

Biomass Feedstock Least Cost Formulation

Christopher T. Wright, PhD

Manager, Biofuels & Renewable Energy Technology Department

Northwest Wood-Based Biofuels Conference
April 29, 2014



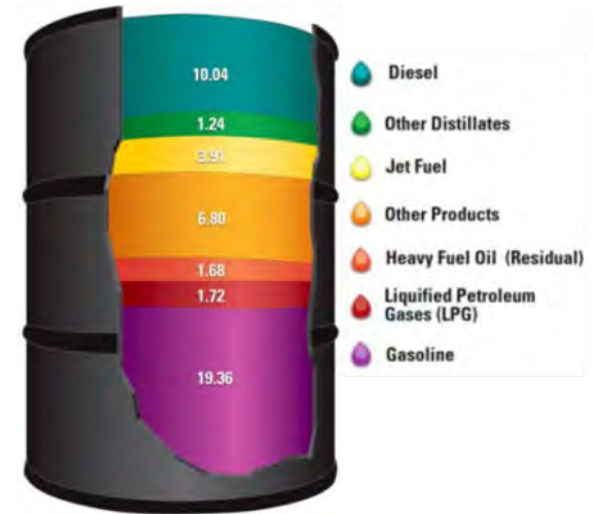
www.inl.gov



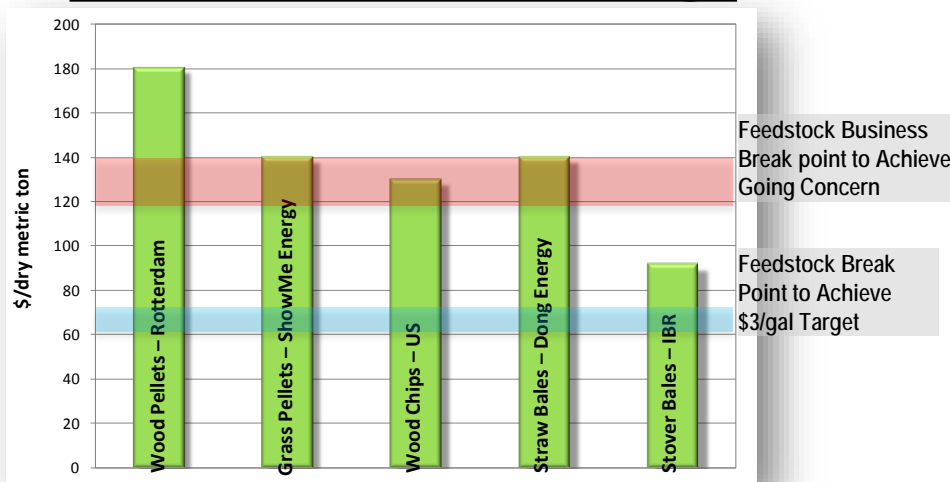
Our Platform Today

- Replacing the whole barrel
 - US spends \$1billion/day on oil imports
 - Reducing dependence on foreign oil requires replacing the whole barrel
- Feedstock costs represent up to one-third current biofuel production costs

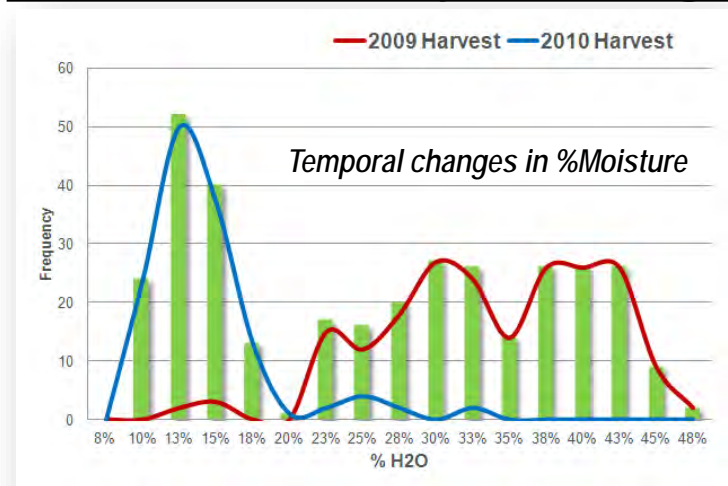
Products Made from a Barrel of Crude Oil (Gallons) (2009)



