




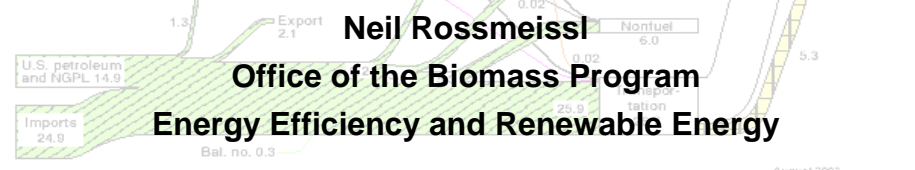
U.S. Department of Energy
Energy Efficiency and Renewable Energy



The President's Biofuels Initiative

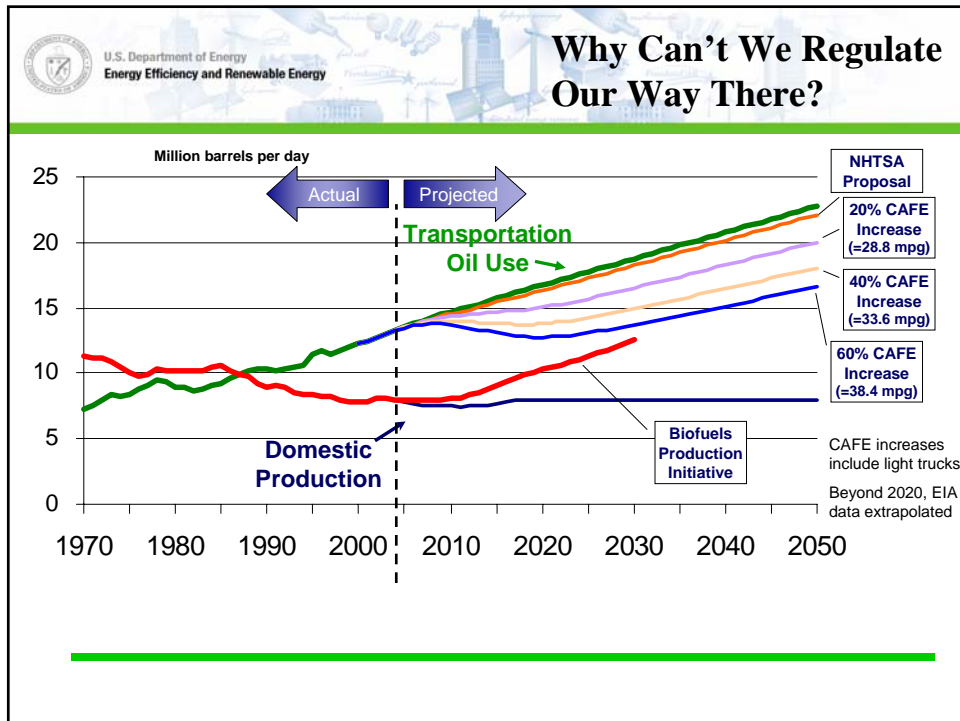



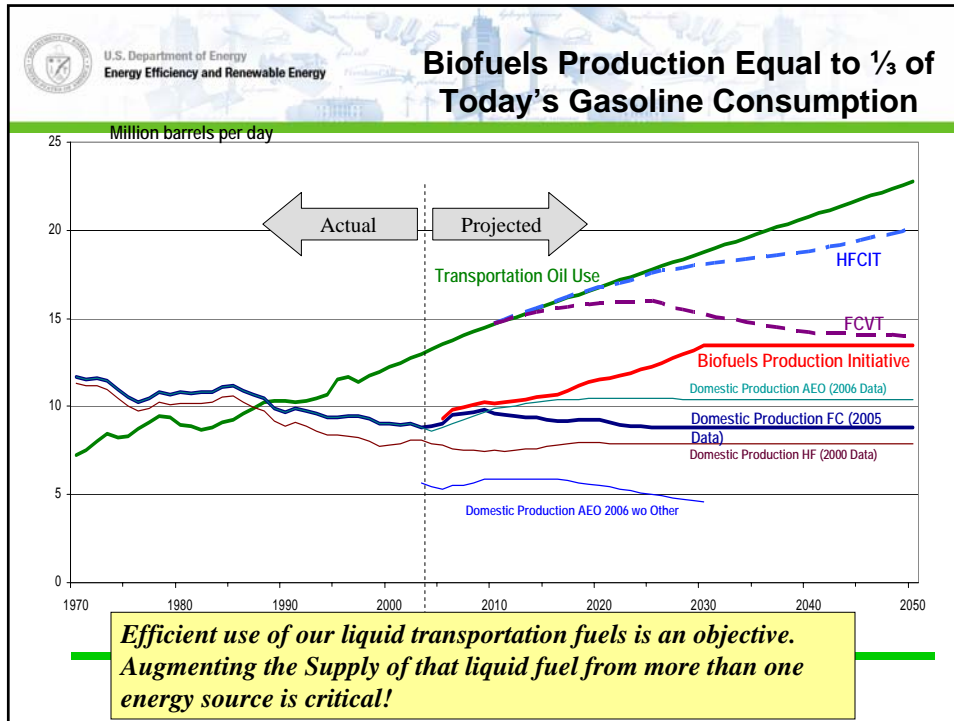
Neil Rossmessl
Office of the Biomass Program
Energy Efficiency and Renewable Energy



Source: Production and end use data from Energy Information Administration, Annual Energy Review 2001
 *Net fossil-fuel electrical imports
 **Includes 0.2 quads of imported hydro
 ***Biomass/other includes wood, waste, alcohol, geothermal, solar, and wind.

August 2003
Lawrence Livermore
National Laboratory
http://eed.llnl.gov/t2w





Program Goals



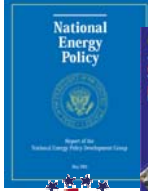




2012 Goal: Fund additional research in cutting-edge methods of producing ethanol, not just from corn, but from wood chips and stalks, or switch grass. Our goal is to make this new kind of ethanol practical and competitive within six years



