

Biomass Vision and Roadmap Update

Current status of process

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What is the Vision Statement?

- *The Vision for Bioenergy and Biobased Products in the United States was created in 2002*
- *It established far-reaching goals to increase the role of biobased energy and products in our nation's economy.*
- *It represented the collective vision of the Biomass Research and Development Technical Advisory Committee established by the Biomass R&D Act of 2000.*

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- Obtained Technical Advisory Committee input on Vision Executive Summary.
- Follow-up analysis and peer review carried out to ensure targets were valid in relation to available feedstocks, conversion technologies, etc.
- Developed draft Vision by December 31, 2005.
- Final Vision will be issued shortly.

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- The updated *Vision* does not change the original 2010 goals but recognizes that in some cases the U.S. is not on track to meet them.
- The *Vision* makes minor changes to its 2020 and 2030 goals and establishes 2015 goals which describe the types of activities that must occur to reach that goal and move down the path to the aggressive targets for 2020 and 2030.
- Finally, the updated *Vision* sets a long-term target for 2050 and the role that biomass can play in energy and product markets at that time.

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Original Vision Goals - 2002

	2001	2010	2020	2030
BioPower Biomass share of electricity & heat demand in utilities and industry	3% (2.7 quads)	4% (3.3 quads)	5% (4.0 quads)	5% (5.0 quads)
BioFuels Biomass share of demand for transportation fuels.	0.5% (0.15 quads)	4% (1.3 quads)	10% (4.0 quads)	20% (9.5 quads)
BioProducts Share of target chemicals that are biobased.	5%	12%	18%	25%

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Updated Vision Goals – 2005

Vision Goals							
	Units	2000	2004	2010	2015	2020	2030
Biopower	Market share (%)	4	4	4	5.5	7	7
	Consumption (Quadrillion Btu)	2.2	2.1	3.1	3.2	3.4	3.8
Biofuels	Market share (%)	0.7	1.2	4	6	10	20
	Consumption (million gasoline-equivalent gallons)	1,100	2,100	8,016	12,852	22,725	50,994
Bioproducts	Production (billion lbs)	12.4	17.6	23.7	26.4	35.6	55.3

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- The Biomass R&D Act of 2000 called for the USDA and DOE to jointly carry out a biomass research and development initiative in the areas of biofuels and bioproducts.
- It also established the Biomass R&D Technical Advisory Committee to advise on the technical program.

- Roadmap Update Workshops will be planned by Regional Chairs with BCS/DOE support
- Roadmaps will incorporate regional experts pertaining to the Roadmap categories: Feedstocks, Processing and Conversion, Product Uses and Distribution, Public Policy
- Workshops will be facilitated by BCS

- Update Roadmap language
- Incorporate New federal/state activities
 - Renewable Fuels Standards
 - Produce 7.1 million gallons of ethanol by 2012
 - Biofuels Initiative
 - Decrease cost to \$1.04 per gallon of ethanol by 2010
 - Displace 40 million gasoline equivalent gallons by 2030
- Revisit path towards achieving Vision Goals
- Invitation only with regional experts

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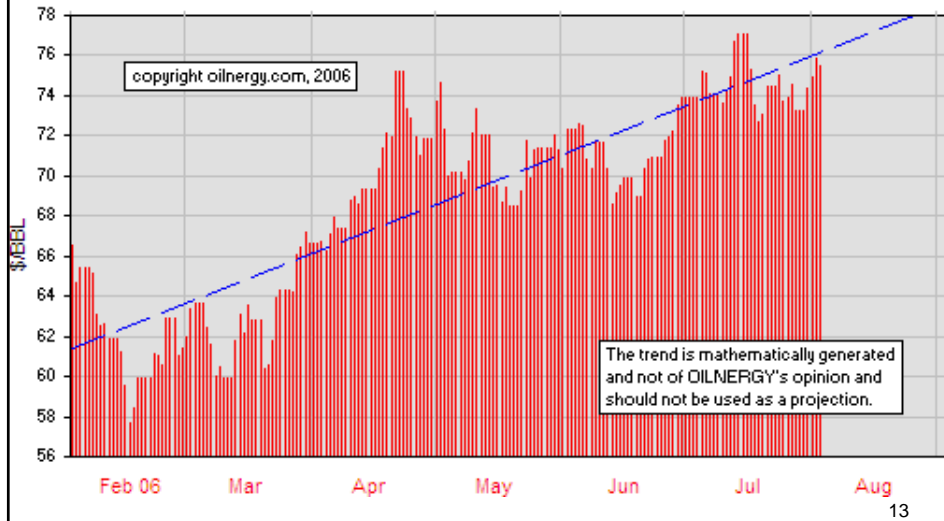
- Midwest Regional Roadmap
 - Chair: Tom Binder, ADM
 - Chicago, IL, April 11-12, 2006
- West Regional Roadmap
 - Ralph Cavalieri, Washington State
 - Sacramento, CA, August 8-9, 2006
- East Regional Roadmap
 - Douglas Hawkins, Rohm & Haas
 - New York, Fall 2006

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- Oregon Forest Research Institute Biomass Report
- Pulp & Paper Industry Roadmap
- CEC Roadmap
- DOE Office of Science Roadmap
- Other state roadmaps

Why have a Roadmap?

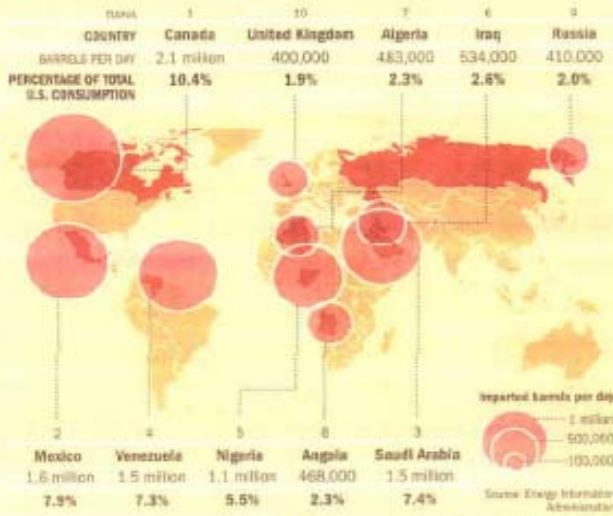
6-MONTH TREND of NYMEX LIGHT SWEET CRUDE PRICE



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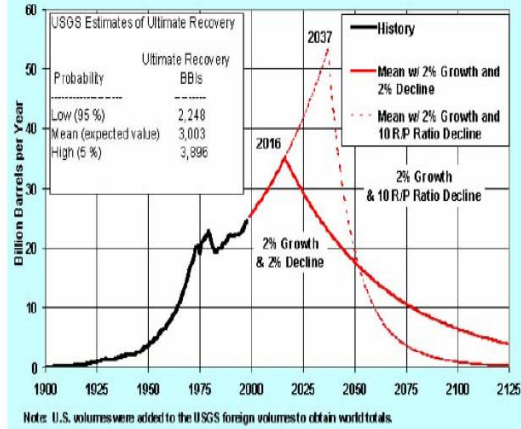
Where the Fuel Comes From

The top 10 foreign suppliers of crude oil and petroleum products to the U.S., accounting for nearly 50% of consumption between January and November 2006.