Feedstock Cost Challenge

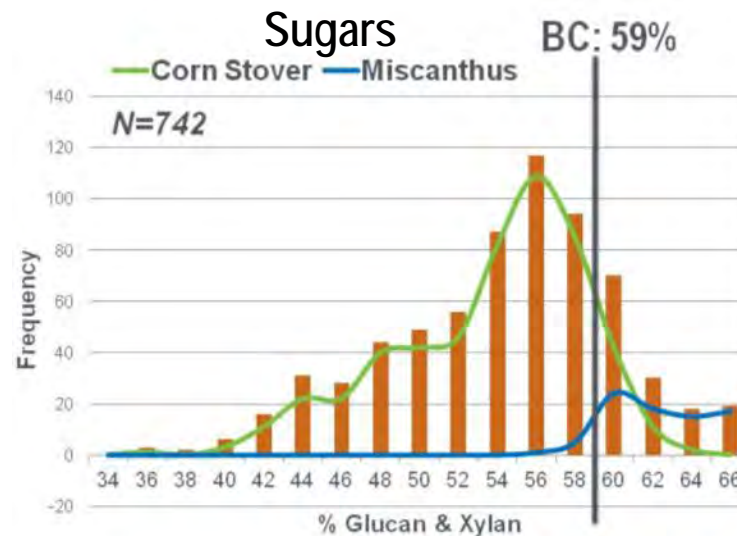
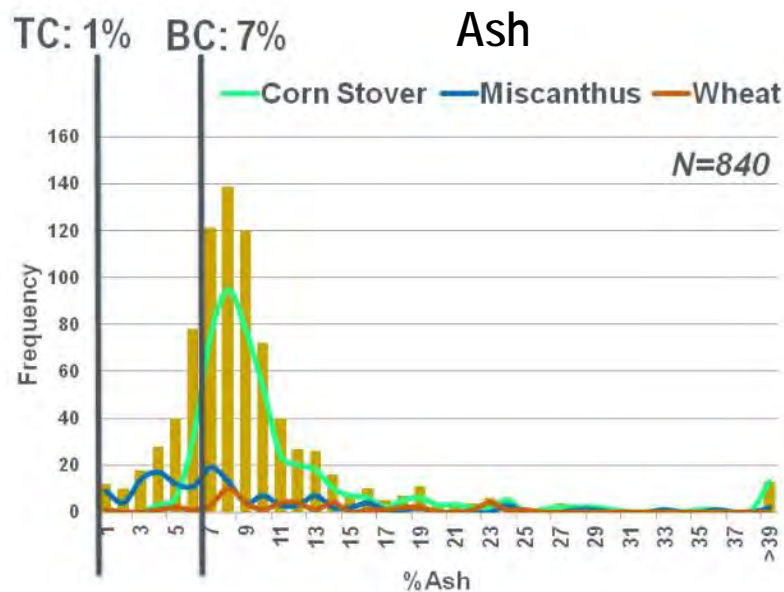
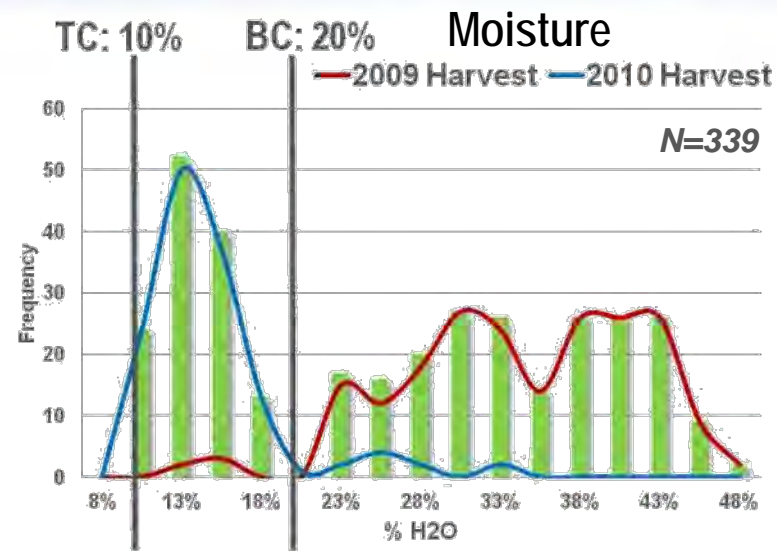


