Food vs Fuel?
Language, Ethics, and Context in the U.S. Ethanol Debate

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Representation of Corn Ethanol in Popular Discourse

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Romney Tours Iowa State Ethanol Research Facility

Presidential Hopeful Discusses Iraq, Jobs

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AMES, Iowa -- The future of the nation's energy was a big topic as presidential hopeful and former Massachusetts Gov. Mitt Romney toured an ethanol research facility in Ames.

He received a lesson on what Iowa State University is doing in the area of renewable fuels and what those fuels can be used for and ways to increase the ethanol production.

Director Larry Jones took Romney through the Center for Crops Utilization Research. Jones showed him a toilet seat made of soy.

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Ethanol In

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Talk E

By Jon
October

(Fortune

Ethyl alc
of ripping ethanol subsidies as corporate pork for agribusi

McCain has argued that government support for ethanol a
raises gasoline prices. He has claimed ethanol does noth
make the U.S. more energy independent. He has even qu
the science behind making fuel from corn - contending tha
provides less energy than the fossil fuels consumed to pro

Putting ethanol in the fast lane

Those may be reasonable positions for a senator from a n
state like Arizona. They may even fly for a presidential ca
running as a straight-shooting maverick, as McCain did in

But for a front-runner - one presumably interested in getting his as-yet-undeclared 2008 Republican presidential campaign off to a winning start - opposing ethanol is political lunacy.

Iowa, home to the first-in-the-nation presidential caucus, is the biggest corn-growing state in the country, and in Iowa ethanol isn't just another campaign issue. It's the cash cow, the golden goose and the fountain of economic youth all wrapped up in one.

tough when it comes to Ethanol and possible price fixing. Following on the heals of President George W Bush's state of the union address where not only was Ethanol mentioned but a host of other alternative energies, Gov Rod Blagojevich and U.S. Senator Barack Obama are asking for an investigation into possible price fixing on E85 fuel.

While citing growth in Illinois since 2004 (86 new fueling stations) Rod criticized the placement of them as most stations are far from the most dense populations. Apparently the rules are so strict for franchise gas stations that selling E85 is very difficult process.

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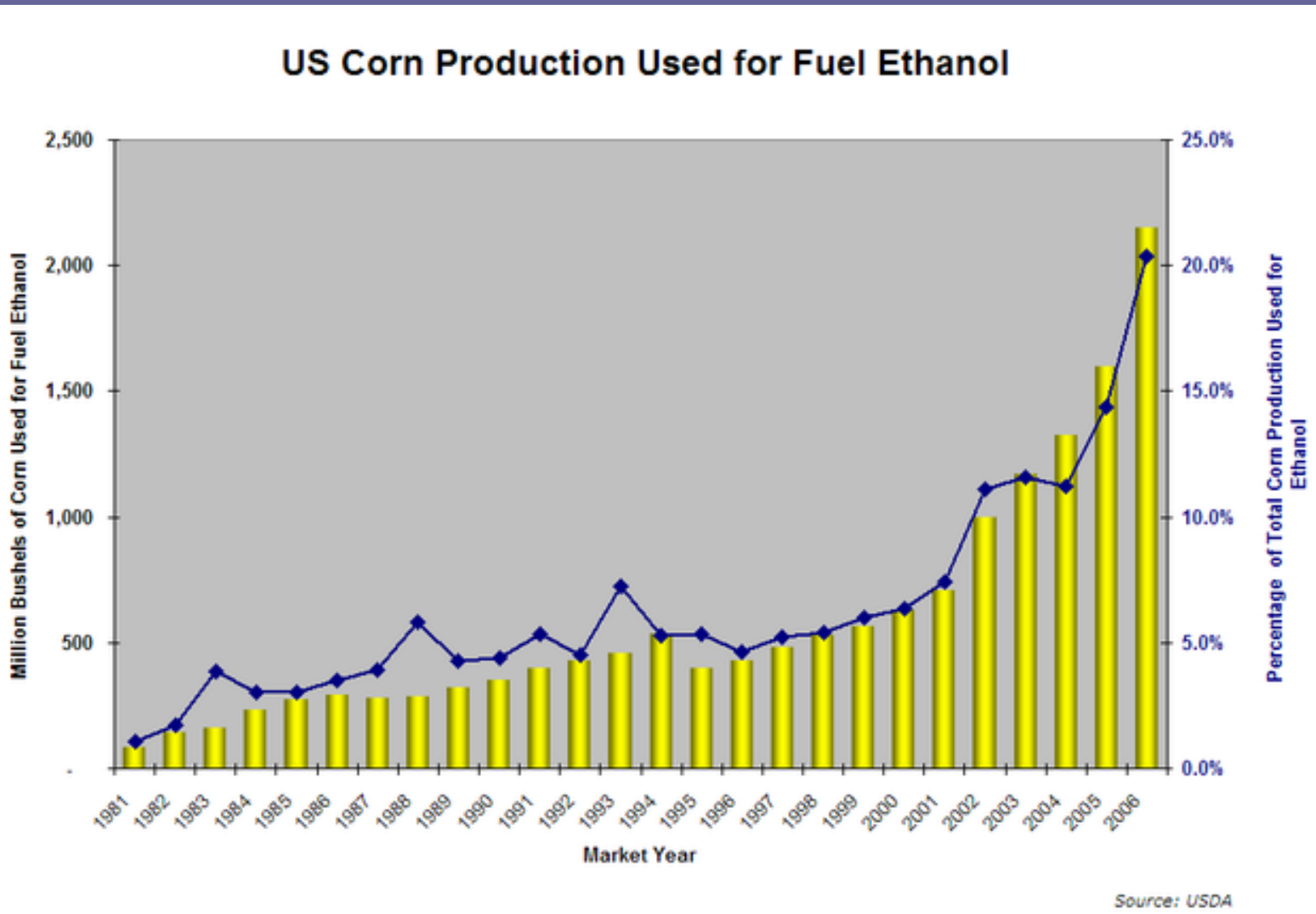
te John
s plans by
anol in the