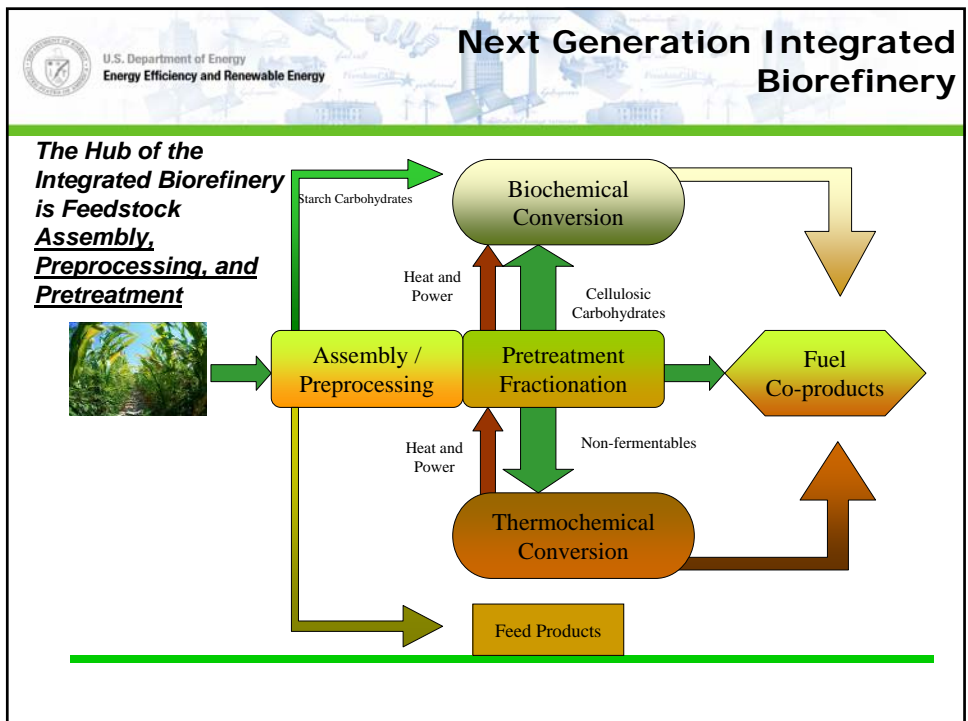
2030 Goal: Replace 30% of our current gasoline consumption with ethanol.

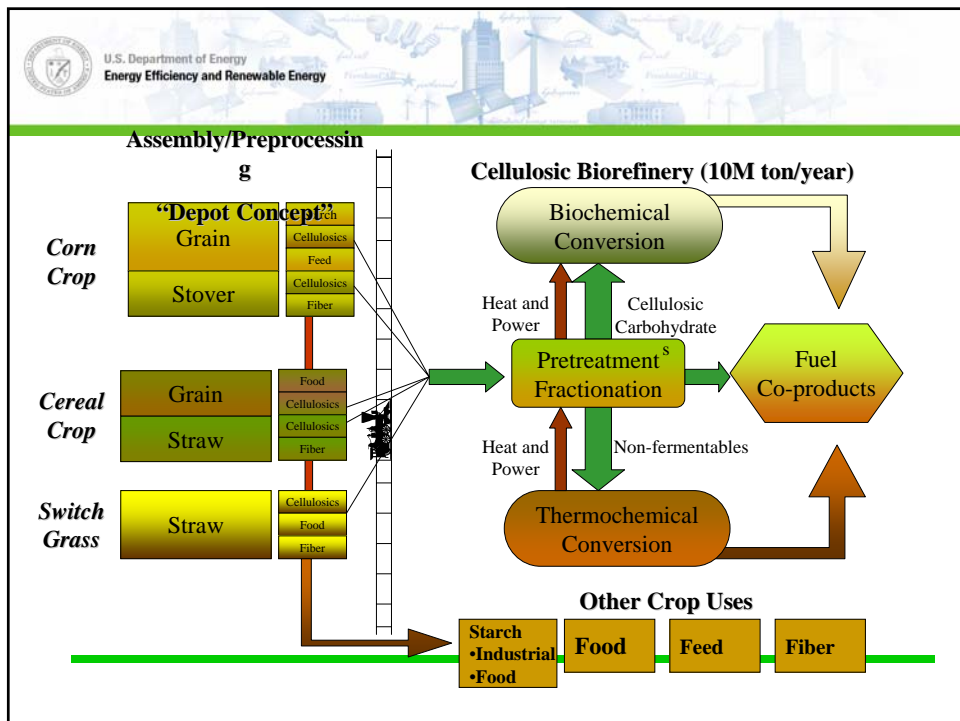
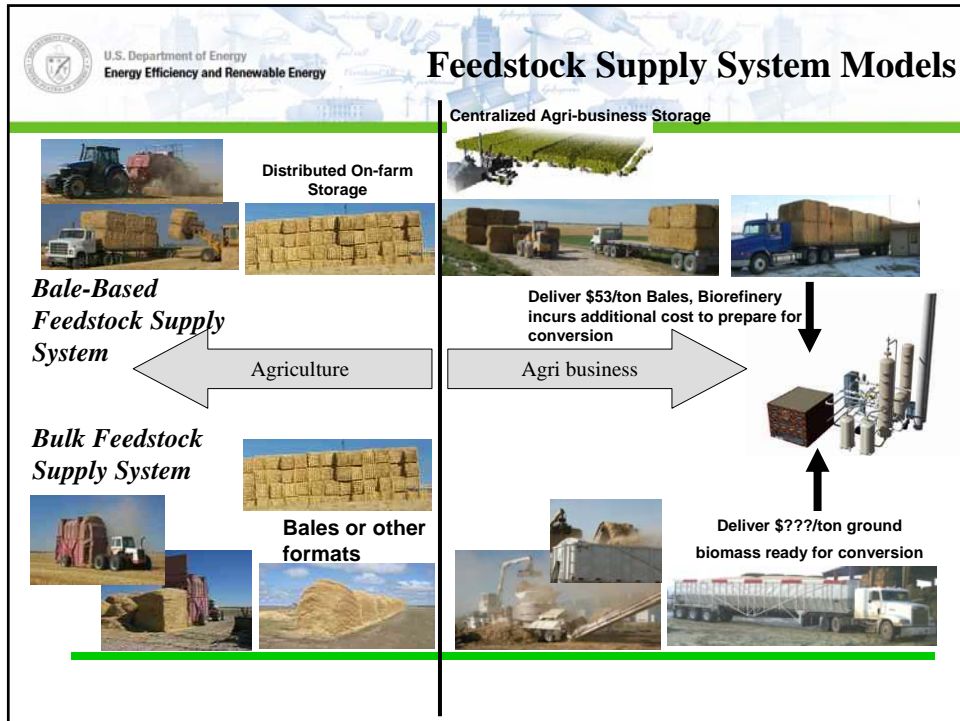
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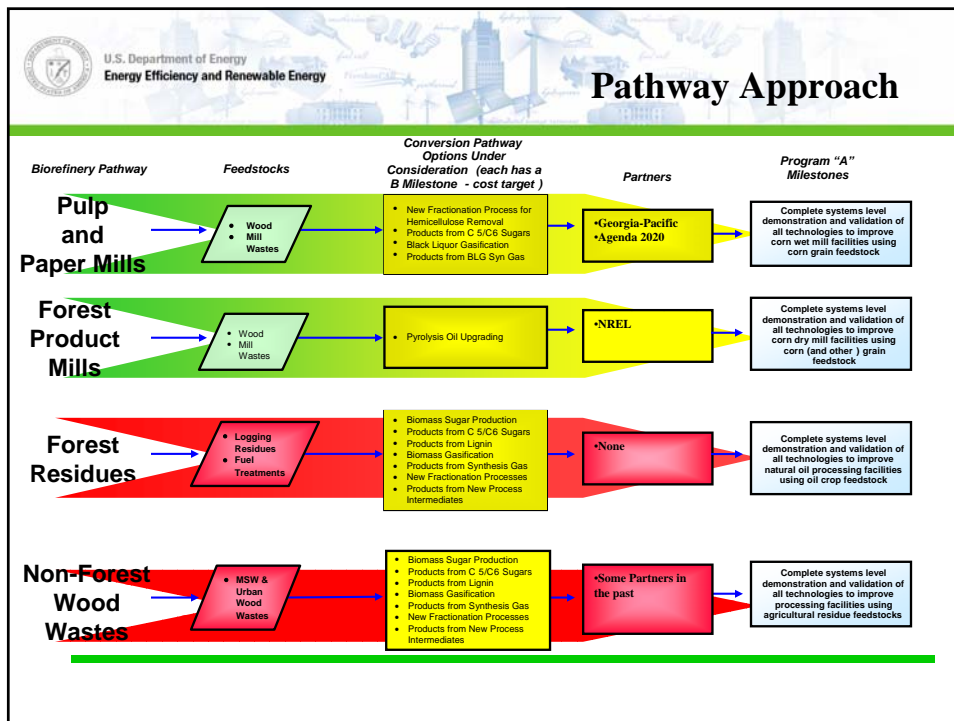
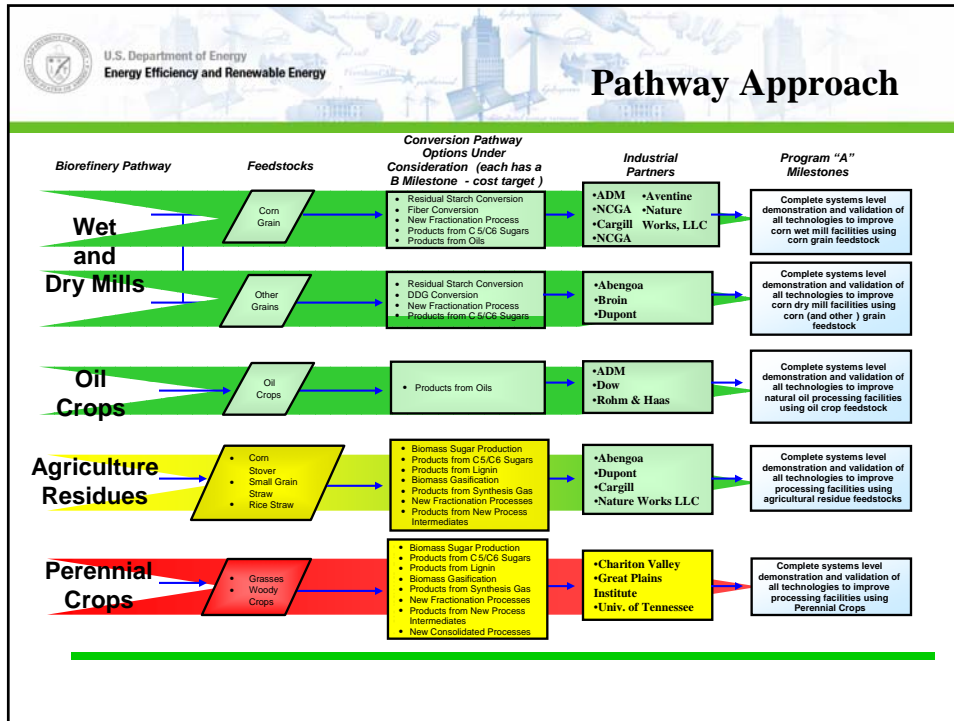
Strong Support and Guidance








