2013 DOE Bioenergy Technologies Office (BETO) Project Peer Review

6.5.2.5 China Task

May 20-23, 2013
Feedstock Production and Logistics Platform

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Goal Statement

- Establish a U.S. and China international feedstock working group to identify and research barriers in biomass production, logistics, and feedstock quality for large-scale, high-volume utilization of lignocellulosic biomass with the goal of enhancing U.S. feedstock tools and promoting U.S. industry to target technologies that can be implemented into the immature Chinese feedstock supply system.

Quad Chart Overview

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

Timeline
Project Start Date: Jun. 1, 2009
Project End Date: Sept. 30, 2015
Percent Complete: 35%

Barriers
Ft-A Feedstock Availability and Cost
Ft-B Sustainable Production
Ft-M Overall Integration
Ft-M Overall Quality Monitoring

Budget
Total Project funding: $835K
DOE Share: 100%
Funding for FY13: $235K
Funding for FY12: $100K

Partners
China National Energy Admin (NEA)
Chinese National Energy R&D Center for Biomass (NECB)
Chinese Agricultural University (CAU)
Swedish University of Agricultural Sciences (SLU)
PetroChina
USDA

Project Overview

- The Idaho National Laboratory is developing R&D collaborative research with Chinese research institutions in the areas of biomass production and logistics analysis.
- The research involves production and logistics modeling focused on implementing U.S. equipment by highlighting cost and efficiency improvements contrasted with Chinese social-political constraints.
- The research also involves logistics modeling of international biomass trade to show the potential of U.S. markets to meet both the growing demand and the lack of infrastructure for biomass feedstocks in China

Approach

- Establish collaborative relationships with Chinese-identified research institutions through annual meetings and regular video conference, teleconference, and e-mail communications
- Exchange feedstock production and logistics methods to establish a research foundation and path forward
- Build and populate database(s) of key production/logistics parameters necessary to develop case study models
- Enhance models through research(er) exchange to capture unique agronomic and logistics practices and verify assumptions
- Expand models to capture international trade (leverage U.S. – Europe International Energy Agency [IEA] work)

Technical Accomplishments

- International Technical Feedstock Working Group
  - Developed agreement between China's National Energy R&D Center for Biomass (NECB), China Agricultural University (CAU), and Swedish University of Agricultural Sciences (SLU) that is foundational for communication and expectations on joint projects.
  - Co-sponsored a visiting researcher to work with INL researchers to adapt the Biomass Logistics Model to Chinese conditions.

同心

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

English	Chinese
This working group charter and collaboration agreement is drafted as a communication tool to facilitate multi-cultural research collaboration and establish shared expectations for the Tri-National Bioenergy Feedstock Development Technical Working Group.	本工作组合作章程作为一个交流工具旨在促进多元文化背景下的合作，并确立三个国家生物能源原料研发技术工作组的共识
This agreement is approved and adopted on March 18, 2013, by a consensus of its members. Signatures:	合作章程在 2013 年 3 月 18 或工作组成员一直通过

U.S. Co-Chair	China Co-Chair	Sweden Co-Chair
Christopher T. Wright Manager, Biofuels and Renewable Energy Technologies, Idaho National Laboratory (INL)	**XIE Guanghui** Professor, China Agricultural University (CAU), National Energy R&D Center for Biomass (NECB)	**XIONG Shoajun** Associate Professor, Swedish University of Agricultural Sciences (SLU)

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Biomass Intermodal Transportation System (BITS)

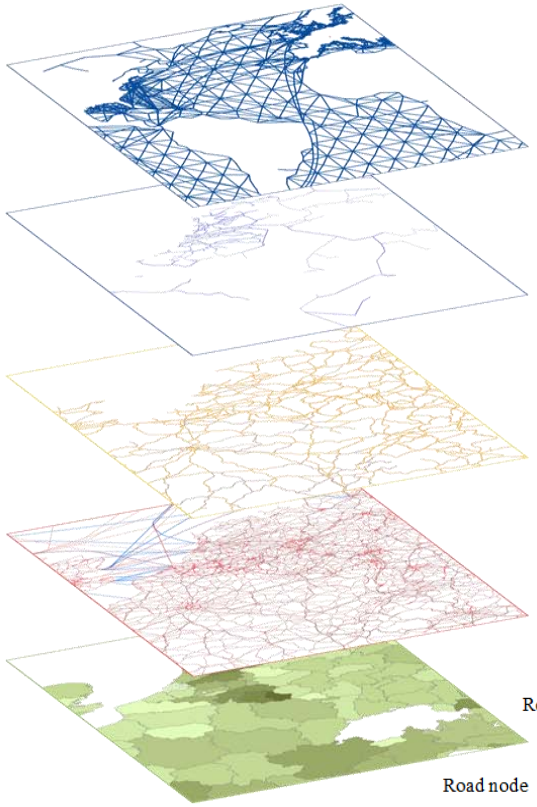
Long distance and short sea shipping
· Global seaways and US deep sea terminals (ORNL-CTA, 2000)
· Ports in Europe and China (World Port Index, 2011)
· Short Sea Shipping Routes (RRG, 2008)

