

Bioenergy: Agricultural Issues and Outlook

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Outline

- Background
- Status of Ethanol and Biodiesel
 - NAFTA, Brazil, Rest of the Americas
- Economics of Ethanol and Biodiesel
- Relation to Broader Economy
- Tradeoffs – Food, Fuel, and Feed
- Future of Industry in 20 Years

Background

- Global interest in bioenergy over past 5 years
- Governments enacted policies to support industry
- Bioenergy production is perceived in a positive way
- Will this bioenergy boom last?
- What will be the impact on agriculture?

Status of Ethanol Industry

Country	2004	2005	2006
	Million Gallons		
Brazil	3,989	4,227	4,491
U.S.	3,535	4,264	4,855
Canada	61	61	153
Colombia	-	97	97
Argentina	42	44	45
Guatemala	17	17	21
Paraguay	-	14	14
Cuba	16	12	12
Ecuador	12	14	12
Mexico	9	12	13
Nicaragua	8	7	8
Honduras	1	1	1
Total	7,690	8,770	9,722

Status of Ethanol Industry

- Brazil - producing ethanol since the 70's
 - Production and exports
 - Flex-fuel cars
- Canada - new government incentives
 - Wheat and corn feedstocks
 - About 10 plants and several under construction
 - Iogen
- Mexico – no fuel ethanol industry
- U.S. – over 100 plants and growing by 50%
 - Government investing significant \$\$ on cellulosic

Status of Ethanol Industry

- Rest of the Americas
 - Dehydration plants

Country	2002	2003	2004	2005	2006
	Million Gallons				
Brazil	0	0	90.3	31.2	433.7
Costa Rica	12	14.7	25.4	33.4	35.9
El Salvador	4.5	6.9	5.7	23.7	38.5
Jamaica	29	39.3	36.6	36.3	66.8
Trinidad & Tobago	0	0	0	10	24.8
Total	45.5	60.9	159.9	135	653.3

- Argentina

Status of Biodiesel Industry

	<u>Production</u> Million Liters	<u>Production</u> Million Gallons
Germany	1,921	507
France	557	147
United States	284	75
Italy	227	60
Czech Republic	136	36
Austria	85	22
Spain	84	22
Denmark	80	21
Poland	80	21
United Kingdom	74	20
Brazil	70	18
Australia	57	15
Sweden	7	2
Other Countries	102	27
World	3,762	994

Status of Biodiesel Industry

- Very different industry than ethanol
- Canada – 2% blend mandate
- Mexico – evaluating opportunities
- U.S. – growing rapidly
- Brazil - new priority
 - 2% blend mandate by 2008, 5% by 2013
 - Currently not competitive w/ petroleum diesel

