Proposal for Biobased Industry Center Grants Program

Project Title: Cellulosic Biofuel Potential under Land Constraints: Feedstock Supplies, Costs, and Locations (Phase II Project Proposal)

Project Leadership

<table>
<thead>
<tr>
<th>Name (PI/Co-PI)</th>
<th>Department</th>
<th>Phone No.</th>
<th>E-mail</th>
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<tbody>
<tr>
<td>John Miranowski</td>
<td>Economics</td>
<td>294-6132</td>
<td><a href="mailto:jmirski@iastate.edu">jmirski@iastate.edu</a></td>
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<td>Matthew Darr</td>
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Research Priority Addressed by this Project:

During Phase I of this project, we developed a long-run biomass production through bioenergy conversion cost model that accounts for spatial variation in biomass potential and land opportunity costs. The model is being used to estimate supply costs for switchgrass- and stover-based ethanol within US Crop Reporting Districts (CRDs). The aggregate supply curve estimated from CRD-level ethanol costs is being used to evaluate the costs of meeting alternative production targets such as RFS2 cellulosic biofuel mandates. By capturing spatial variation in biomass potential and opportunity costs between and within CRDs, we are able to capture important economic tradeoffs in biomass production, transportation, and conversion not previously reported.

In Phase II, we are proposing to extend the model results developed in Phase I to include additional sources of variability in feedstock supply within and between CRDs and incorporate economies in biomass harvest, storage, and transportation (HST). The extended model would capture the impact of local variability in biomass yields, production costs, and equipment efficiency on local biomass supplies. The latter component is designed to incorporate the supply cost impacts of alternative biomass HST equipment and techniques within and between CRDs.

Our previous research evaluated single feedstock biorefineries. This project will also consider multiple feedstock biorefineries, utilizing both stover and switchgrass. In particular, the use of an alternative feedstock may serve as a ‘risk-mitigating’ strategy for biomass-to-biofuel conversion plants. For example, previous Farm Bills allow periodic harvest of biomass from CRP land with approval and modest rental payment reduction. Contracting with CRP enrollees to harvest switchgrass periodically may provide a least-cost way of laying off risk in major stover feedstock localities. Alternatively, we can estimate the economic benefits from multiple feedstock conversion in terms of reduced local biomass supply costs to the conversion facility or in terms of reduced feedstock supply variability when acquiring multiple feedstocks.

The proposed research addresses two key policy priority issues established for the Biobased Industry Center Grants Program: 1) Measurement and Management of Feedstock Supply Risk and 2) Analysis of RFS. Consideration of multiple feedstocks in biomass conversion and HST options in biofuel supply costs allows us to consider two options of addressing local feedstock supply variability and laying-off risk. The aggregate supply curves for biomass-to-biofuel conversion provide a foundation for analyzing the aggregate supply costs of alternative pathways in meeting the RFS by 2016.
Objectives
1. Extend the biofuel supply cost model to capture additional feedstock supply variability and potential economies in biomass HST.
2. Use the extended model to estimate supply costs under alternative production conditions to meet biofuel targets under alternative RFS pathways.
3. Evaluate the economic tradeoffs in commercial scale feedstock production and the economic benefits from multiple feedstock conversion.

Approach
Biomass supply costs, and ultimately, biofuel costs are location-specific and vary with local feedstock supply conditions. We propose to extend the supply cost model developed in Phase I to incorporate additional sources of variability in local biomass supplies due to biomass yield variability and biomass HST costs. Taking into account the location-specific economic tradeoffs in biomass production through bioenergy conversion, including the variability of biomass supply costs, the extended model will be used to estimate CRD-level biomass supplies and supply variability. These biomass supply results will be used to identify: 1) biomass supply risk at the local biorefinery and cost of risk mitigating strategies, and 2) potential changes in local feedstock mixes, local biomass supply costs, and optimal biorefinery production decisions. The new local supply cost estimates can be aggregated to estimate new aggregate biofuel supply curves necessary to evaluate the cost of meeting RFS production targets under alternative pathways. The model results will also be used to evaluate the economic tradeoffs involved in commercial scale biomass supply as well as potential strategies to manage financial risk associated with variable feedstock supply.

Workplan and Schedule
Phase 1 (July-November 2012): Collect and organize data needed for analysis including land use, engineering estimates, biomass and commodity crop yields, and cost coefficients for biomass HST.

Phase 2 (December 2012-June 2013): Develop the above extensions to the model using data within and across CRDs to determine local biorefinery supply potential and feedstock costs. Use model output to evaluate the economic tradeoffs involved in commercial scale biomass and potential strategies to manage financial risk associated with variable feedstock supply.

Dissemination Plan
Dissemination plans include presentation of results at conferences and meetings and publication in applied agricultural and/or bioenergy journals.

Budget (indirect not allowed)

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<th>CATEGORY</th>
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Miranowski, John A.

