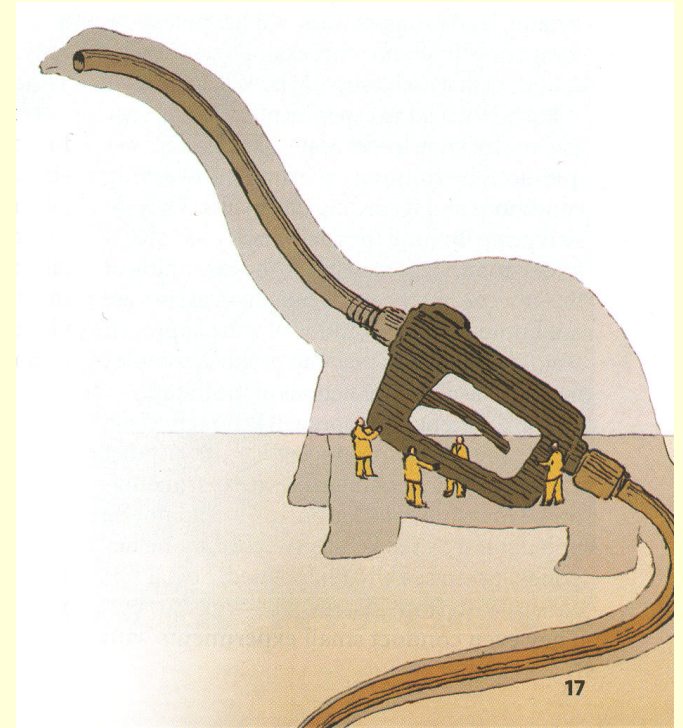


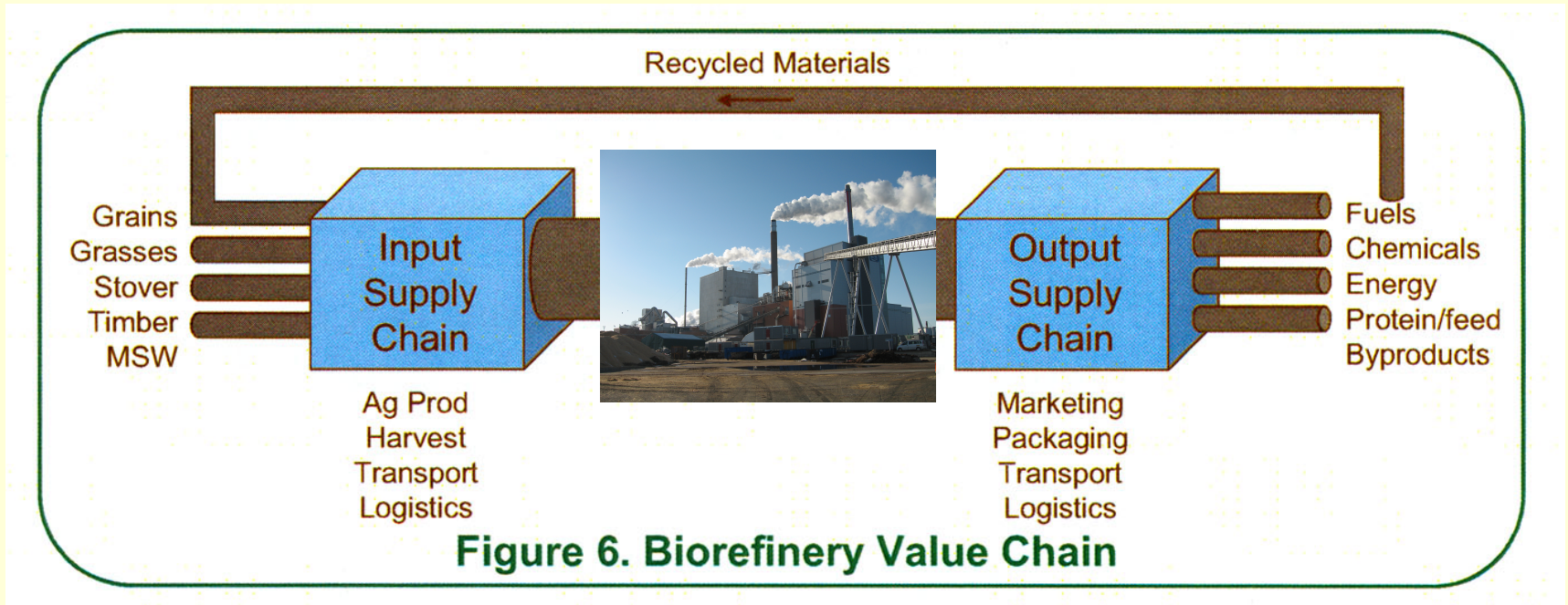
Biobased Energy Systems (and Michigan)