Annual Production Scenarios with 2 Percent Growth Rates and Different Decline Methods



Energy consumption in 2050 three times larger than today

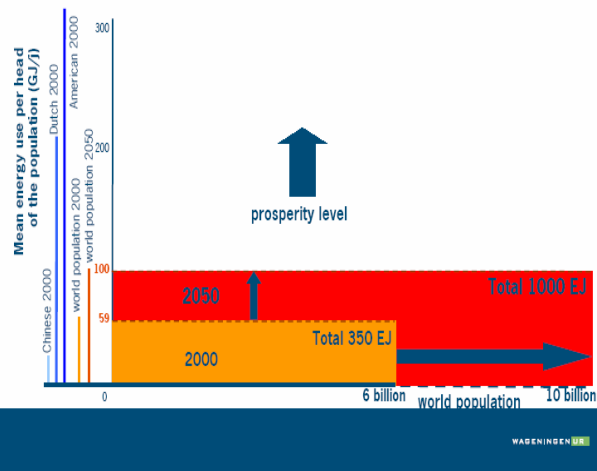
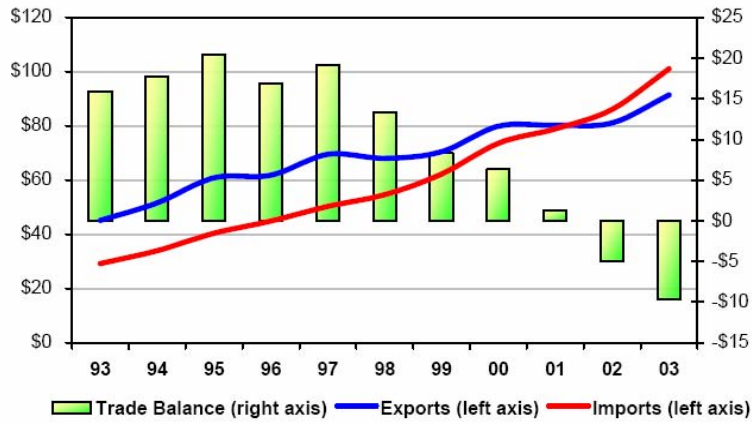
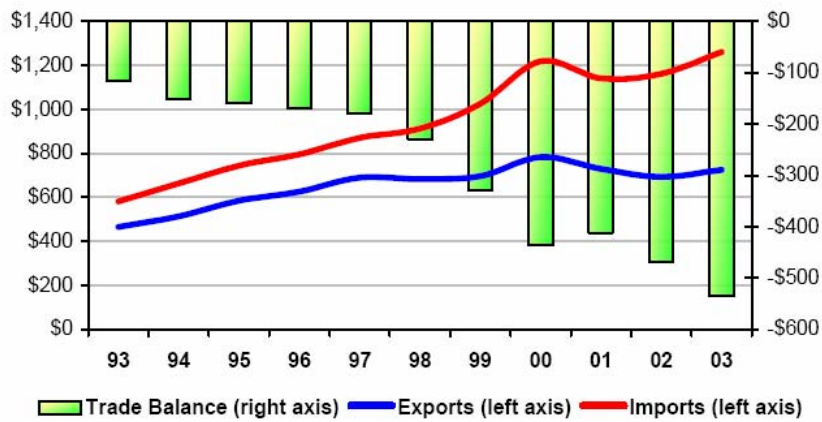


Figure 1
US Trade in the Business of Chemistry
(\$ Billions)

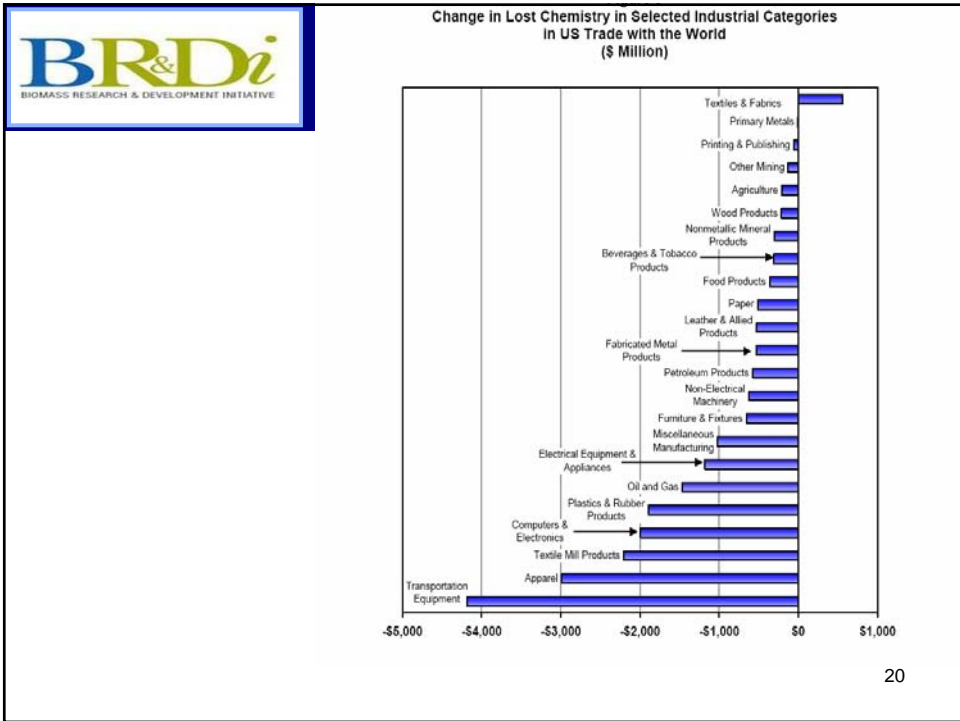
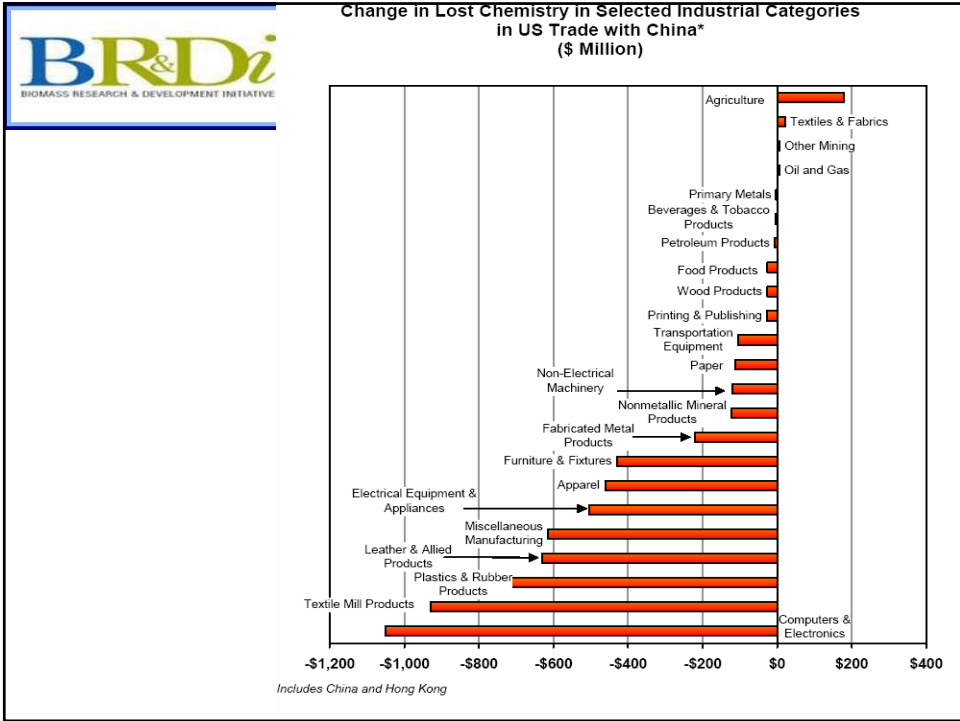