ould force oil
stall ethanol pumps at a quarter of their service stations
makers to build cars that can run on biofuels.

boost the use of ethanol, currently made mostly in the
m corn, should appeal to voting farmers in Iowa, which


US Corn Production Used for Fuel Ethanol
Million Bushels of Corn Used for Fuel Ethanol
2,500
2,000
1,500
1,000
500
-
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Percentage of Total Corn Production Used for Ethanol
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
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1997
1998
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2000
2001
2002
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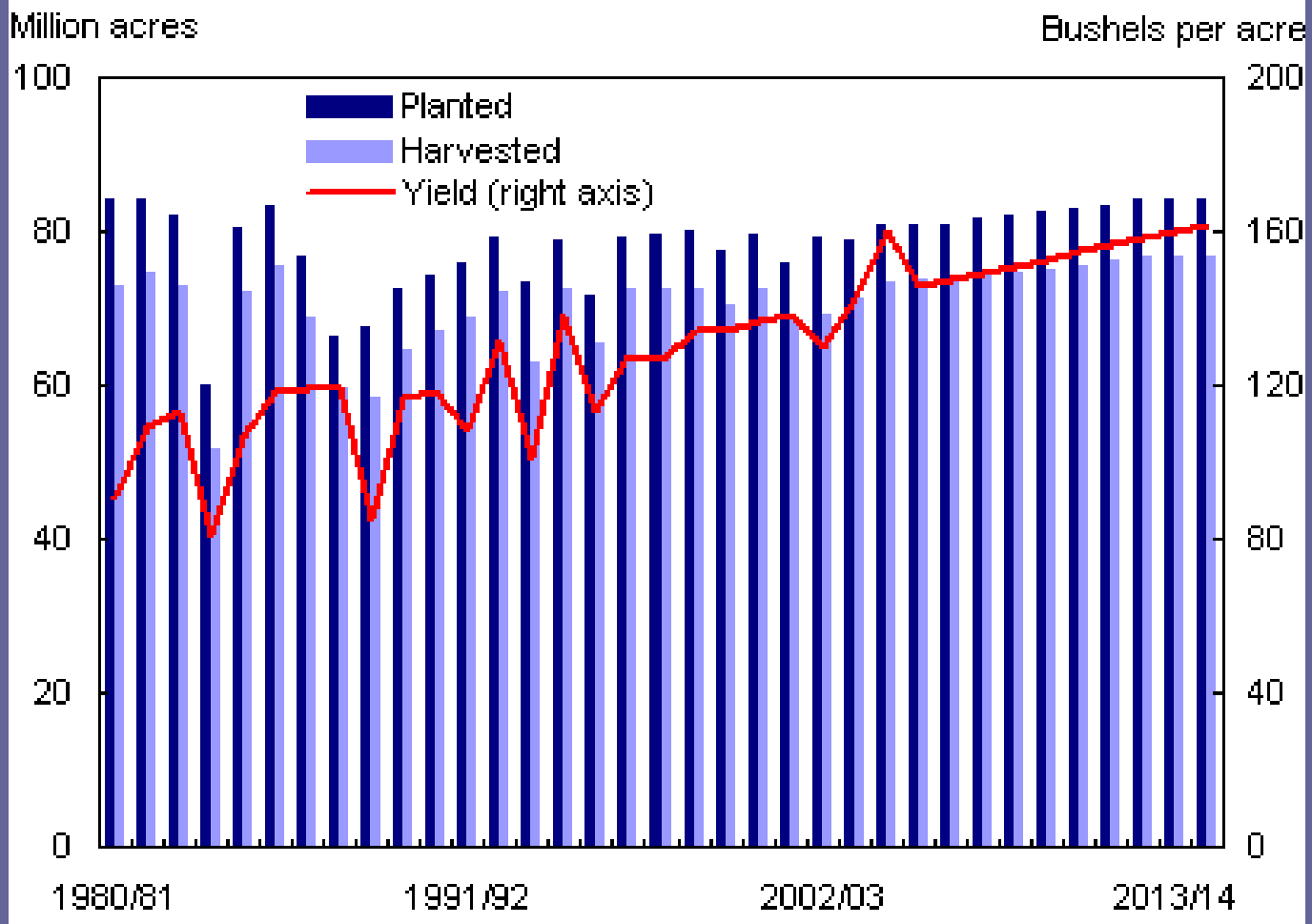
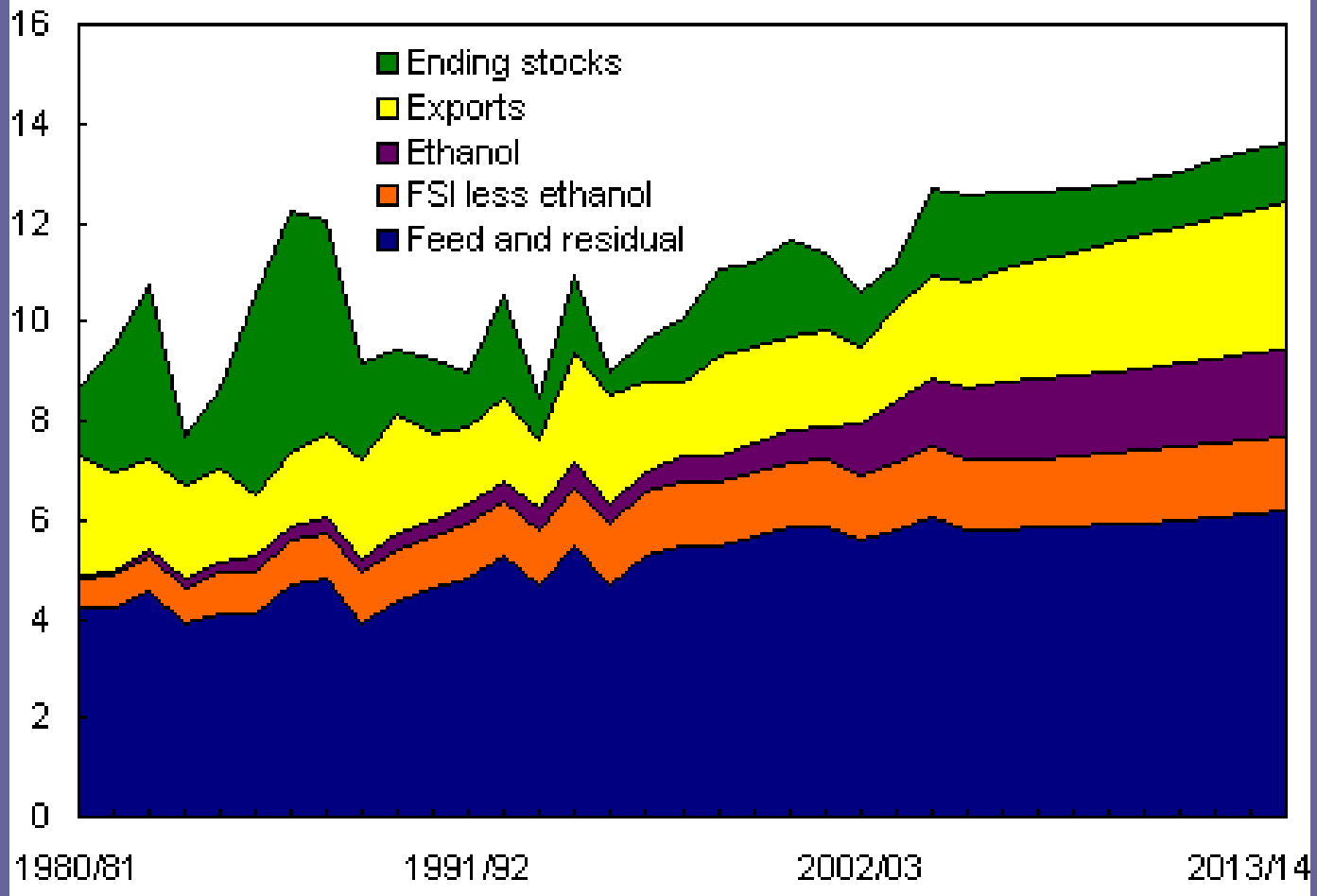
2005
2006
Market Year
Source: USDA

