19. Ethanol Markets and the Development of a Cellulosic Ethanol Industry

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Dave Lambert received his Ph.D. from Oregon State University. He began his academic career at the University of Nevada, Reno, in 1984 teaching courses in microeconomics and decision analysis and conducting research on the use of public lands in the Intermountain West. Lambert left Nevada in 1998 to become the Department Chair in Agribusiness and Applied Economics at North Dakota State University. In his eleven years at North Dakota, he combined his administrative duties with teaching and continuing a research program in production economics. Lambert has served as the Vice President of the Western Agricultural Economics Association and chaired several committees of the Agricultural and Applied Economics Association. He recently ended a three year term as the Managing Editor of the Journal of Agricultural and Resource Economics. Although administrative tasks occupy most of Lambert's current time, he will be teaching a graduate course in Production Economics this Fall and maintains research interests in production economics and energy policies. This presentation is based on research begun at North Dakota investigating the use of crop residues in an emerging cellulosic ethanol industry.

Abstract/Summary

To meet federal mandates on the production of next-generation biofuels, cellulosic ethanol production is targeted to expand from near-zero production in 2010 to over 16 billion gallons by 2022. Dedicated energy crops, herbaceous crop residues, and woody plant byproducts are expected to provide most of the feedstock. This presentation provides an overview of ethanol policies and projects possible logistical systems for an herbaceous crop residue-based ethanol industry.

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Figure 1. Total Global Petroleum Production and Use (Thousand barrels per day)

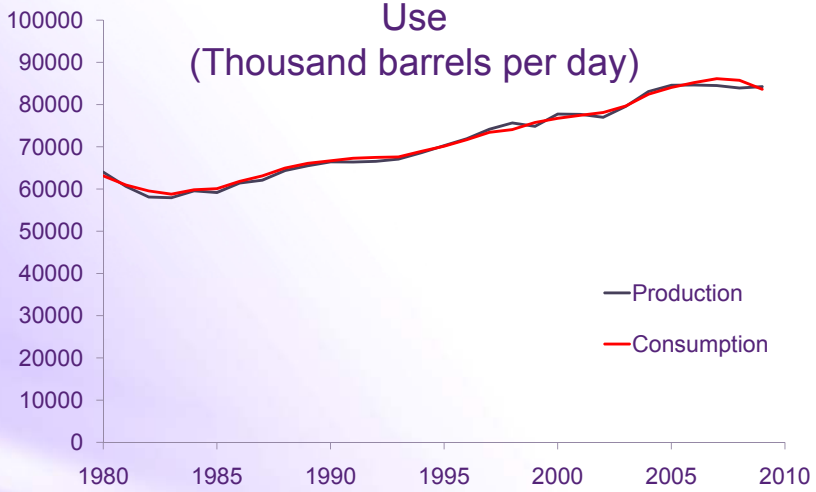


Figure 2. Total Petroleum Consumption

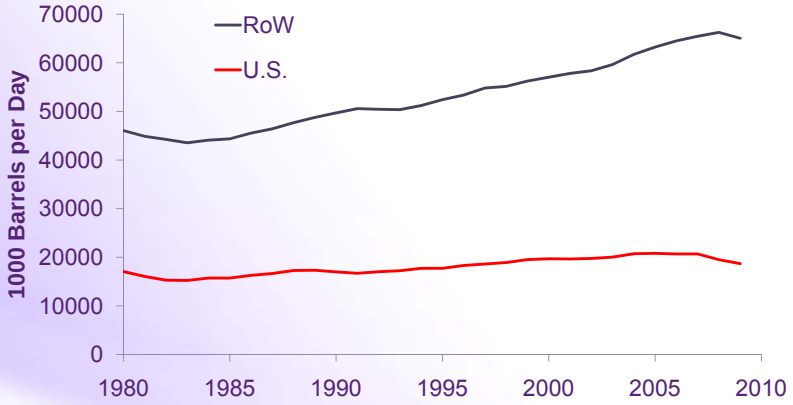


Figure 3. U.S. Proven Petroleum Reserves (Billions of barrels)