Feedstock Quality Challenge



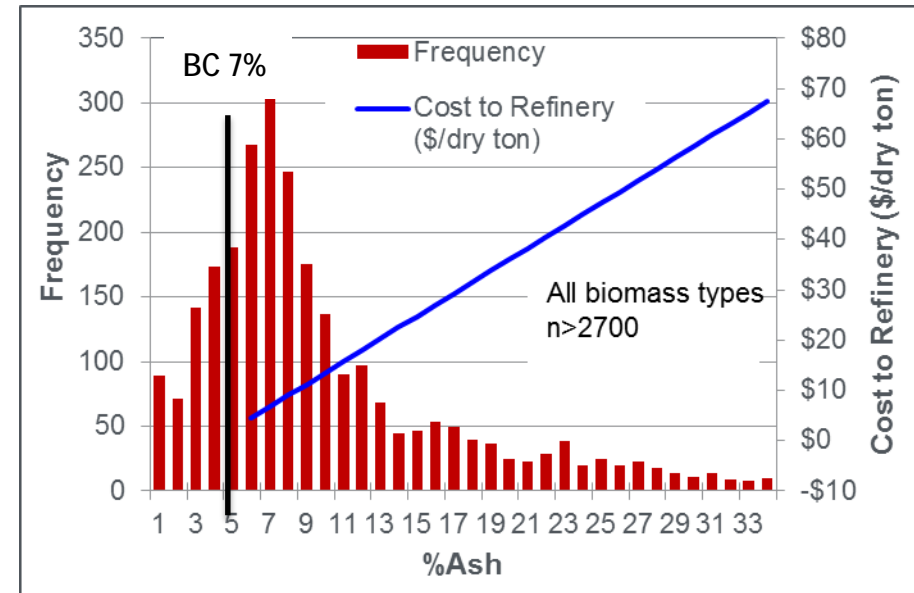
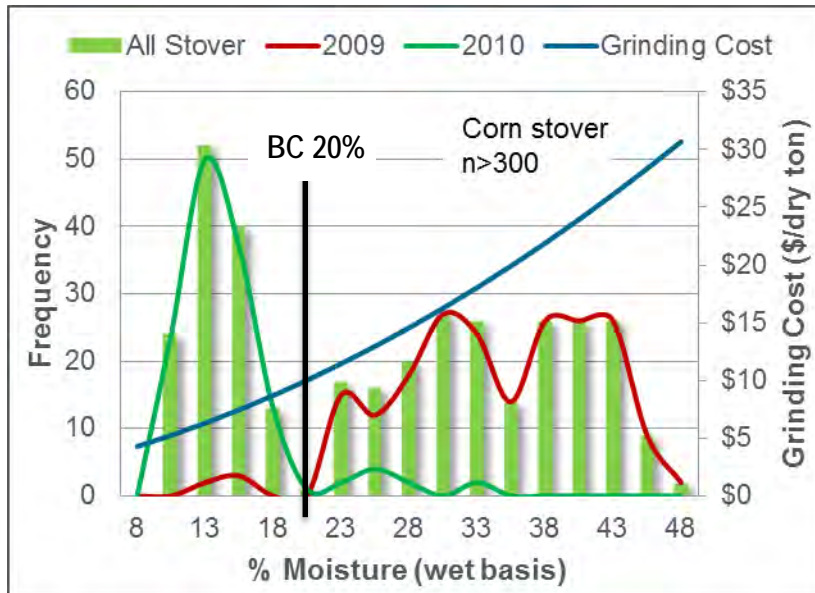
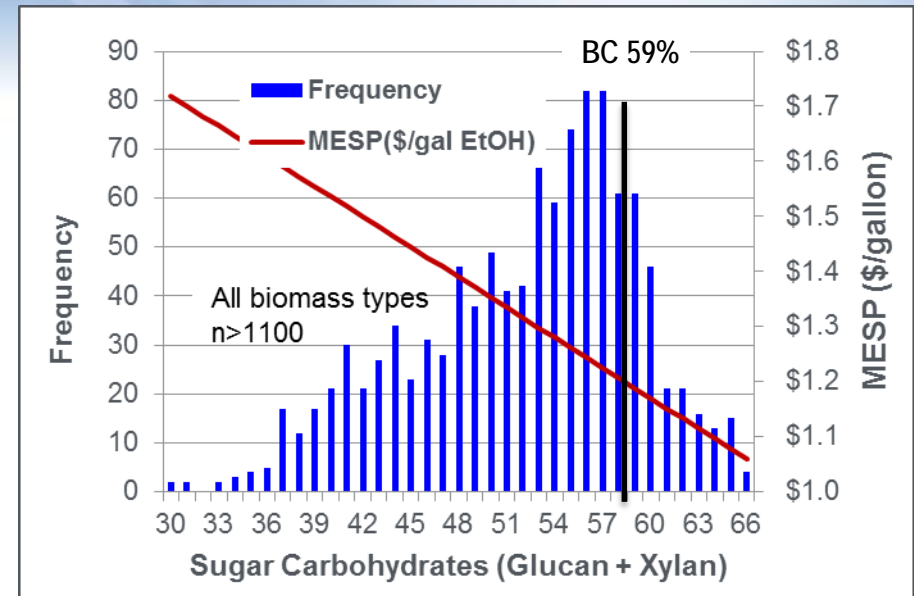
Feedstock Quality Challenge

