DOE Bioenergy Technologies Office (BETO)
2019 Project Peer Review

Waste to Wisdom: Utilizing forest residues for the production of bioenergy and biobased products

March 6th, 2019
Feedstock Supply and Logistics Session

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Forest Residues

Logging Slash

Forest Thinnings

103 million tons/year @ $60/bone dry ton (Billion-ton Report, 2016)

Forest residues are underutilized or wasted due to high collection and transportation costs and low market values.

Project Goal:

To develop biomass conversion technologies and in-woods operational logistics that facilitate forest residues utilization for the sustainable production of bioenergy and biobased products.

Project Outcomes:

Addressed key barriers in forest residue utilization, including…

- Production of quality feedstock from forest residues;
- Development of biomass conversion technologies (BCTs) operating at or near the forest, and assessment of market potentials for BCT products;
- Improving the knowledge of environmental benefits and societal perceptions.

Quad Chart Overview

Timeline

- Project start date: 9/30/2013
- Project end date: 12/31/2017
- Percent complete: 100%

Barriers addressed (FY19 MYP):

- Feedstock Availability and Cost
- Biomass Material Handling and Transportation
- Feedstock Supply System Integration and Infrastructure

	Total Costs Pre FY17	FY 17 Costs	FY 18 Costs	Total Project Funding (2013-2017)
DOE Funded	3,102,127	1,790,469	989,378	5,881,974
Project Cost Share	1,791,578	130,838	81,972	2,004,208 (34%)

Partners:

Forest Products Co. (10%); USDA Forest Service (20%); Land-Grant Universities (40%)

Biomass Engineering Co. (30%)

Objective:

Production of bioenergy and biobased products

End of Project Goal:

- Production of quality feedstocks from forest residues
- Development of biomass conversion technologies
- Evaluation of environmental and economic benefits