Inland waterways
· USA: National Waterway network (ORNL-CTA, 2000)
· Europe: Inland waterway network Trans-Tools (CEMT class II – VI) (JRC, 2009)

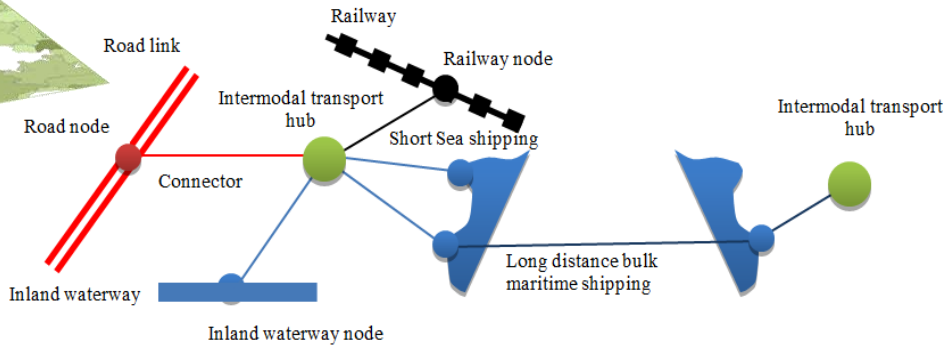
Rail freight network
· USA: CTA operational railroad network (ORNL-CTA, 2000) · Europe: rail freight network Trans-Tools (JRC, 2009)

Road network
· USA: Oak Ridge National Highway Network (ORNL-CTA, 2000)
· Europe: road network Trans-Tools (JRC, 2009)

Origins and destinations
· USA: intermodal bulk terminals (ORNL-CTA, 2000)
· Europe: centroids NUTS-3 regions (JRC, 2009)
· China: sea ports (World Port Index, 2011)



Least Cost Optimization for moving biomass supply to regions of demand



Technical Accomplishments

- 2 case studies evaluated
  - Southern pine wood chips
  - Midwest corn stover
- Results ranged from $139 to 152/Dry Ton. Current wood pellet prices in Europe range from $120-$180/Dry Ton.

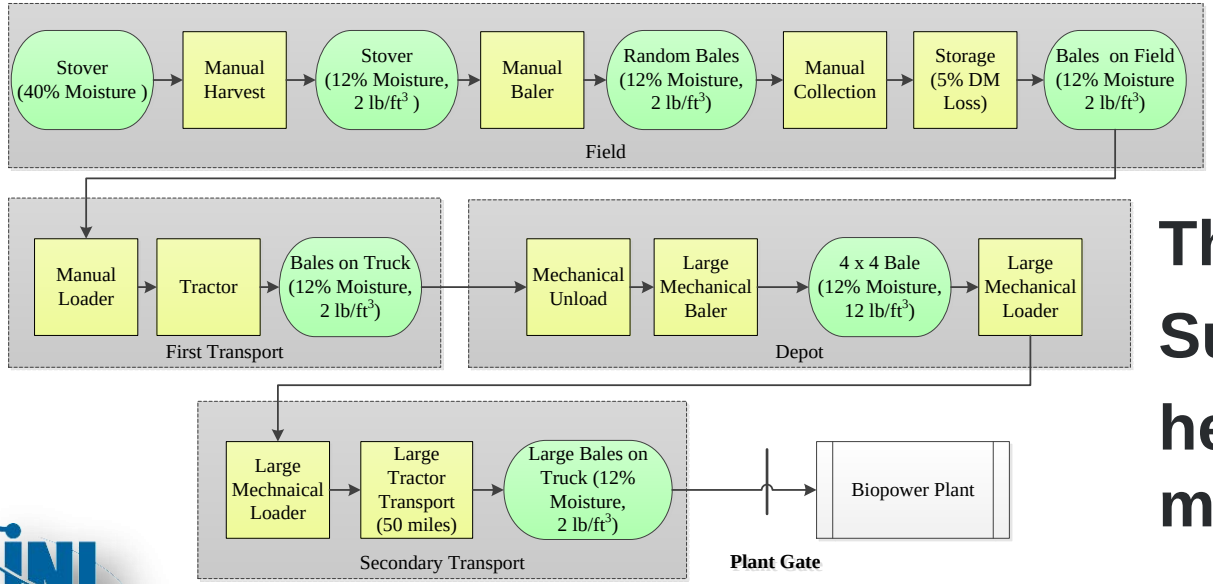
	Case 1	Case 2
Feedstock	Woody thinnings	Corn Stover
Field-side	Southeast U.S.	Midwest U.S.
Transport to depot	Wood chips, 50 miles by truck	Square bales, 50 miles by truck
Depot	Pelletization	Pelletization
Transport to terminal	100 miles by truck	100 miles by truck
Terminal	Savannah (GA)	St Louis (MO)
International transport	Intermodel Transport	Intermodel Transport
Destination	China (Shanghai)	China (Shanghai)

