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# **What Factors Will Determine the Choice of Future Biofuel Feedstocks?**

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# Today's Presentation: Setting the Stage for Second Generation Biofuels

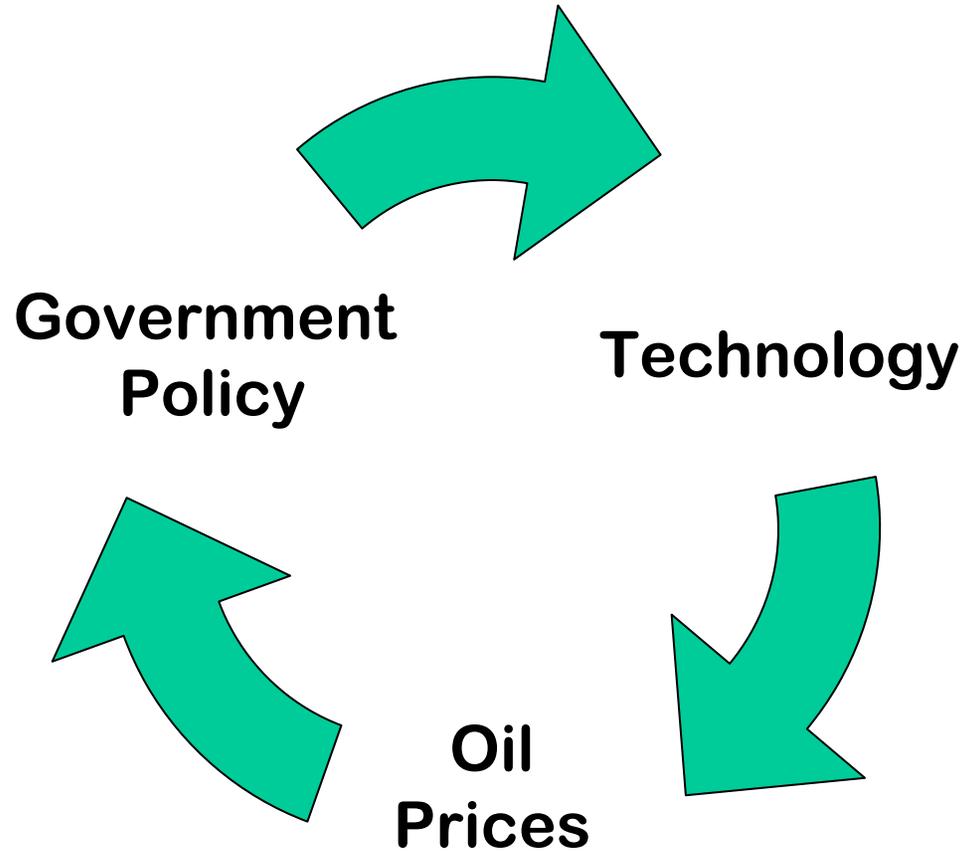
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- I. Examine “first generation” biofuels, mainly ethanol
  - Brief historical review
  - Key policies
  - Ethanol markets and economics
  
- II. Discern possible lessons for cellulosic fuels
  
- III. Identify risk factors

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# Underlying Drivers Shaping Biofuel Markets

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# Ethanol History Shaped by Markets and Policies

