Biomass 2012: Feedstock Logistics Breakout Session

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Raw Biomass to Feedstocks: The Role of Feedstock Logistics in a National Scale Industry

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Defining Feedstock Supply & Logistics

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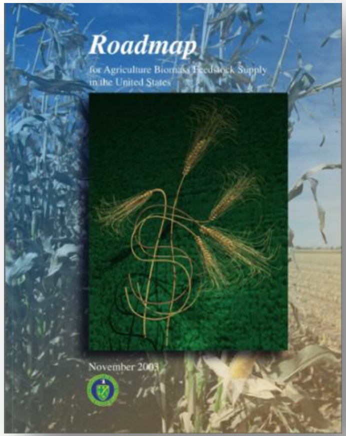
Equipment Performance Metrics
- Equipment Efficiency / Capacity
- Dry Matter Losses
- Operational Window

Biomass Performance Metrics
- Physical, Chemical, & Rheological Properties
- Product Bulk/Energy Density
- Material Stability

Documents Guiding Supply System Logistics Core R&D



Biomass Production:
- Ag. Resources
- Forest Resources

Feedstock Production Interface

Harvest & Collection → Storage → Preprocessing → Transportation → Handling & Queuing

Harvest & Collection:
- Equipment Capacity
- Compositional Impacts
- Pretreatment Impacts

Storage:
- Shrinkage
- Compositional Impacts
- Pretreatment Impacts
- Soluble Sugar Capture

Preprocessing:
- Equipment Capacity
- Equipment Efficiency
- Material Bulk Density
- Compositional Impacts
- Pretreatment Impacts

Transportation:
- Truck Capacity
- Loading compaction
- Loading efficiencies

Handling & Queuing:
- Handling efficiencies
- Handling compaction
- Material Bulk Properties

Biomass Conversion:
- Biopower
- Biofuels
  - Biochem
  - Thermochem

Feedstock Conversion Interface

Identifying the Resource Base

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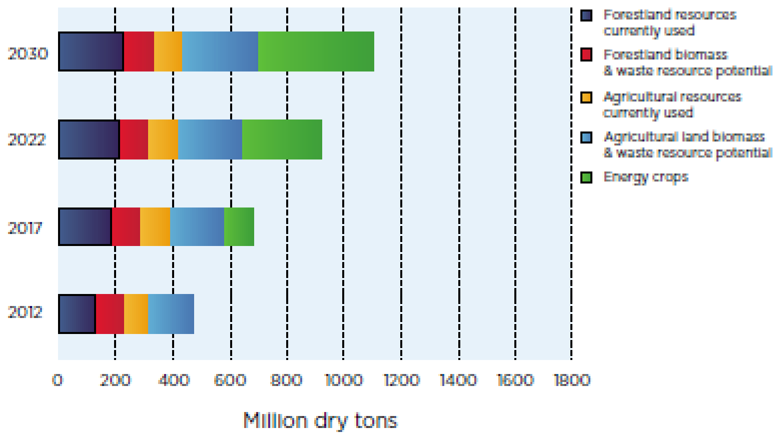
Feedstock	2012	2017	2022	2030
		Million dry tons		
Baseline scenario				
Forest resources currently used	129	182	210	226
Forest biomass & waste resource potential	97	98	100	102
Agricultural resources currently used	85	103	103	103
Agricultural biomass & waste resource potential	162	192	221	265
Energy crops[a]	0	101	282	400
Total currently used	**214**	**284**	**312**	**328**
Total potential resources	**258**	**392**	**602**	**767**
Total – baseline	**473**	**676**	**914**	**1094**
High-yield scenario (2%–4%)				
Forest resources currently used	129	182	210	226
Forest biomass & waste resource potential	97	98	100	102
Agricultural resources currently used	85	103	103	103
Agricultural biomass & waste resource potential[b]	244	310	346	404
Energy crops	0	139–180	410–564	540–799
Total currently used	**214**	**284**	**312**	**328**
Total potential	**340**	**547–588**	**855–1009**	**1046–1305**
Total high-yield (2-4%)	**555**	**831–872**	**1168–1322**	**1374–1633**

Note: *Under the high-yield scenario, energy crops are shown for 2% to 4% annual increase in yield. Numbers may not add up due to rounding.*

[a] Energy crops are planted starting in 2014.