Cost Summary ($/DM ton)	Case 1	Case 2
Harvesting	$ 8.09	$ 1.94
Bailing/Bundling	$ 0.00	$ 11.47
Collection	$ 8.68	$ 1.88
Total Harvest & Collection	**$ 16.77**	**$ 15.29**
Transport From Field	$ 15.46	$ 10.36
Transport From Depot	$ 8.49	$ 14.24
Transport From Terminal	$ 61.95	$ 90.01
Total Transportation	**$ 85.90**	**$ 114.61**
Preprocessing Field Side	$ 9.17	$ 0.00
Preprocessing Depot	$ 24.07	$ 15.88
Total Preprocessing	**$ 33.24**	**$ 15.88**
Storage Field Side	$ 0.17	$ 4.73
Storage Depot	$ 0.00	$ 0.32
Storage Refinery	$ 1.74	$ 0.00
Total Storage	**$ 1.91**	**$ 5.05**
Handling and Queuing Refinery	$ 1.60	$ 0.70
Total Handling and Queuing	**$ 1.60**	**$ 0.70**
Total	$ 139.42	$ 151.53

Chinese Biomass Feedstock Supply System

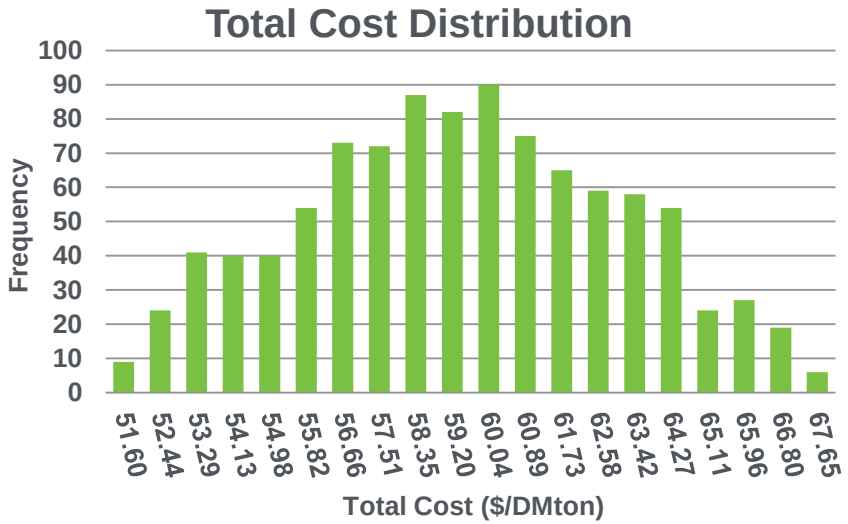
	Rural Supply System
Biopower Plant Demand	350,000 tons/yr
Feedstock	Corn Stover
Region	Northern China
Transport to Depot	Small bales, 3.3 miles by tractor
Depot	Large Bales
Transport to Biopower Plant	50 miles by truck

	Ownership	Operating	Total	# Equipment
Harvesting	0.03	10.19	10.22	7,741
Bundling	0.00	7.73	7.73	5,291
Collection	0.01	0.61	0.61	275
Transport To Depot	2.44	2.93	5.37	307
Storage	0.00	1.26	1.26	-
Preprocessing	13.41	20.92	34.33	50
Transport to Plant	0.47	0.64	1.12	4
Total	**16.35**	**44.28**	**60.64**	



The Chinese Biomass Supply System is heavily driven by man-power.

