

Impact of Biofuels Production and Commercialization on Small/Medium-Sized Farms

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Presented at the 2008 Annual meeting of the AAEA, Orlando, Florida
July 27

Outline of Presentation

- Definitions
- Background Information
- Broad look at energy and bio-energy
- National Energy Policy
- Opportunities, Prospects and Issues worth thinking About
- Conclusions

Definitions of Biofuels

- Fuels made from biomass. Biofuels include ethanol, biodiesel and methanol. www.drivingethanol.org/ethanol_facts/glossary.aspx
- Renewable fuels derived from biological materials that can be regenerated. This distinguishes them from fossil fuels which are considered ... climatechange.ucdavis.edu/terms.html
- Biofuels are any fuel derived from biomass. Agricultural products specifically grown for conversion to biofuels include corn and soybeans. R&D is being conducted to improve the conversion of non-grain crops, such as switchgrass and a variety of woody crops, to biofuels. ... www.gogreenva.org/
- Green vehicles rely on a variety of power sources such as batteries, fuel cells, and biofuels. While the industry is ultimately moving towards zero emissions vehicles, plug-in hybrids and partial emissions are a necessary step along the way. www.greentechmedia.com/articles/greentech-market-taxonomy-chart.html
- Fuel derived from plant sources. Most of the biofuels produced in the United States is derived from corn; Brazil produces large quantities from ... www.actionaidusa.org/glossary/

Definitions of Biofuels (Cont'd)

- Transportation fuels derived from biomass (biomass is the collective name for all plant material, including wheat, grass and wood). ... www.avantium.com/index.php
- Wood, waste, and alcohol fuels. www.eia.doe.gov/oiaf/1605/archive/95report/glossary.html
- Liquid or gaseous fuels derived from biomass and used to power vehicle engines. They can be manufactured from crops, trees, animal fat or the biodegradable fraction of waste. ... www.total.com/en/corporate-social-responsibility/special-reports/biofuels/biofuels_glossary_11300.htm
- Biofuels are liquid fuels, such as ethanol or biodiesel, made from biomass. Biofuels can be used to run cars, trucks, and hopefully in the future, ships and airplanes. engineering.suite101.com/article.cfm/biofuels_a_glossary_of_terms
- Biofuels are fuels that are derived from biomass (recently living organisms such as wood) or their metabolic by-products, such as manure from cows. They are a renewable energy source, unlike other natural resources such as petroleum, coal and nuclear fuels. ... www.transport.govt.nz/glossary/

Definitions of Biofuels

- Fuels derived from Biomass which are burnt to generate heat and power. Examples are bio-ethanol and bio-diesel.
www.mediapaper.co.uk/glossary.aspx
- Biofuels are fuels made from biological products. Two examples are ethanol and biodiesel. Ethanol is a commercial alcohol that is made today from grain. It can also be made from cellulose fibres such as straw, but this is a new approach and is still under development. ...
www.psteckle.com/Kyoto%20Protocol%20Definitions.htm
- Renewable fuels generally derived from agricultural crops or biomass resources such as agricultural, wood, animal, and municipal wastes and residues. Biofuels can refer to fuels for combustion for heat and electricity production, but are generally fuels utilized for transportation. ...
www.westernbiofuelsinc.com/glossary1.html
- Biofuel (also called agrofuel) is a basic abbreviation of biorganic fuel. This is a scientific name for any plant or animal substance that can
...en.wikipedia.org/wiki/Biofuels
- Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.
www.newfuelnow.com/energyterms/b/

Definition of Small Farms

- 91% of all farms and ranches in the US are small-scale enterprises
- 27% of the nation's food and fiber is produced by small farmers
- < \$250,000 gross annual farm income

Farm Typology (ERS)

- **Small [family farms](#)** (gross sales less than \$250,000)
- ***Rural-residence family farms:***
- **Retirement farms.**
- Small farms whose operators report they are retired
- **Residential/lifestyle farms.**
- Small farms whose operators report a major occupation other than farming.
- ***Intermediate family farms:***
- **Farming-occupation farms**--Small family farms whose operators report farming as their major occupation.
 - **Low-sales farms.** Gross sales less than \$100,000.
 - **High-sales farms.** Gross sales between \$100,000 and \$249,999.

Farm Typology (Cont'd)

- **Large-scale [family farms](#)** (Gross sales of \$250,000 or more)
- ***Commercial family farms:***
 - **Large family farms.** Gross sales between \$250,000 and \$499,999.
 - **Very large family farms.** Gross sales of \$500,000 or more
- **Nonfamily farms** Any farm not classified as a [family farm](#), that is, any farm for which the majority of the farm business is not owned by individuals related by blood, marriage, or adoption.

Background Information: Bioenergy in US

- **Biomass Technical Advisory Committee established by the Biomass R&D Act of 2000 (Title III of the Agricultural Risk Protection Act of 2000)**
- **The Act established research initiative focused on producing fuels, power, chemicals, and materials from a wide variety of biomass.**
- **The Act also calls for establishment of the Biomass Research & Development Board and a Biomass Technical Advisory Committee**
- **Committee consisted of 26 experts from**
 - **industry**
 - **Academia**
 - **non-profits, and the**
 - **agricultural and forestry sectors**

Vision of the Technical Committee/NRC Statement

“By 2030, a well-established, economically viable, bioenergy and biobased products industry will create new economic opportunities for rural America, protect and enhance our environment, strengthen US energy independence, provide economic security, and deliver improved products to consumers.”

