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

DOE Bioenergy Technologies Office (BETO) 2015 Project Peer Review

1.2.1.5

International Feedstock

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Feedstocks

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Goal Statement

Put the U.S. bioeconomy strategy in the context of global, competitive feedstock markets.

- Evaluate international impacts on U.S. feedstock supply costs
- Improve U.S. feedstock cost and volume projections
- Leverage existing expertise and collaborations
- Enable BETO, EERE, or related agencies (e.g., USITC) to take proactive measures to address potentially adverse trade and business impacts on the U.S. biofuel industry

Quad Chart Overview

Timeline

- Project start date: June 1, 2009
- Project end date: Sept. 30, 2017
- Percent complete: 40%

Barriers

- Barriers addressed
  - Ft-A. Feedstock Availability and Cost
  - Ft-J. Overall Integration and Scale-Up
  - Mt-A. Optimization of Supply Chain Interfaces and Cross-System Integration
  - At-C. Data Availability across the Supply Chain

Budget

	Total Costs FY 10 –FY 12	FY 13 Costs	FY 14 Costs	Total Planned Funding (FY 15-Project End Date
DOE Funded (x1000)	$474	$225	$142	$475
Project Cost Share (Comp.)*				

Partners

- Collaborators
  - Oak Ridge National Laboratory
  - Utrecht University, the Netherlands
  - TU Vienna, Austria
  - IEA Bioenergy Task 40 members

1 – Project Overview

HISTORY

- FY09-13: U.S. Department of State initiative: China research engagement
- FY14 collaboration with Utrecht University: international logistics modeling

CONTEXT

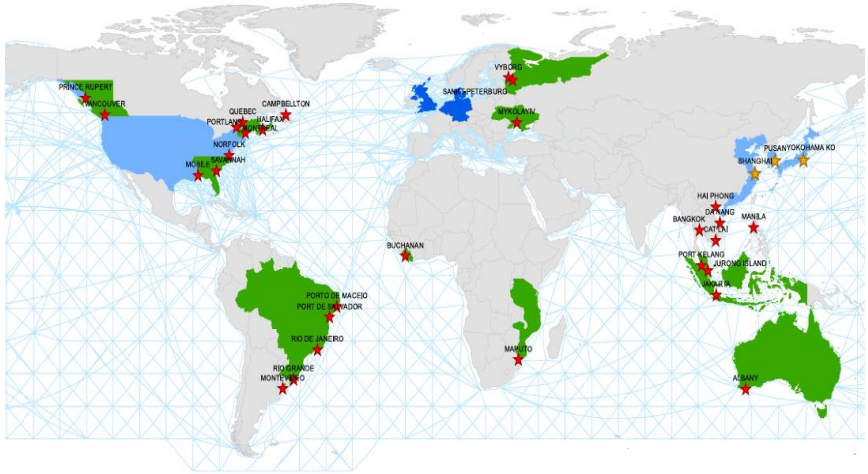
- Current State Of Technology is U.S.-centric (does not reflect global markets)
- U.S. is currently the largest exporter of, e.g., wood pellets to Europe
- Trade offers opportunities and threats to the U.S. bioeconomy development

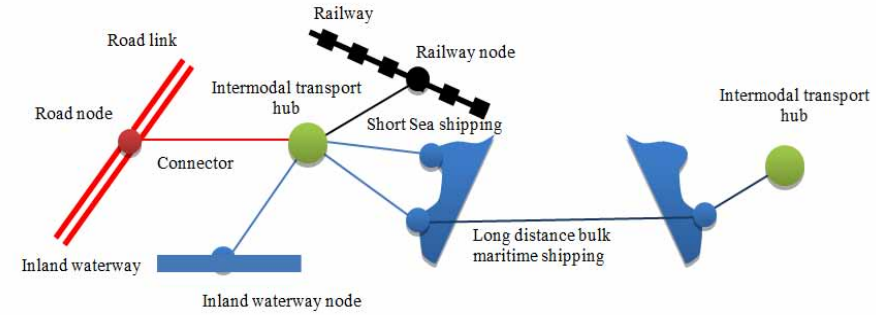
OBJECTIVES

- Assess how international markets will influence the U.S. grower payment and overall supply cost and volumes earmarked for the U.S. biofuel industry
- Identify integration opportunities among global supply chains to harmonize infrastructure ambitions and quality metrics