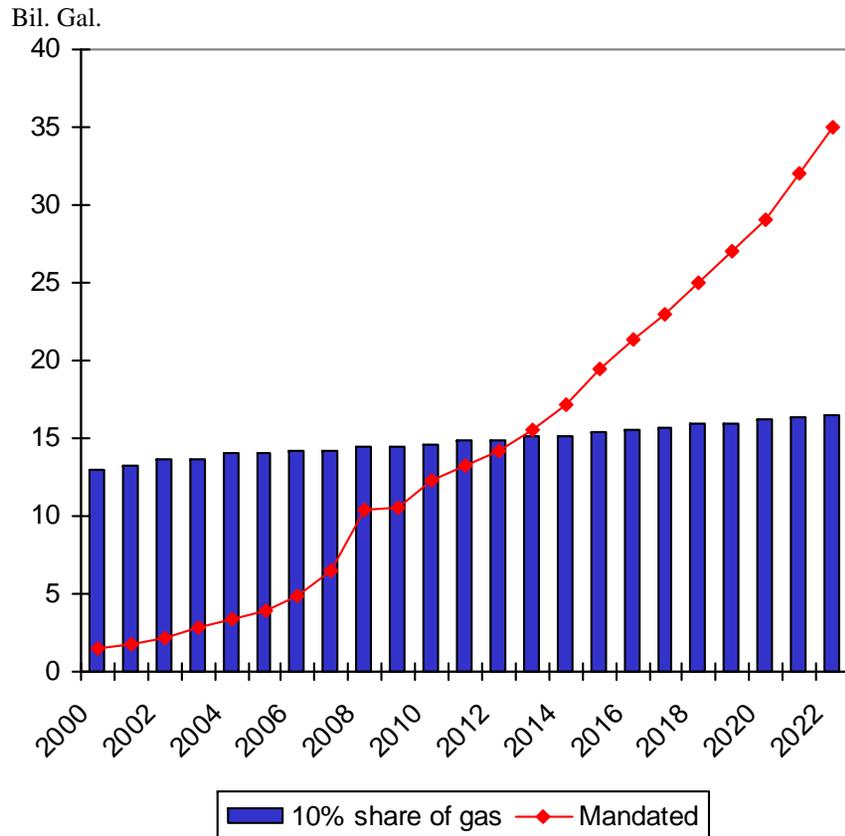
Recent Gains Reflect Shift in California, High Oil Prices, and 2005 Energy Bill

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- Early 1900s: Original fuel for the Ford Model T but could not compete with cheaper petroleum and lead additives for engine knock
- 1970's: reborn with rise of OPEC and spike in energy prices, along with formal government support (exemption from federal excise tax, import tariffs, and various State incentives)
- 1980s: fades as crude oil prices fall
- 1990s: limited role, mainly supported by clean air mandates for reformulated fuel, along with methyl tertiary butyl ether (MTBE), another oxygenate
- By 2004, California, the largest gasoline State, started to blend 5.7 percent ethanol after its request for a waiver from oxygenated fuel use was denied
- Smooth logistics of moving ethanol from the Midwest to a coastal State paved the way for further growth
- Prompted by soaring oil prices, the 2005 law mandated 7.5 bil. gal. by 2012, but more importantly, removed liability protection for MTBE, which polluted groundwater

# New Energy Bill Mandated Ethanol Use Will Exceed 10 Percent of Gasoline Use by 2013 \*

Ethanol at 10 Percent Gasoline Blend vs. Mandated Target



- New mandate rises to 35 billion gallons by 2022 \*
- Ten percent ethanol blend is maximum under current vehicle warranties
- U.S. gasoline use was 142 billion gallons in 2007
- Assumed annual future growth of 1.0 percent in gas use results in ethanol demand of 16 billion gallons by 2022, compared with 35 billion gallons mandated
- Additional ethanol use will have to come from flexible fuel (E-85) vehicles or change in engine warranties to allow higher than 10-percent blend

\* Assumes total renewable fuel mandate of 36 billion gallons minus 1 billion gallons for biodiesel

# Rise in Ethanol Price Triggered Investment Boom But Also Contributed to Higher Feedstock Prices and More Volatility

- Policy umbrella accompanied by dramatic spike in ethanol price unleashed a flood of investments
- The surge in ‘green’ investments and venture capital has also been accompanied by investor and speculative buying of commodities as an asset class
- Volatility in crop markets has increased sharply, also reflecting global tightness in wheat and robust demand for food because of strong income growth