U.S. corn area and yield



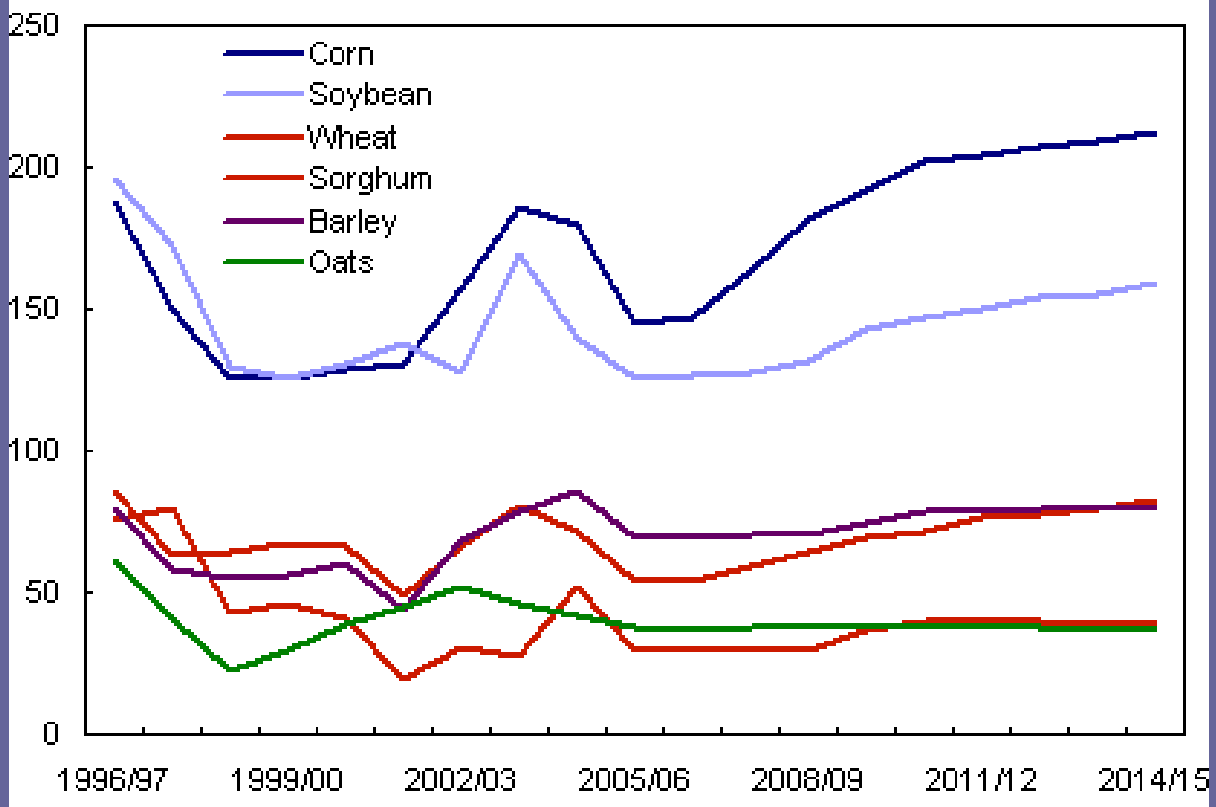
Source: *USDA Agricultural Baseline Projections to 2014*, February 2005.
Economic Research Service, USDA.

U.S. corn utilization



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

Net returns for various crops



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

Agricultural Economics

"Increased feed demand and increased ethanol demand translate into higher expected futures prices for both corn and soybeans… Current market signals indicate that the market wants corn acres more than soybean acres. If this trend continues, expect Iowa corn acreage to grow, Iowa soybean acreage to decline, and the proportion of Iowa acreage enrolled in the Conservation Reserve Program to shrink." (Hart 2006)

Subsidies and Mandates

- Energy Policy Act of 2005 mandates 7.5 billion gallons of “renewable” fuel by 2012
  - Being filled almost entirely by ethanol
- Tariff of $0.54 on imported ethanol
- Volumetric Ethanol Excise Tax Credit provides a tax credit of $0.51 for every gallon of ethanol blended into gasoline
  - E85, which is 85% ethanol, receives a tax credit of $0.43.

Is corn ethanol really:

- Renewable?
- Sustainable?
  - Air
  - Water
  - Soil
  - Socially
  - Economically
- Capable of producing energy independence?
- Worthy of high government subsidies?