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US Trade in Goods with the World
(\$ Billions)



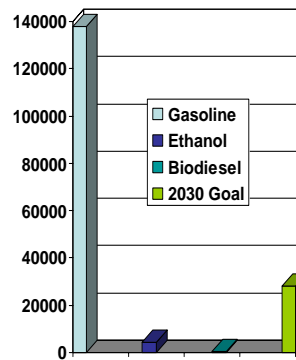
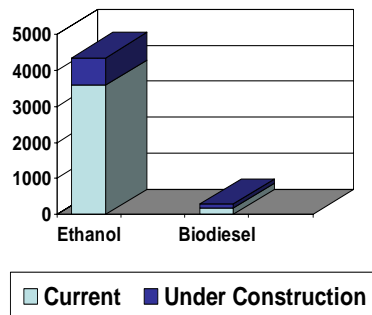
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What role can biomass play?

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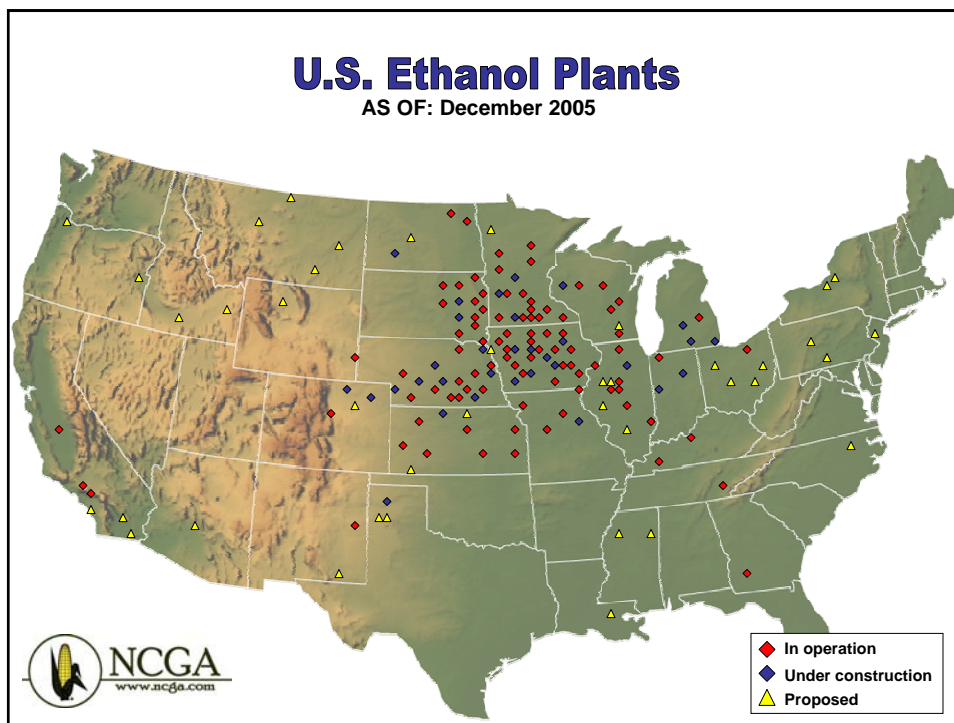
Fuel Production Capacity Million Gallons per Year 2004 data



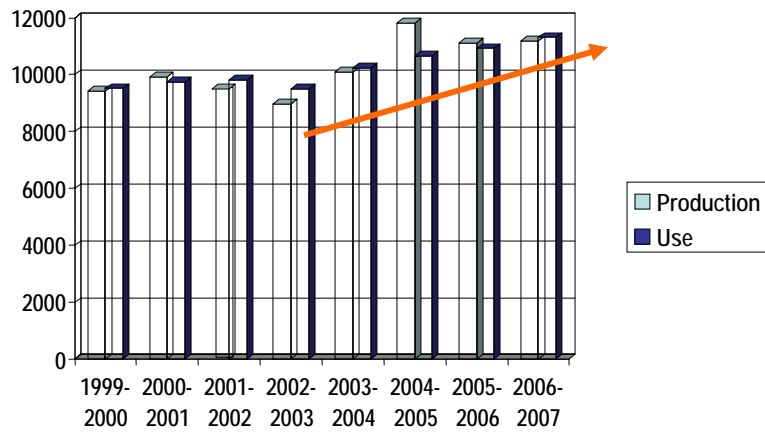
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- Ethanol and biodiesel industry creates domestic jobs
- Ethanol industry has grown to 81 plants in 20 states which support 147,000 jobs in the United States, mostly in rural communities.
- On average, a 40 million gallon per year ethanol plant supports 41 full-time jobs and nearly 700 jobs throughout the entire economy.
- Cuts the trade deficit by \$34.1 billion through 2012.