“Biobased products have the potential to improve sustainability of natural resources environmental quality, and national security while competing economically.” NRC

National Energy Policy

- May 17, 2001
- “The US has significant potential for renewable resource energy development ... They can provide a reliable source of energy ... and they can also generate income for farmers, landowners, and others who harness them.”
- “... we need to accelerate our search for innovative uses for farm products.” \$150m in 2001 for biodiesel, ethanol.
- In August 2001, USDA agencies started using biodiesel and ethanol in their fleet cars where practicable and reasonable in cost.
<http://www.usda-biobasedproducts.net/public>

Energy Policy (Cont'd)

- December 19, 2007
- Energy Independence and Security Act (EISA) was enacted in 2007
- Renewable Fuel Standard (RFS)
- Total renewable fuel sold or introduced into commerce to reach 36 billion gallons by 2022
- Ethanol (biofuel) from corn starch to reach 15 billion gallons. Remainder from “advanced biofuel” (cellulosic biofuel and biomass-based diesel)
- Biomass-based diesel will reach 1 billion gal in 2012. This compares to 600 million gal of soybean-based biodiesel in the 2008 projection.

Broad Look at Energy and Bioenergy: What is Bioenergy?

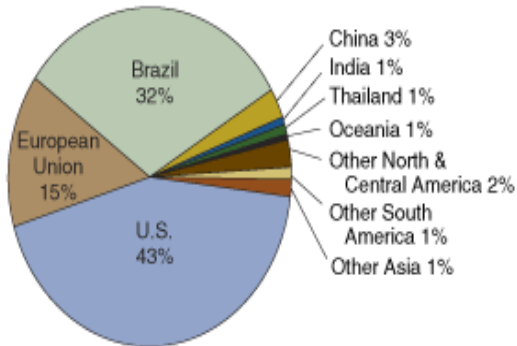
- Renewable energy derived from biological sources to be used for heat, electricity, or vehicle fuel
- Currently biofuel derived from plant materials is among the most rapidly growing renewable energy technologies (corn-based ethanol in US is largest source of biofuel additive or substitute)

Global Biofuel Production Outlook

- Global biofuel production tripled from 4.8 billion gallons in 2000 to 16 billion in 2007 (< 3% of global transportation fuel supply).
- 90% of production is concentrated in the US, Brazil, and the EU; this will change if development programs in China and Malaysia (for example) succeed.
- Leading feedstock for producing biofuels are corn, sugar, and vegetable oils. Pressures on food prices led China to put moratorium on expanded use of corn for ethanol and currently promotes use of cassava, sweet sorghum, jatropha which do not directly compete with food crops.

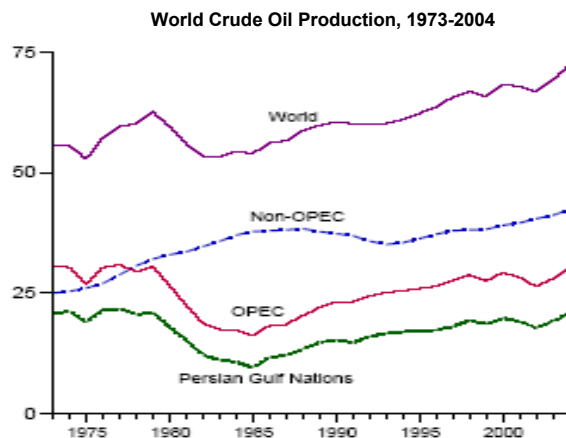
World Biofuel Production

About 90 percent of global biofuel production is concentrated in U.S., Brazil, and Europe, 2007



Source: FO Licht, includes only ethanol for fuel.

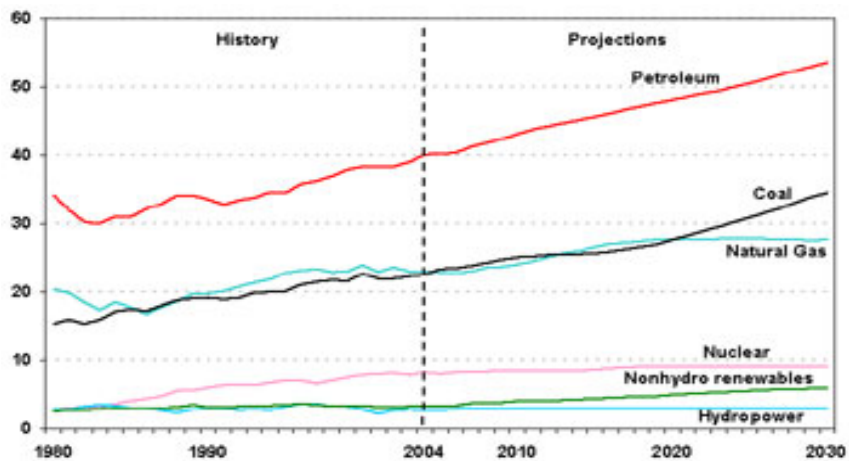
Energy Outlook (EIA)