- The President's Goals of replacing 75% of Middle East Oil imports by 2025 and for research to make cellulosic ethanol production practical and competitive by 2012
- The Energy Policy Act of 2005 provides direction on program content as well as loan guarantee authorization for commercial scale demonstrations.
- The President's National Energy Policy includes multiple recommendations that support bioenergy.
- The Biomass R&D Act of 2000 directs DOE and USDA to enhance and coordinate biomass R&D efforts.
- The Energy Title (Title IX) of the Farm Bill provides support for increased use of biomass energy and products and for R&D.









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Research in cutting-edge methods of producing ethanol

Producing ethanol from potential feedstocks

Hurdles to Overcome

Overall Needs

- Production of Ethanol from feedstocks available across the U.S.
- Lower the cost of feedstock
- Conversion Technology Options

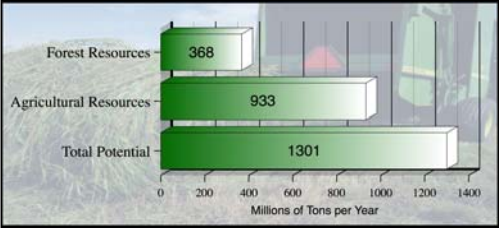
Research Focus

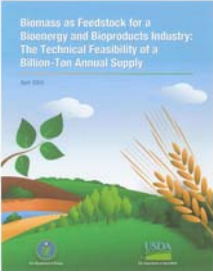
- Faster Fermentation Times
- Improve Yield of ethanol per ton of feedstock
- Continue to Reduce Enzyme cost
- Improve Sugar recovery and conversion

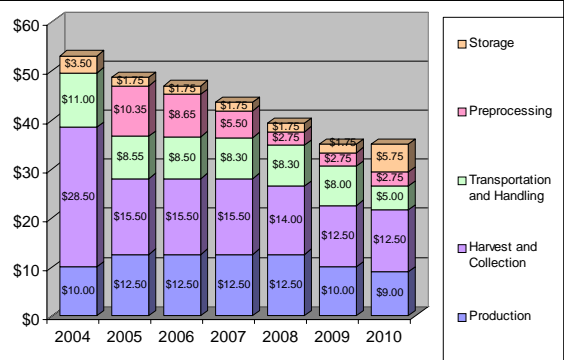
What the Initiative Provides

- Baseline for other feedstock beyond corn harvest residue (stover)
- Investigate the Conversion of a much broader number of possible feedstocks
- Develop regional feedstock partnerships to identify local opportunities for feedstock production and ethanol production
- Reestablish the Thermo-Chemical conversion technology as a second possible pathway to success
- Fermentation Organism Development solicitation
- Accelerated research on all major hurdles to \$1.07 gal production cost