1 - Project Overview

Forest Residues

Production of Quality Feedstock

In-woods Biomass Conversion

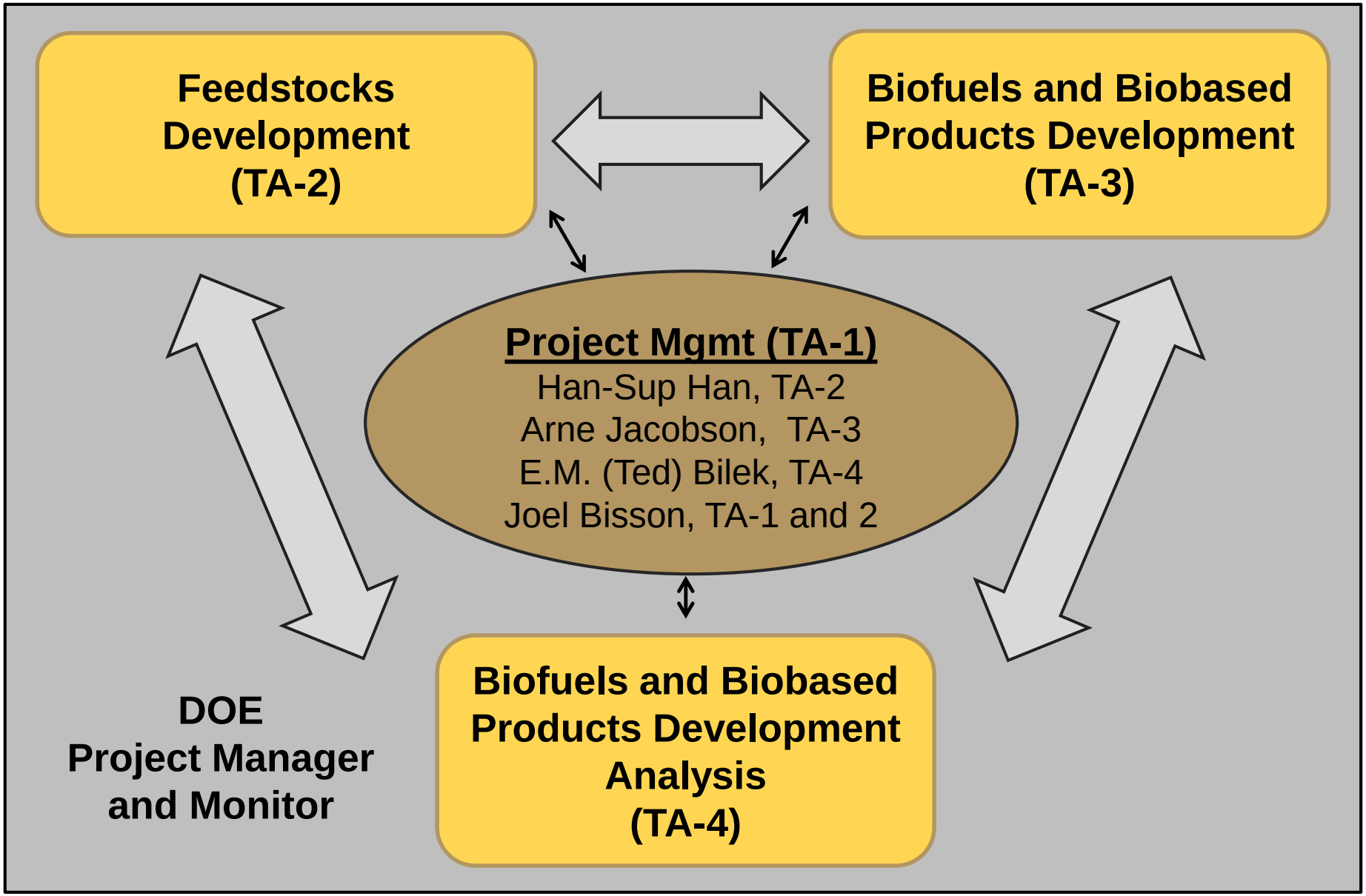
Biochar

Briquettes

Torrefied chips

⇒ funded by Biomass Research Development & Initiative (BRDI)

1 - Approach (Management – TA1)



2 – Approach (Technical)

TA2 - Feedstock Development:

- Sort and process forest residues to produce quality feedstocks
- Compress forest residues into high-density bales
- Develop logistics models integrating both in-woods biomass operations and conversion technologies

TA3 - Biofuels and Biobased Products Development:

- Evaluate the technical performance of three proven technologies (biochar, torrefaction, and briquettes) that are designed to run near a forestry operations site
- Utilize the results from the testing conducted above to refine and scale up the biomass conversion technologies

TA4 - Biofuels and Biobased Products Development Analysis:

- Evaluate financial feasibilities of stump-to-market operations
- Determine their socio-economic and environmental impacts
- Analyze ecological sustainability of the processes

3 - Technical Accomplishments and Results

Task Area 2 - Feedstock Development

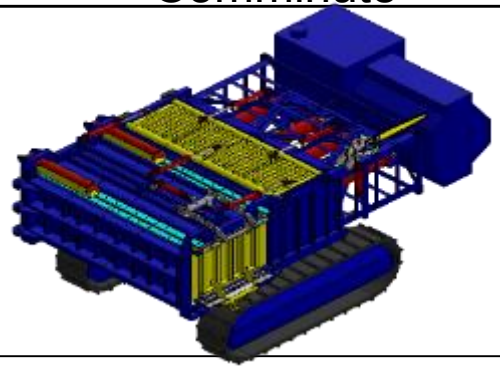
Quality feedstock production:

- New in-woods operations logistics to produce high-quality feedstock: sorting & processing, comminuting, and screening
- Balers were developed to handle all remaining forest residuals for easy transportation and long-term storage
- Evaluated feedstock quality: moisture content, size distribution, bulk density, and ash content

wood chips (<0.75”) micro-chips (<0.25”) sawdust (<0.16”)

Sort and Process

Comminute



Baling

3 - Technical Accomplishments and Results (cont'd)

Task Area 3 - Development of Biomass Conversion Technologies

- Biochar: Tested original biochar system design with a variety of feedstocks and improved product output (1.7 ton/day), emissions, safety, and labor requirements.
- Torrefaction: Built 16 ton/day torrefaction system and tested at various operating conditions to evaluate highest quality final product.
- Densification: Produced dense, durable briquettes from forest residues and torrefied biomass without binders.
- In-field demonstrations: Configured several conversion systems into integrated plant systems to demonstrate operations for near-forests biomass conversion.