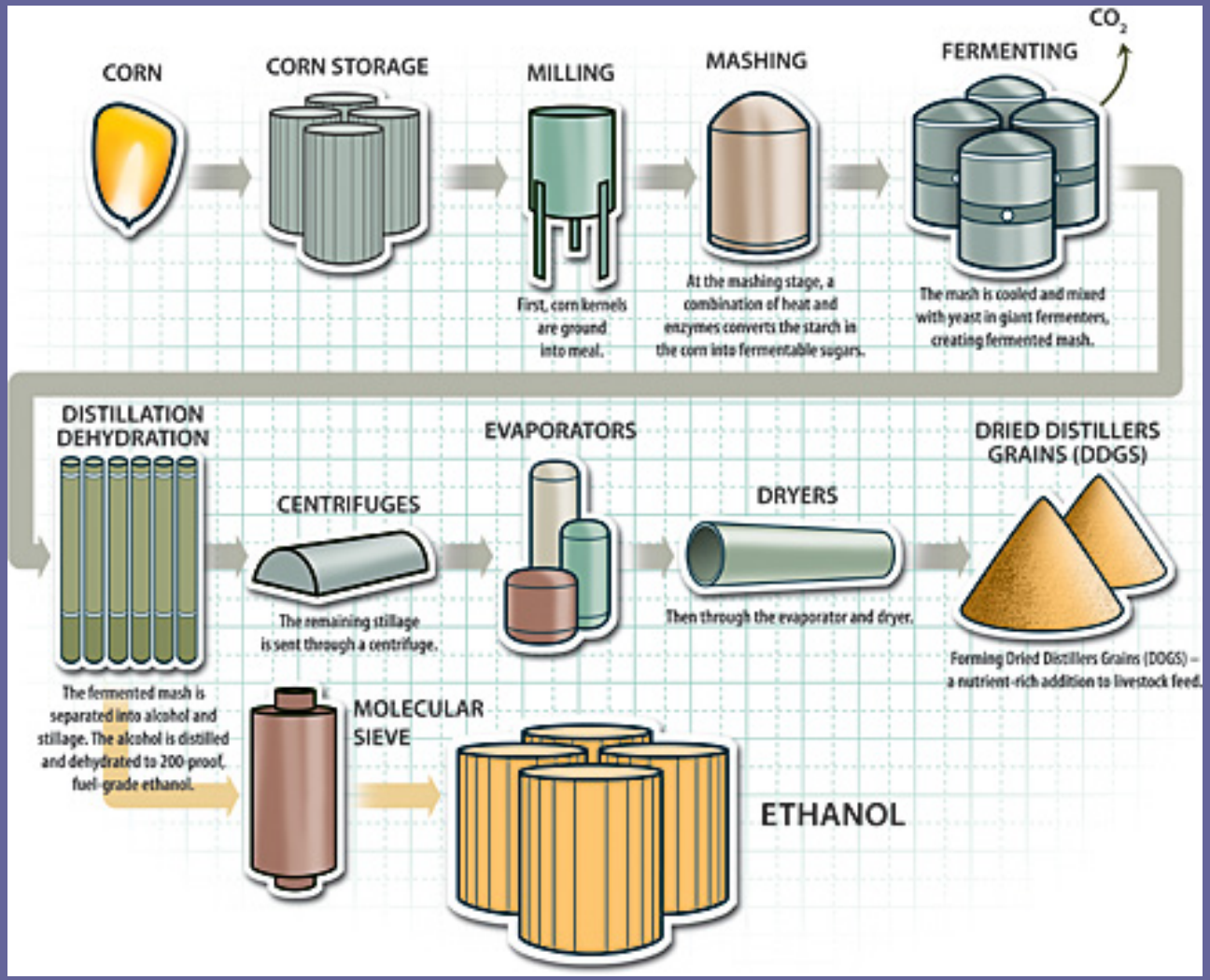
A review of recent literature indicates that answers depends on

1) How terms are defined
2) Where system boundaries are drawn
3) What variables are measured
4) Who is defining, drawing, and measuring

Inputs to corn agriculture

- Fertilizers
  - Nitrogen
    - Natural gas through Haber-Bosch process
  - Phosphorus (Phosphate mines)
    - 25 years reserve (present technology)
    - 100 – 400 years base reserve (new technology and/or higher energy extraction) (Roberts and Stewart 2002)
  - Potassium
  - Lime
- Herbicides
- Pesticides
- Farm equipment
- Hybrid seed production
- Irrigation water
- Labor
- Transportation
- Topsoil