Status of Biodiesel Industry

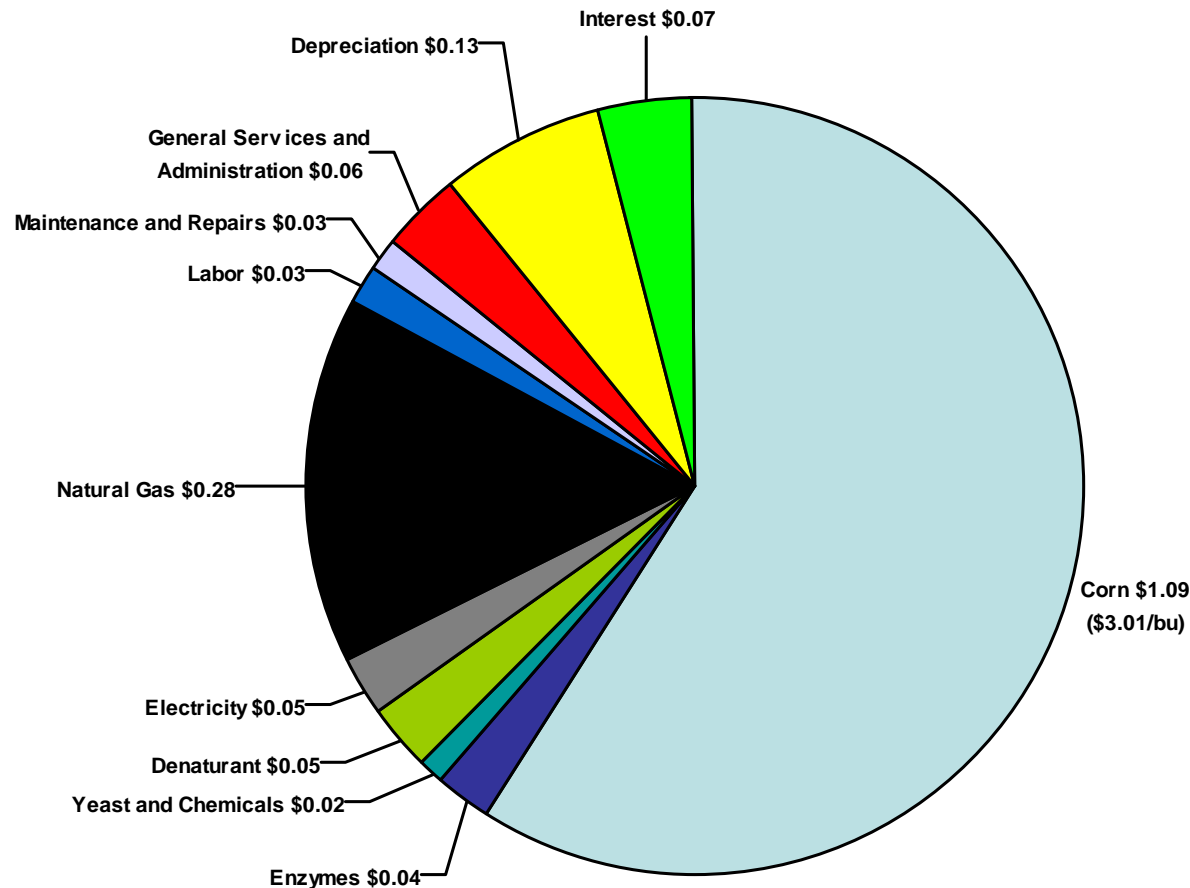
- Rest of the Americas
 - Argentina
 - Others

Economics of Ethanol

- Primary feedstock are grains and sugarcane
- More efficient process than before
 - U.S.: corn and sorghum
 - Brazil: sugarcane
- Ethanol yields per acre higher with cane than grains