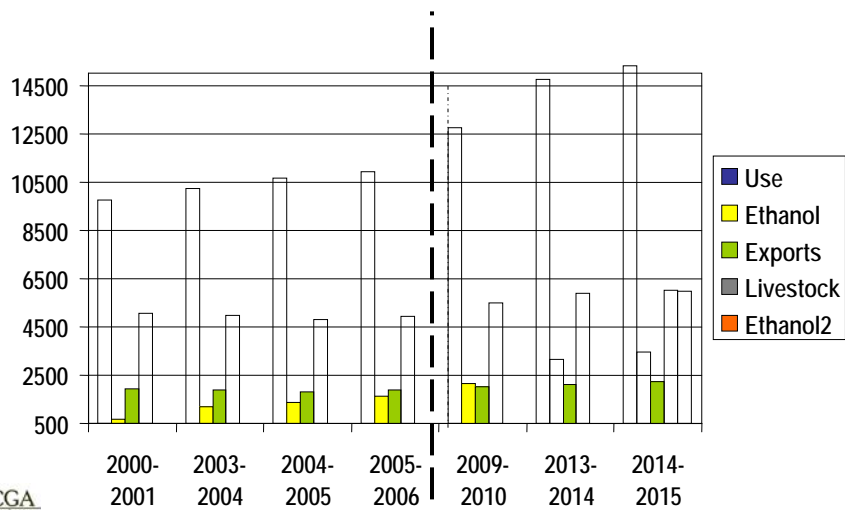
(Data 8/2005 From http://www.eere.energy.gov/biomass/economic_growth.html#trade and "Homegrown for the Homeland - Ethanol Industry Outlook for 2005")



Corn Production and Use: 1999-2006

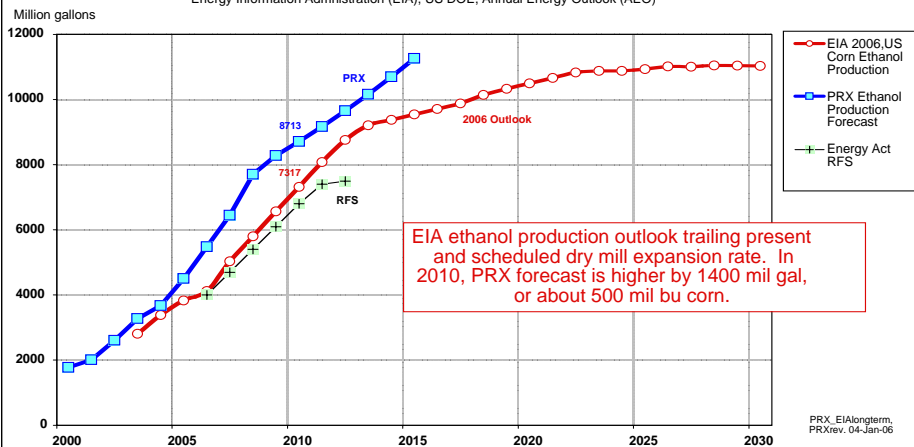


Corn Use – 1999-2015



US CORN ETHANOL PRODUCTION, with PRX ESTIMATE

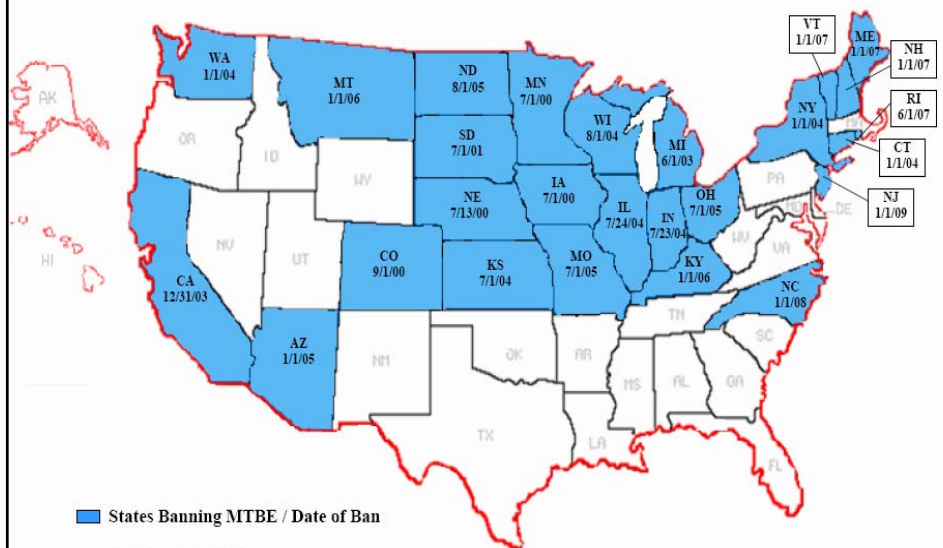
Energy Information Administration (EIA), US DOE, Annual Energy Outlook (AEO)



According to the EIA:

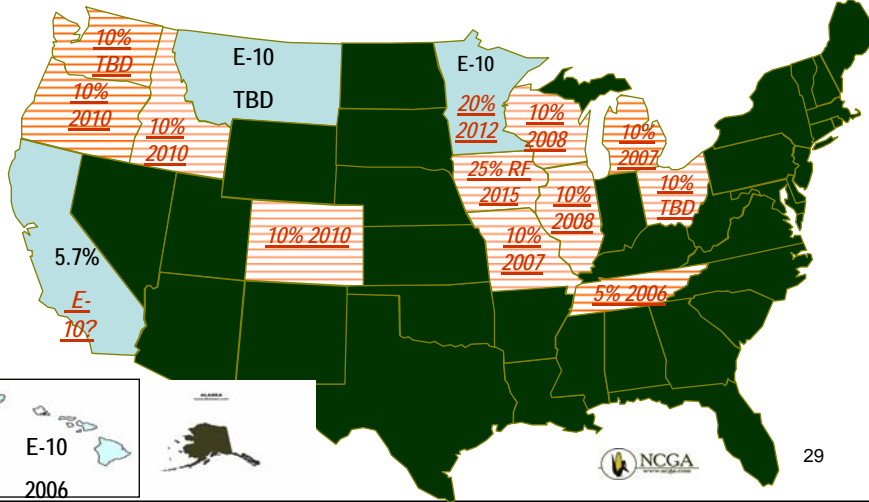
"The AEO2006 reference case includes only those sections of EPACT2005 (the recent Energy Bill) that establish specific tax credits, incentives, or standards—about 30 of the roughly 500 sections in the legislation."