Here's the target



Here's the real hard part



What's it look like? Who finances? Who controls?

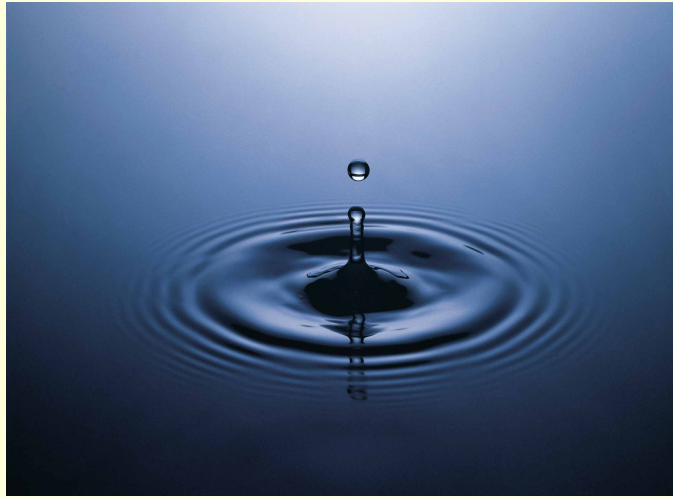
Today: exploiting the supply chain



Simple chemistry



Relationships you don't see: 4 to 1



Increase in ethanol production from corn could significantly impact water quality and availability if new practices and techniques are not employed