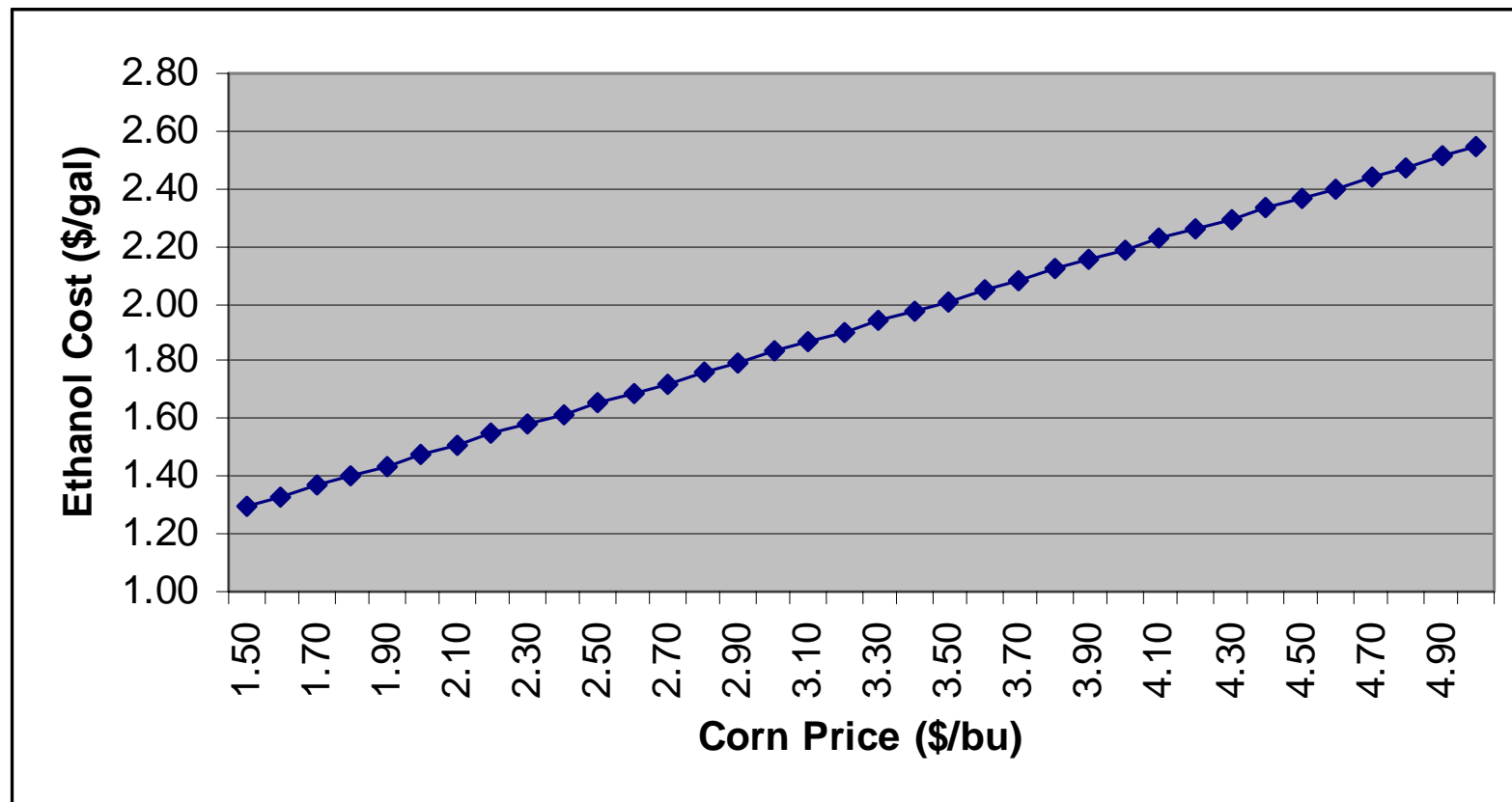
Economics of Ethanol

- Cost of grain ethanol in the US: \$1.81/gal at \$3.01/bu of corn w/o \$0.35 credit for DDGS



Economics of Ethanol

- Relationship of cost of ethanol to cost of feedstock



Economics of Ethanol

- Cost of sugarcane based ethanol

	Brazil ¹	U.S.
Sugarcane Cost	0.84	0.95
Administrative and Processing Cost	0.38	0.47
Capital Cost and Other Costs		0.45
Total Cost	1.22 ^{2,3}	1.87

¹Source: Chaves, 2006.

²Excludes capital costs.

³Cost of production was \$0.89/gallon with exchange rate at R\$3.00/\$US in 2005.