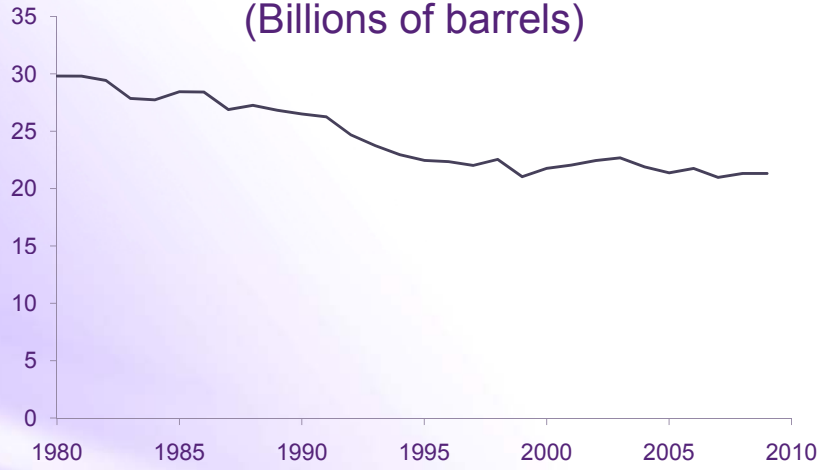


Figure 4. Total U.S. Consumption and Imports

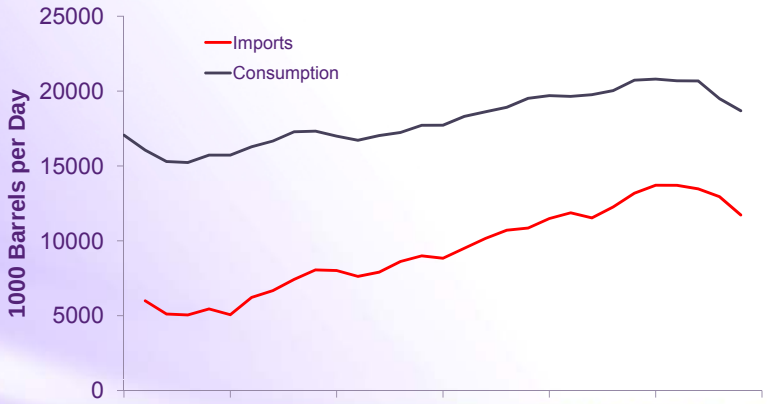


Figure 5. U.S. Fuel Ethanol Annual Production

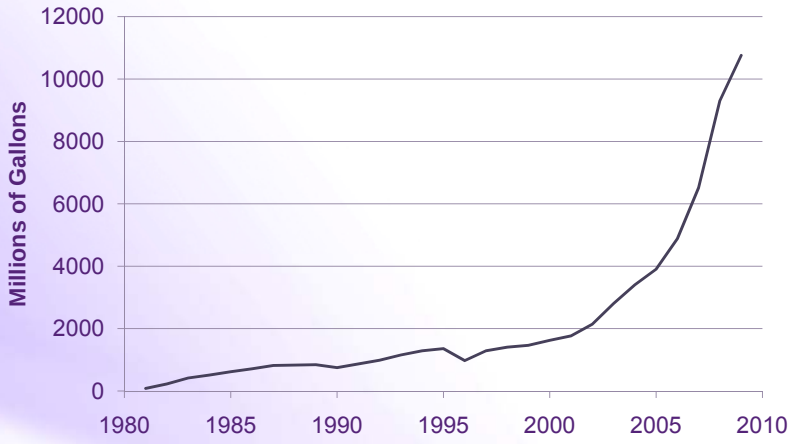
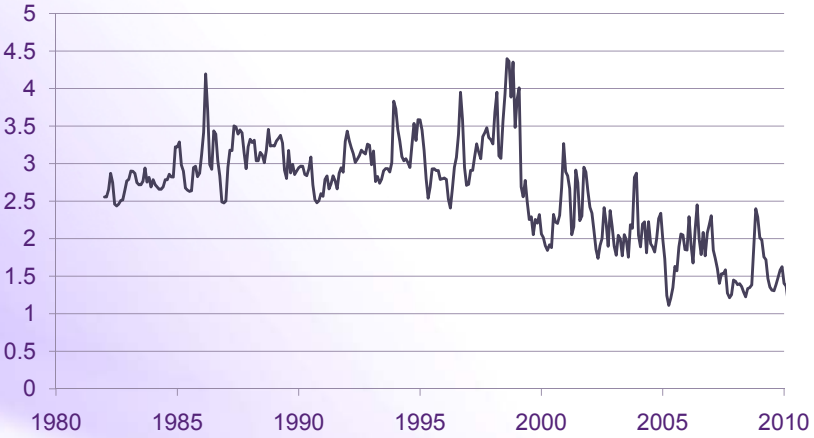