State Bans on MTBE, TBA, and Other Ethers

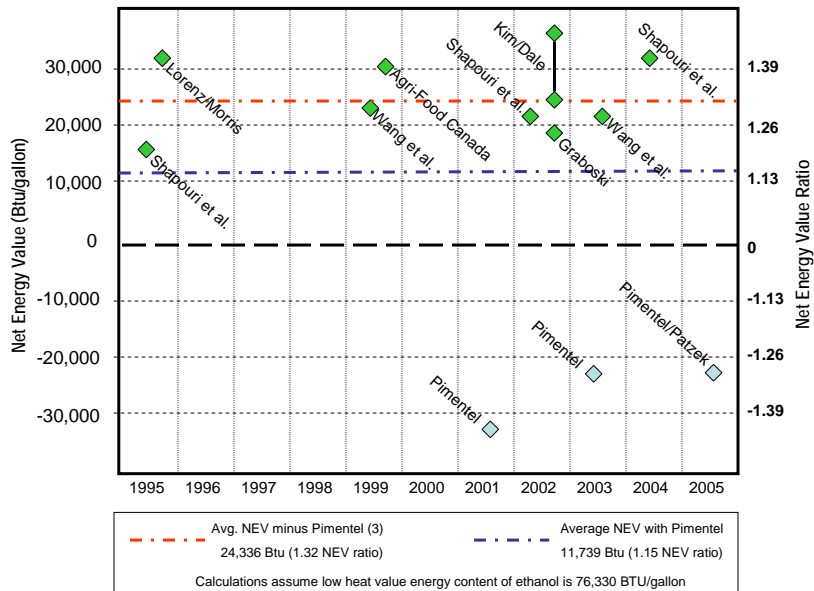


Ethanol Use Requirements

■ Law enacted
 Legislative Proposals (05-06)



Comparative Results of Ethanol Energy Balance Studies 1995-2005

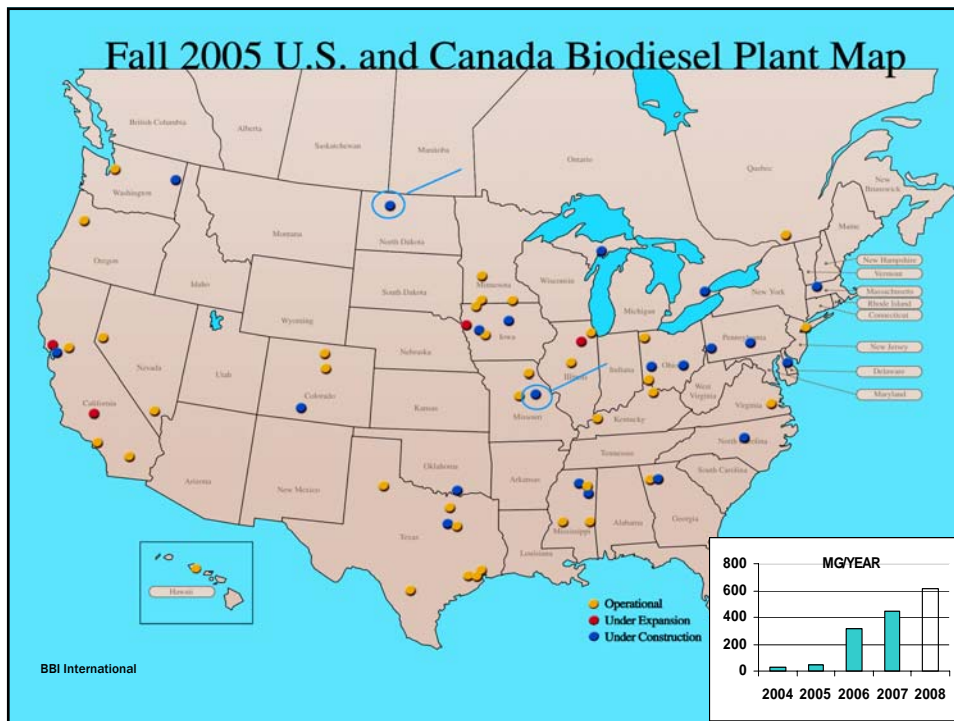


Sources: Office of Energy Efficiency and Renewable Energy (U.S. Department of Energy) : Dale, Bruce, Michigan State University, presentation at World Congress on Industrial Biotechnology & Bioprocessing, Orlando, Florida, April 22, 2005.

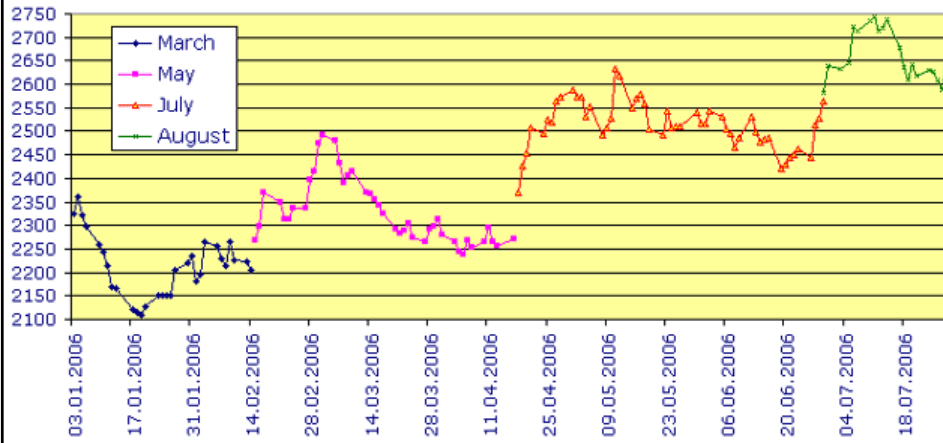
	Production
	Gal/Year
2000	1,989,400
2001	6,437,200
2002	8,814,600
2003	18,400,000
2004	18,900,000
2005	100,000,000*