**--National Research Council, 10
October 2007**

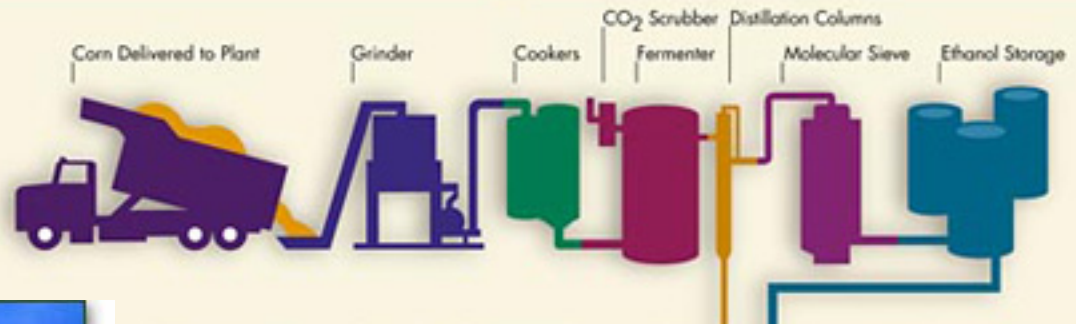
Relationships you don't see



Carbon dioxide: 1 to 1

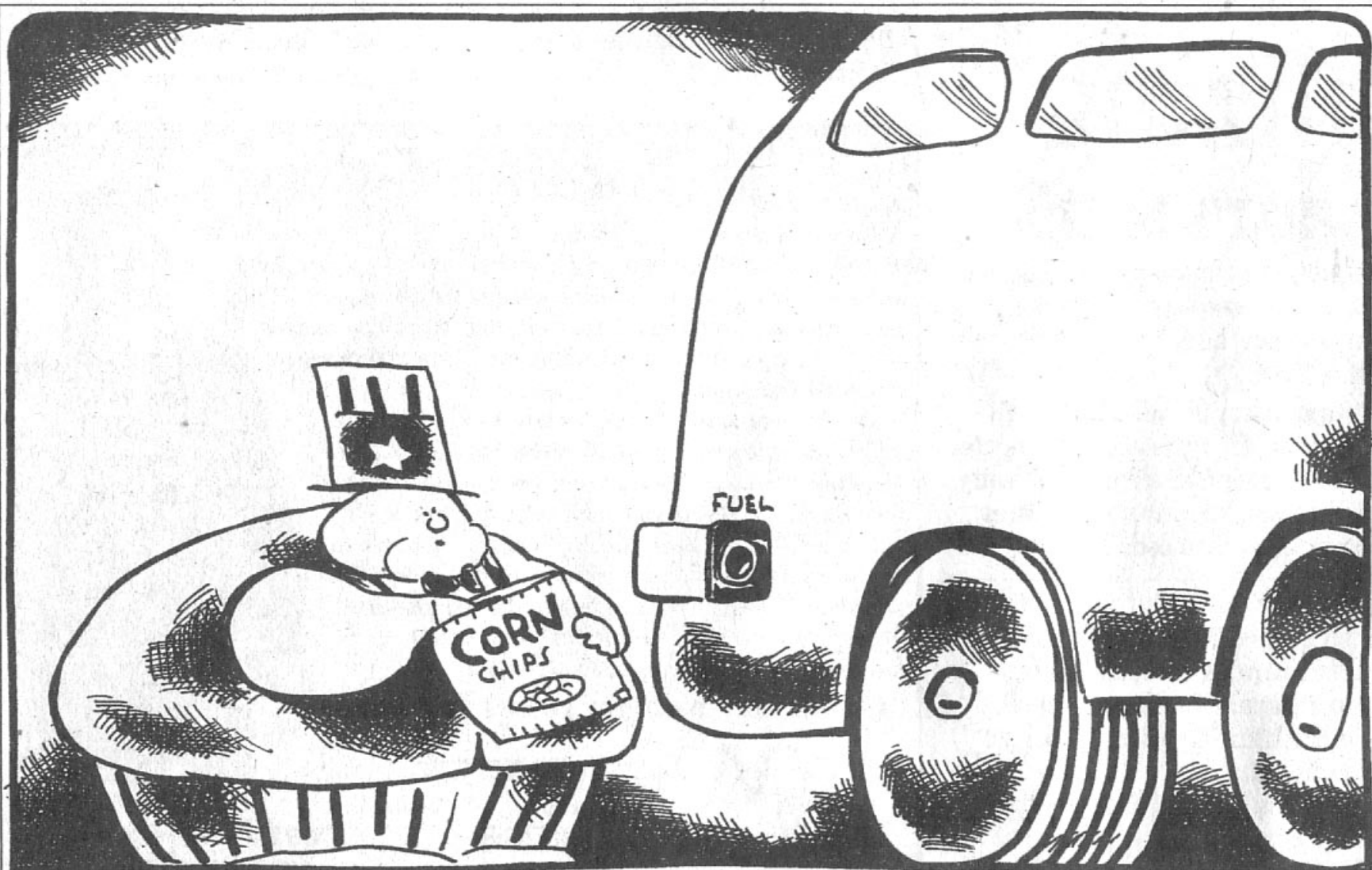
Distillers dried grains: 6 lbs per gallon