Economics of Ethanol

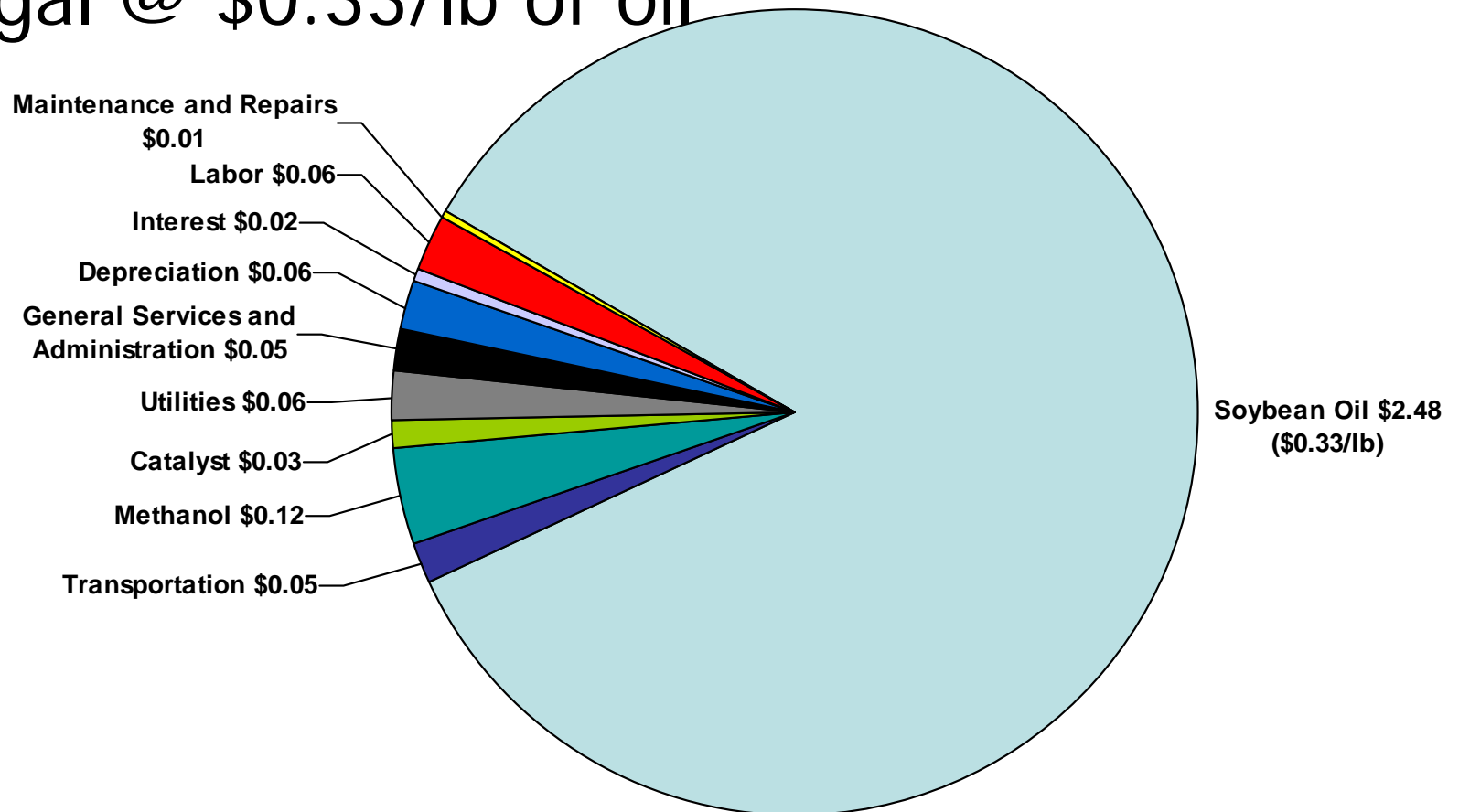
- Cellulosic ethanol anywhere between 3-10 years
- Considered to be the future of ethanol production
- Only one operational cellulosic ethanol
 - Canada using wheat straw
- Many others are moving to commercial scale plants
- In the U.S. cost around \$2.50, expected to go down to \$1.20 in 5 years

Economics of Biodiesel

- Primary feedstocks are vegetable oils and animal fat. Also used cooking oil.
- Infant industry in the Americas, mature industry in Europe
- Feedstock cost and quality issues
- Industry concern due to renewable diesel