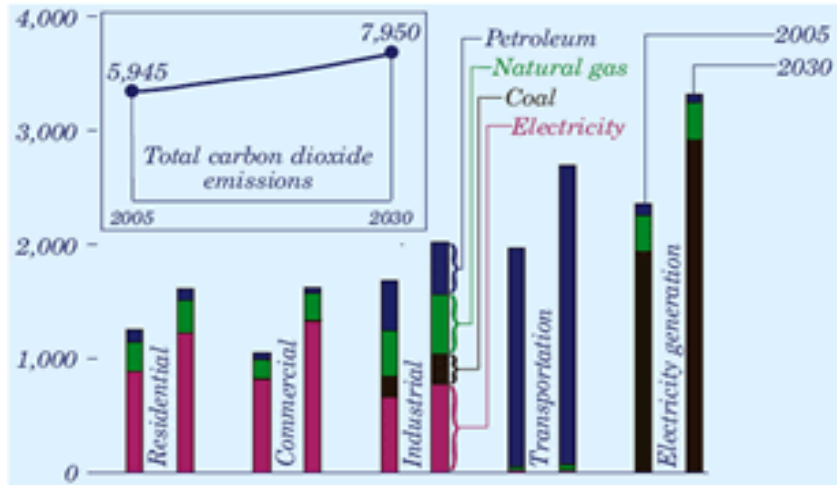
Top World Oil Producers, 2006
(thousand barrels per day)

Rank	Country	Production
1	Saudi Arabia	10,665
2	Russia	9,677
3	United States	8,331
4	Iran	4,148
5	China	3,858
6	Mexico	3,707
7	Canada	3,288
8	United Arab Emirates	2,945
9	Venezuela	2,803
10	Norway	2,786
11	Kuwait	2,675
12	Nigeria	2,443
13	Brazil	2,166
14	Algeria	2,122
15	Iraq	2,008

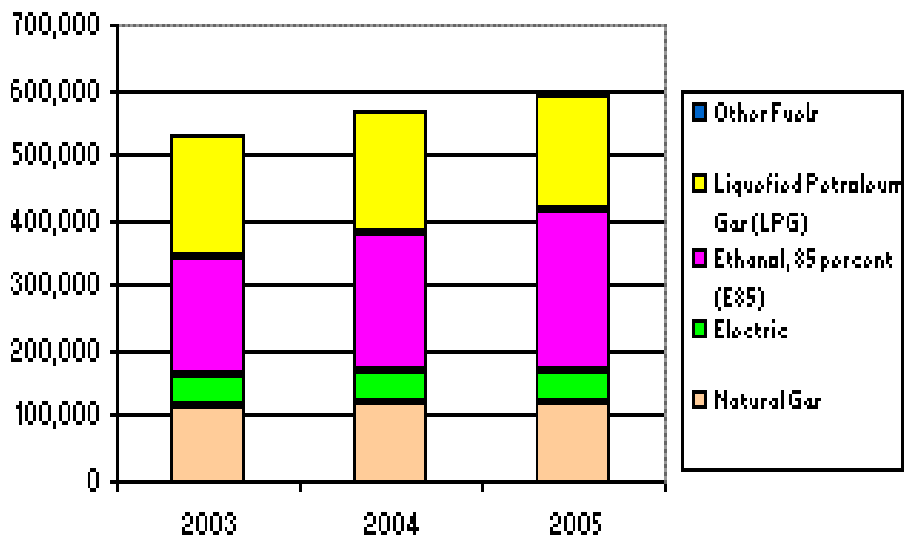
U.S. Energy Consumption by Fuel (1980-2030),
[Quadrillion Btus]



U.S. Carbon Dioxide Emissions
By sector and fuel for 2005 actual and 2030 projected
(million metric tons)



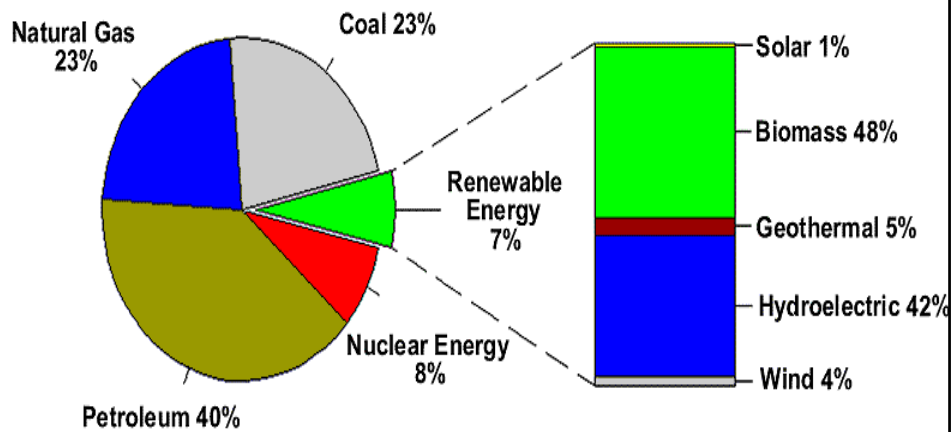
**Estimated Number of Alternative Fueled Vehicles
in Use in the U.S., 2003-2005 (EIA)**



The Role of Renewable Energy Consumption in the Nation's Energy Supply, 2006

Total = 99.960 Quadrillion Btu

Total = 6.844 Quadrillion Btu



Biomass (organic matter available on a recurring basis)

- Out of the small contribution of energy from renewable resources, biomass is the largest contributor in this category of renewable resources.
- Advancement in biomass technologies
 - Extensive training, education and research (for example, increased crop yields, new energy crops) improved conversion efficiency).
 - Collaborative efforts among industry, local, state and federal government (technical, market, and policy obstacles)
 - Communication and collaboration will overcome (appropriate mix of market incentives and public policy).