Ethanol Manufacturing

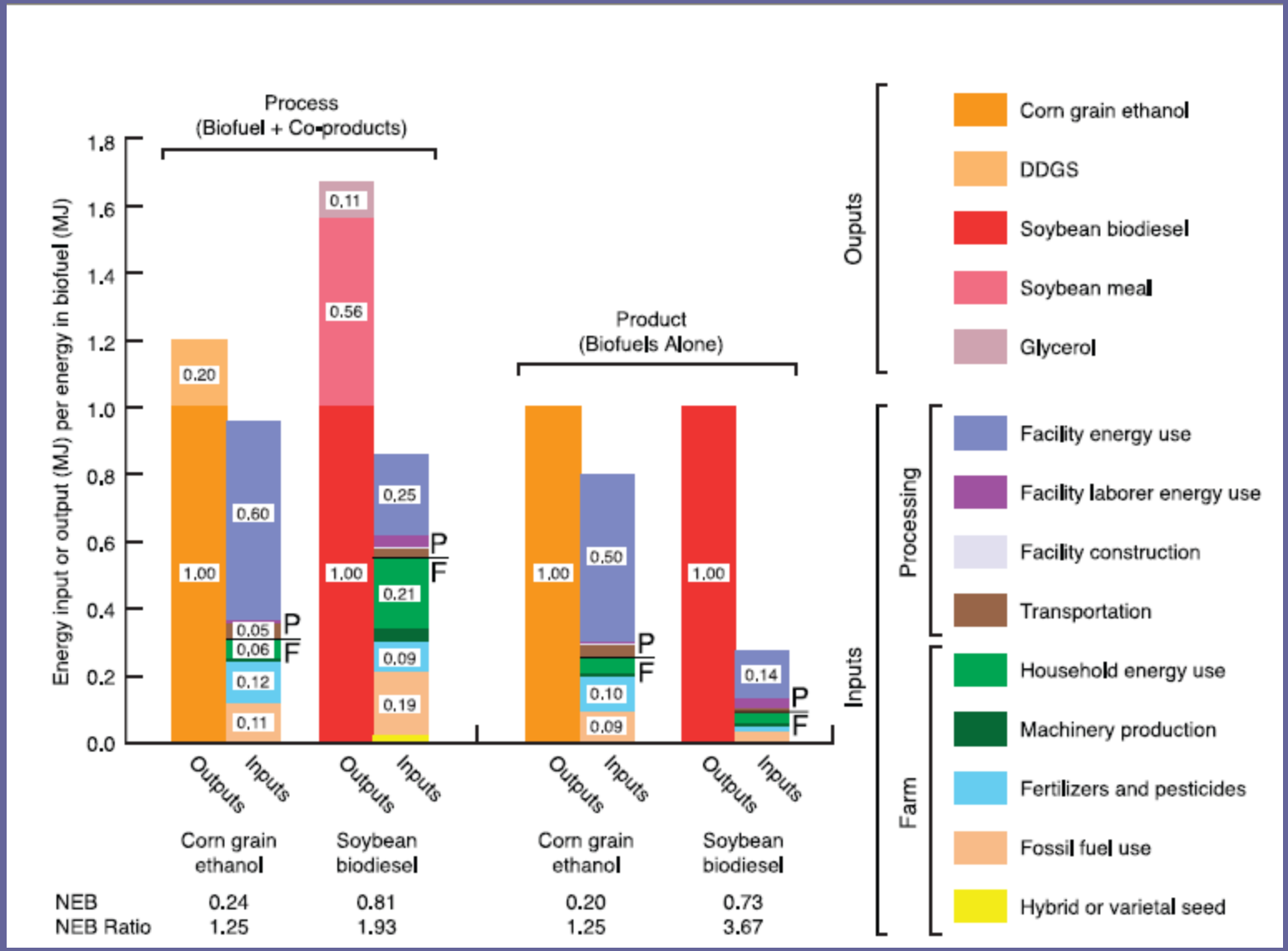


http://www.verasun.com/images/content/process.jpg

Life Cycle Analysis

- Equivalent energy values assigned to all inputs and outputs
- Net energy benefit (NEB) ratio =

  Ethanol energy output / Nonrenewable input
- Often presented with and without energy equivalence of ethanol “co-products,” such as distiller’s dry grain, in output calculations



Ethanol (and biodiesel) energy balance graph in Hill et al. (2006)

Study	NEB Ratio (including co-products)	NEB Ratio (only biofuel)
Marland and Turhollow (1991)	1.29	1.14
Lorenz and Morris (1995)	1.65	1.07
Grabowski (2002)	1.38	1.09
Shapouri et al. (2002)	1.38	1.14
Pimentel and Patzek (2005)	.84 (loss of 16%)	.78 (loss of 22%)
Kim and Dale (2005)	1.63	1.22
Hill et al. (2006)	1.25	1.25

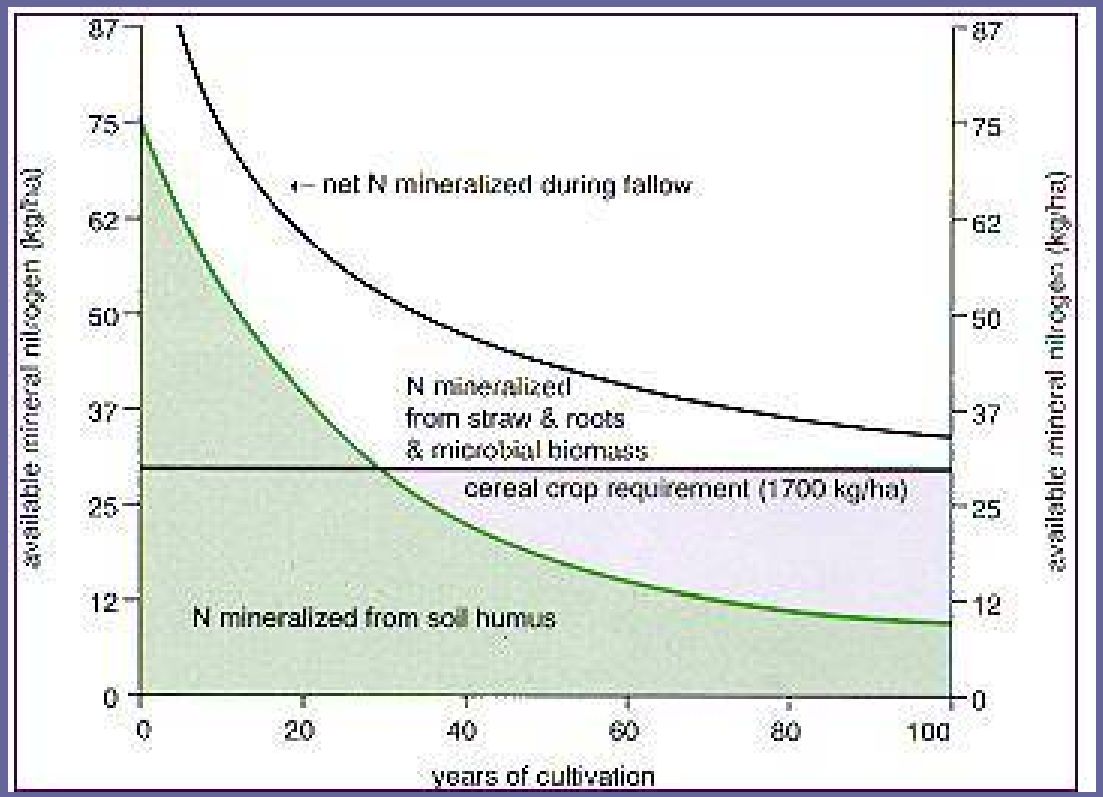
With the exception of Hill et al. (2006), all calculations based upon data presented in Hammerschlag (2006).