Figure 6. Ratio of Ethanol to Gasoline Prices
(BTU equivalency basis)



http://www.neo.ne.gov/statshtml/66.html

Figure 7. EISA Targets for Ethanol Production

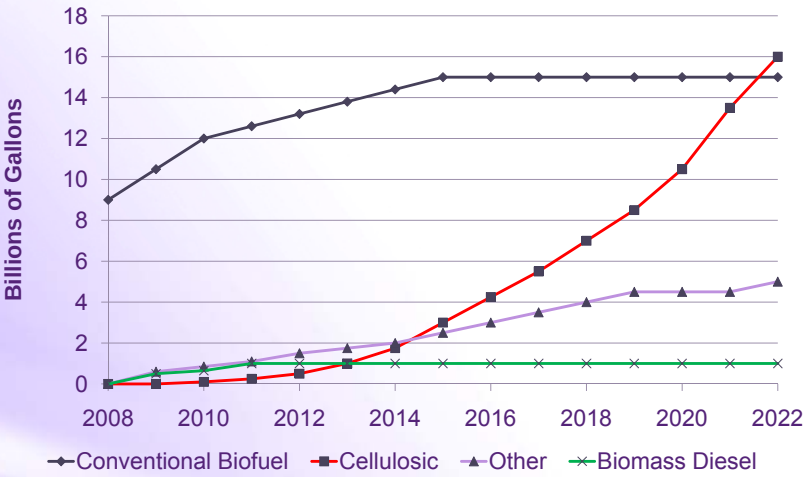
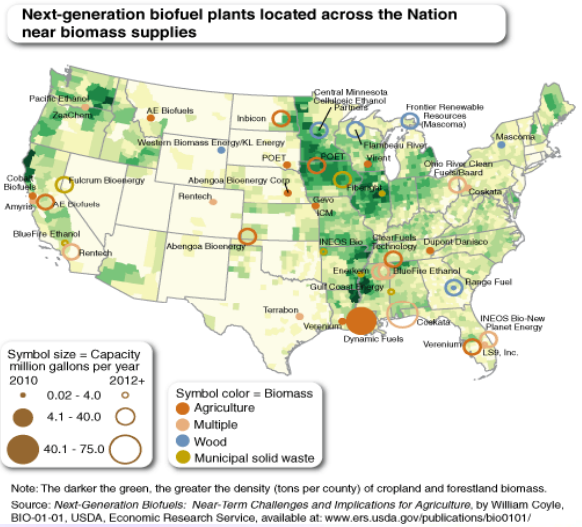


Figure 8. U.S. Biomass Supply



Note: The darker the green, the greater the density (tons per county) of cropland and forestland biomass.