2 – Approach (Technical)

- Expand existing INL feedstock supply and logistics model (Biomass Logistics Model)
- Integrate data and modeling experience from collaborators
  - EU biomass demand and supply projections (TU Vienna)
  - EU logistic networks and international trade projections (Utrecht University)
- Merge in a U.S. stand-alone model able to simulate international market interactions with respect to woody and herbaceous feedstock (volumes and cost)
- Apply results in future Billion-Ton Updates (ORNL)





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2 – Approach (Management)

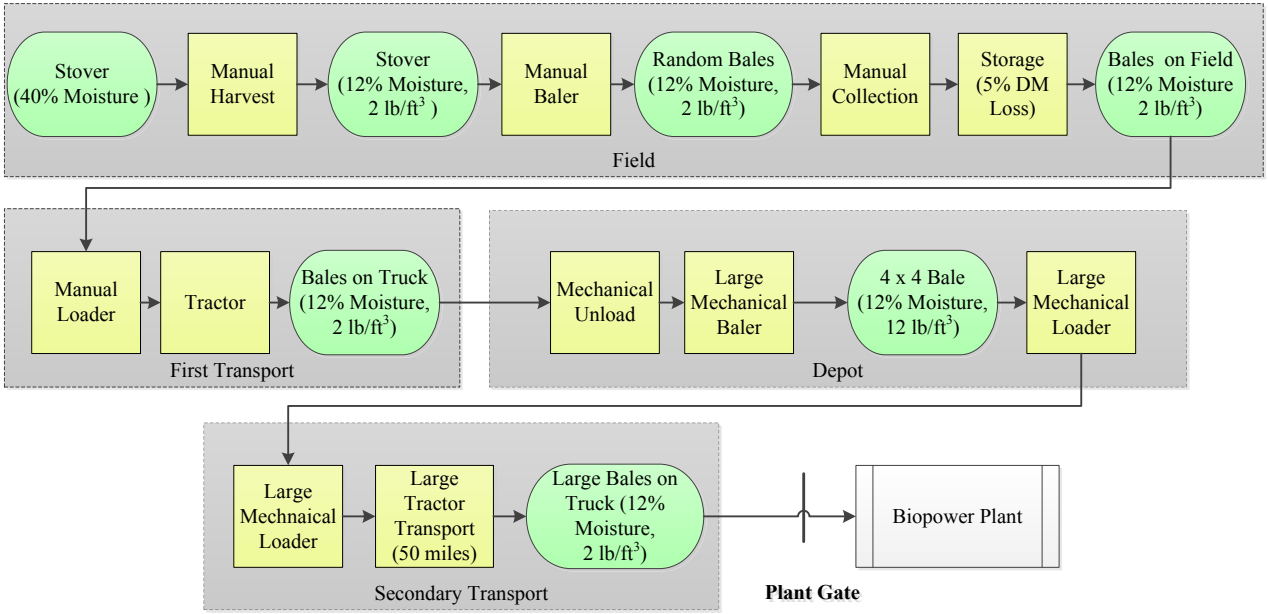
- INL pulls data and models from collaborators.
- INL aligns data with other initiatives, e.g., IEA Bioenergy Intertask activities.
- INL leverages existing collaborations to include results in future updates of BETO's Billion Ton Update.
- INL uses various communication channels to disseminate results and publish academic papers.

- Potential challenges:
  - Models: Data alignment and automation of connections (overcome)
  - Scope: many focus regions worth investigating (need to limit scope)
  - Policy context: dynamic (may change over the course of the project)

3 – Technical Accomplishments/Progress/Results

International Technical Feedstock Working Group

- Chinese, Swedish, and U.S. research partners
- Adaptation of INL Biomass Logistics Model (BLM) to Chinese conditions (paper in review)
- Chinese logistics heavily manual labor focused
- Chinese aim is to meet future demand largely from local resources
- Project focus shifted to other high impact markets (European Union)