Biochar production system

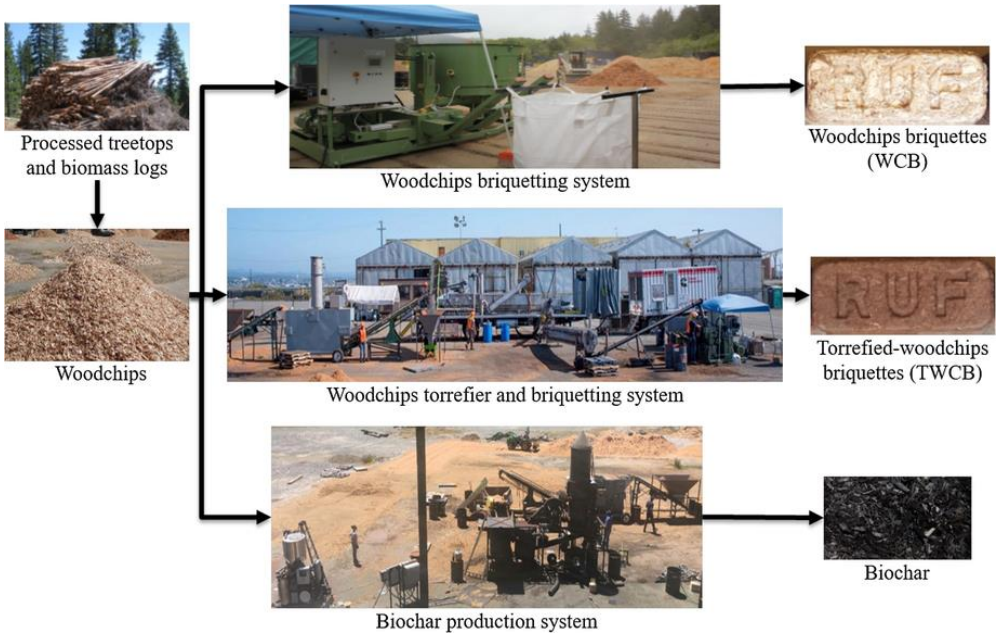
Torrefaction / Briquetting System

Torrefied briquettes (top two) and biomass briquette (bottom)

3 - Technical Accomplishments and Results (cont'd)