Conversion of Available Feedstocks





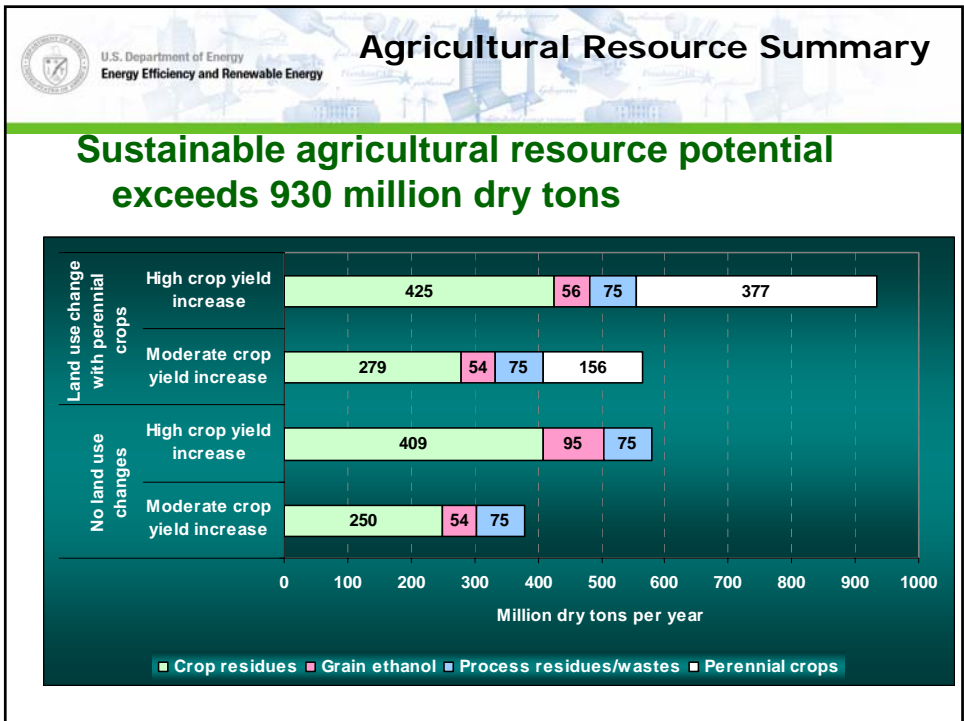
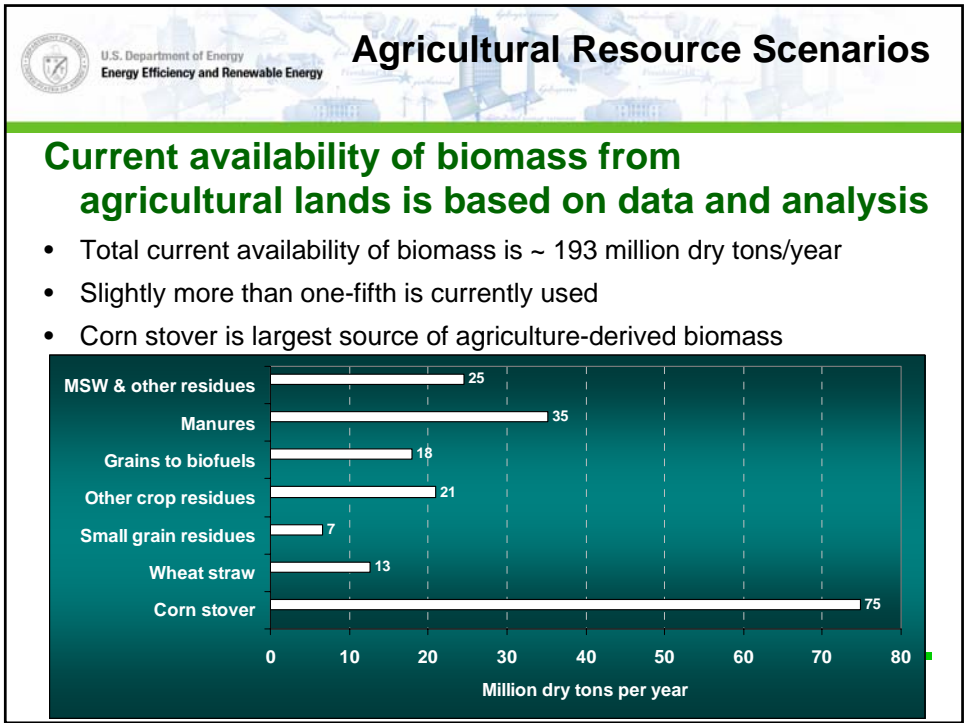


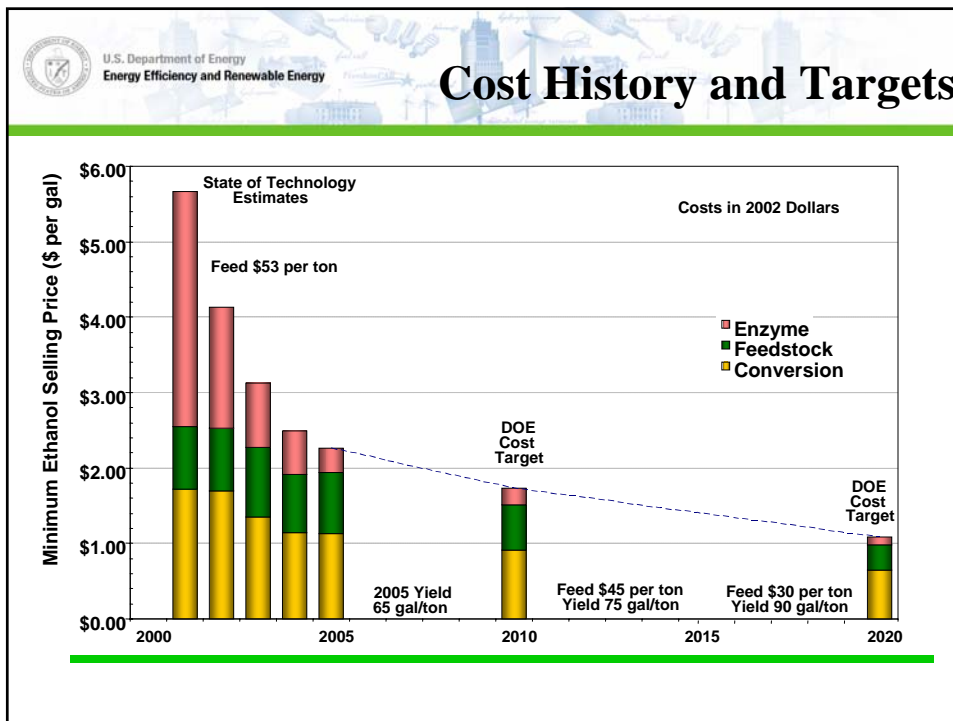
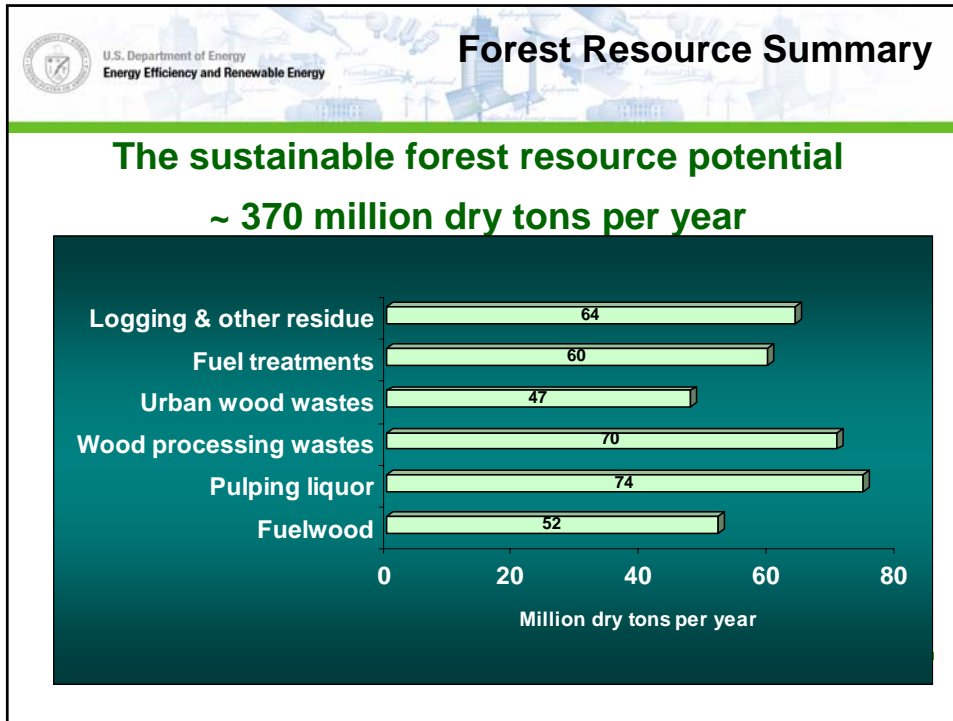
Year	Production	Harvest and Collection	Transportation and Handling	Preprocessing	Storage	Total
2004	\$10.00	\$28.50	\$11.00	\$3.50	\$0.00	\$53.00
2005	\$12.50	\$15.50	\$8.55	\$10.35	\$1.75	\$48.65
2006	\$12.50	\$15.50	\$8.50	\$8.65	\$1.75	\$47.90
2007	\$12.50	\$15.50	\$8.30	\$5.50	\$1.75	\$47.55
2008	\$12.50	\$14.00	\$8.30	\$2.75	\$1.75	\$43.30
2009	\$10.00	\$12.50	\$8.00	\$2.75	\$1.75	\$35.00
2010	\$9.00	\$12.50	\$5.00	\$2.75	\$1.75	\$31.00