Monthly Ethanol Prices  
Jan. 2000-Jan. 2008  
Nebraska Rack





# Ethanol Margins Slipped This Fall But Generally Remained Positive

Corn Cash Price DTN National Index  
Monthly Average, Aug 2006-Jan 2008



Estimated Ethanol Monthly Margins  
Aug 2006-Jan 2008





# Biodiesel Margins Fall Sharply as Soybean Oil Prices Soar

Soybean Oil Price CBT Adjusted for Basis  
Aug 2006-Feb 2008



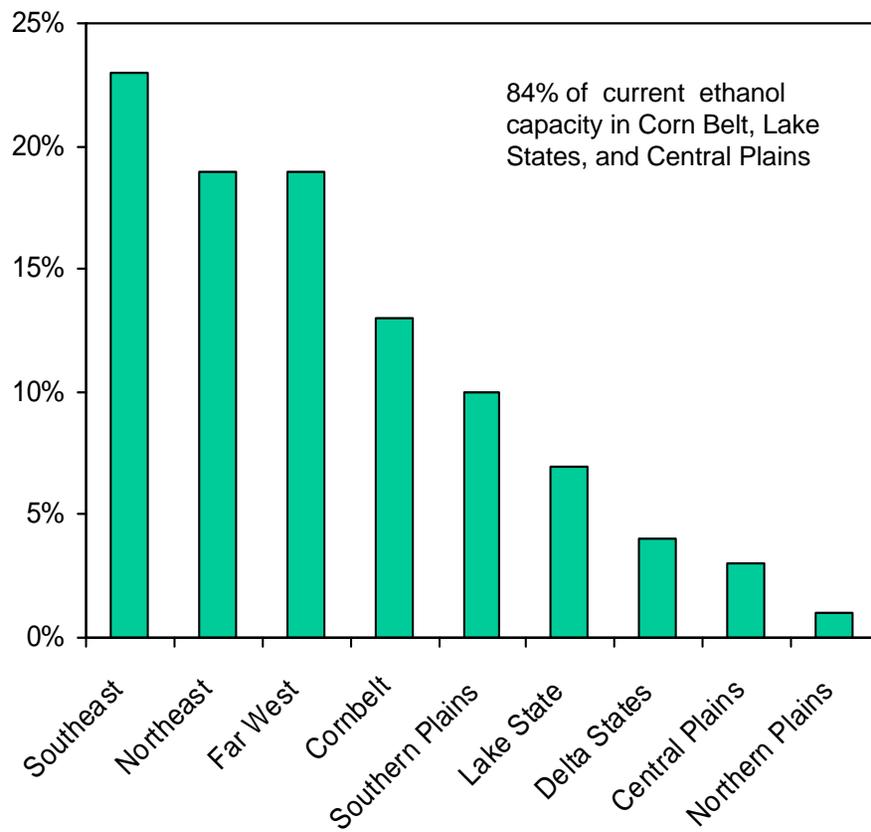
Estimated Biodiesel Margins  
Discretionary Market