Task Area 4 - Biofuels and Biobased Products Development Analysis

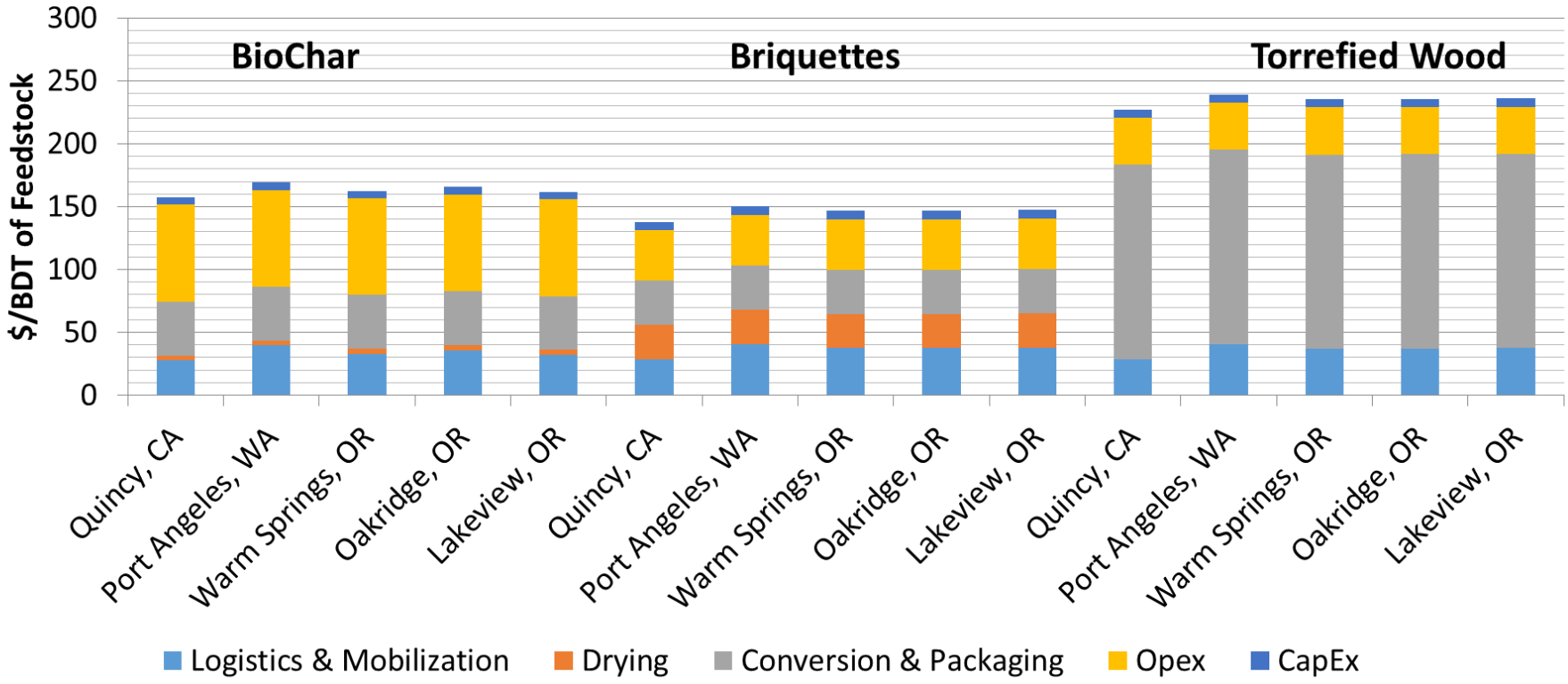
- Larger systems can make better use of labor, reducing unit costs; but it is important to balance machine capacities.
- Value capture is an important issue due to reduced site preparation costs as well as non-market benefits such as reduced wildfire risk, improved air quality, and carbon sequestration resulting from wood waste utilization.
- Biochar can remediate old mine soils and reduce lead contamination.
- Public perceptions are generally positive towards wood waste utilization, but education and publicity are warranted.



Waste to Wisdom Demonstration Systems and Products

3 - Technical Accomplishments and Results (cont'd)