Source: *Next-Generation Biofuels: Near-Term Challenges and Implications for Agriculture*, by William Coyle, BIO-01-01, USDA, Economic Research Service, available at: www.ers.usda.gov/publications/bio0101/

Table 1. Kansas Crop and Residue Yields

Crop	2005-9 Average Yield	Maximum Crop Residue Yield	Acres to Supply 100 MGY Cellulosic Plant*
Winter Wheat	37.4 bu/ac	1.91 tons/ac	2,228,100
Corn for Grain	135.4 bu/ac	5.69 tons/ac	747,300
Sorghum for Grain	75.6 bu/ac	2.12 tons/ac	2,007,600

*** - Assumes maximum harvest of 33% of available residue.**

Hugoton, KS

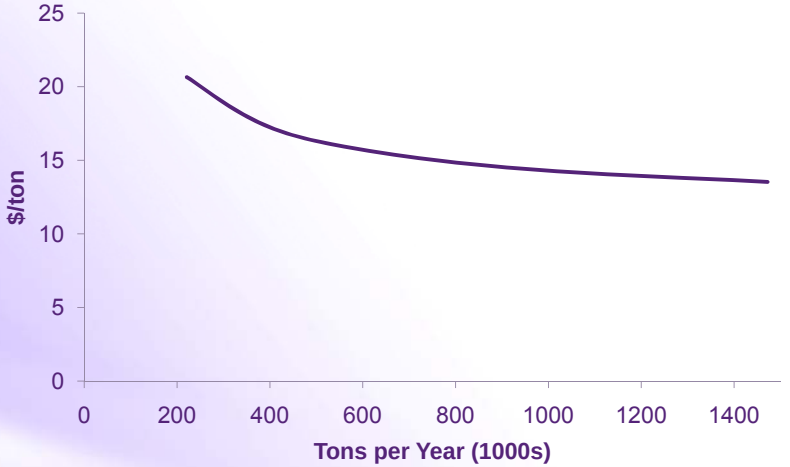
Table 2. Base Parameter Values

HCR Harvest	$8.00/ton	HCR Yield	1.1 ton/ac
Soil Value	$12.27/ton	Straw Storage	$0.30/ton/month
Truck Load	17.00 ton	PreT Storage	$0.15/ton/month
HCR Transport	$0.19/ton/mile		

Table 3. Average Total Costs – Pretreatment and Refining

Plant capacity (tons of HCR/year)	Pretreatment Plant	Ethanol Processing Plant
220,590	$20.65	$57.56
441,511	$16.78	$52.63
883,022	$14.59	$47.71
1,766,044	$12.70	$42.78

Figure 9. AFEX Pretreatment ATC



Base Case Results

- Breakeven ethanol price = $1.22/gallon
- Transportation costs are low compared to investment and processing costs
  - Input transportation costs = $8.1 million/year
- IRTS of pretreatment plant dominates transportation costs → build large pretreatment plant
  - Amortized investment and plant operation costs = $98.0 million/year
- Value of feedstock declines with distance from plant

Figure 10. Marginal Values of extra HCR

		$0.68		
	$2.37	$3.53	$2.37	
$0.68	$3.53	$5.47	$3.53	$0.68
	$2.37	$3.53	$2.37	
		$0.68		

Feedstock Cost

- Total delivered cost of feedstock:

$8.00 / ton	Harvest
$12.27 / ton	Nutrient loss
$0.90 - $6.37 / ton	Transportation cost
$5.47 - $0.00	Marginal value
= $26.64	Total delivery cost

Scenario Analysis

1. Change local yields and crop residue supplies
2. Change plant amortized investment and operating costs
3. Permit livestock feeding of AFEX pretreated crop residues