Tri-National Bioenergy Feedstock Development Technical Working Group
中国-美国-瑞典三方生物能原料研发技术工作组
CHARTER&COLLABORATION AGREEMENT
合作章程

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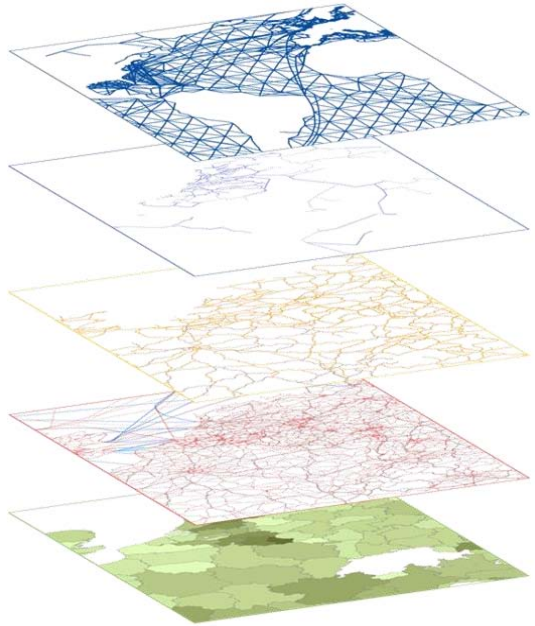
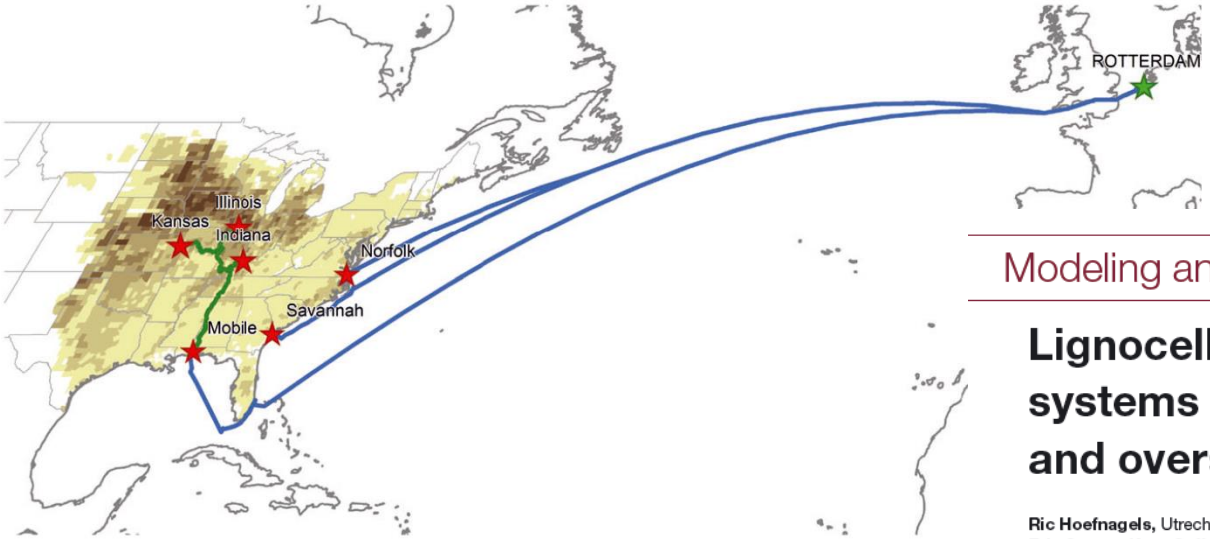
3 – Technical Accomplishments/Progress/Results

IEA Bioenergy Task 40 collaboration

- Successful link: INL Biomass Logistics Model (BLM) and Utrecht University Biomass Intermodal Transportation System (BITS)
- Detailed logistic layers and costs
- Assessment of U.S.-Netherlands least cost transport routes (published)