US Renewable Energy Profile 2006 and % Δ 2005-2006

Renewable Energy Consumption	Quadrillion Btu	Change 2005-2006 (Percent)
Total	6.844	6.9
Biomass	3.277	5.2
Biofuels	0.758	27.6
Waste	0.404	0.3
Wood Derived Fuels	2.114	-0.1
Geothermal Energy	0.349	1.8
Hydroelectric	2.890	6.9
Conventional		
Solar/ PV Energy	0.070	6.5
Wind Energy	0.258	45.1

Source: Energy Information Administration.

Drivers for biofuel production

- Economic (rural economic development)
- Environmental protection
- Political (National security; for every 10 barrels of oil produced domestically, the US imports 11)
- Energy Policies (2000, 2001, 2007 EISA)

Corn Grain Trade Pattern

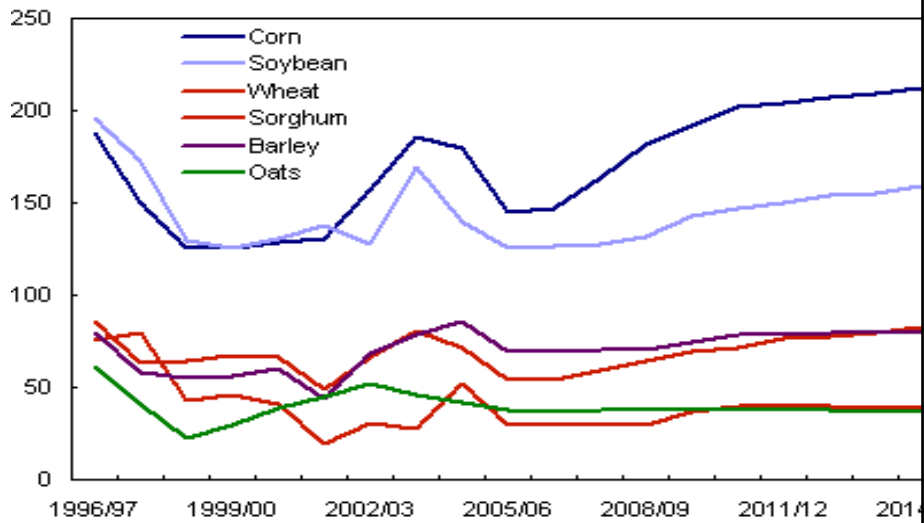
- Corn is the largest component of world coarse grain (corn, sorghum, barley, oats and rye) trade contributing about 75% of total volume.
- Most of the corn traded is used for feed; smaller amounts are traded for industrial and food uses. Processed-corn products and byproducts—including corn meal, flour, sweeteners, and corn gluten feed.
- Exports are significant for the U.S. corn industry -- exports averaging 21% of total use during the 1990s. Corn grain (excluding popcorn or sweet corn) accounted for an average of over 11% U.S. agricultural exports by value.

Corn Trade Pattern (Cont'd)

- The US is the world's dominant corn exporter, averaging 70% of world corn exports during the 1990s. U.S. corn exports soared in the 1970s from 13 million metric tons to a record 62 million in 1979/80 but dropped to 31 million metric tons in 1985/66/.
- In the second half of the 1980s, U.S. exports rebounded, reaching 60 million metric tons in 1989/90.
- In the 1990s exports declined again. During the 1990s and into the current decade, U.S. corn exports have varied because of China's inconsistent export policies, and production developments in Argentina

Net returns for various crops

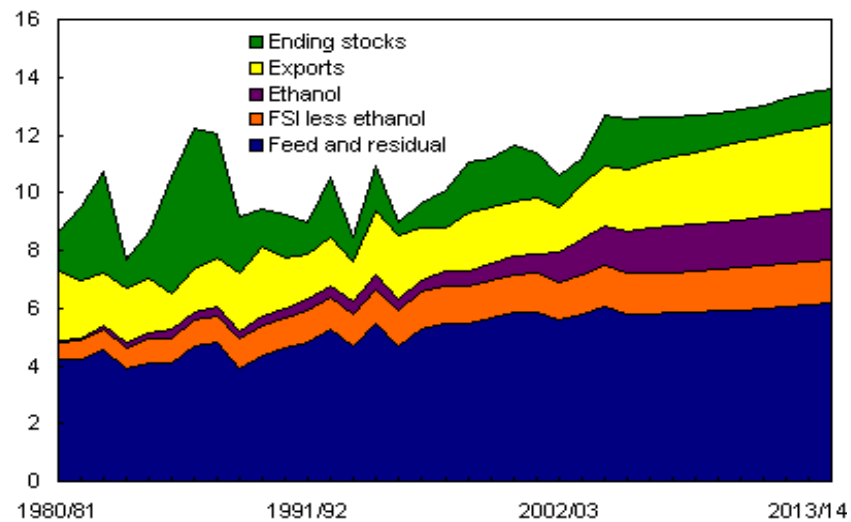
Dollars per acre



Source: *USDA Agricultural Baseline Projections to 2014*, February 2005.
Economic Research Service, USDA.