Sensitivity Analysis



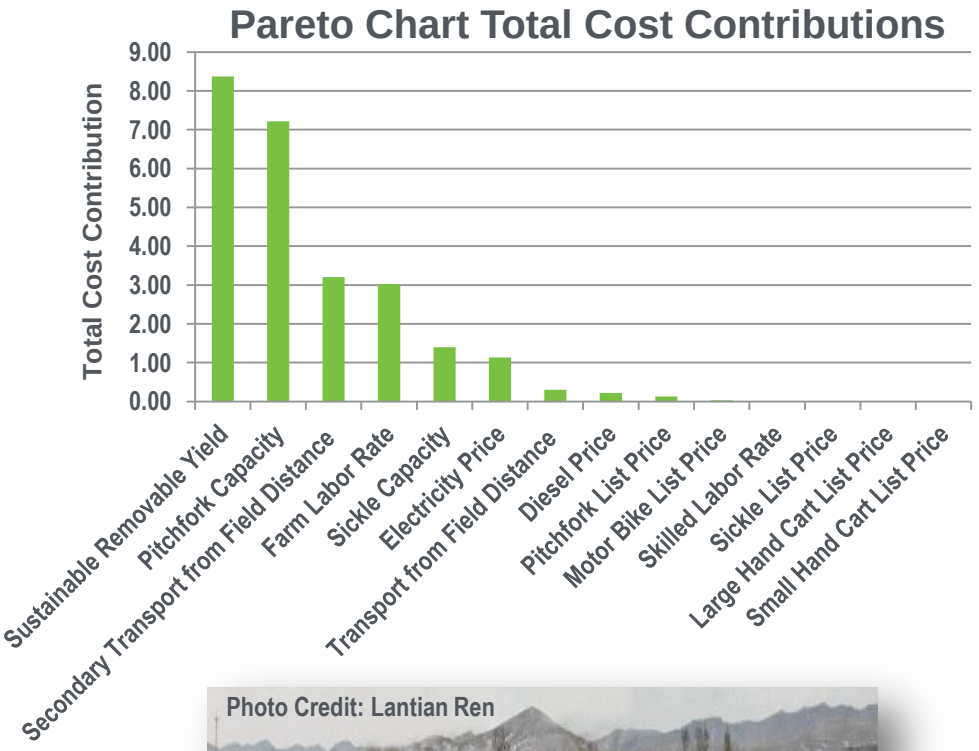


Photo Credit: Lantian Ren

Technical Accomplishments

Milestone	Performer	Due	Completion Metrics	Status
Task 1: ML.6 Expand Chinese supply system model for cost sensitivity.	INL, China Agricultural University	1/31/13	Report & Model Results	Complete
Task 3: ML.8 Complete the establishment of a bilateral technical feedstock working group with at least two members and a document describing the function of the group.	INL, China Agricultural University	5/30/13	Concept Paper	Complete
Task 4: ML.9 Take part in and help organize if requested the US-China Biofuels Cooperative Missions held yearly (calendar) in alternating country locations.	INL, NREL, PNNL, ANL, ORNL	5/30/13	Trip Report	On Target
Task 5: ML.10 Develop an initial integrated cost model with the local supply system and international trade models to produce cost tables for the total logistics of international biomass utilization.	INL	9/30/13	Report & Model Results	On Target

Relevance

MYPP: …provide a secure, reliable, and affordable biomass feedstock supply for the U.S. bioenergy industry, in partnership with USDA and other key stakeholders…(p. 2-13)

MYPP: …establish…criteria under which 155 million dry tons (DT) per year would be feasible by 2017…at required conversion specifications at or below $80/DT ($2011)…(p. 2-14)

Working with Chinese research institutions and companies will enhance U.S. feedstock modeling and open large markets for equipment and technology

- Leverage Chinese research and markets to advance U.S. methods and competitiveness
- Enhance modeling robustness through identification of new barriers and constrains (i.e., low machine use and high labor force)
    - Identify feasible biomass feedstock logistics systems (constrained by Chinese policy and infrastructure) to demonstrate U.S. industry solutions and market U.S. equipment and technologies

Critical Success Factors

Success Factors (technical, market, business)

- Well developed relationships both technical and social (T,B)
- Proper understanding of Chinese infrastructure and potential to develop feedstock supply system (T,M)
- Strong techno-economic modeling capabilities to provide data context and share in technical relevance (T)
- Industrial partners to validate to verify and demonstrate case study results (T,M,B)

Potential Challenges (technical and non-technical)