Modeling and Analysis

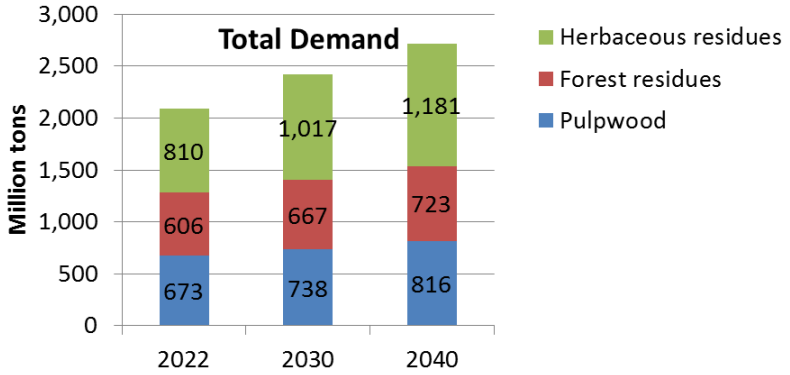
Lignocellulosic feedstock supply systems with intermodal and overseas transportation

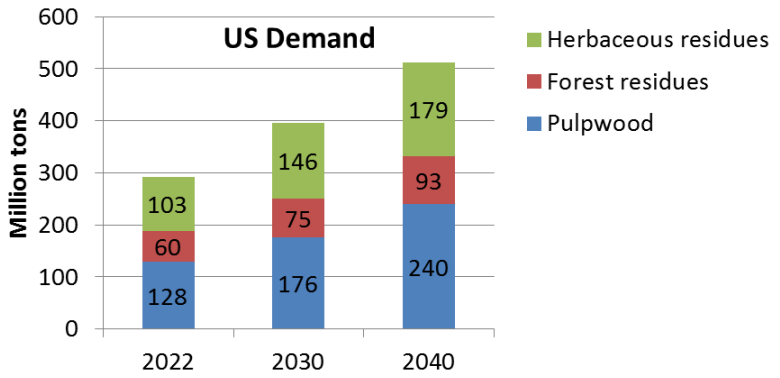
Ric Hoefnagels, Utrecht University, the Netherlands
Erin Searcy, Kara Cafferty, Idaho National Laboratory, Idaho Falls, USA
Thijs Cornelissen, Martin Junginger, Utrecht University, the Netherlands
Jacob Jacobson, Idaho National Laboratory, Idaho Falls, USA
André Faaij, University of Groningen, the Netherlands

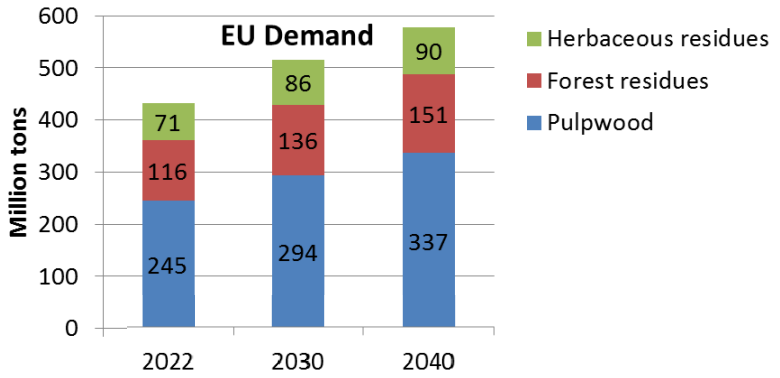
3 – Technical Accomplishments/Progress/Results

Expansion to global demand/trade projections

- Projection years match RFS2, BT2, and BT2-update
- Focus: U.S., EU, China, Brazil, India, Japan
- Feedstock specific demand linked to sector demand (policy driven)
  - Dominance of woody biomass in large heat/power markets (EU, Japan)
  - Dominance of herbaceous in advanced biofuel markets (U.S., Brazil)
- Import demand from US depends on oversea supply volumes and costs
- Result: EU will be key import region due to:
  - High local supply costs (esp. pulpwood)
  - Limited supply in volume
  - Higher willingness-to-pay than other regions (due to policy incentives/penalities)