# Location is One Disadvantage for Corn Ethanol

## Potential Cellulosic Feedstocks Closer to Fuel Demand

Share of Gasoline Use  
by Agricultural Regions

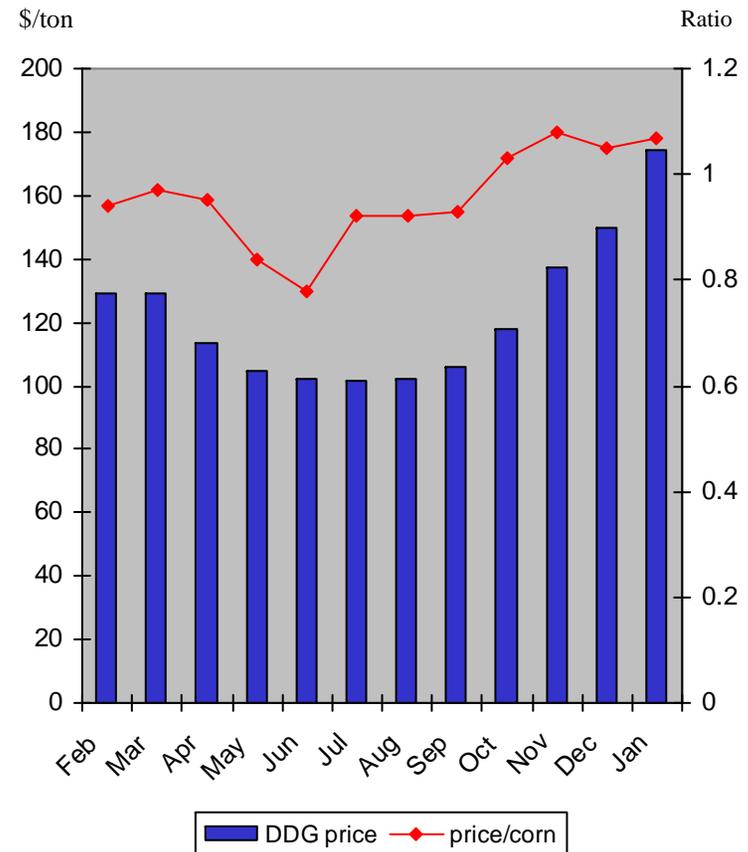


- California is the largest gas-consuming state, followed by Texas, Florida, and NY
- Only 2 Corn Belt states in the top ten: Illinois fifth and Ohio sixth
- Largest demand is in Southeast, Northeast, and West and augurs well for alternative feed stocks, given long distances and lack of pipelines to move ethanol from Midwest to coasts
- However, decentralized alternatives must be weighed against economies of scale issues

# Plants Can Afford High Corn Prices If Ethanol Price Stays High Enough

- At current corn price of \$4.75 per bushel and \$2.20 ethanol price, margins are about \$0.35 a gallon
- At ethanol price of \$2.20 per gallon, estimated breakeven point is \$5.95 per bushel
- At \$4.75 corn, breakeven price of ethanol price is \$1.86
- Revenue from distillers grain by-products is significant
- Distillers prices have been rising in tandem with corn—lower DDG prices could weaken margins
- Plants have potential to tap corn oil as another revenue source if vegetable oil prices stay high

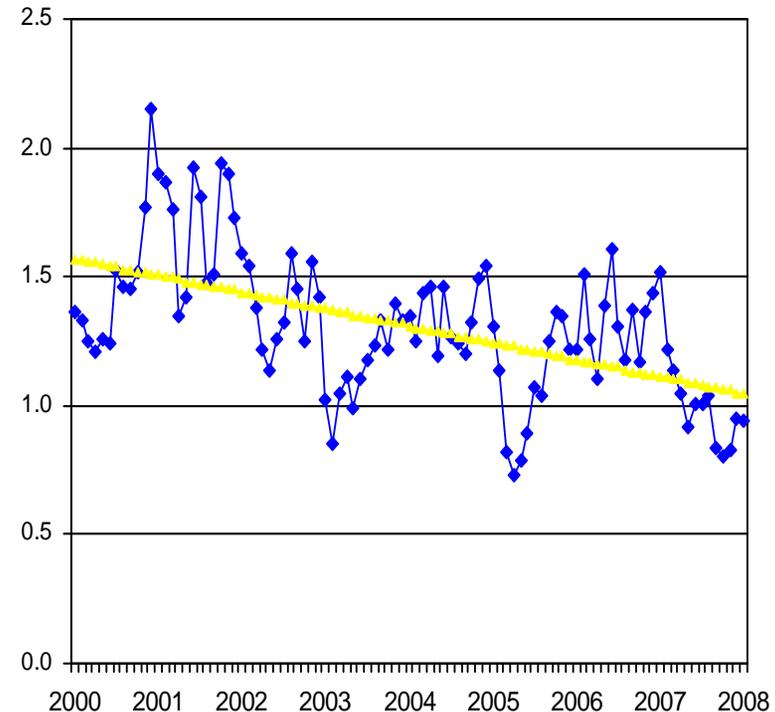
DDG Price and Price Relative to Corn  
Last 12 Months



# Ethanol's Price Premium to Gasoline Is Shrinking

- With production well over mandated use, falling prices in 2007 stimulated more discretionary blending
- Huge near-term expansion of ethanol production and infrastructure limitations may lead to a buyers market, at least temporarily
- Price is also influenced by mandates and regional supply/demand imbalances
- If ethanol consistently gets priced at discount to gas, margins could turn negative, especially in a weaker oil market