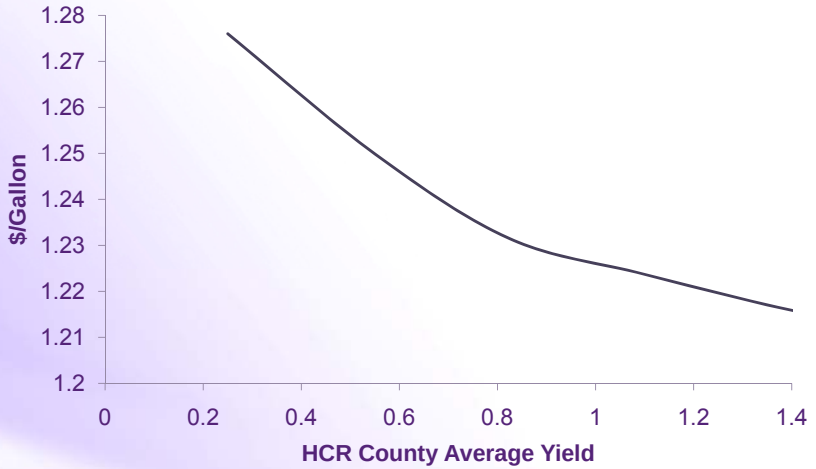
Alternative Scenario #1

Change crop yields

Table 4. Sensitivity Analysis – County Yield

Crop Residue Yields/Acre:	0.55	0.83	1.10	1.38	1.65
Straw Transport (millions)	$11.12	$8.97	$8.07	$7.22	$6.57
Total Cost (millions)	$145.78	$143.63	$142.73	$141.88	$141.23
Harvested HA (millions)	3.21	2.14	1.61	1.28	1.07

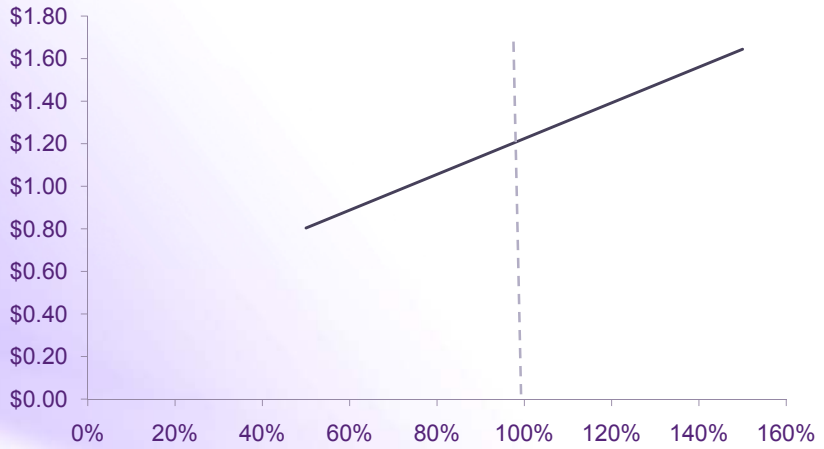
Figure 11. Ethanol Cost per Gallon as a function of HCR Yield



Alternative Scenario #2

Vary plant investment and operating costs

Figure 12. Breakeven Price per Gallon as Plant Costs Vary

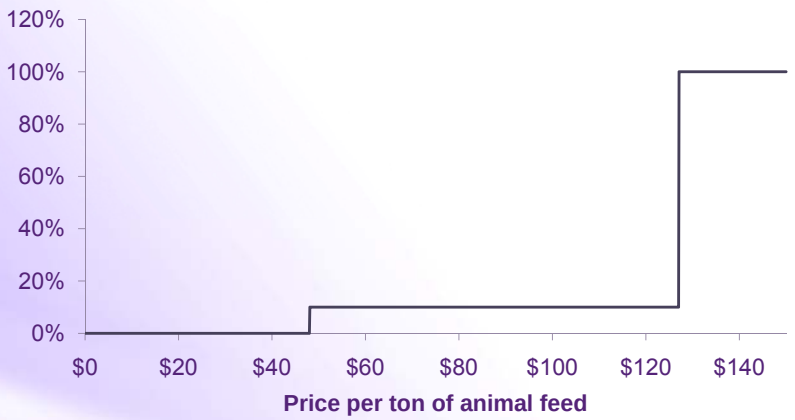


Alternative Scenario #3

Use of AFEX-treated feedstock for livestock feeding

Figure 13. Proportion of Treated HCR Used as Animal Feed

Note – proportion fed between $48 and $127 will depend upon the size of the region being considered



Concluding Comments