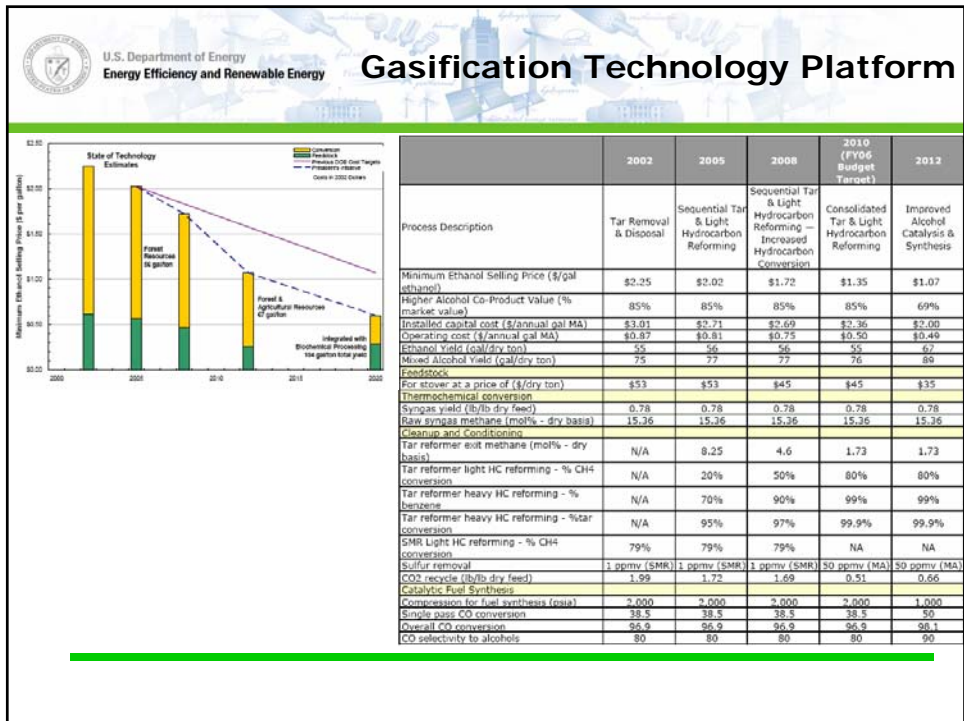
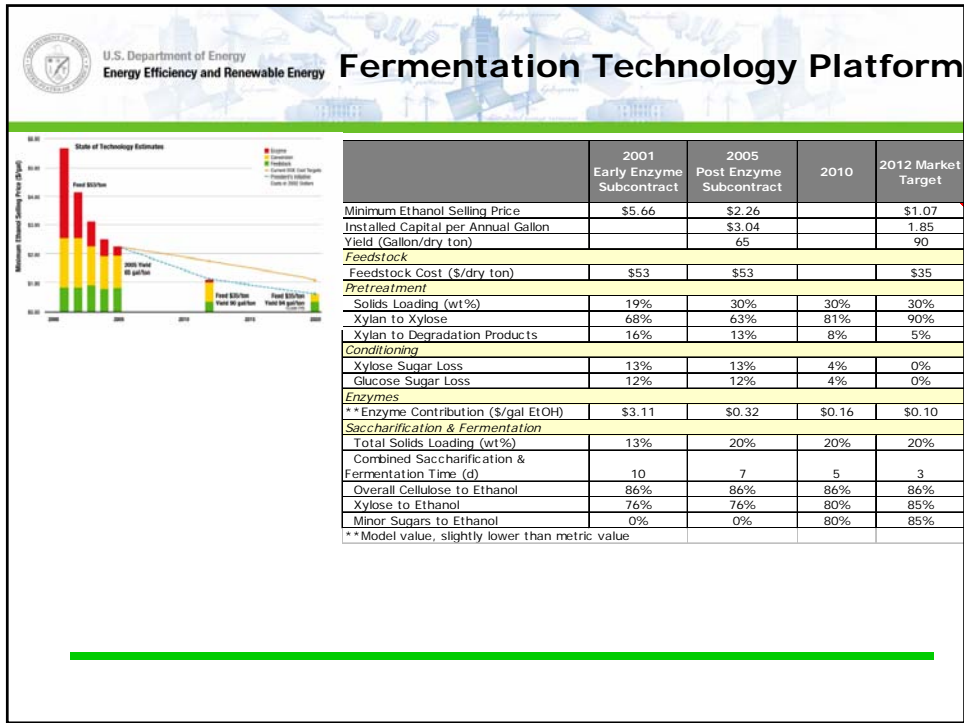
- "Billion Ton" study indicates that enough biomass is potentially available to displace > 30% of current U.S. petroleum consumption
- But it requires variety of biomass types
 - Agricultural lands
 - Corn stover, wheat straw, soybean residue, manure, switchgrass, poplar/willow energy crops, etc.
 - Forest lands
 - Forest thinnings, fuelwoods, logging residues, wood processing and paper mill residues, urban wood wastes, etc.