Professor of Economics, 1995-Present
382B Heady Hall
Iowa State University
Ames, IA 50011
Phone: 515-294-6132; Fax: 515-294-6644; Email: jmirski@iastate.edu

_Academic Background_
PhD: Harvard University - 1975
AM: Harvard University - 1969
BS: Iowa State University - 1966

_Positions Held_
Chair of the Department of Economics, Iowa State University, 1995-2000
Director, Resources and Technology Division & CED, ERS, USDA, 1984-1995
Executive Coordinator, Secretary’s Policy Coordination Council, USDA, 1990-1992
Assistant and Associate Professor of Economics, ISU, 1975-1984

_Recent Publications_


MATTHEW J. DARR

Education and Training
Ph.D. Food, Agricultural, and Biological Engineering, The Ohio State University, 2007
M.S. Biosystems and Agricultural Engineering, University of Kentucky, 2004
B.S. Food, Agricultural, and Biological Engineering, The Ohio State University, 2002

Professional Experience
2008-present Assistant Professor, Iowa State University
2004-2007 Research Associate II, The Ohio State University
2002-2004 Graduate Assistant, University of Kentucky

Research Interests
Dr. Darr has an expertise and background in biomass storage and upgrading technologies, advanced machinery engineering, machinery logistical analysis, and distributed control of embedded systems. Dr. Darr’s current research emphasis includes equipment development for enhanced densification and logistics for cellulosic biomass feedstock, optimized storage and material upgrading for long term biomass feedstock stability, and machinery automation to support both biomass feedstock collection and optimal fertilizer placement. Dr. Darr has published 17 peer-reviewed journal articles and 26 conference papers and proceedings. He has been PI or Co-PI on 34 grants or contracts totaling over $7,500,000.

Dr. Darr is the lead PI for $1.3 million Department of Energy Sun Grant research project focused on evaluation of in-field corn stover densification technologies and the interaction of densification on storage quality, machinery logistics, and production costs. Project work involves field scale harvesting, transportation, and storage of both wet and dry biomass and both single pass and multi-pass harvesting as well as an in-depth analysis of machinery logistics requirements of biomass production.

Dr. Darr is investigating on-farm methods of biomass upgrading, including torrefaction, to serve as transformative technologies for reducing the production cost of cellulosic feedstocks. Techno-economic analysis has shown that immediate upgrading can significantly reduce storage and transportation costs as well as improve the overall efficiency of biomass harvest. Additional research is ongoing to determine the optimal process variables and to fully quantify the material properties of a torrefied biomass.

Publications –most closely related to proposed project


**Synergistic Activities - no more than 5 professional and scholarly activities related to the effort proposed**

Member of ASABE PM-23/7/2 Forage & Biomass Engineering Committee.

Inventor of CyCAN Machinery Logistic Analysis Tool used by 8 commercial industries in assessing logistics of biomass feedstock supply systems.

Invited speaker for USDA Feedstock Logistics Program Area.

**Collaborators (last 48 months)**
Stuart Birrell, Robert Brown, Larry Johnson (Iowa State University); Rob Anex (University of Wisconsin); Scott Shearer (The Ohio State University); John Fulton (Auburn University); Kevin Kenney (Idaho National Labs); Kyle Althoff (DuPont Dansico Cellulosic Ethanol); Loren Steenhoek, John Pieper (Pioneer); Aaron Bruns, Kevin Ehrecke (John Deere); Pat Kendrick, Maynard Herron, Bob Matousek (AGCO).

**Graduate Students (last 48 months)**
*Past MS Students:*** Jonathon Roth (MS ABE 2010), engineer, John Deere; Curt Thoreson (MS ABE 2011), engineer, John Deere; Jeff Zimmerman (MS ABE 2011), engineer, AGCO

*Current MS Students:* Keith Webster (IAT), Ben Potter (ABE), Andy Jennett (ABE), Alex Nykamp (ABE), Jeremy Brue (ABE), Kevin Peyton (ABE), Brittany Schon (IAT), Ben Covington (IAT), Levi Powell (IAT), Slobodan Gutesa (ABE)

*Current PhD Students:* Dorde Medic (ABE), Ajay Shah (ABE), Robert McNaull (ABE), Justin McGill (ABE)

**Graduate Advisor:** Lingying Zhao, The Ohio State University
Alicia S. Rosburg

Department of Economics
University of Northern Iowa
209 Curris Business Building
Cedar Falls, IA 50613

(319)-273-3263
alicia.rosburg@uni.edu

Education

Ph.D. Economics, Iowa State University August 2007 - Present
Major Professor: John Miranowski
Fields: Environmental and Resource Economics, Agricultural Economics, Human Resources, and Applied Econometrics
Expected Graduation Date: Summer 2012

B.A. Economics, University of Northern Iowa May 2006
Minor: Mathematics

Employment

Instructor, Department of Economics, University of Northern Iowa Fall 2011 – Present

Refereed Journal Articles


Conference Proceedings and Reports


Other Research Contributions