- Conversion specs (vertical lines) for biochem (BC) and thermochem (TC) quality assumptions
- Distributions represent variability in biomass properties relative to spec
- Distributions likely greater if broader range of resources are considered



Impact of Variability

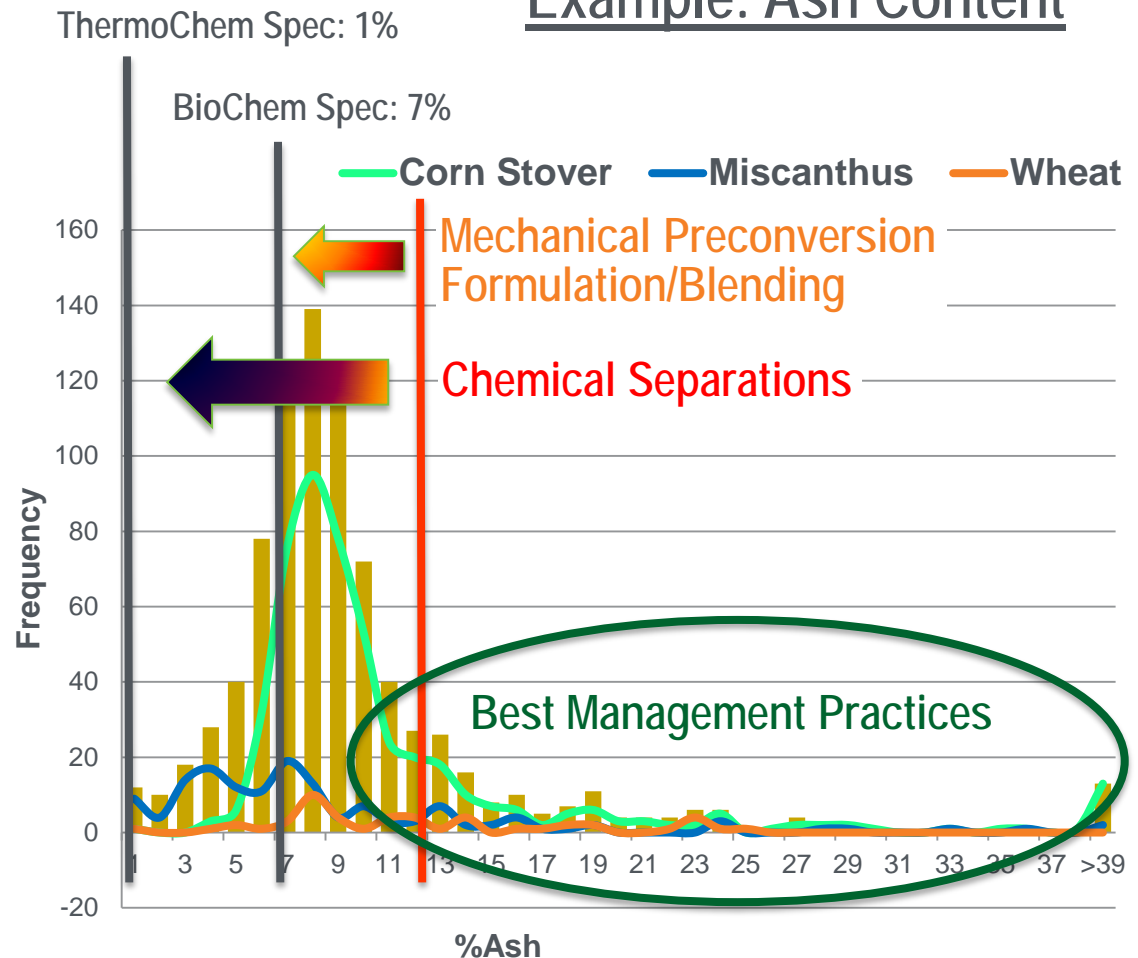
- Moisture costs include storage, grinding, drying...
- Ash costs include disposal, equipment wear, pretreatment capacity, product yield...
- Sugar costs include pretreatment capacity, product yield...