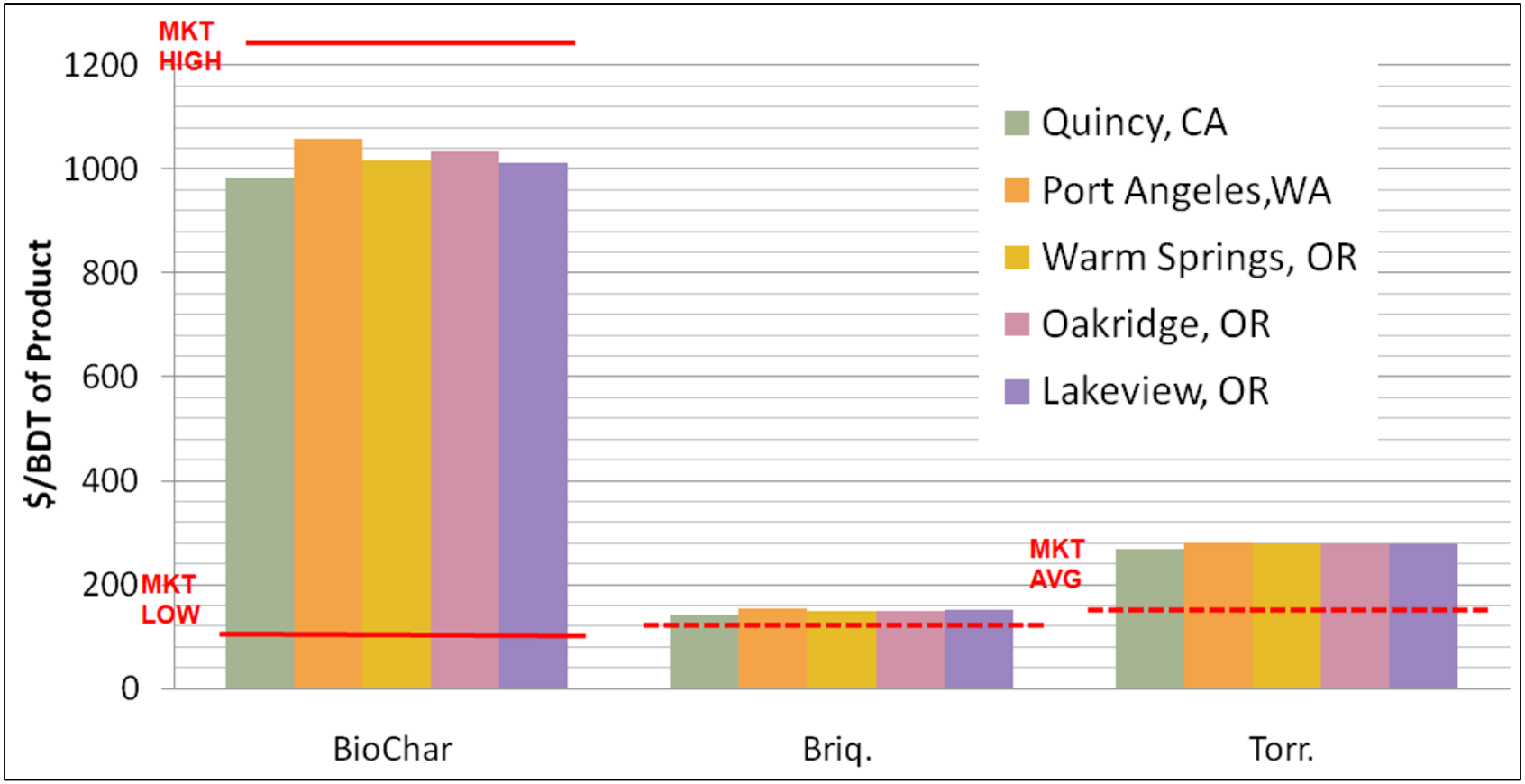
What are the different supply chain costs?



Regional variation 5-10%

3 - Technical Accomplishments and Results (cont'd)

Will the market support the supply chain costs?



Biochar likely best candidate
depends on local & regional market conditions

4 - Project Relevance (to BETO 2019 MYP)

This project aims to address barriers and challenges related to "Feedstock Availability and Cost," Biomass Material Handling and Transportation," and "Feedstock Supply System Integration and Infrastructure"

"Waste to Wisdom" – an integrated approach that supports BETO's 2019 MYP barriers and challenges :

- Reduce costs of in-woods biomass operation logistics while improving biomass quality and processing efficiency
- Show how integrating BCTs into feedstock logistics can increase transportation efficiencies and improve longer-term feedstock storage in depots or biorefineries
- Provide products that reduce physical and chemical variability to ensure a more reliable and efficient biofuel as a drop-in replacement for coal, compatible with existing infrastructure and reducing overall emissions
- Provide credible data and projections on current and future cost, social and environmental impacts, and quality of biobased products, which will reduce uncertainty to developing biorefinery technologies

Summary

- ✓ **Overview:** Utilization of forest residues for the sustainable production of biofuels, bioenergy, and biobased products
- ✓ **Approach:** Integration of new biomass conversion technologies with in-woods feedstock production and supply operations
- ✓ **Technical Accomplishments/Results:**
  - Developed new operations logistics of supply quality feedstock from forest residues
  - Produced biochar, torrefied wood, and briquettes using mobile biomass conversion processes that were operated near the forest operation sites
  - Developed strategies and technologies to improve economics of utilizing forest residues for production of bioenergy and biobased products
  - Socio-economic and environmental benefits from utilization of forest residues were overwhelmingly positive.
- ✓ **Relevance:** Significant advancement in meeting the 2019 MYP goals of sustainable supply of terrestrial feedstock and development of innovative biomass conversion techs.
- ✓ **Future work**: Completed.

Questions?