U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

U.S. Department of Energy (DOE) Bioenergy Technologies Office (BETO) 2019 Project Peer Review

1.2.1.5 Resource Mobilization

March 6, 2019

Feedstock Logistics

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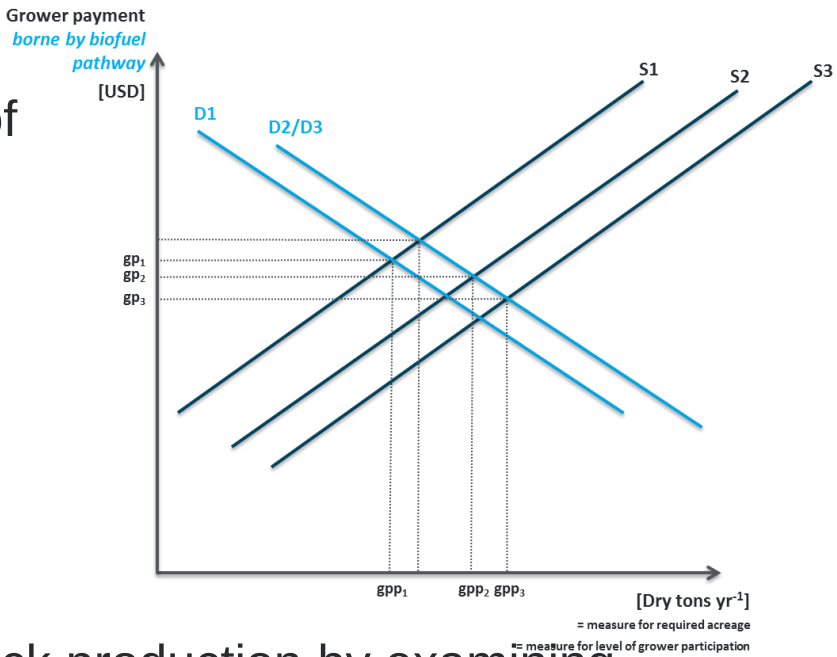
Damon S. Hartley, Ph.D.

Idaho National Laboratory

Goal Statement

- **Goal:** Identify socio-economic factors that affect the decision to produce bioenergy crops and investigate the potential effect of strategies designed to increase the willingness to adopt the production of bioenergy feedstocks.



- **Outcomes:**
  - Identify strategies to reduce the near-term biorefinery supply chain establishment and operating cost.
  - Analyze adoption of bioenergy feedstock production by examining producer and consumer behavior, leading to grower participation levels of 20% of the amenable and suitable acreage.
- **Relevance to industry:** Increasing grower participation directly supports reducing supply chain costs. Additionally, increased participation supports the mobilization of the U.S. billion ton biomass resource base, which current mobilization and participation rates may not achieve.

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Quad Chart Overview

Timeline

- Project start date: 10/01/2017
- Project end date: 09/30/2020
- Percent complete: 42%

	Total Costs Pre FY17	FY 17 Costs	FY 18 Costs	Total Planned Funding (FY 19-Project End Date)
DOE Funded	--	$255K	$255K	$510K
Project Cost Share	NA	NA	NA	NA

- **Partners/Collaborators:** **Collaborators include WBS#'s: 1.1.1.2, 1.1.1.3, 4.2.1.20**

Barriers addressed

- Ft-A. Terrestrial Feedstock Availability and Cost
- At-A. Analysis to Inform Strategic Direction

Objective

- Identify socio-economic factors that affect the decision to produce bioenergy crops and investigate the potential effect of strategies designed to increase the willingness to adopt the production of bioenergy feedstocks.

End of Project Goals

- Identify scenarios that increase biomass feedstock production, and reduce cost, by increasing grower participation to at least 20% of the suitable acreage within the supply shed.