Source CCC Data

*Estimate

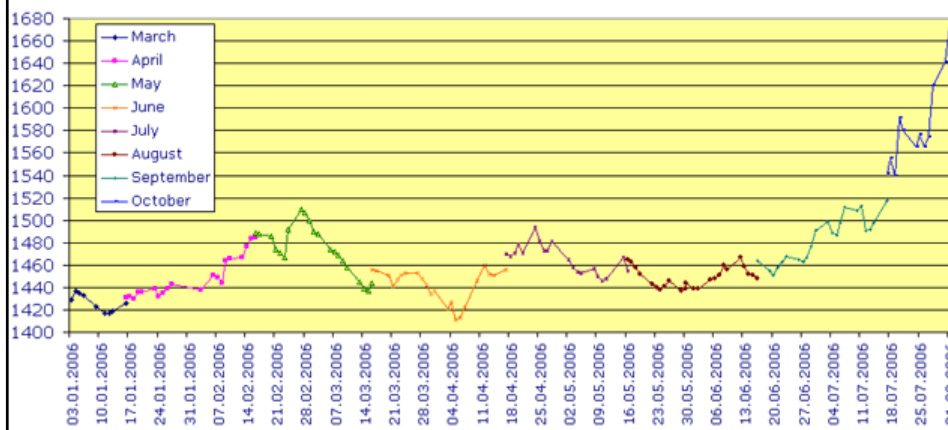


Soy Oil Price History



Source: <http://www.palmoil.com/index.php?q=D1VTW1NASglEAhEbVg9RAAsI>
Data from Chicago Board of Trade

Palm Oil Prices

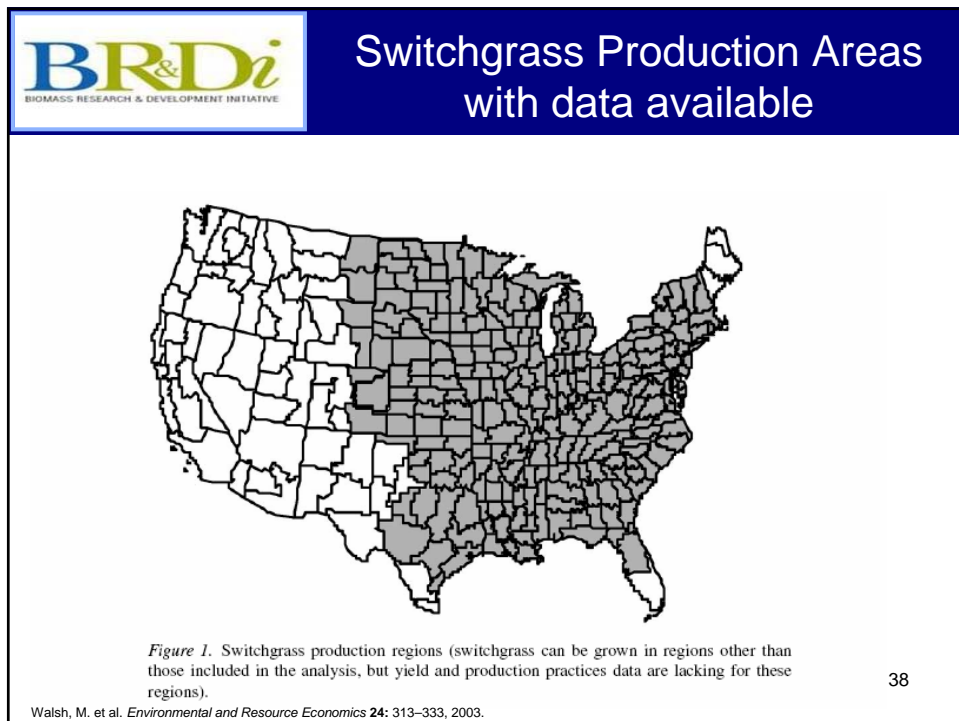
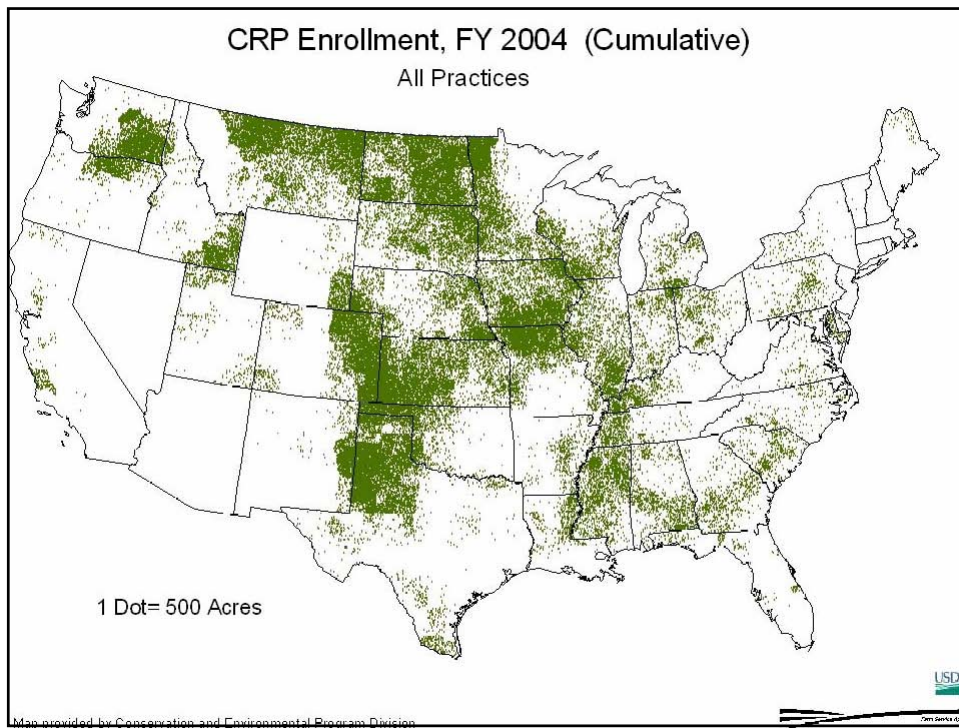


- Crop Year 2004 Approx. Production 18.7 B lbs
- 7.5 billion pounds of biodiesel derived from soy oil would represent approximately 40% of current total soy oil demand. This would be 1 billion gallons or 2% of diesel demand.

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- Dedicated perennial energy crop production potential
- On Conservation Reserve Program (CRP) Acreage
- Using switchgrass, hybrid poplar, willow, etc.

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Hybrid Poplar Production Areas with data available



Figure 2. Hybrid poplar production regions (hybrid poplar can be grown in regions other than those included in the analysis, but yield and production practices data are lacking for these regions).

Walsh, M. et al. *Environmental and Resource Economics* 24: 313–333, 2003.