[b] Agricultural residues are generated under a high-yield traditional crop scenario with high no-till adoption (see Table 4.6). Energy crop yield growth follows a baseline growth pattern of 1% annually.

- At or below $60/dry ton at the farm gate or landing



Delivering the Billion Ton

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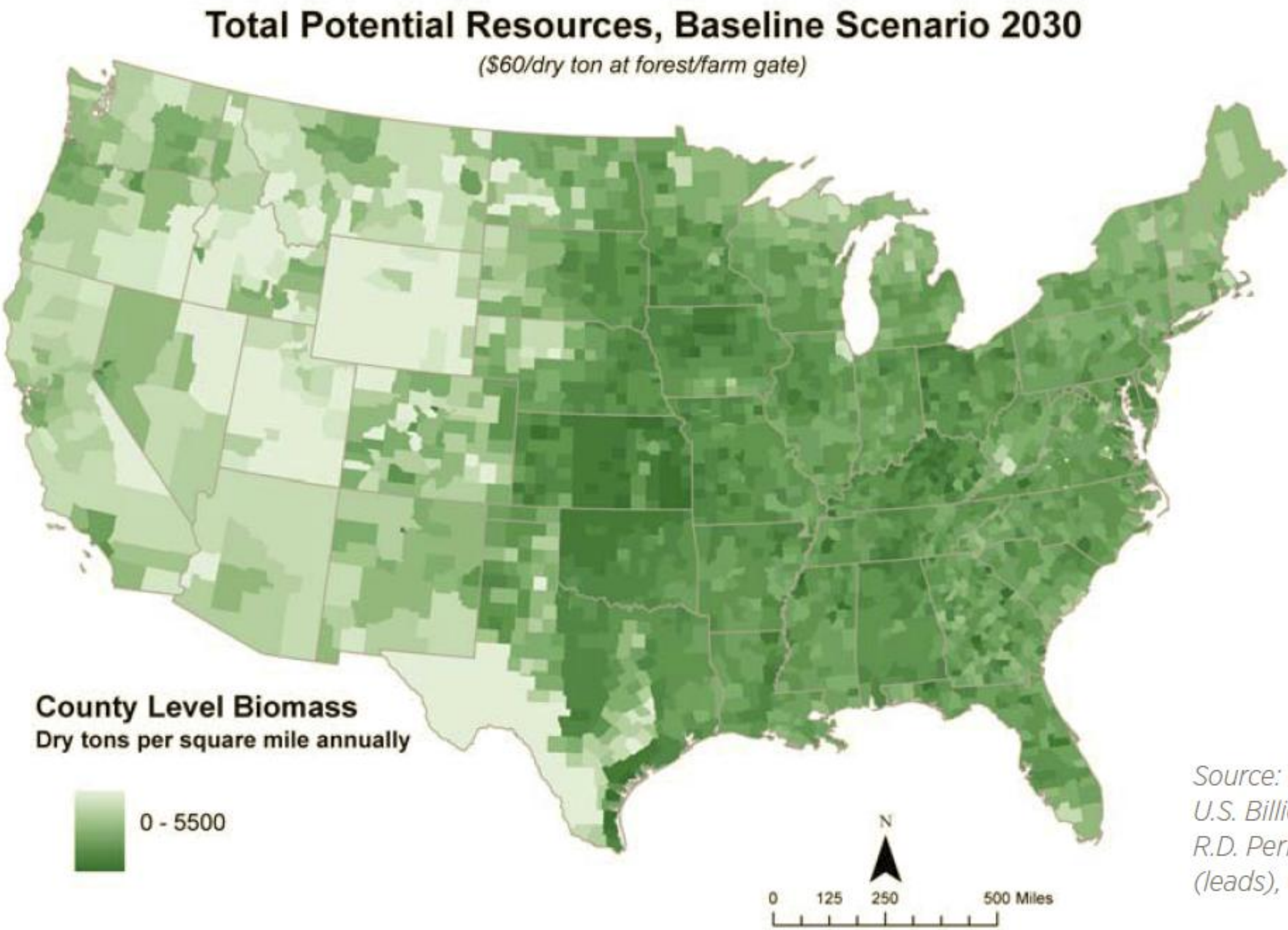

Source: U.S. DOE, 2011. U.S. Billion-Ton Update, R.D. Perlack and B.J. Stokes (leads), ORNL/TM-2011/224.