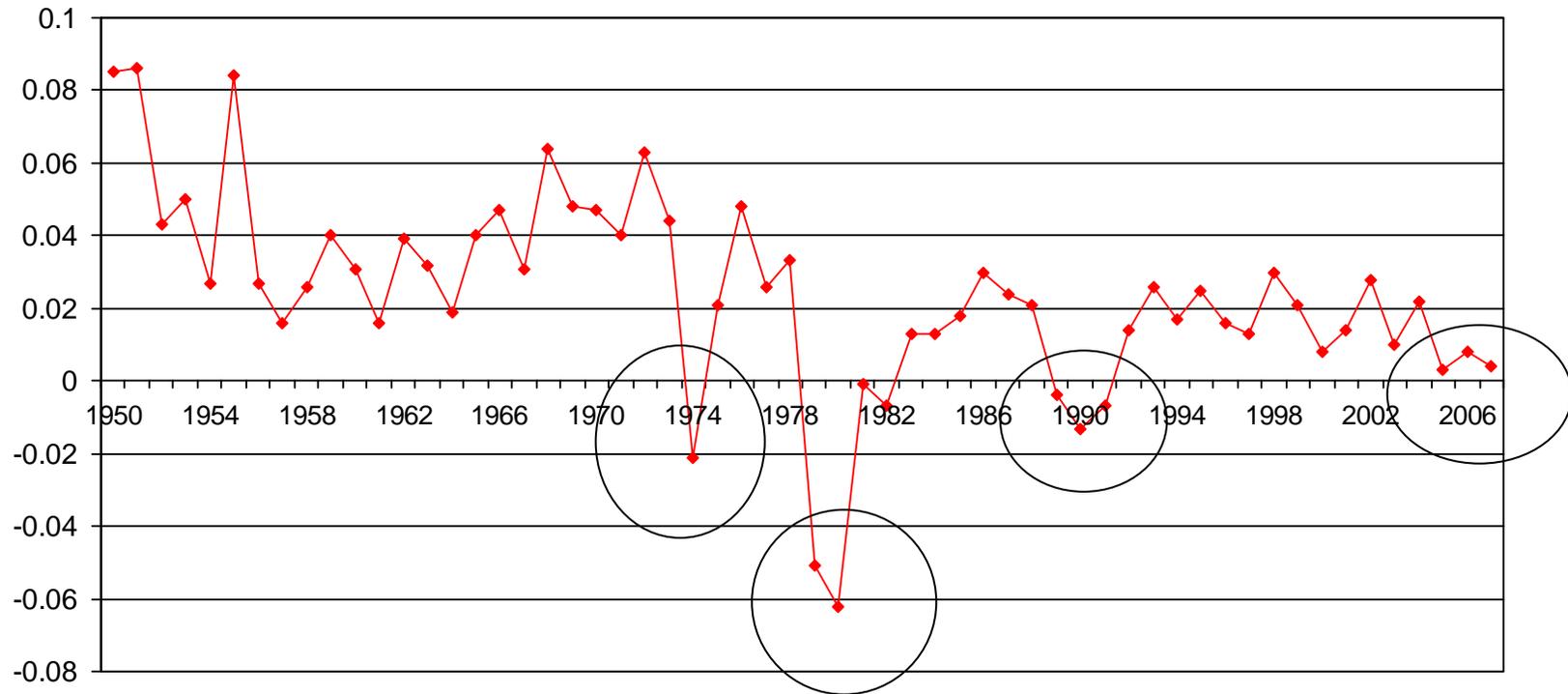
Ratio of Ethanol to Gas Price  
Monthly Jan. 2000-Jan. 2008  
Nebraska Rack



# Weak Economic Growth Slows Energy Demand

## High Prices Tend to Slow Gasoline Use

Annual Growth in U.S. Gasoline Use, 1950-2007



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# Advantages of Using Corn As a Feedstock For Ethanol

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- Corn has a record of strong productivity gains due to huge investment in genetics and equipment, now mostly by private sector
- Investment incentives for private sector research: huge acreage, annual purchase of hybrid seed and other inputs, technology boost to margins, and frequent equipment upgrades
- Unrivalled harvesting, storage, and distribution system
- Established grades and standards, end-user familiarity, and massive economies of scale
- Pricing and risk management system for producers and end-users
- Just-in-time delivery model—little or no storage costs for corn
- Corn Belt plants have abundant local supplies while unit trains can supply non-Corn Belt plants

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# What Factors Will Make New Feedstocks Commercially Viable?