2/4/2005

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Federal Agency Collaboration – Guiding Legislation

- Healthy Forest Restoration Act of 2003, Title II
- Memorandum of Understanding (MOU) for Woody Biomass Utilization (DOE/USDA/DOI)
- MOU for Biomass to Hydrogen (DOE/USDA)
- Biomass Research and Development Act of 2000
 - Biomass R&D Technical Advisory Committee (30 representatives from industry, academia, non-profit, state, forestry, agricultural sectors)
 - Vision for Bioenergy & Biobased Products in the US (currently being updated)
 - Roadmap for Bioenergy & Biobased Products in the US (currently being updated)
 - Interagency Biomass R&D Board (cabinet-level representatives from DOE/USDA/DOI/EPA/NSF/OFEE/DOT)
- Farm Bill 2002, Title IX
 - Federal Procurement of Biobased Products (Section 9002)
 - Renewable Energy Systems and Energy Efficiency Improvements (Section 9006)
 - Biomass Research and Development (Section 9008)
 - Joint DOE/USDA Solicitation for FY02 – FY06
 - Continuation of the Bioenergy Program (Section 9010)















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USDA & DOE Collaboration

- Biomass R&D Initiative (BRDI) (ongoing)
 - Multi-agency effort to coordinate and accelerate all Federal biobased fuels and products research and development
 - Solicits RFP for annual USDA/DOE Joint Solicitation
 - Revision of Vision and Roadmap for Bioproducts & Bioenergy in the U.S. documents
 - Overseen by USDA and DOE POC
- Feedstock Projects Stage Gate Review (March 2005)
 - Independent review of USDA & DOE feedstock-related R&D portfolio
- Billion Ton Study (April 2005)
 - Joint study released by USDA & DOE that categorizes the nation's biomass resources for the production of biobased fuels and power
- USDA/DOE Joint Biomass Conference (Fall 2006)



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Vision & Roadmap Updated Goals


Revised Vision Goals:

		2000	2004	2010	2015	2020	2030
Biofuels	Market Share	0.7	1.2	4.0	6.0	10	20
	Million GGE	1,104	2,111	8,016	12,852	22,725	50,994
Biopower	Market Share	3.0	3.0	4.0	5.5	7.0	7.0
	Quads	2.04	2.13	3.10	3.20	3.40	3.80
Bioproducts	Production (million lbs)*	12,429	17,600	23,700	26,400	35,600	55,300

The Roadmap for achieving these goals is being updated on a regional basis over the course of the next year.


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Biofuels Summary & Conclusions

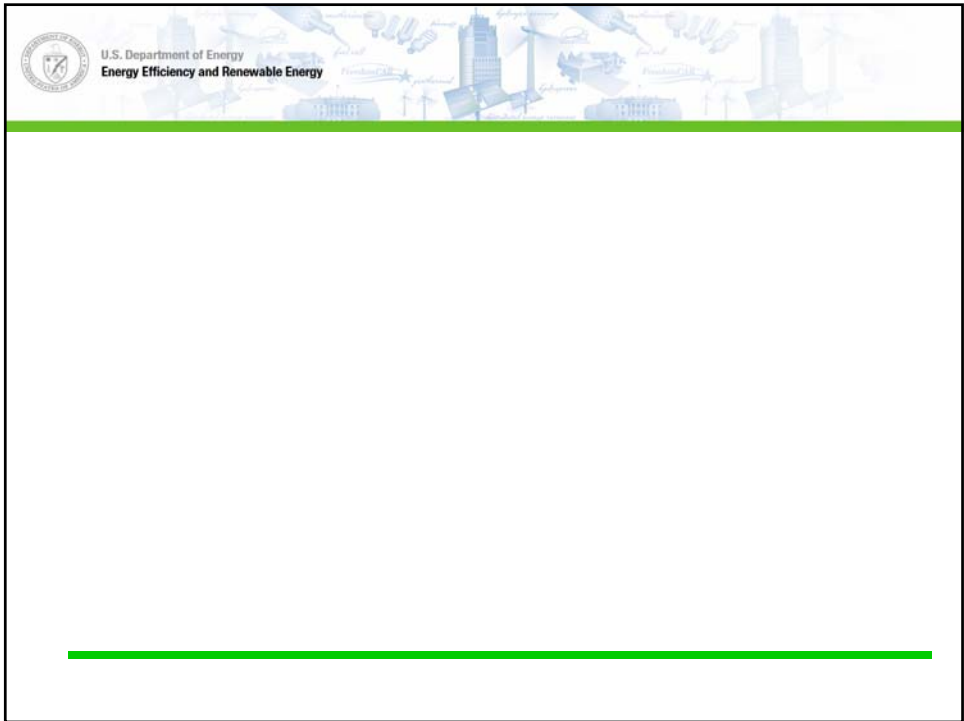
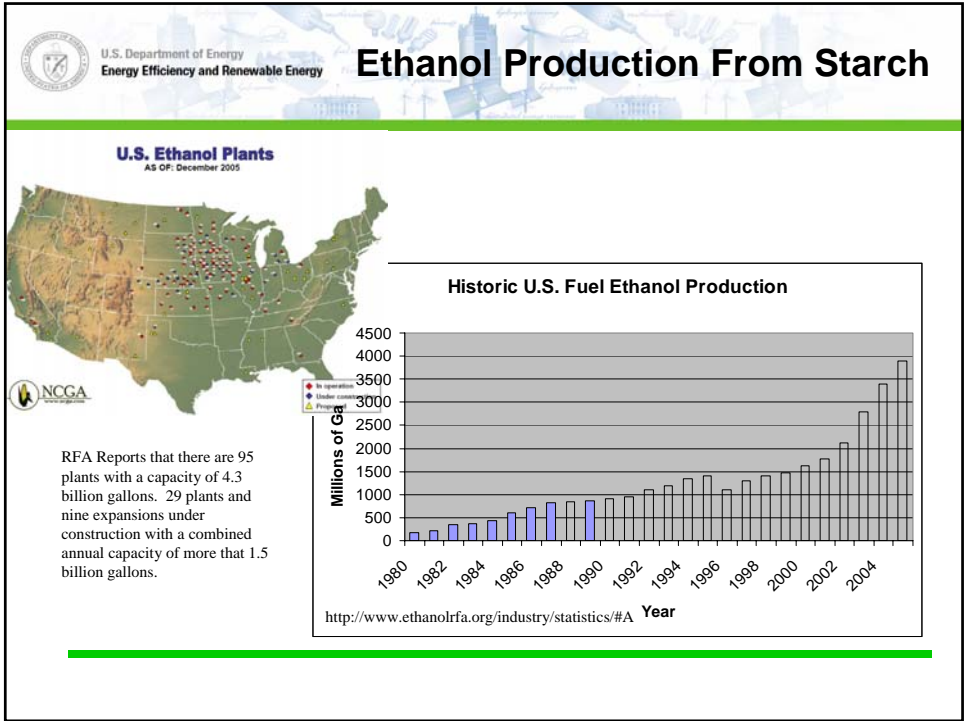