1-Project Overview

CONTEXT&HISTORY

- FY14: global logistics model connection (collaboration with Utrecht University)
- FY15: *International Feedstock* AOP (adapted following 2015 peer-review)
- FY16-17: Domestic feedstock market and mobilization focus
- FY18-20: Producer Decision Making

OBJECTIVES

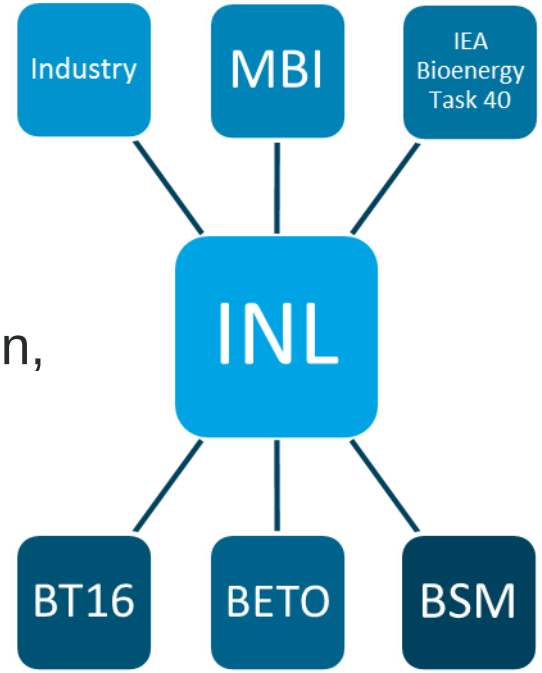
- Identify leverage points of non-biofuel feedstock industries (e.g., animal feed or biopower) to grow the mobilized resource base.
- Identify risks and opportunities for increasing feedstock mobilization through increased grower adoption.

CREATIVE ADVANTAGE

- Provide credible, objective analyses of feedstock supply systems and strategies to support BETO investments in the development of a sustainable, economically viable national scale bioenergy industry.
- Innovative methods to evaluate the barriers and opportunities of the developing bioenergy and bioproducts industry.

2 – Approach (Management)

- Bi-Weekly conference calls with BETO, four written reports (milestones) per year.
- Annual results vetted by peer-review (academia) and disseminated at industry conferences.
- Data collection and alignment through collaboration, industry outreach, and engagement in platform working groups.
- Leveraging of existing collaborations to create synergies across the platform and reduce costs.

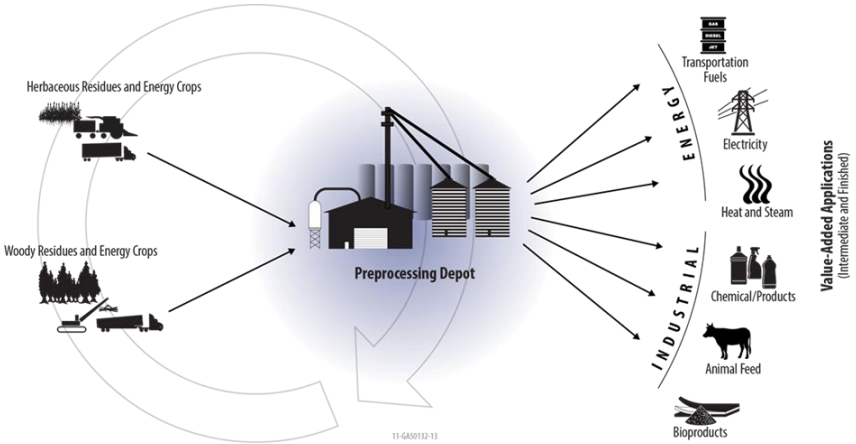


- Potential challenges:
  - Limiting scope to most relevant feedstock markets.
  - Keeping up to date on continuously changing policies and markets.
- People: Patrick Lamers, Damon Hartley, Ruby Nguyen, Mike Griffel, Mohammad Roni

2 – Approach (Technical)

TECHNICAL APPROACH

- Examine current biomass-using industries for opportunities to access market advantaged feedstocks.
- Explore the ability of supply push to be able to drive the development of a bioeconomy.



- Determine and model the factors that influence grower participation in bioenergy supply chains.

TECHNICAL CHALLENGES

- Determination of most relevant feedstocks for a region.
- Maintaining current data on markets and their requirements.
- Adequately summarizing behaviors for heterogeneous populations.