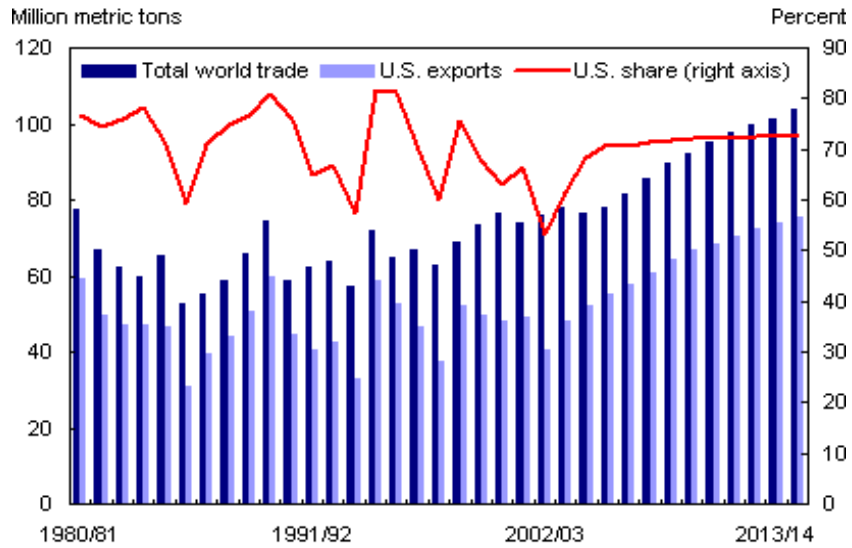
U.S. corn utilization

Billion bushels



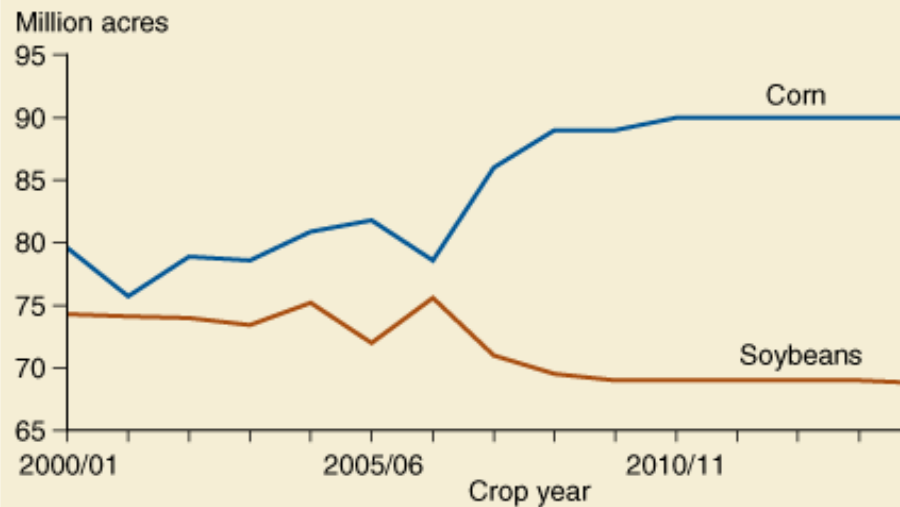
Source: *USDA Agricultural Baseline Projections to 2014*, February 2005.
Economic Research Service, USDA.