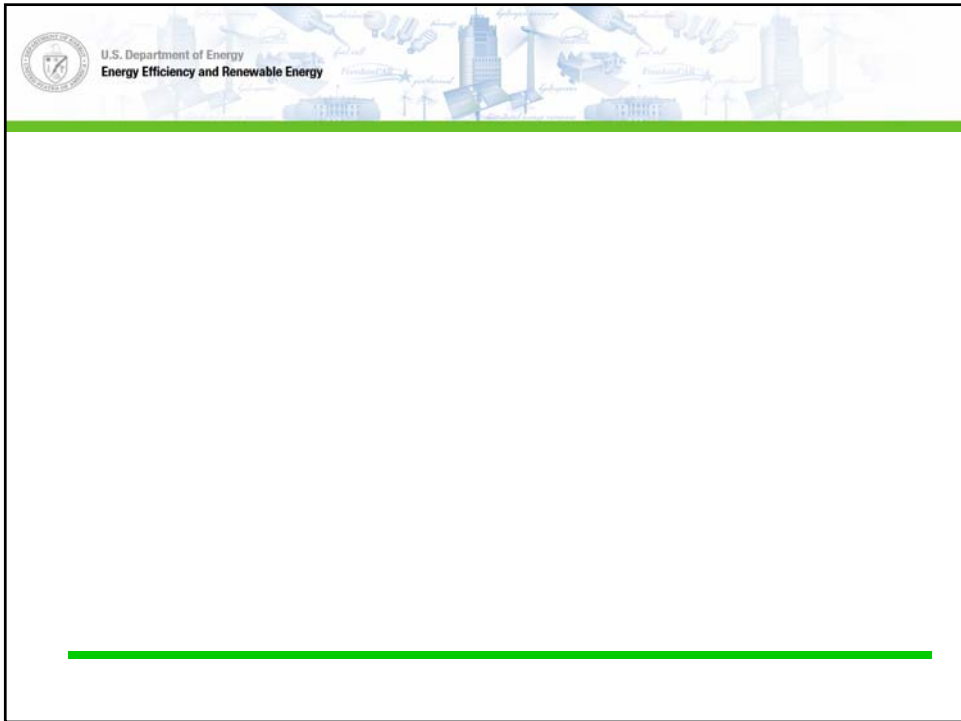
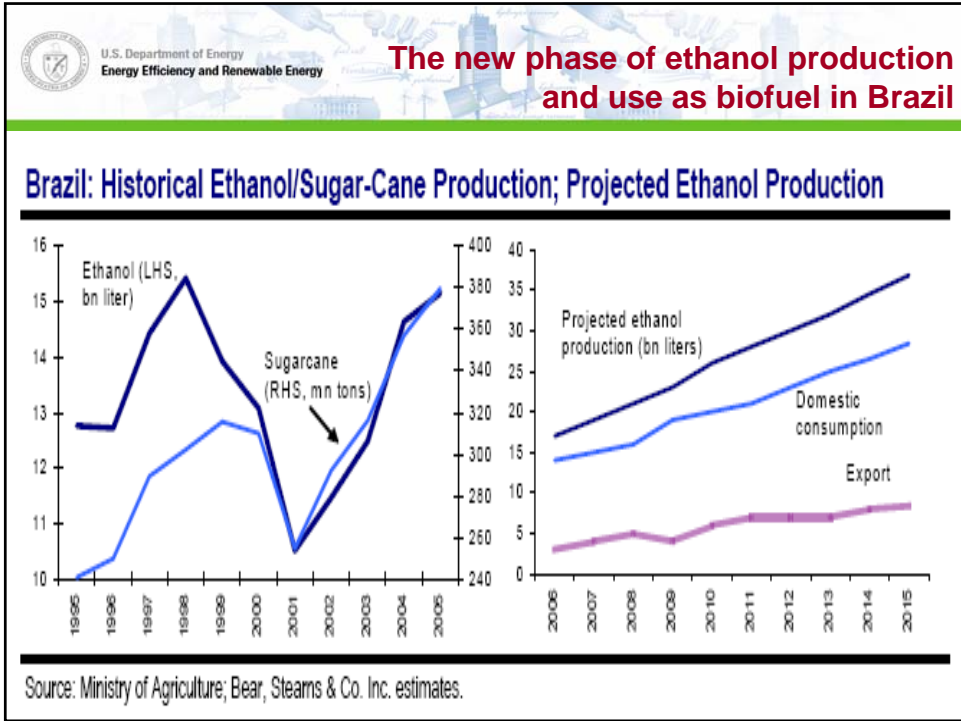
- ✓ The only domestic & renewable option for liquid transportation fuels coupled with vehicle efficiency to reduce imports.
- ✓ Resource base sufficient to supply a large fraction of U.S. needs
- ✓ The “net” energy balance is very good.
- ✓ A sustainable solution to meet the near-term “gap” caused by Peak Oil
- ✓ Science & Technology will create many other opportunities that extend beyond today’s ethanol & biodiesel

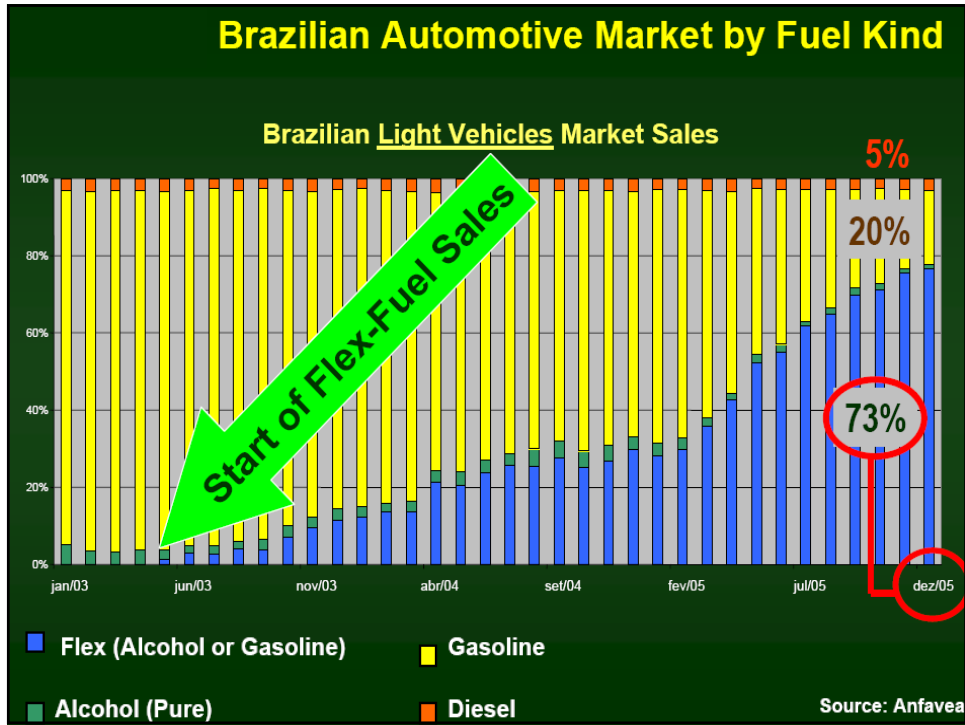


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- Supporting Information







Data Sources and Notes for "Biofuels Production Initiative"