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Willow Production Areas with data available

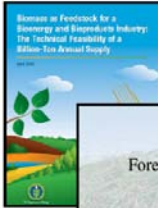


Figure 3. Willow production regions (willow can be grown in regions other than those included in the analysis, but yield and production practices data are lacking for these regions).

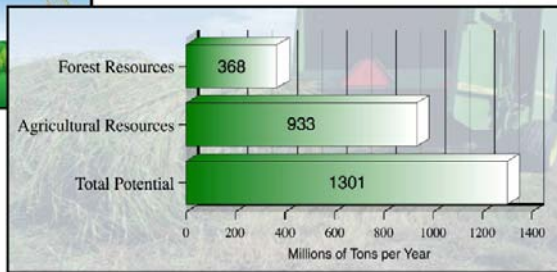
Walsh, M. et al. *Environmental and Resource Economics* 24: 313–333, 2003.

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U.S. Biomass Resource Assessment



- Updated resource assessment - April 2005
- Jointly developed by U.S. DOE and USDA
- Referred to as the "Billion Ton Study"

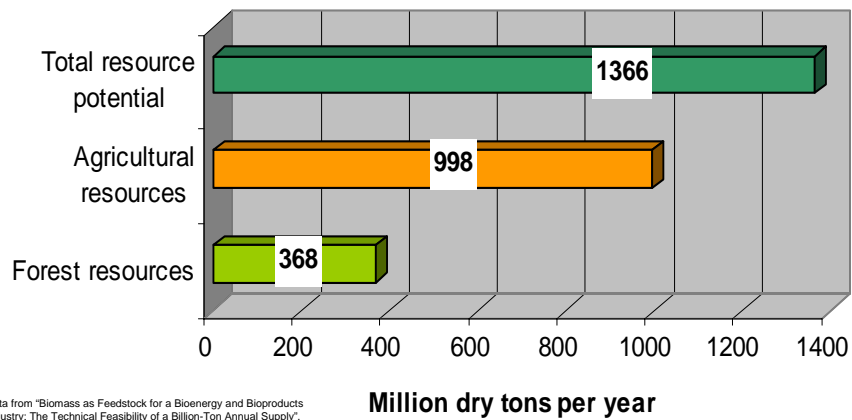


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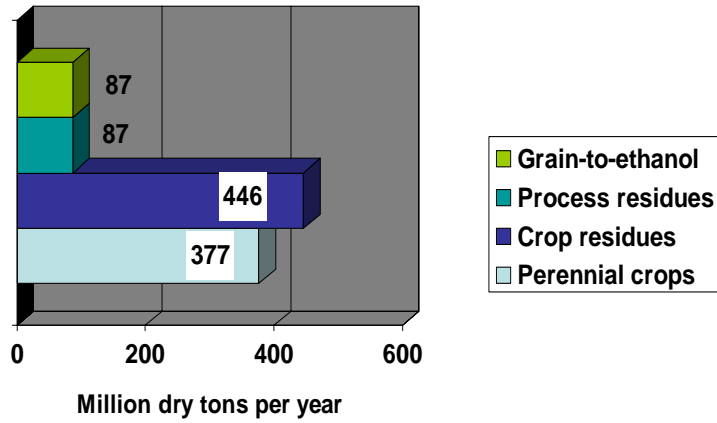
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Annual biomass resource potential

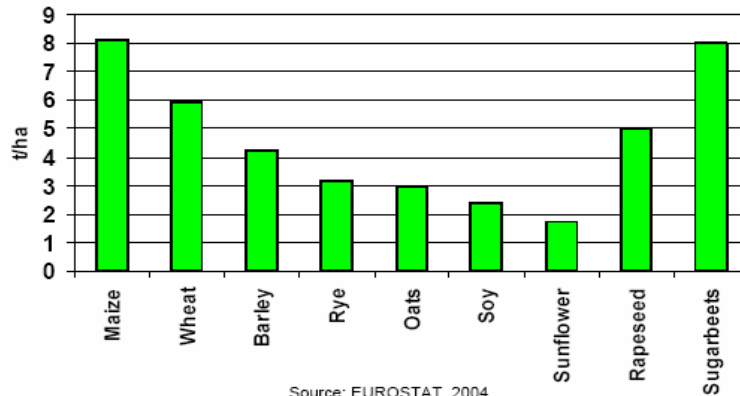


Data from "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply", DOE and USDA, April, 2005



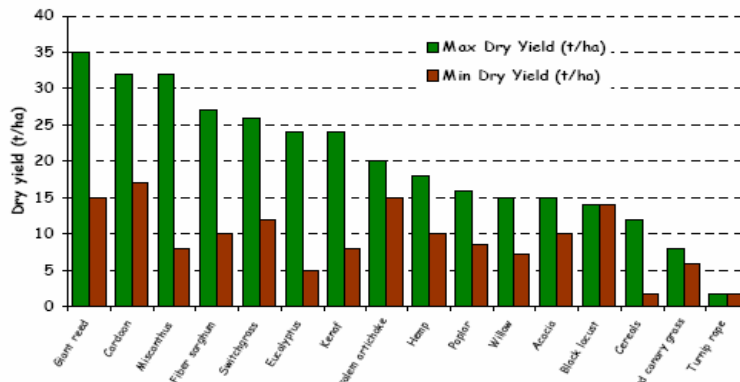
Data from "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply", DOE and USDA, April, 2005