World and U.S. corn trade

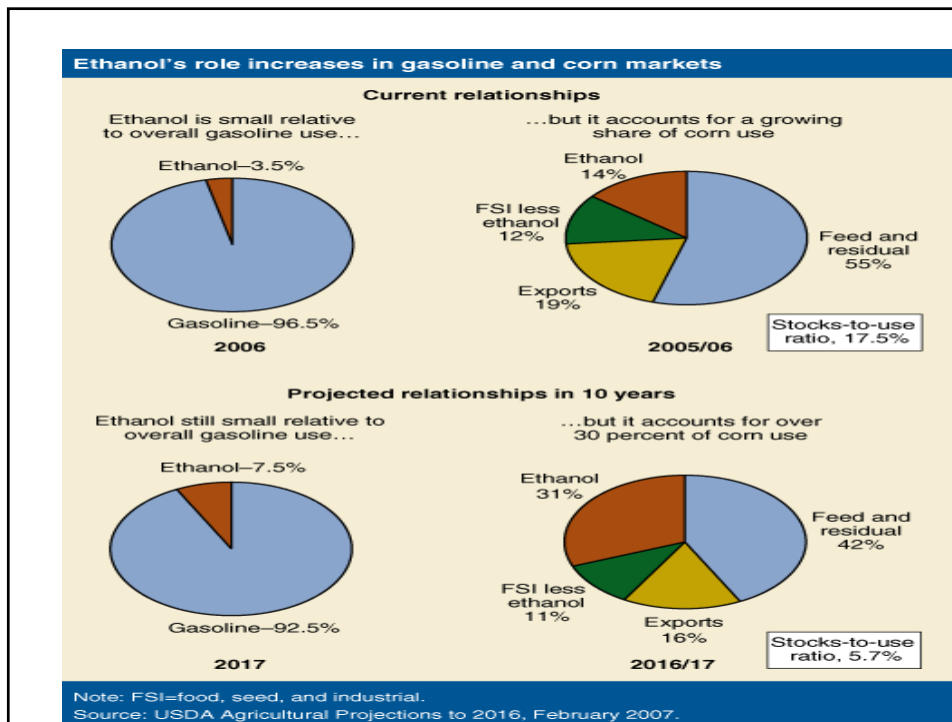


Source: *USDA Agricultural Baseline Projections to 2014*, February 2005.
Economic Research Service, USDA.

Corn and soybean projected plantings: Much of the corn area expansion comes from soybeans



Source: *USDA Agricultural Projections to 2016*. February 2007.

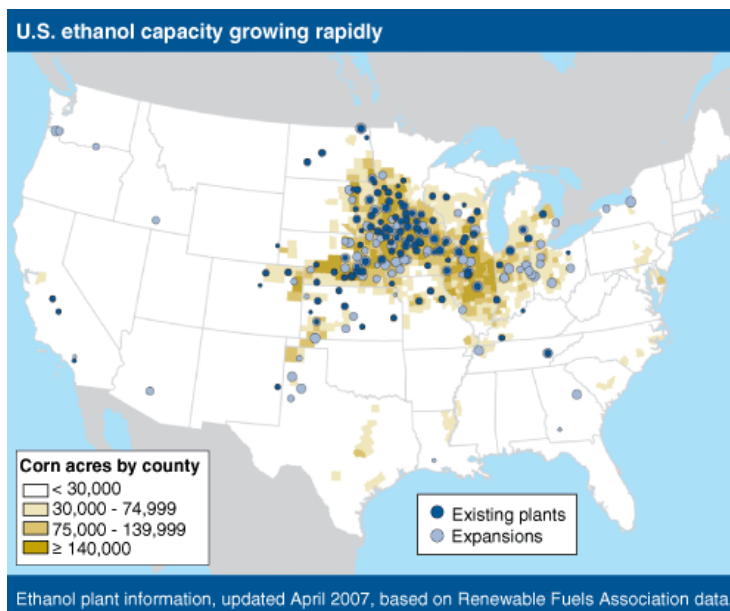


The Ethanol Industry: Background Information

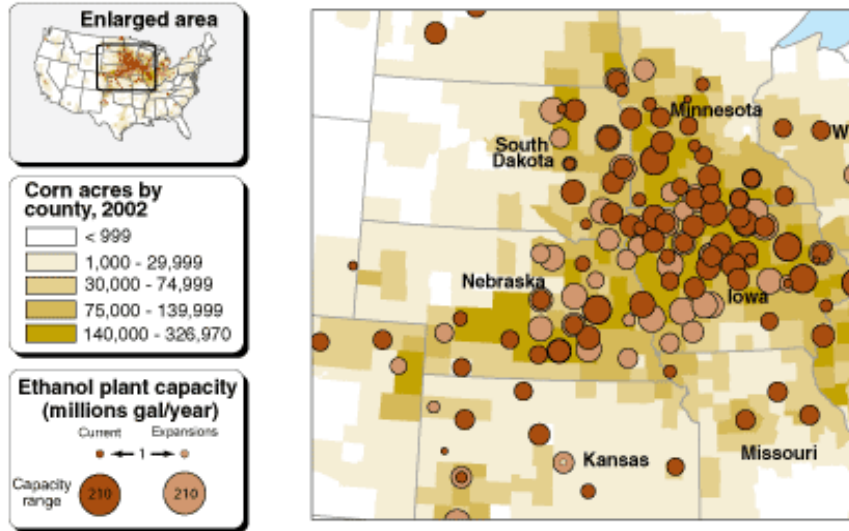
- Ethanol industry is quite heterogeneous
- Plants differ by size, type of technology, source of financing, traditional grain-processing experience, and diversification
- Growth: 20 m gals in 1979; 750 m gals in 1986; 4 billion gallons in 2005 to 5 billion gals in 2006.
- Between 1980 and 1986, cost of production ranged from \$1.40 - \$1.50/gal
- In 1986, a state-of-the-art plants should produce 60 - 90 million gals/year

Ethanol production in US

- US ethanol production increased to 5 billion gallons in 2006, 1 billion gallons more than in 2005
- Production expected to exceed 10 billion gallons in 2009
- In 2006, ethanol represented only 3.5% of US motor vehicle gasoline supplies market even though 14% of corn crop went into ethanol production
- By 2009-2010m this will increase to 30%