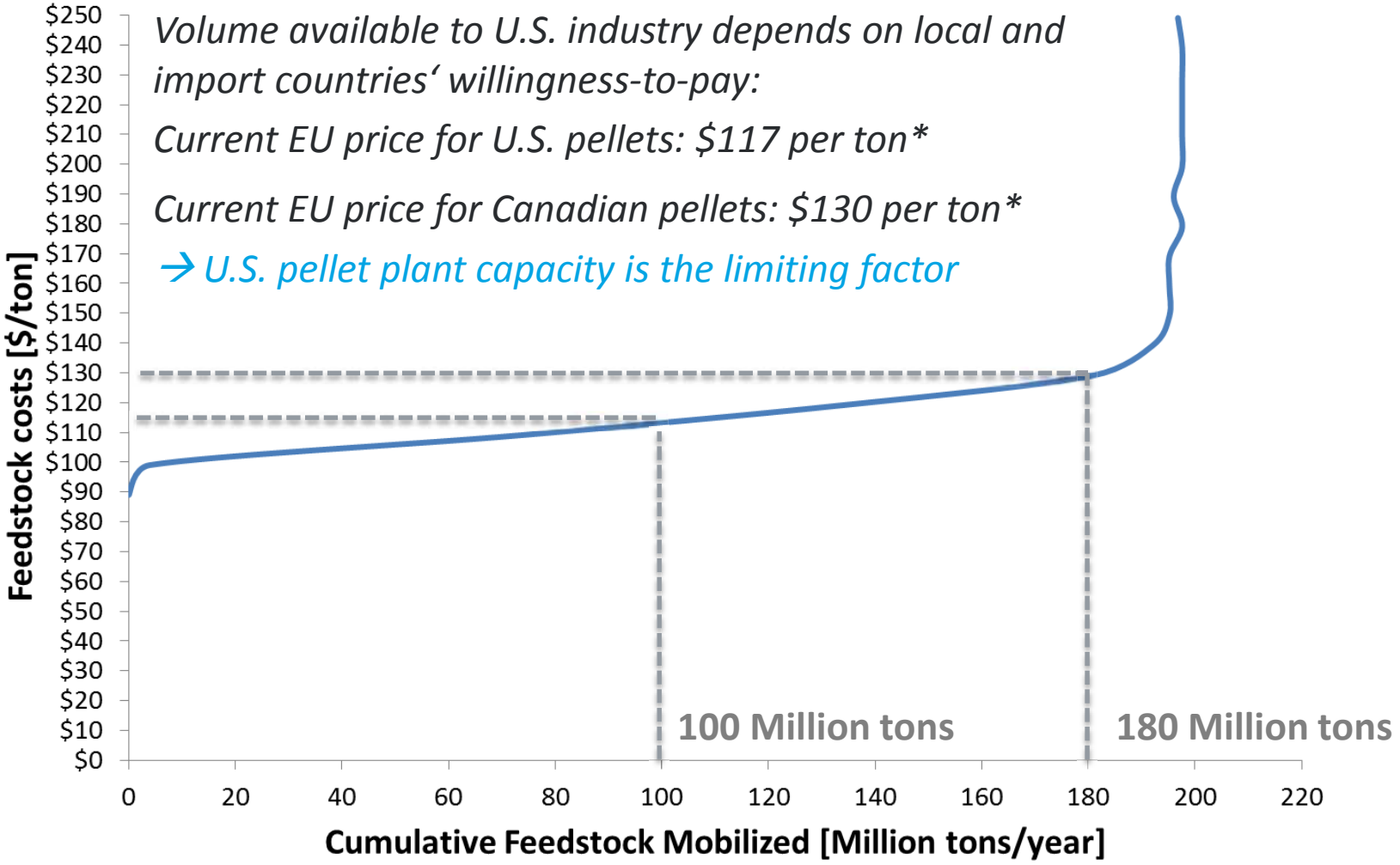






4 – Relevance

U.S. woody biomass cost supply curve by 2030 (preprocessed at plant gate)



* free alongside ship

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4 – Relevance

- **Trade is inevitable** but **impact on U.S. markets unclear**

- **BETO target of 350 million tons of feedstock at $80/ton delivered by 2022 appears very difficult** given oversea demand and willingness-to-pay

- Future **U.S. trade portfolio** will **depend on local market value of advanced biofuels** and U.S. producers willingness-to-pay / purchasing power
  → depends on the future U.S. policy framework