Solutions to Variability

- Challenge: Developing cost effective solutions to variability
- Solution: A graded approach
 - Best Management Practices
 - Preprocessing Technologies
 - Blending
 - Multiple sources of same feedstock
 - Different feedstocks
 - Amendments

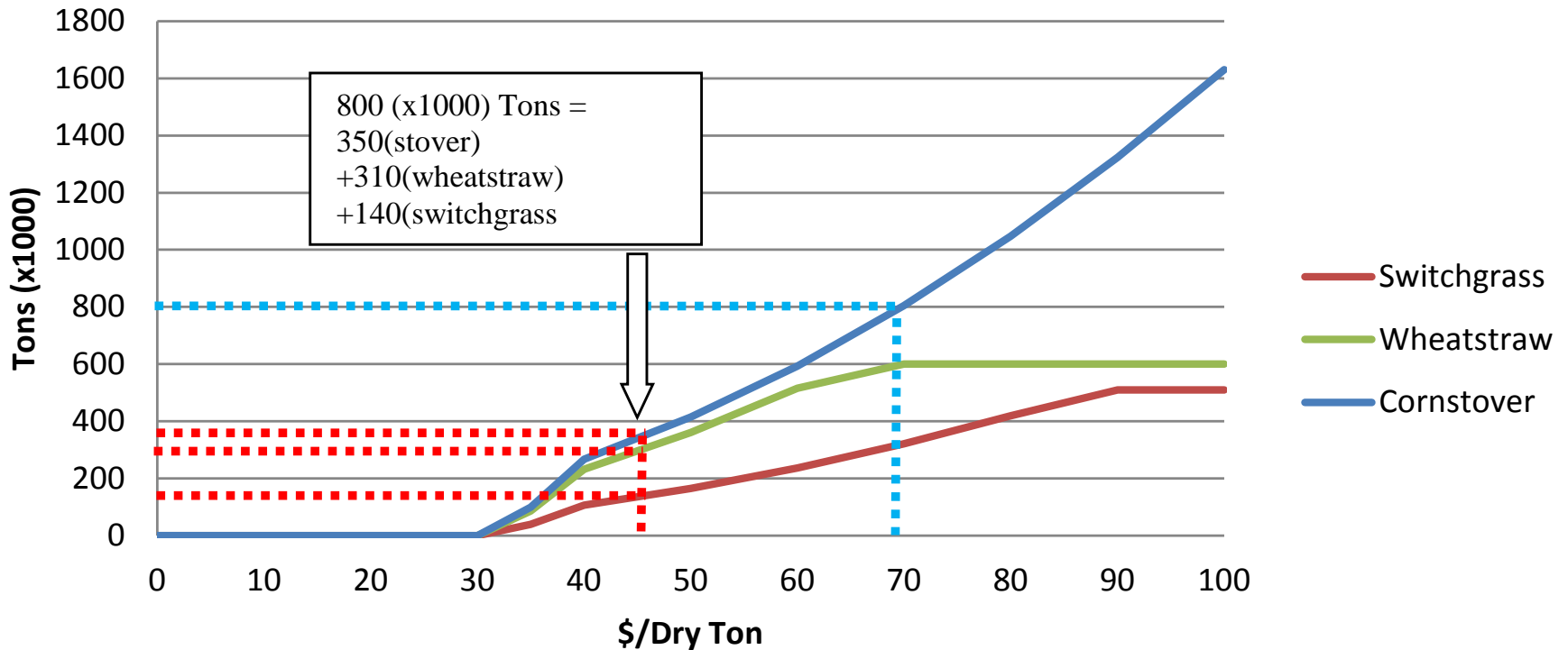
Example: Ash Content



Least-Cost Formulation Example

\$80 per dry ton target

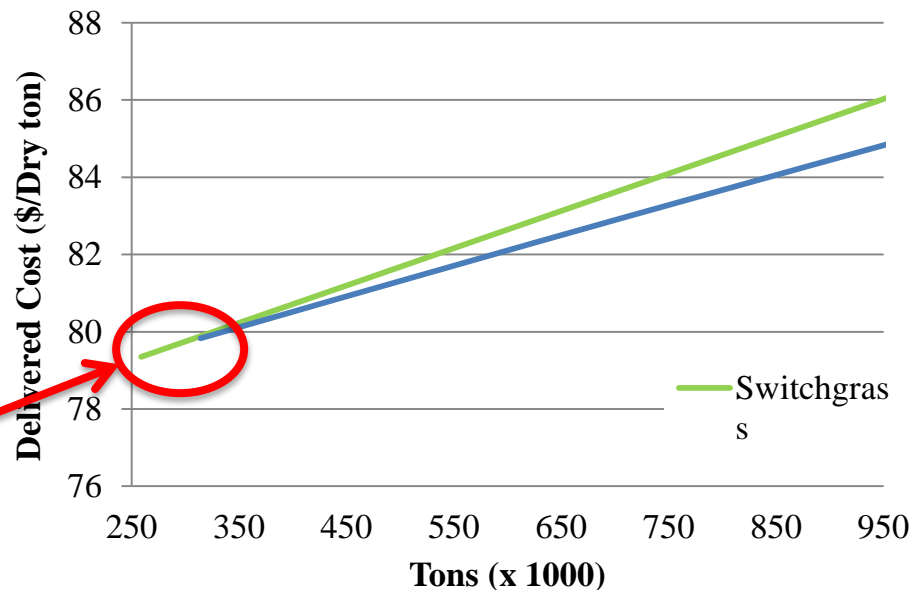
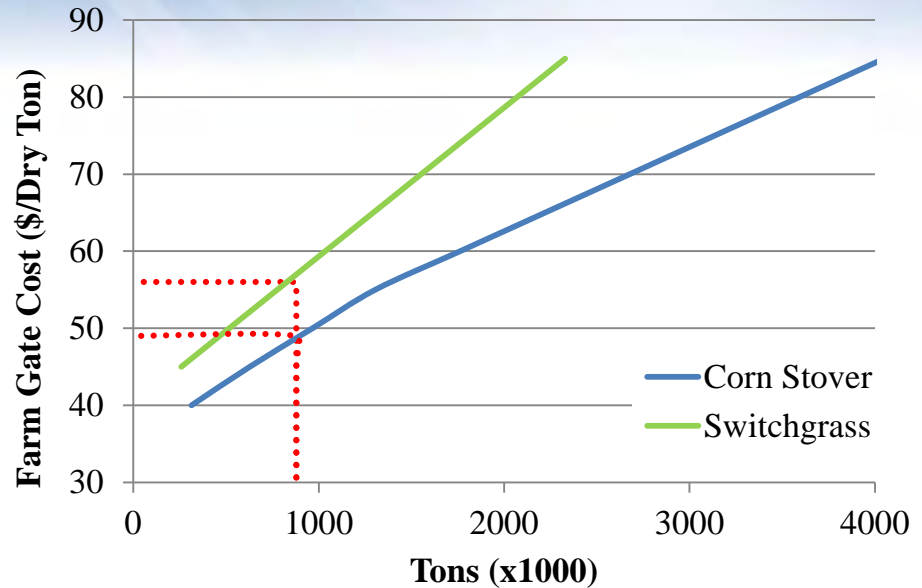
Farmgate Cost Curves for Multiple Feedstocks