2 – Approach (Technical) cont'd

Success Factors

- Model results that approximate verifiable behavior of feedstock producers.
- Provide analyses that indicate the expected outcomes of the actions of both producers and consumers of biomass feedstocks.
- Defined scenarios that lead to successful and sustained development of a bioeconomy.

Go/No-Go Decision Point

The Go/No-Go decision will assess the capability to model the dynamics and related costs associated with setting up herbaceous biorefinery supply chains as they relate to different levels of grower participation.

Go Criteria: Demonstrate modeled pathways that lead to a minimum increase of grower adoption to 10% of the amenable and suitable acreage.

No-Go: Evaluate completeness of model methods and determine if alternative strategies should be employed.

3 - Technical Accomplishments/Progress/Results

Current Uses of Biomass and Opportunities

- **Combustion**
  - Primarily uses woody feedstocks.
  - Utilizes both primary and secondary resources.
  - Lower demand in Europe but a possible increase in Asian demand.
  - Potential oversupply could lead to opportunities.
- **Animal Feed Markets**
  - Primarily uses herbaceous feedstocks.
  - Serves as roughage supplement.
  - Markets dependent on hay prices and pasture.
  - Feed markets could outcompete biofuels.
- **Absorbents**
  - Animal bedding, Erosion Control, Specialty.
  - Regional Markets.
  - High value markets are relatively small.

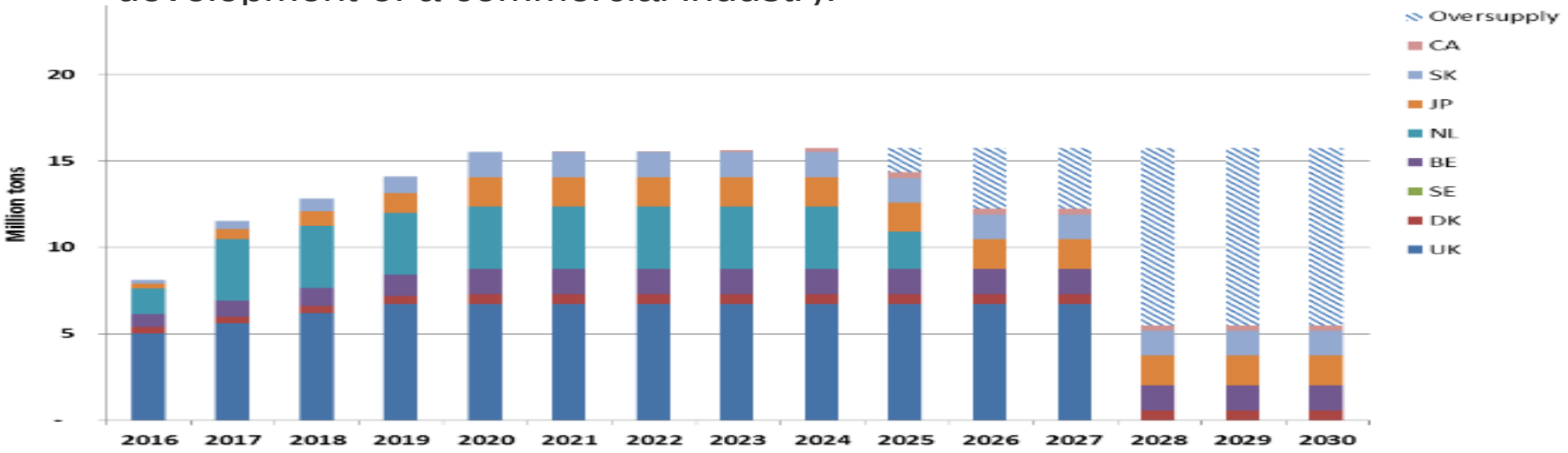
Source: alamy.com

Source: Palcon, LLC

3 - Technical Accomplishments/Progress/Results

Supply Push Driving Development

- Expected excess capacity of ~10 million tons of pellets by 2030, primarily from the expiration of European contracts.
- Excess capacity and material does not drive development, but does support growth, if assumed that all materials are fungible.
  - Reduced cost of excess pellets facilitate commercial investment and plant utilization.
- Pellets reduce risk in quality and supply chain development.
  - Accounting for the differences, there could be a supply push that aids the development of a commercial industry.