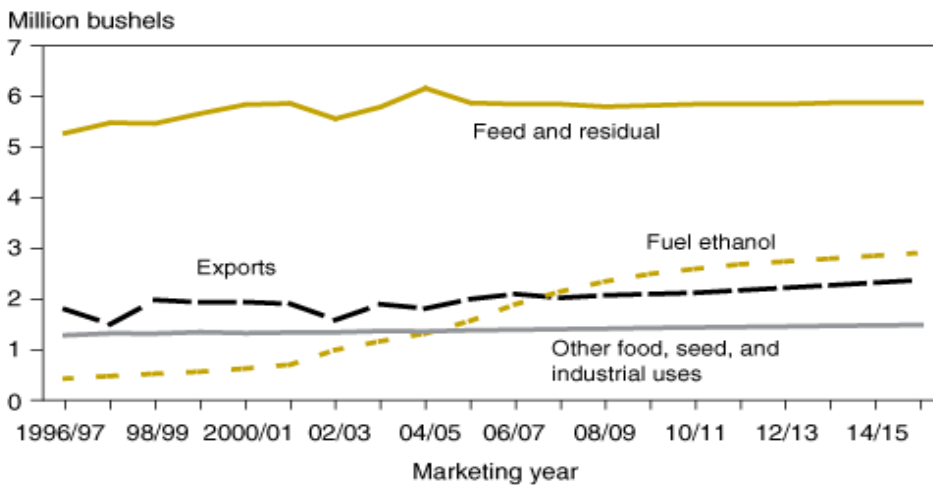


The U.S. ethanol sector is adding over 6 billion gallons to its ca



Sources: 2002 Census of Agriculture; Renewable Fuels Association and other industry sources.

USDA's projections suggest that corn use by ethanol producers will grow much faster than corn use by other industries



Note: Feed and residual corn use is calculated by subtracting the other three categories plus ending stocks from total supply. Thus, the term "residual" refers to a statistical residual. Corn used in ethanol production is accounted for in fuel alcohol use. Distillers grains, a coproduct of ethanol production, are not accounted for in the balance sheet for corn.

Source: USDA agricultural projections.

Issues Worth Thinking About

- Food security
- Social (benefits of the new economy)
- Environmental
- International Trade (how will countries react?)
 - Mexico capped tortilla prices in early 2007
 - Sugar prices hit a 10-year high in 2006 (with pressures on low-income families in Brazil)
 - Indonesian government increased export duties on crude palm oil in mid 2007 to curb rising cost of domestic cooking oil

The opportunity for bio-energy (and bio-products)

- 67% of the \$1.5 trillion global industrial chemicals and plastics businesses could be served by renewable feedstock
- Uses of bioenergy and bioproducts will be tripled by 2010 meeting the goal of creating \$15 – \$20 billion a year in new income for farmers and rural America
- Reduce greenhouse gases by about 100 million metric tons of Carbon (70 million cars off the road)
- Bioproducts will change the economics, policy and trade of agricultural commodities around the world (NRC reports that 50% of US fuels and 90% of organic chemicals will come from renewable resources by the turn of the century).
- Bioproducts industrial products will be a major source of economic growth in this century.

Bioenergy (Cont'd)

- By 2020, there will be a 10-fold increase in biobased products and bioenergy use will vastly increase US energy self-sufficiency
- By 2020, US would use 30 quadrillion Btus (quads) of primary energy for bioenergy and biobased products, enough to meet incremental demand growth for petroleum fuels and petrochemical products while keeping fossil fuel energy at current levels.
- Current primary energy consumption in the US is 96.6 quads, projected to be 127 quads.

Bioenergy Opportunities (Cont'd)

- Long period of sustained and expanded demand for agriculture
- Net far, income to reach \$180 billion from 2007 – 2025
- Opportunities for rural development
- \$15 billion – \$100 billion saving in government payments
- 59 billion gallon reduction in gasoline imports (\$150 billion)

More Prospects ...

- By 2025, American farms, forests and ranches can produce:
 - 86 billion gallons of ethanol
 - 1.1 billion gallons of biodiesel
 - 932 billion kwh of electricity
 - 15.45 quads of energy from biomass and wind energy
- (UT, 2007) Figures based on improved cellulosic ethanol to 89 gal/ton by 2025 and corn ethanol conversion to 3 gal/b by 2015).

Prospects for Bio-Energy

“By 2030, a well-established economically viable bioenergy (and biobased) products industry will create new economic opportunities for rural America, protect and enhance the environment, strengthen US energy independence, provide economic security, and deliver innovative products to the economy.” Vision for Bioenergy and Biobased Products in the United States, 2002.

Biobased Products and Bioenergy Roadmap

- 100 representatives of agriculture, industry, academia, national laboratories, government agencies, and other organizations
- Follow-up on earlier Biobased products and Bioenergy Vision
- Create an overarching executive-level plan for an integrated bioenergy and bioproducts industry. Benefits discussed.

Some Supporting Trends

- Rapid biotech progress (genomics, metabolic engineering, enzyme design, molecular evolution, computational biology and bioinformatics) will lead to multiplying biomass feedstock production, ethanol conversion efficiency and creating high-value bioproducts.
- Increasing potential of biobased products and bioenergy (alternatives to supplement petroleum-based products)
- Growing interest in distributed production
- Emerging technologies for efficient biorefineries

Energy intensity in U.S. agriculture has declined over time due to energy efficiency gains and changes in commodities produced, 1948-2002

Total farm output per unit of energy use (1996 = 1.0)



Source: USDA, Economic Research Service.