Crop yields



Source: EUROSTAT, 2004

Yielding potential of energy crops in EU25

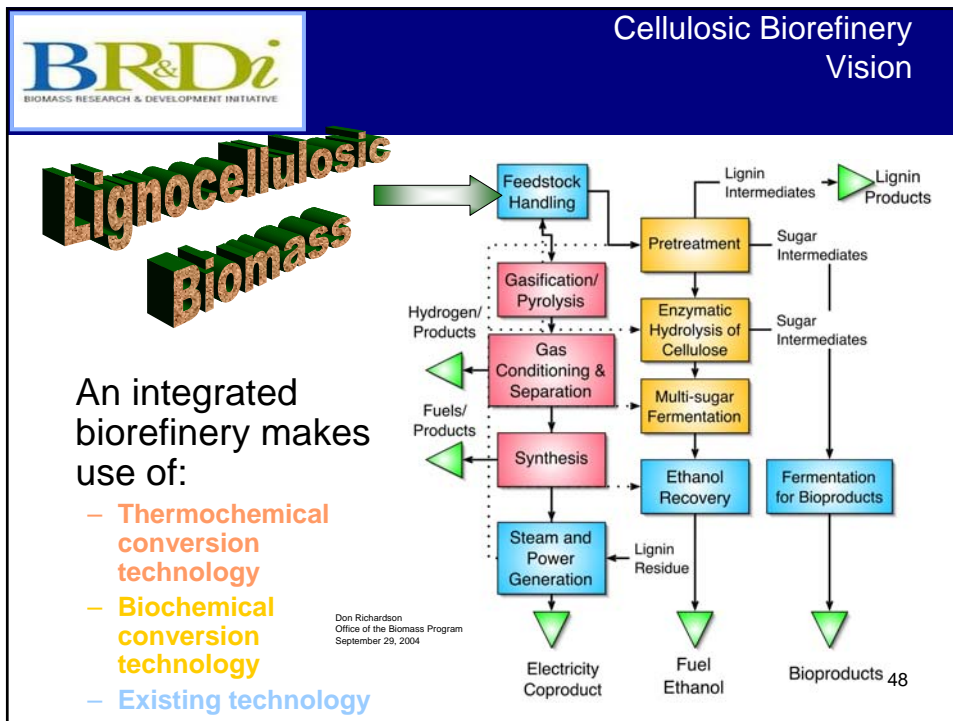
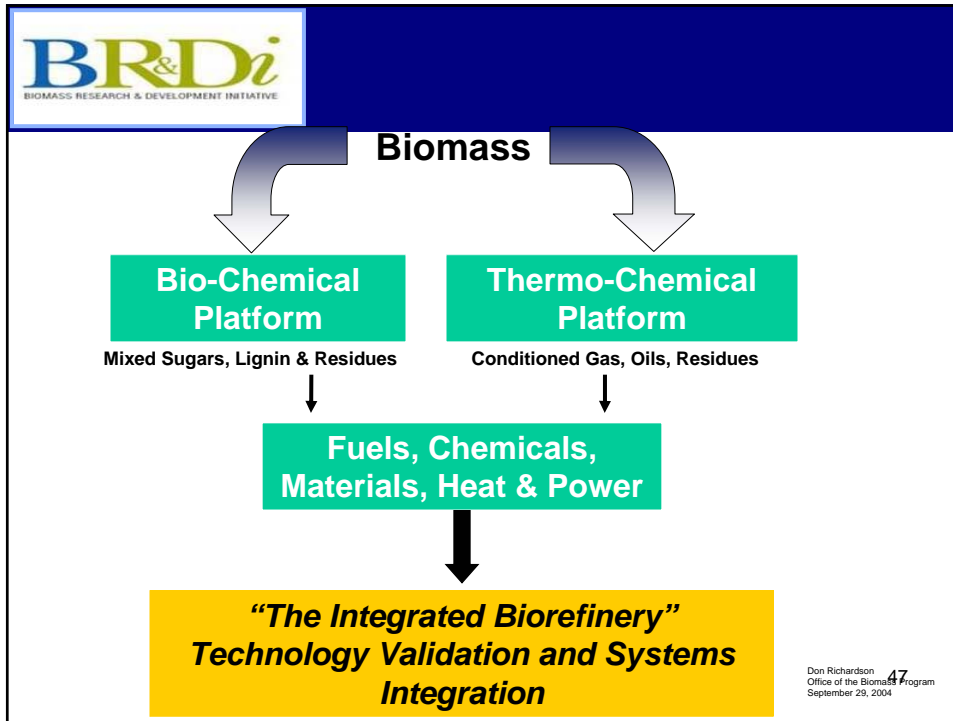


EC project: Altener Biomass in the Mediterranean

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What conversion technologies are available?

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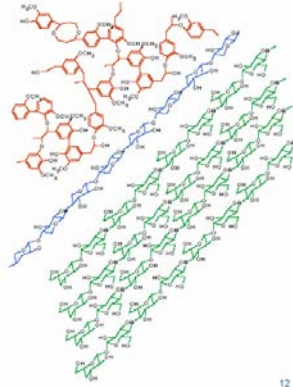


Non-Edible Constituents of Biomass

- Lignin:** 15%–25%
- Complex aromatic structure
 - Very high energy content
 - Resists biochemical conversion

- Hemicellulose:** 23%–32%
- Xylose is the second most abundant sugar in the biosphere
 - Polymer of 5- and 6-carbon sugars, marginal biochemical feed

- Cellulose:** 38%–50%
- Most abundant form of carbon in biosphere
 - Polymer of glucose, good biochemical feedstock



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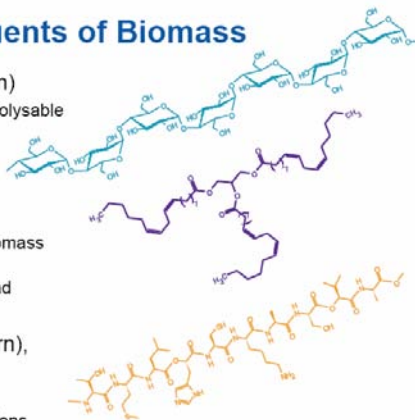
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Edible Constituents of Biomass

- Starch:** 70%–75% (corn)
- Readily available and hydrolysable
 - Basis for existing U.S. "biorefineries"

- Oil:** 4%–7% (corn), 18%–20% (soybeans)
- Readily separable from biomass feedstock
 - Basis for oleochemicals and biodiesel

- Protein:** 20%–25% (corn), 80% (soybean meal)
- Key component of food
 - Chemical product applications

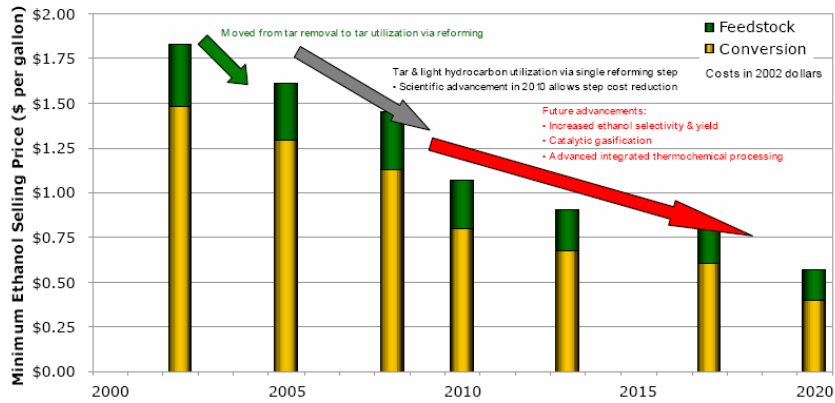


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Ethanol From Thermochemical Mixed Alcohols



Integrated Biorefinery