Resource Competition

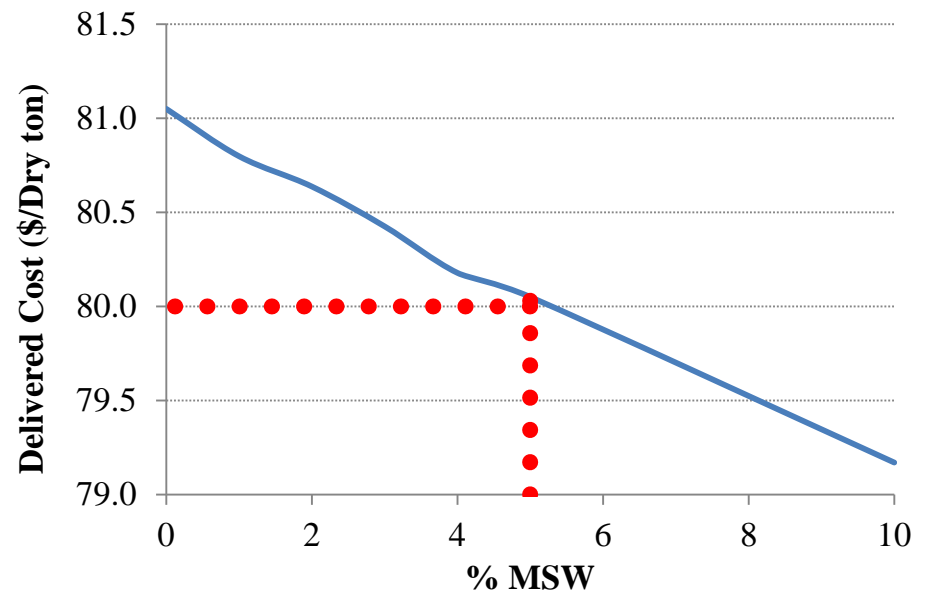
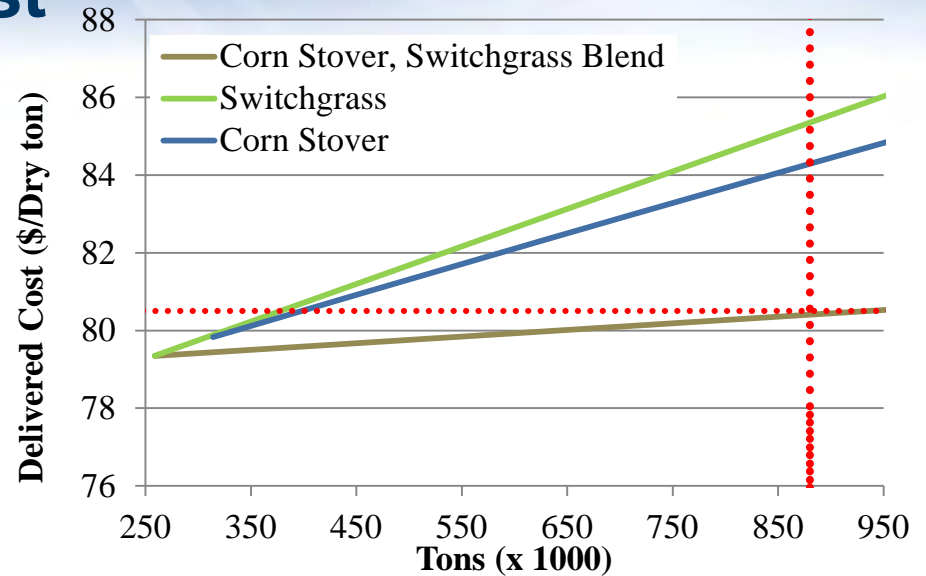
- How can switchgrass compete with corn stover?
- Consider all costs not just access or farmgate costs
- Delivered Feedstock Cost Includes
 - Grower Payment/Farmgate Cost
 - Logistics Costs
 - Dockage Fees
 - Conversion Performance

Approximately 300,000 tons of switchgrass can be accessed at a lower delivered cost than corn stover