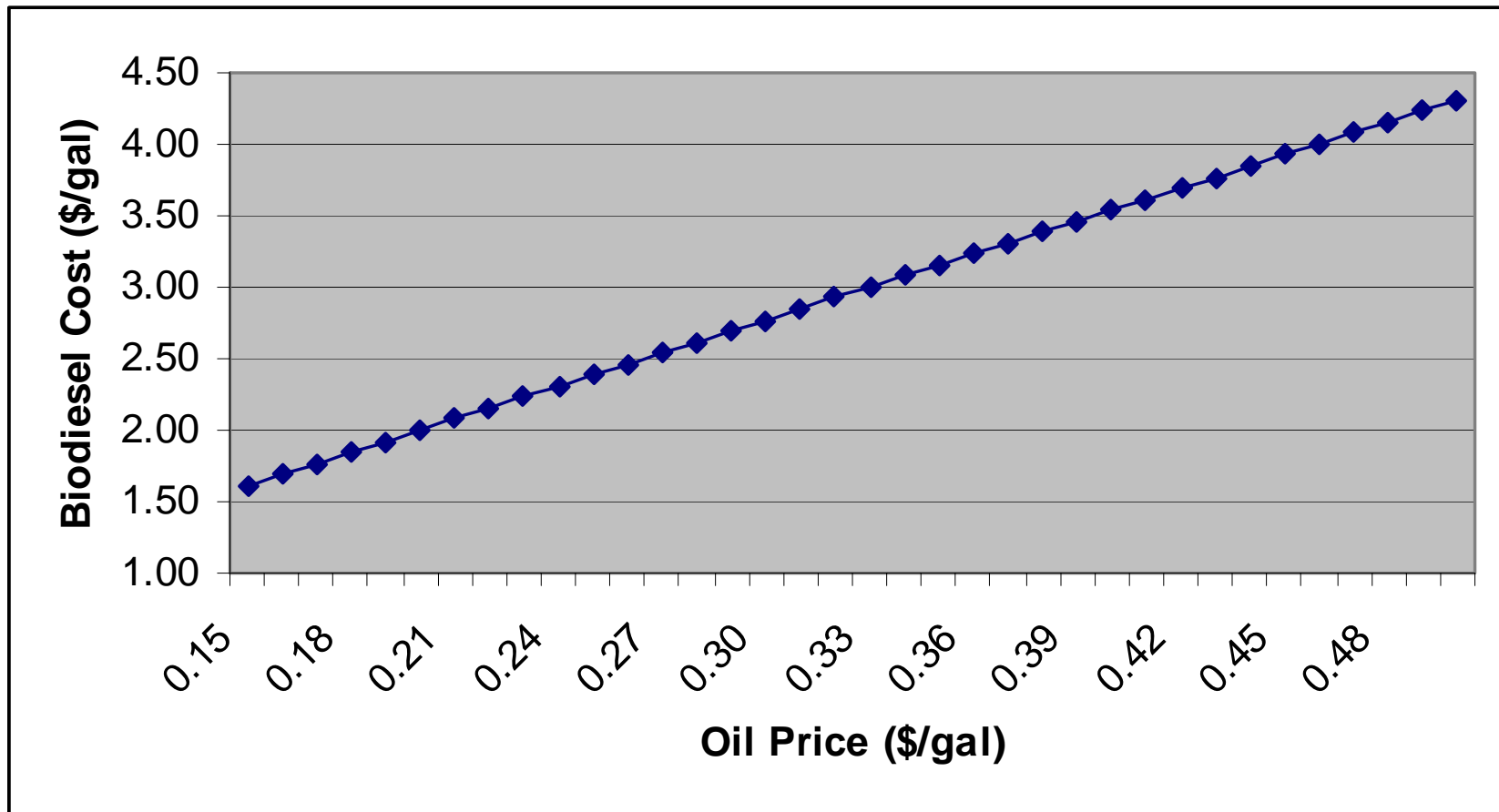
Economics of Biodiesel

- Cost of biodiesel from vegetable oil
\$2.94/gal @ \$0.33/lb of oil



Economics of Biodiesel

- Relationship of cost of biodiesel to cost of feedstock



Relation to Broader Market

- Strong positive relationship between crude oil and U.S. gasoline, diesel and ethanol prices

- Regression equation results:

Gasoline (\$/Gal) = \$0.0917 + 0.0311 * Crude Oil (\$/Barrel)

$R^2 = 0.98$

Diesel (\$/Gal) = \$0.4499 + 0.0378 * Crude Oil (\$/Barrel)

$R^2 = 0.97$

Ethanol (\$/Gal) = \$0.5206 + 0.0310 * Crude Oil (\$/Barrel)

$R^2 = 0.72$

[Indication that other factors such as government policies (RFS & tax credits) are also affecting ethanol prices and not being priced as a gasoline extender]

Relation to Broader Market

- Estimated relationship between gasoline, diesel and ethanol prices to cost of crude oil

<u>Crude Oil</u>	<u>Gasoline</u>	<u>Diesel</u>	<u>Ethanol</u>
--\$/barrel--	--\$/gal--	--\$/gal--	--\$/gal--
30	1.03	1.58	1.45
40	1.34	1.96	1.76
50	1.65	2.34	2.07
60	1.96	2.72	2.38
70	2.27	3.10	2.69
80	2.58	3.48	3.00

Note: Not a given that these relationships will hold in the future.

Tradeoffs – Food, Fuel and Feed

- Concern in livestock organizations in NAFTA countries
- Short term effect likely to lose some livestock producers pressure meat prices upward
- Long term effects really depend on final COP for cellulosic ethanol
 - If significantly less than current feedstocks then will likely be another industry collapse or bailout
 - Otherwise, extend fuel supplies and reduce ethanol prices pressuring plant margins
- NAFTA Countries -- Tradeoffs
 - Motivations for developing renewable fuels different
 - U.S. – Ag and supply, Canada – Environ. and Ag, Mexico - ???
 - All will pay more for meat and vegetable oils
 - Substantial benefit from large supply of low cost protein meals
 - Consumers and livestock producers in each country will suffer while crop producers benefit.

Future of Industry in 20 Years

- Bioenergy future appears bright but... depends on:
 - Relative costs of production on a BTU basis
 - Weather problems will change public opinion
- Not all countries will be able to share in bioenergy boom
- Cellulosic ethanol the future of the industry?
- Governments appear to be on board to support industry