3 - Technical Accomplishments/Progress/Results

Grower participation in Biorefinery Supply Chains

Crop Residues

Target: Profit oriented growers.

Drivers: Additional revenue, buffer against volatility.

Barriers: Additional cost, potential field impacts.

Energy Crops

Target: Producers w/ non-production objectives.

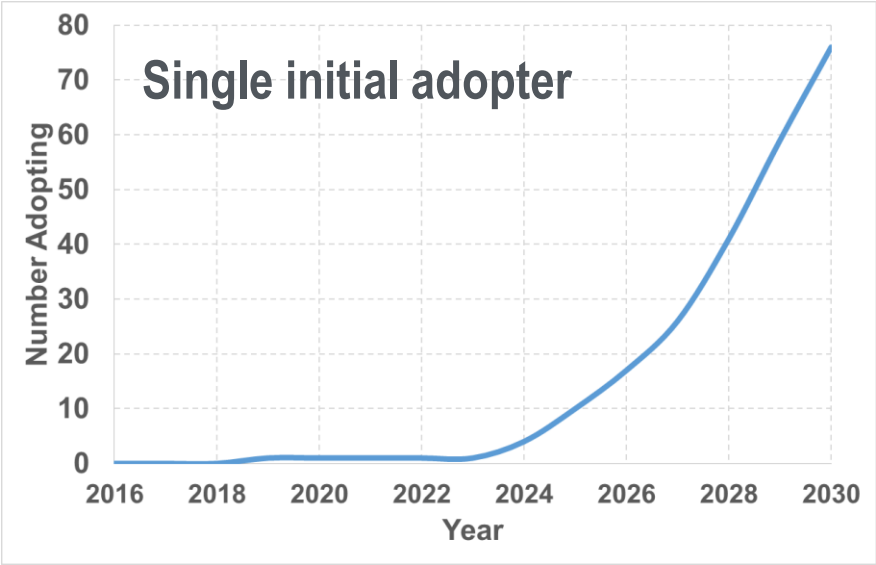
Drivers: management of marginal land, operational benefits (reduced labor and inputs).

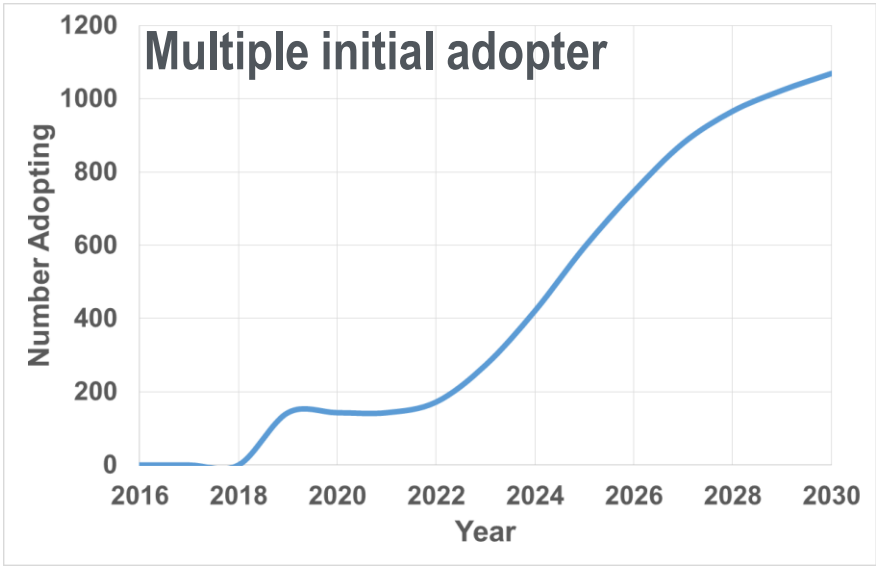
Barriers: Uncertainty, lack of knowledge, uncertain markets, lack of crop insurance.