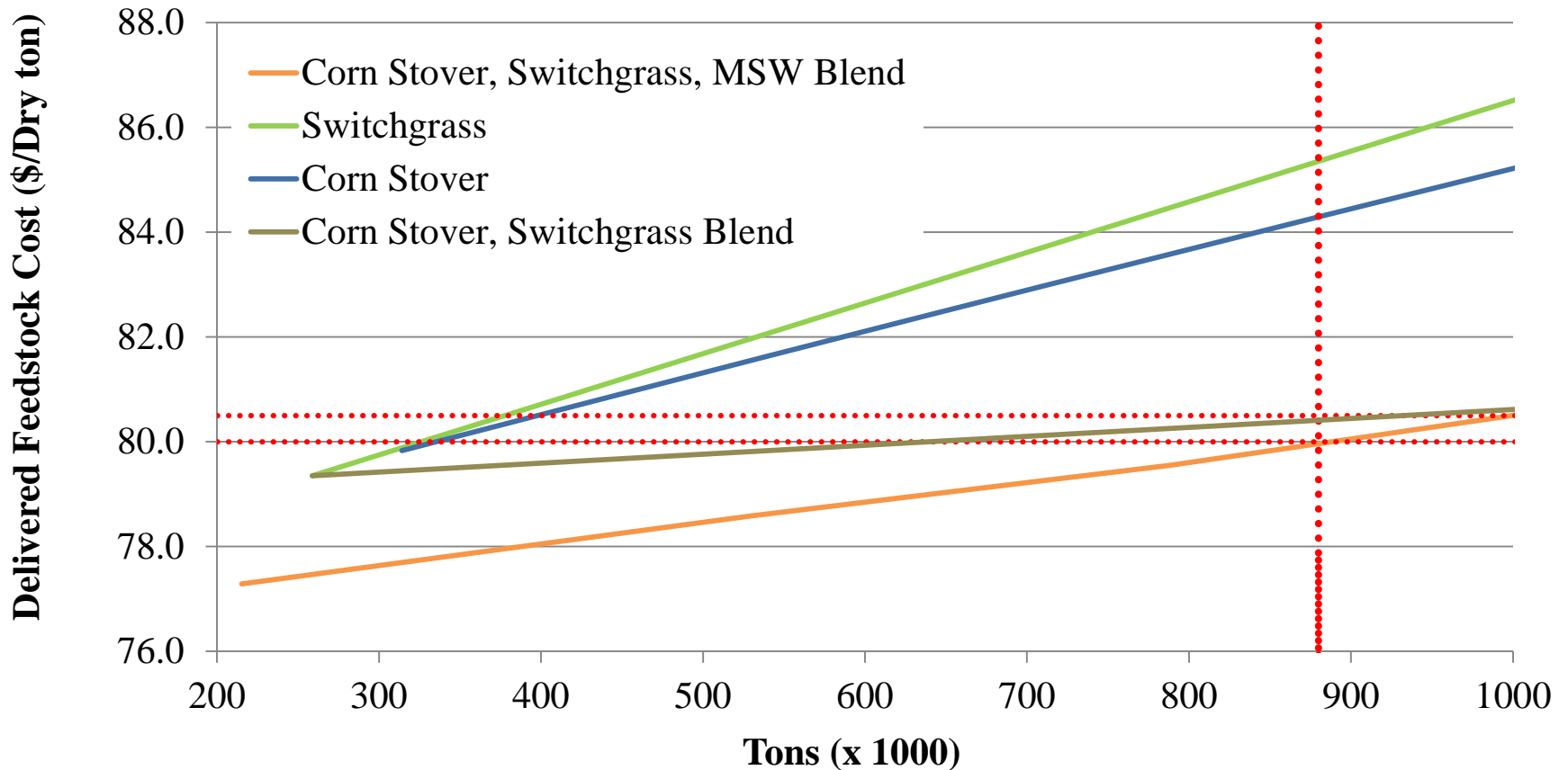
Blended Feedstock Cost

- Least-Cost Blend: 65/35 blend of corn stover and switchgrass, ~\$81/ton
- Still does not meet \$80 target
- 5% MSW needed to hit \$80/ton
- 60/35/5 blend of corn stover, switchgrass, and MSW (C&D)



Total Least Cost Formulation with Blended Feedstock

- 65/35/5 blend of corn stover, switchgrass, and MSW (C&D)



Total Feedstock Cost and Quality

Cost Element	Single-Pass Corn Stover	Multi-Pass Corn Stover	Switchgrass	Municipal Solid Waste	Blend
Formulation Contribution	35%	25%	35%	5%	–
Grower payment/access cost	27.20	27.20	29.80	18.00	27.70
Harvest and collection (\$/dry T)	10.50	19.20	15.40	–	13.90
Transportation (\$/dry T)	8.70	8.30	7.20	18.00	8.60
Preprocessing (\$/dry T)	23.40	23.40	19.70	19.70	21.90
Storage (\$/dry T)	6.50	6.50	5.50	4.50	6.10
Handling (\$/dry T)	1.90	1.90	1.90	1.90	1.90
Total Delivered Feedstock Cost (\$/dry T)	78.30	86.60	79.60	62.10	80.00
Delivered Feedstock Specifications*					
Ash content (wt. %)	3.5	7	4	10	4.9
Moisture content (% , wet basis)	9	9	9	9	9
Carbohydrate content (wt. %)	64	57	57	57	59

*Corn stover and switchgrass composition data were obtained from the INL Biomass Library.



Thank-you