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- Assured feedstock supply: need to attract growers for the energy crop or guarantee a reliable flow of other biomass
- Efficient logistics for harvesting, delivery, and storage
- Develop a market with price discovery and risk management or provide alternatives such as contracting
- By-product to generate additional revenue or to trim costs, such as burning the by-product to help power the plant
- Profit opportunities for plants to attract investment
- Avoid running up the price--like soybean oil--to make biofuel production uneconomic
- Allow startup time to build feedstock supplies

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# Biofuel Risk Factors: Oil Prices

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Current outlook is uncertain: expectations for weaker economic growth are counterbalanced by geopolitical concerns and speculative price push

- A decline in oil prices will likely mean lower ethanol prices
- As recently as 1998, oil fell to \$10 barrel in the wake of the Asian financial crisis.
- Demand Side Wildcards
  - Consumer squeeze/recession
  - More conservation
  - Vehicle technology/mpg improvements
- Supply Side Wildcards
  - Lagged response to strong price signals begins to increase supply
  - Calming of political hot spots
  - Blockbuster new energy discoveries

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# Biofuel Risk Factors: Government Policy

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- Response to changing markets could lead to unknown policy change
- 2005 Energy Bill only lasted 27 months
- What if the policy criteria or objectives change?
  - More focus on water use
  - Refine carbon rules
  - View of energy independence widened to include fertilizer
  - Restrictions on land use
- If ethanol import tariff expires on schedule (Jan. 1, 2009), cheaper imports from Brazil could compete in coastal markets
- Pressure mounts from higher food costs
- Subsidy and/or mandate adjustments

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# Biofuel Risk Factors: Technology

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- Unpredictable developments can change the game: for example, the DVD makes the videocassette obsolete or cell phones do an end-around land-line phones
- Competing fuels breakthroughs:
  - Improved engine performance for diesel, and more substitution for gasoline, as in Europe
  - Plug-in hybrids drawing from the electric grid
  - Improvements in battery technology
  - Butanol
  - Fuel cells/hydrogen vehicles

