Integrating Biology and Techno-Economic Analysis to Create BTEA

Break-out Track 3 Session 6
10:30 am to noon
Room 522 ABC

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This Bio-Techno-Economic Modeling Approach is being Developed as Part of the NCSU Project: Jet Fuel from *Camelina Sativa*

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Objectives of the Jet Fuel from Camelina Project

Genetically transform camelina to increase yield, oil content, and oil composition to create a cost effective renewable source of jet fuel.

Economic Modeling Objective

Develop a model that incorporates the costs, revenues, and risk of a complete “genes to fuel” supply chain and that is adaptable to a wide range of locations and deployment of technology to support commercialization.
The Initial Modeling Framework

We first used ASPEN, ICARUS, the Mississippi State Univ. Crop Budget Program, and EXCEL to model crop production, logistics, crushing, and fuel processing.
Important Findings from the Initial Model

Feedstock is a big share of total cost
Co-products may be an important share of revenue
YIELD YIELD YIELD is an important way to drive down cost
Fundamental challenges of modeling and designing systems with biological components

Organisms are chemical factories that are:

- self-assembling,
- self reproducing,
- evolving,
- self powering,
- self input acquiring,
- continuously adapting to environment,
- and pre-programmed (genetics)
Fundamental challenges of modeling and designing systems with biological components

Exposure to highly variable environment introduces uncertain outcomes.

Cultivating pre-programmed organisms with objectives / responses that may differ from what we desire (lack of control).
“Reprogramming” Genetics to Control Biological Components

genetics define the upper limits of performance in biological systems,

select for individuals that better fit our objectives (traditional breeding)

new gene editing technology supersedes current GMO debate !!!???
Pragmatic approach to Incorporating Biological Reality

Probability Distribution of Yields

develop production functions / yield prediction models based on observed performance;
conditioned on:
  site specific variables: weather and soils, farm management variables, and others;

=> predict yield distributions anywhere in US;
Effects of Incorporating Biological Reality

Bio-Techno-Economic Model

Crop Growth Model

Transport

Camelina Production

Camelina Seed Storage

Transport

Camelina Oil Extraction

Transport

Camelina Oil Storage

Transport

Jet Fuel Refinery

Transport

Meal

Jet Fuel

Co-Products

Yield distribution drives costs, profit and risk, adoption by farmers, contract design, logistics, plant scale, and co-location with fuel conversion.

Oil proportion of seeds affects seed quantity required,

Oil composition affects the conversion process, costs, and possibly product mix.
Output of the BTEA Model

Predicted Probability of Profit from a ‘Genes to Fuel’ Complex

Developers can vary scale, crop production, storage, process, location, and price risk and other factors and compare investment, costs, profits, and cash flow risk.

The Bio-Techno-Economic model provides a far more realistic preview of project feasibility.
Spin-Offs

Agricultural Information Systems design for commercial crops

For farm managers and for input providers

Employing the biological model and analyzing real time data to support management decisions