Greenhouse gas emissions

Study	Emissions change
Ulgiati (2001)	Reduce: 21%
Kim and Dale (2005)	Reduce: 41 – 61% (no till)
Hill et al. (2006)	Reduce: 12%
Patzek (2004)	Increase: 31%

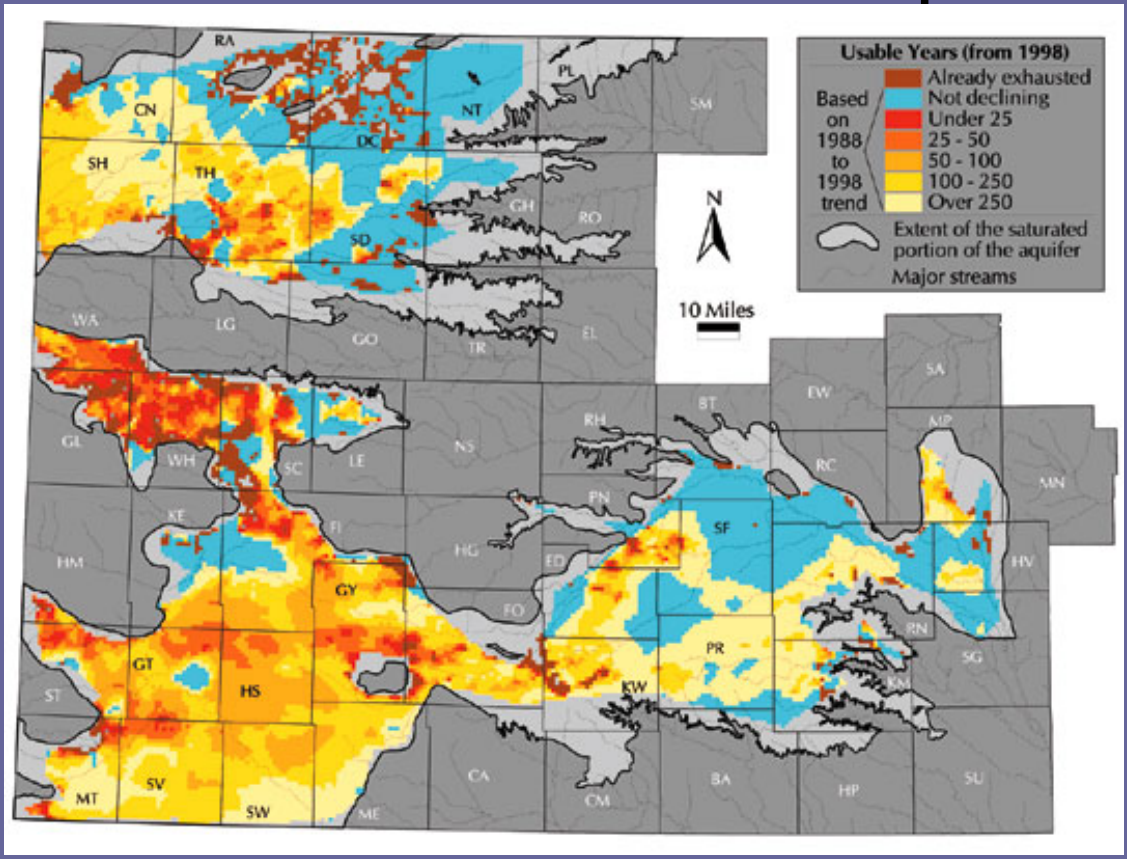
Importance of the “outliers:” Patzek and Pimentel

Inclusion of co-products as energy output implies unsustainable “mining” of soil humus (Patzek 2004)