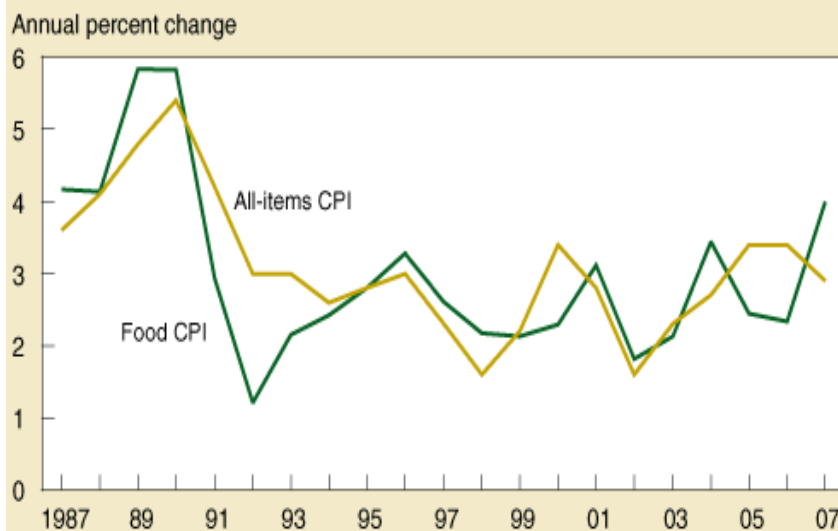
Critical Support Factors

- Supportive government policies
- R&D funding and capital investment
- Leadership
- Sustained federal support
- Federal coordination/integration
- Strategic partnerships
- Demonstration of life-cycle benefits
- Major educational efforts**
- Accelerated innovation and deployment
- Public outreach and marketing

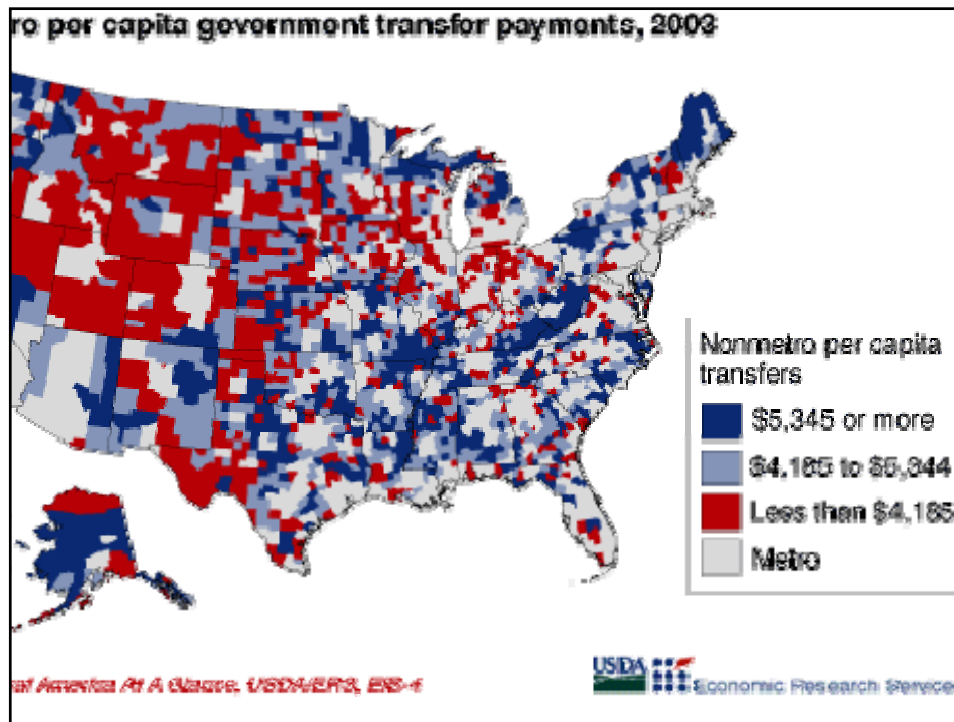
Conclusions – Impacts of Biofuel Production and Commercialization on Small/Medium farms

- Expanding ethanol market will boost farm incomes. Higher corn and soybean prices will generate higher total farm cash receipts over the next few decades
- Lower government payments under the current commodity programs
- Higher food prices (this is already happening!) could benefit small farmers, *ceteris paribus*
- Higher feed prices will lead to adjustments in livestock market to farmers' benefit.

Retail food prices increase 3 percent per year, on average



Source: ERS calculations using Bureau of Labor Statistics' Consumer Price Index data.



Conclusions (Cont'd)

- Growth of the ethanol industry has been a notable development in rural America since 2000. 75% of ethanol production plants are in nonmetro counties and are larger than existing plants.
- 70% of the nonmetro ethanol in operation are located in counties that declined in population from 2000 to 2006 (50% of all nonmetro counties lost population).
- Employment generated may not be high, but wages in are higher than local averages (average employment 35 jobs/plant). The plants are able to create jobs and income and are in areas that have been unable to retain population
- Some expected economic benefits for nonmetro areas
 - ▶ Increased market for local corn
 - ▶ Higher farmland values
 - ▶ Investment income from local ownership of some plants
- 80% of new plants under construction are in nonmetro counties.

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Questions?

THANKS.

***YOUR PRSENCE IS
APPRECIATED!***