- Existing Fuels Market**

- 139.6 billion gallons of finished motor gasoline in 2004: EIA Petroleum Supply Annual 2004, Volume 1, Table 3. U.S. Daily Average Supply and Disposition of Crude Oil and Petroleum Products, 2004, http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/current/pdf/table_03.pdf
- 37.1 billion gallons of on-highway diesel in 2004: EIA Fuel Oil and Kerosene Sales 2004, Table 13. Adjusted Sales of Distillate Fuel Oil by Energy Use in the United States: 2000-2004, http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/fuel_oil_and_kerosene_sales/historical/2004/pdf/table13.pdf
- Energy Policy Act of 2005, H.R.6, Sec. 1501 Renewable Content of Gasoline: "any gasoline sold or introduced to commerce in the U.S. must contain, on an annual average basis, the applicable volume of renewable fuel." applicable volume is 4 billion gallon per year in 2006 and increases steadily to 7.5 billion gallon per year in 2012.
- State MTBE ban information from *Ethanol Industry Outlook 2005*, Renewable Fuels Association, <http://www.ethanolrfa.org/industry/outlook/>
- 2002 MTBE Demand: *Transportation Energy Data Book, Edition 24*, Oak Ridge National Laboratory, Center for Transportation Analysis, 2004. ~93,500 Btu/gal MTBE.
- MTBE-Ethanol equivalent: conversion from *Ability of the U.S. Ethanol Industry to Replace MTBE*, AUS Consultants, March 2000, retrieved from <http://www.ethanolrfa.org/resources/reports/>
- # of FFV (as of the end of production of model year 2005): National Ethanol Vehicle Coalition, "Frequently Asked Questions," Accessed Jan 17 2006, <http://www.e85fuels.com/e85101/faq.php>. Fuel consumption is estimated using the ratio of 1.9 million FFV to 1.5 B gal/yr ethanol. Ratio is from "Legislative Information Alert: E85 Infrastructure Development," National Ethanol Vehicle Coalition, Accessed Dec 27 2005, <http://www.e85fuel.com/pdf/infrastructure.pdf> and from "For Your Information," National Ethanol Vehicle Coalition, July 27 2001, <http://www.e85fuel.com/news/072701.htm>. Note that the much of the 1.5 million FFVs on the road use gasoline and not E85. Approximately 100,000 FFVs (Federal and State government, and fuel provider fleets vehicles only) ran on E85 in 2004 (EIA, DOE, Alternatives to Traditional Transportation Fuels, Table 21. Number of Onroad Alternative Fuel Vehicles in Use by User, Weight Class, Fuel Type and Configuration, 2004, October 2005, http://www.eia.doe.gov/cneaf/alternate/page/atftables/atf21-35_04.html)

Data Sources and Notes for “Biofuels Production Initiative”

• **Ethanol Production**

- 3.9 billion gallons of fuel ethanol production in 2005: Renewable Fuels Association “Historic U.S. Fuel Ethanol Production,” <http://www.ethanolrfa.org/industry/statistics>
- 4.5 billion gallons existing capacity in 2005 and an additional 1.9 billion gallon capacity from construction and expansions totaling 6.4 billion gallons ethanol production capacity: Renewable Fuels Association Plant Locations, “U.S. Fuel Ethanol Industry Plants and Production Capacity,” <http://www.ethanolrfa.org/industry/locations/>
- Between 12 and 18 billion gallons of fuel ethanol from corn in 10 years is reasonable.: Analysis by NCGA in December 2005, “NCGA Corn-to-ethanol Capacity estimates for 10% fuel ethanol inclusion nationwide by 2015”
 - Analysis includes increased corn yield per acre (from 148.4 to 178-187 bu/acre), acreage (from 74.3 million acres to 76-78 million acres due to ability to grow corn on corn due to biotechnology and crop management programs), and ethanol yield (2.73 gal/bu to 2.9-3.0 gal/bu due to greater number of dry mills).
 - Does not take into account emerging ethanol production technologies.
- Low heating valued for Ethanol (75,700 Btu/gallon) and Gasoline (115,000 Btu/gallon): Bioenergy Conversion Factors: http://bioenergy.ornl.gov/papers/misc/energy_conv.html



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Biomass Program Funding

Activity	Funding (\$ in thousands)		
	FY 2005	FY 2006	FY 2007
	Approp	Approp	Request
Feedstock Infrastructure	1,984	479	9,967
Platforms R&D	29,288	15,140	50,530
Utilization of Platform Outputs R&D	20,473	23,322	89,190
Congressionally Directed Activities	35,332	51,777	0
Technical/Program Management	394	0	0
TOTAL	87,471	90,718	149,687

Data Sources and Notes for “Biofuels Production Initiative”

• Environmental Benefits

- E85 emissions are from Appendix D in Brinkman, N., Wang, M., Weber, T., Darlington, T., *Well-to-Wheels Analysis of Advanced Fuel/Vehicle Systems—A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions*, May 2005, <http://www.transportation.anl.gov/software/GREET/publications.html>.
 - Cellulosic ethanol production analysis includes electricity export.
 - Emissions reductions were calculated using the P90 (90% probability that actual values would be equal to or below the P90 values) values.
 - Ethanol has higher NO_x, VOC, and PM emissions than gasoline due to farming operations (fossil fuel consumption, use of nitrogen fertilizers, nitrification and identification in corn fields) and ethanol production (use of coal or natural gas to produce steam in ethanol mills) (pages 5, 7). (NO_x is a GHG; VOCs contribute to GHGs when they react/degrade in the atmosphere).
- Biodiesel emissions are from Figure IV.A.1-1 Basic Emission Correlations in *A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions, Draft Technical Report*, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA420-P-02-001, October 2002. Emissions are calculated for heavy-duty highway engines.

Data Sources and Notes for “Biofuels Production Initiative”

• Rural Development

- 2004 Rural Development numbers are from Urbanchuk, J.M., “Contribution of the Ethanol Industry to the Economy of the United States,” LECG LLC, January 2005, <http://www.ethanolrfa.org/resource/reports/>
 - Applies the detailed industry RIMS II multipliers (Bureau of Economic Analysis, U.S. Department of Commerce) to estimates of spending by the ethanol industry.
- 40 million gallon mill rural development numbers are from Urbanchuk, J.M., and Kapell, J., “Ethanol and the Local Community,” AUS Consultants and SJH & Company, June 2002, retrieved from <http://www.ethanolrfa.org/resource/reports/>
 - Applies final demand, two-digit industry RIMS II multipliers from the Bureau of Economic Analysis, U.S. Department of Commerce to the estimates of new capital spending and annual operating expenditures of a 40 million gallon dry ethanol plant.