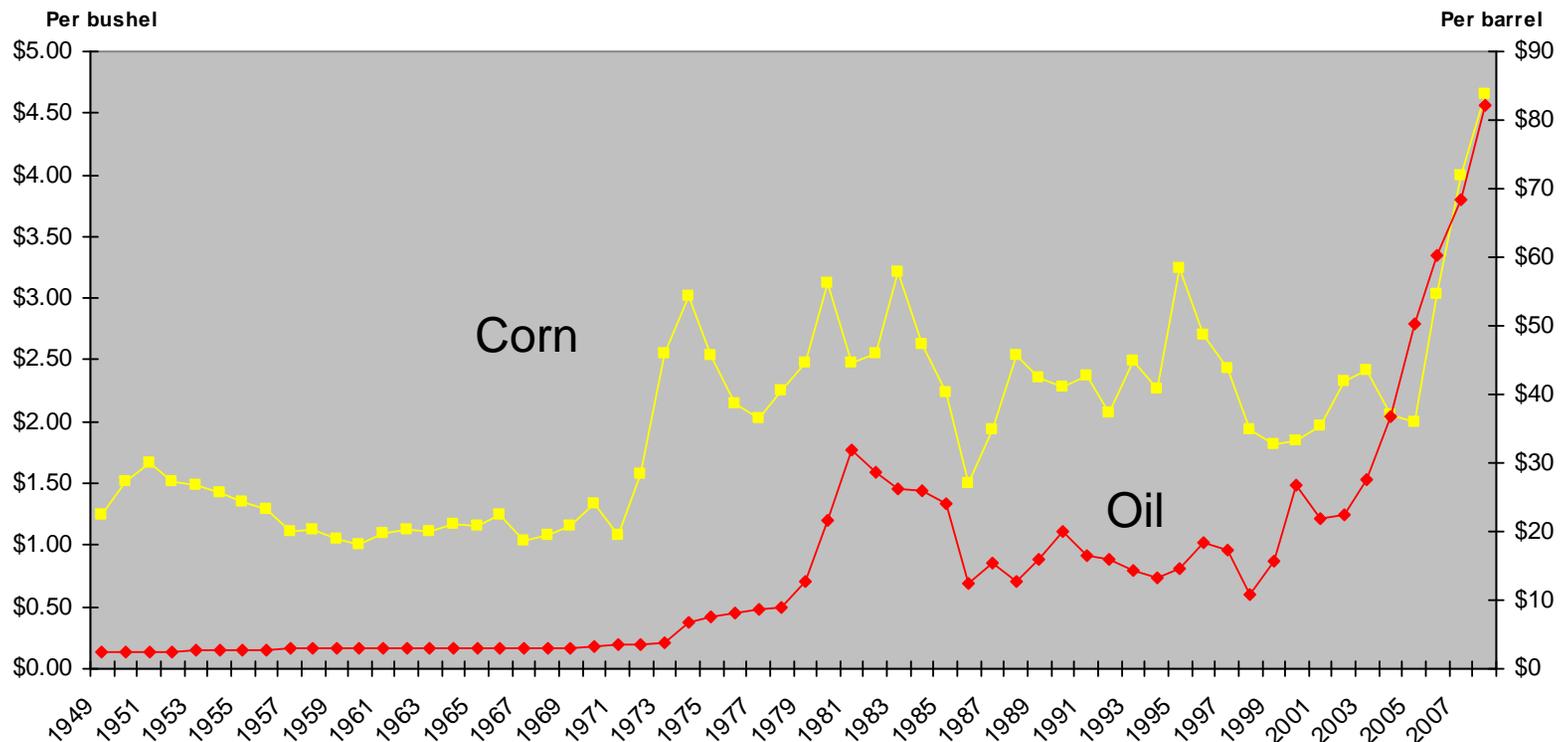
# Appendix

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# Until Recently, Agricultural and Energy Prices Had Virtually No Relationship in Post-WWII Era

Crude Oil Price vs. Corn Price, 1949-2008F





# 2007 Energy Bill Raises the Mandate “Advanced” Biofuels to Augment and Then Surpass Corn

Applicable Volumes of Renewable Fuel (Billions of Gallons)

Calendar Year	Non Corn Starch Ethanol, Biogas, Butanol, Biomass	+Biodiesel	+ Cellulosic Biofuel	= Total Advanced Biofuels	+ Corn Starch Ethanol	=Total Renewable Fuel
2009	?	0.5		0.6	10.5	11.1
2010	?	0.65	0.1	0.95	12	12.95
2011	?	0.80	0.25	1.35	12.6	13.95
2012	?	1.0	0.5	2.0	13.2	15.2
2013	?	?	1.0	2.75	13.8	16.55
2014	?	?	1.75	3.75	14.4	18.15
2015	Secretaries of Energy and Agriculture will determine applicable volumes for calendar years not specified in the table.	?	3.0	5.5	15.0	20.5
2016		?	4.25	7.25	15.0	22.25
2017		?	5.5	9.0	15.0	24.0
2018		?	?	7.0	11.0	15.0
2019	?	?	8.5	13.0	15.0	28.0
2020	?	?	10.5	15.0	15.0	30.0
2021	?	?	13.5	18.0	15.0	33.0
2022	?	?	16.0	21.0	15.0	36.0



# New Energy Bill Raises Renewable Fuel Mandate for Corn-Starch Ethanol

New Mandate vs. USDA Long-Term Ethanol Baseline Projections (Pre-Energy Bill)