- Social and political differences between the U.S. and China (N)
- Basic agricultural policy and practice differences (T,N)
- Acceptance of U.S. agricultural systems for rapid bioenergy expansion (T,N)

Critical Success Factors

Advancement of the state of technology and U.S. agriculture and biofuels competitiveness

- Mechanization of Chinese agriculture is a huge leap forward for both the food and prospective energy industries in China
- Expansive markets exist for existing U.S. equipment from harvesting to preprocessing to handling and transportation.
- Expansive markets exist for existing U.S. conversion technologies that depend on functional and cost effective supply systems.
- Different Chinese feedstock varieties, characteristics, and plant traits are available to enhance U.S. feedstocks made available through a collaborative building of an international branch of the feedstock library

Future Work

- Develop an international branch of the biomass feedstock library to enhance the existing U.S. based version
- Perform surveys to improve library data and better reflect China conditions for the BLM
- Perform site-specific analyses using Chinese BLM and publish results
- Develop scope and execution strategy for DOE/USDA/ PetroChina collaboration to advance biofuels technologies
- Through working group, conduct surveys and reviews to identify socio-economic inhibitors that restrict bioenergy industry expansion and international trade
  - Perform industry-led feedstock supply system field demonstration in China

Summary

- Approach
  - Establish collaborative relationships
  - Exchange feedstock production and logistics methods
  - Enhance feedstock library database and models through research(er) exchange
  - Expand models to capture international trade and facilitate large equipment and technology markets
- Technical Accomplishments
  - International Technical Feedstock Working Group
  - Biomass Intermodal Transportation System (BITS)
  - Verified Chinese Biomass Feedstock Supply System
  - Supply System Sensitivity Analysis

Summary

- Relevance
  - MYPP: …develop sustainable technologies to provide a secure, reliable and affordable biomass feedstock supply…[and]…reduce costs from harvest to biochemical conversion plant gate…
  - Leverage Chinese research and markets to advance U.S. methods and competitiveness
- Critical Success Factors
  - Proper understanding of Chinese infrastructure and potential to develop feedstock supply system
  - Industrial partners to validate, verify, and demonstrate model results
- Future Work
  - Develop an international branch of the biomass feedstock library
  - Perform industry-led feedstock supply field demonstration in China

Questions

Response to FY11 Peer Review Comments

Critical Comment #1:

- Relevance to meeting the U.S. emerging demand for biomass and the urgency for meeting RFS targets is low. This project is useful in an international trade and geopolitical context, but does not appear to be core to achieving US production objectives in ways that rationalize diversion of the limited talent at US institutions away from critical milestones directed at U.S. second generation bioenergy commercial launch…weak justification for being relevant to the DOE biomass goals. I didn't see the relevancy.

Response

- U.S. relevance hinges on two key concepts. First, the U.S. and China are the largest developed and developing countries in the world and will compete for limited energy resources now and in the future. We should work together to build a sustainable and renewable energy portfolio for the health of both of our economies. Second, China is the largest developing market for durable goods in the world and is a tremendous consumer base for U.S. products, including those related to bioenergy. If we can agree that these are important international issues and opportunities, then this project has relevance.

Response to FY11 Peer Review Comments

Critical Comment #2:

- Critical factors and challenges all come down to the fact that the team must develop a good, productive relationship across national boundaries. I am not sure what or how they will determine success of this DOE effort. Chris said that exporting our technology on logistics may be the benefit of to the US. this will be a long term result if it ever occurs. Culture and political aspects will be a challenge.

Response

- INL, as part of a larger National Lab effort, has established a strong working relationship directly with the China Agricultural University and collaboratively (USDA) with China's National Energy Agency, Ministry of Science and Technology, and PetroChina. These relationship have resulted in a researcher exchange, Chinese work scope to improve feedstock production and logistics models and DOE's biomass characterization library. Through these relationships, the near term use and demonstration of U.S. systems/equipment is being favorably discussed with a desire to demonstrate a viable feedstock supply system on par with DOE's 2012 accomplishments using U.S. equipment.

Response to FY11 Peer Review Comments

Critical Comment #3:

- I recommend that the project leadership be more focused on methods to tap the intellectual capital in China to benefit US development programs.

Response

- Now that a much stronger relationship has been developed between some Chinese recognized leading institutions, our ability to develop work scope that taps China's intellectual capital is good. The first of this work will happen over the next year as the visiting researcher returns to China to implement a data gathering plan that will improve modeling assumptions, add biomass samples to the Library Database, and lay the groundwork for a logistics system demonstration in a couple of years.