- **Short-/Mid-term oversea demand could help** U.S. feedstock supply industry to shift from the conventional to an advanced feedstock supply system (long-term local use)

- DOE workshop in February 2015 vetted this assumption as U.S. biofuels industry represenatives concluded that **markets will be the primary driver to enable** a future U.S. billion-ton bioeconomy

5 – Future Work

- Derive **U.S. feedstock supply curves at** potential **export locations** (Q2 2015)
- Quantify the **willingness-to-pay** of key market actors (Q3 2015)
- **Game-theoretic modeling** of different trade/demand scenarios (Q4 2015)
- **Supply chain case studies** to define harmonization potential with respect to infrastructure ambitions and quality metric (e.g., U.S. wood pellet supply chains) (Q1-2 2016)
- **Presentations** at IEA Bioenergy Workshop and Triennium Conference (Q3 2015, Q1 2016)
- 2 additional **publications** in academic journals (Q4 2015, Q4 2016)

Summary

- **Global markets define feedstock supply prices and volumes**
- **The U.S. cannot operate outside global markets**
- The speed and extent of a **U.S. bioeconomy development can be supported but also hampered by international feedstock competition**
- An **integrated assessment is required to inform BETO**, EERE or related agencies (e.g., USITC) and to enable them to take proactive measures with respect to potentially adverse trade and business impacts on the U.S. biofuel industry
- Leveraging international data and expertise via existing collaborations keeps **operational costs low**, yet provides robust results

Questions

Publications

- Ren, L., Cafferty, K., Roni, M., Jacobson, J., Xie, G., Wright, C., *Analyzing and Comparing Biomass Feedstock Supply Systems in China: Corn Stover and Sweet Sorghum Case Studies*. Bioresource Technology, submitted.
- Roni, M., Cafferty, K., Hess, R., Jacobson, J., Kenney, K., Searcy, E., Tumuluru, J., *Supply Chains for Bioenergy and Biorefining: Lignocellulosic Crop Supply Chains*. Woodhead Publishing Series in Energy, submitted.
- Hess, J.R., Lamers, P., Roni, Md., Jacobson, J., Heath, B., *Country Report 2014 – United States. IEA Bioenergy Task 40: Sustainable International Bioenergy Trade: Securing Supply and Demand*. 2015.
- Three chapters in: International Bioenergy Trade: History, status & outlook on securing sustainable bioenergy supply, demand and markets. M. Junginger, C. S. Goh and A. Faaij. Berlin, Springer, 2014.
    - Lamers, P., F. Rosillo-Calle, L. Pelkmans and C. Hamelinck. *Developments in international liquid biofuel trade*, pp. 17-40.
    - Lamers, P., D. Marchal, J. Heinimö and F. Steierer. *Woody biomass trade for energy*, pp. 41-64.
    - Searcy, E., J. R. Hess, J. S. Tumuluru, L. Ovard, D. J. Muth, E. Tromborg, M. Wild, M. Deutmeyer, L. Nikolaisen, T. Ranta and R. Hoefnagels. *Optimization of Biomass Logistics and Transport*, pp. 103-124.
- Hoefnagels, R., Searcy E., Cafferty, K., Cornelissen, T., Junginger, M., Jacobson, J., Faaij, A., *Lignocellulosic feedstock supply systems with intermodal and overseas transportation*, BioFPR, 2014, **8**(6): 794-818.
- Goh, C. S., Junginger, M., Cocchi, M., Marchal, D., Thrän, D., Hennig, C., Heinimö, J., Nikolaisen, L., Schouwenberg, P.-P., Bradley, D., Hess, R., Jacobson, J., Ovard, L., Deutmeyer, M., *Wood pellet market and trade: a global perspective*. BioFPR, 2013, **7**(1): 24-42.

Presentations, Outreach

- Lamers P., *Towards Sustainable International Biomass Trade Strategies,* Biotrade2020+, Brussels, Belgium, October 2014.
- Lamers P., *Biomass trade and supply system opportunities for a worldwide bio-based economy,* World Bioenergy, Jönköping, Sweden, June 2014.
- Jacobson J., *Commoditization of Biomass for International Trade*, International Energy Agency-Task 40 workshop, Miami, Florida, October 2013.