Session Focus

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- Three grand challenges in feedstock logistics for a national scale industry
  - Stability
  - Density
  - Quality

- Meeting short term industry needs
  - Equipment capacities and efficiencies
  - Process improvement
  - Improved business models

- Priority themes for emphasis
  - Feedstock quality
  - Infrastructure compatibility
  - Scale up to meet national goals
  - Delivered feedstock cost

Schedule

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- Richard Hess
  - Provide the technical basis for the DOE commodity feedstock supply system vision
  - 15 minutes
- Bobby Bringi
  - Discuss specific technology concepts focused on quality upgrading in distributed preconversion to infrastructure compatible commodity feedstocks
  - 15 minutes
- Bob Rummer
  - Introduce the latest developments in forestry and dedicated woody energy crop systems
  - 15 minutes
- Kevin Comer
  - New equipment concepts for herbaceous feedstock supply and logistics systems
  - 15 minutes
- Discussion
  - 25 minutes

Key Questions

- Each presenter
  - What are the most prevalent short term challenges industry is having with biomass logistics (specific examples)
- Audience
  - What are the feedstock quality parameters of biggest concern and impact
  - What is the highest impact technology or process improvement needed over the short and long term

Addressing Near-term Barriers that Allow an RFS Scale Industry to Evolve

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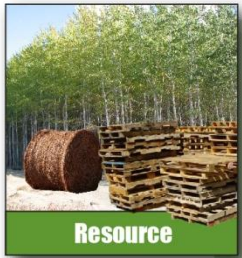
Reduce Costs Through Improved Logistics

- Effeciency and capacity (machinery performance)
- Losses
- Operational window



IMPROVE CONVERSION PERFORMACE

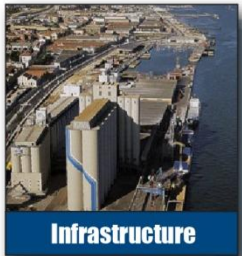
Raw Biomass ▸ Feedstock

- Reduce feedstock variability (composition, moisture, physical and mechanical properties
- Minimize carbohydrate losses
- Transform to feedstock classes and grades

Years 1-5
Achieve Grade A feedstock standards from field-run biomass resource

Years 5-10
Upgrade and achieve absolute specifications (advanced feedstocks for advanced biofuels)

Years 10+
Develop new customized feedstocks for optimized conversion



DEVELOP INFRASTRUCTURE-COMPATIBLE LOGISTICS SYSTEMS

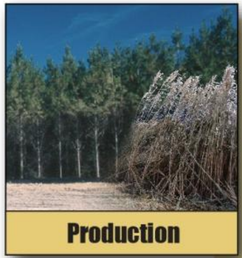
Feedstock ▸ Commodity Feedstocks

- Develop harvest, collection, and storage systems optimized for biomass
- Network flexibility for both local and national markets
- Implement industrial scalability and efficiency from field to conversion infeed
- Couple to existing high-capacity solid/liquid infrastructure
- Transform to uniform handling formats

Years 1-5
Develop infrastructure-compatible biomass-specific equipment/ processes

Years 5-10
Develop infrastructure-compatible biomass-specific equipment/ processes that accept multiple resource types

Years 10+
Optimize processes/ infrastructure based on market drivers



MAXIMIZE GROSS AND FUNCTIONAL YIELD

Residues ▸ Billion Ton

- Scale up sustainable resource production to meet future demand

Years 1-5
Leverage/build on existing crop development and biotechnology from other agricultural industries

Years 5-10
Develop crops and cropping systems that are optimized for bioenergy production

Years 10+
Maximize sustainable biomass production/ yield of multiple resource types

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Delivering the Resource: Raw Biomass and Commodity Feedstock Pathways

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Tradable Intermediate Products