power.

- Do the results resemble historical changes?
- Can discrepancies be identified and accounted for?
- How does analysis match estimates of price interactions relative to other analysis and based on manager and additional external expert review.

5 – Future work (FY18 and FY19)

Task 4: Evaluation of the potential penetration of bio-products under alternative future market scenarios and analysis of cascading supply chains for bio-based products (builds upon tasks 1 and 2)

Quantify several metrics including costs, lifecycle emission, waste generation, and feedstock/inputs use efficiency.

Task 5: Simulations of the impacts of interactions between biofuels and bio-products on the prospects of advanced biofuel technologies (builds upon tasks 1 and 2)

Quantification of the impacts of interactions between biofuels and bio-products on the economics of the biofuel industry.

Summary

1. Overview

Project explores economic underpinning of bioeconomy strategies, including those which maximize economic, social, and environmental value of biomass

2. Approach

Applies economic principles to combine techno-economic and market data to explore feasible bioeconomy alternatives, highly collaborative

3. Technical Accomplishments/Progress/Results

New project, collecting data and designing approach

4. Relevance

Questions directly relate to EERE and BETO R&D approaches and fill market data gap, work proposal directly relates to real-world questions

5. Future work

Simulations of interactions of biofuels and bioproducts

Thank you!