Patzek and Pimentel

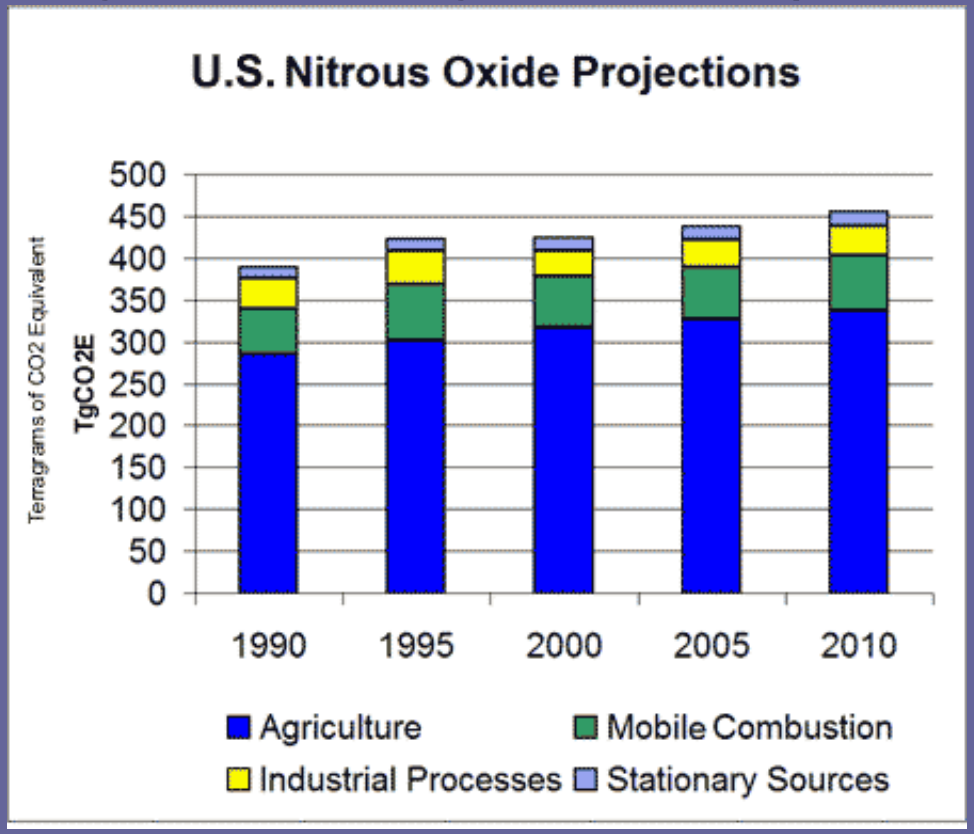
Irrigation with “fossil” aquifers should be included as non-renewable input



Kansas Geological Survey (2001)

Patzek and Pimentel

Nitrous oxide emissions from fertilizers should be included as greenhouse gas, CO2 equivalents



USEPA 2002

Gulf of Mexico “dead zone”

USDA 2003

Wikipedia

Other ecological externalities not included in NEB ratio

Groundwater contamination

Destruction of grassland and forest ecosystems through conversion to corn

Energy Independence in Context

- Hill et al. (2006) point out that converting the *entirety* of U.S. corn crop into ethanol would meet only 12% of current U.S. gasoline demand
- By extension, converting entirety of global corn output would meet approximately 27% of U.S. gasoline demand
- Assuming a 1.65 NEB ratio and ignoring transport scaling factors, U.S. fossil fuel consumption would be reduced by a maximum of 8% through domestic corn and 17% through a complete diversion of global corn to ethanol
- More realistic 1.25 NEB = 3% domestic; 7% global
- Average fuel economy standard of 30 mpg for cars (from 27.5) and 23 mpg for trucks (from 20.7) would achieve higher energy independence results than the most optimistic corn to ethanol conversion scenario

Greenhouse gas emissions

1.65 NEB, 61% reduction over equivalent gasoline (Kim and Dale 2005), and entirety of domestic corn =

5% reduction in carbon dioxide emissions

1.25 NEB, 12% reduction over equivalent gasoline (Hill et al. 2006), and entirety of domestic corn =

0.4% reduction in carbon dioxide emissions

Socio-economic ripples

- Higher corn prices
  - Feed prices
    - Perhaps inspire changes in animal agriculture, American dietary habits?
  - Land use conversions
  - Developing countries
    - Risk of subsistence farm land being replaced by corn for export to U.S. ethanol and meat producers?

Cellulosic alternative?

- Tilman et al. (2006) obtained NEB of 5.44 for ethanol derived from polyculture grasses grown on agriculturally marginal/depleted soils.
- Estimated that such systems could globally displace:
  - 13% of petroleum transportation fuels
  - 19% of electricity consumption
  - 15% of GHG emissions

Summary

- Corn ethanol can produce very little, if any, gains in U.S. energy independence or reductions in GHG emissions.
- Billions of dollars in subsidies likely to further entrench current industrial farming practices, which are known to produce a large suite of negative environmental consequences.
- Modest increases in fuel economy standards would achieve the same fossil fuel savings as the most optimistic ethanol conversion scenarios.
- Bioenergy focus should be on rapid development of
  - Low-input cellulosic biomass
  - Waste recycling
  - Design efficiencies
  - Ecosystem restoration
- The current turn to industrial agriculture for short-term maintenance of an inherently unsustainable transportation fuel system is misguided, perhaps tragically so.

Thank you

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