3 - Technical Accomplishments/Progress/Results

Grower Adoption

- Opportunities for energy crops exist within the agricultural landscape.
- Energy crops would require a contract structure that is similar to programs that currently exist .
- The adoption of energy crops is a function of how quickly the knowledge of the production systems penetrates the population of producers.
- Considerable effort would be required by the biorefineries to establish a network of growers that are willing to supply .





4 - Relevance

Project Impact

- This project aims to understand the motivations and drivers of the actors within a bioenergy supply chain, and how to access those materials for the development of a bioeconomy.
- Lack of biorefinery demand requires non-biofuel markets to mobilize biomass resources (which makes them accessible to biorefineries).
- Availability of resources that have advantageous attributes may be able to drive the development of a market given sufficient quantities and market conditions.

Customers

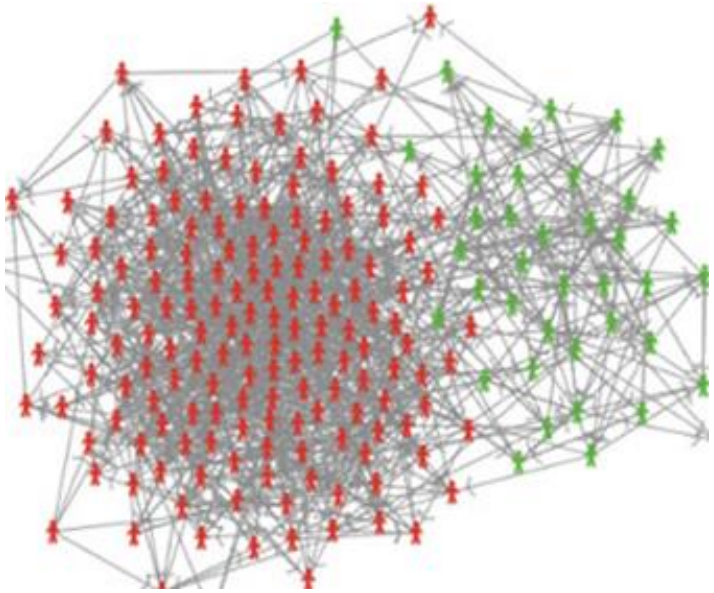
- DOE is the primary customer of this project, however, other Federal agencies (e.g., USDA), investors/stakeholders within the bioenergy industry, pioneer biorefineries and university partners are potential beneficiaries of this project.

Products and Outputs

- Credible, objective analyses of feedstock supply systems and strategies to support BETO investments in the development of a sustainable, economically viable national-scale bioenergy industry.

5 – Future Work

- Simulate the behavior of growers in relation to the adoption of new practices.
- Validate the results by comparing to the participation in conservation programs, adoption of cropping practices, etc.
- Examine behavior changes in relation to changing market, economic and social forces.
- Identify strategies that can be utilized to increase producer participation in bioenergy supply chains.
- Model the interactions between producers and consumers to determine how supply chains are likely to develop.



Depiction of social networks and information exchange in agent-based simulation.

5 – Future Work

UPCOMING KEY MILESTONE

- **March 31, 2019:** Identify scenarios that lead to a modeled grower participation of >10% over current participation rates.

GO/NO-GO DECISION POINT:

- **March 31, 2019:** The Go/No-Go decision will assess the capability to model the dynamics and related costs associated with setting up herbaceous biorefinery supply chains as they relate to different levels of grower participation.
  - **Criteria:** A Go Decision requires the ability to demonstrate a modeled pathway that leads to a 10% increase in grower participation within a supply shed.

Summary

Key Takeaways

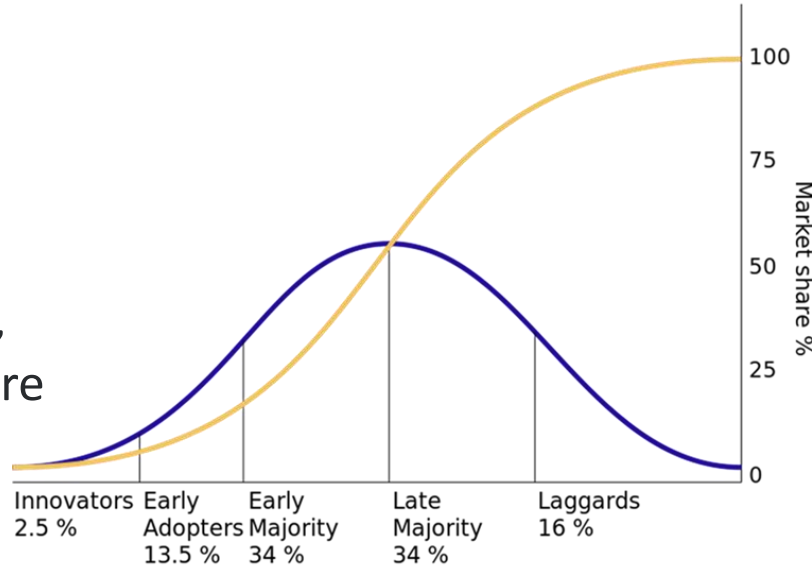
Overview: We are identifying the factors necessary to develop robust, biomass supply chains to enable the development of a bioeconomy.

Approach: From the input of industrial partners, develop solutions to overcome existing and future barriers to the mobilization of feedstocks.

Accomplishments: Characterization of current biomass markets, identification of potential market opportunities, quantification of producer motivations.

Relevance: Identify barriers to biomass supply, inform the development of feedstock supply systems.

Future Work: Model the development of biomass supply chains in terms of supplier/consumer dynamics.



Diffusion of innovation through society (Bass,1969)

Questions?

Responses to previous reviewers comments

- **Review Comment:** I do not believe this work is relevant for the creation and growth of the market in the near term.
- **Response:** This project provides meta-level analysis to inform BETO on current market and industry trends including intermediate biomass (feedstock) supplies and demand (domestic and international) as well as associated cost structures. It can be regarded as the market analysis supplement to INL's Feedstock State-of-Technology (SOT) work (WBS#1.1.1.2). While the SOT determines ways to reduce feedstock supply costs while keeping quality specifications, this work sets out to understand past, current and near-term biomass markets to determine ways to scale up, deploy, and commercialize the (processing) technology, required infrastructure, and market mechanisms. In this respect, this project may not directly create (new) markets, but it improves the understanding about creating possible pathways to do so.

Publications and Presentations

Journal articles

1. Daioglou, V., M. Muratori, P. Lamers, et al. (submitted). Implications of climate change mitigation strategies on international bioenergy trade. Climatic Change.
2. Thrän, D., K. Schaubach, D. Peetz, M. Junginger, T. Mai-Moulin, F. Schipfer, O. Olsson, P. Lamers (2018). The dynamics of the global wood pellet markets and trade – key regions, developments and impact factors. Biofuels, Bioproducts & Biorefining. DOI: 10.1002/bbb.1910.
3. Lauer, M., J. Hansen, P. Lamers, D. Thrän (2018). Making money from waste: the economic viability of producing biogas and biomethane in the Idaho dairy industry. Applied Energy, 222, 621-636.
4. Roni, M., P. Lamers, R. Hoefnagels (2018). Investigating the future supply distribution of industrial grade wood pellets in a global bioenergy market. Biofuels. DOI: 10.1080/17597269.2018.1432268.
5. Olsson, O., A. Roos, R. Guisson, L. Bruce, P. Lamers, et al. (2018). Time to tear down the pyramids? A critique of cascading hierarchies as a policy tool. WIREs Energy & Environment. DOI: 10.1002/wene.279.

Publications and Presentations cont'd

Conference Presentations

1. Lamers, P. (2017). Task 40: Sustainable Biomass Markets and International Trade to support the Bioeconomy. Bioeconomy 2017, Washington D.C., U.S. Department of Energy Bioenergy Technologies Office, July 11-12.
2. Thrän, D., Peetz, D., Schaubach, K., Trømborg, E., Pellini, A. Lamers, P. et al. (2017). Global Wood Pellet Industry and Market – Current Developments and Outlook. European Biomass Conference & Exhibition, Stockholm, Sweden, June 12-15.