Inputs you don't see



Unintended Consequences





Decision Time

TOM SWICK

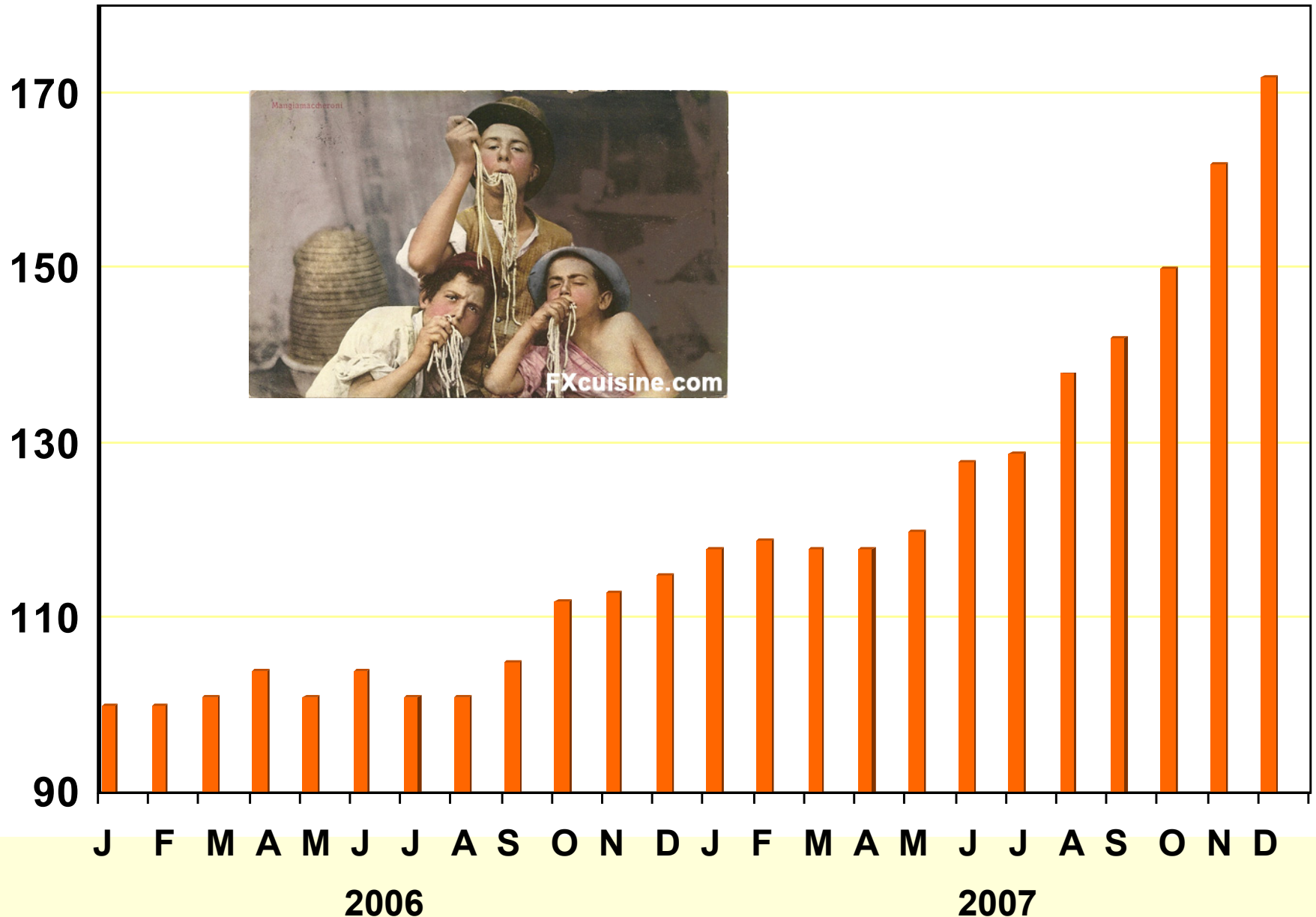
UNIVERSAL PRESS SYND.
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CAN I WIN
FOR LOSING?



Monthly commodity food price Index (January 2006 = 100)

Data from the Economist, 19 January 2008



Collateral damage?

Animal agriculture

Ethanol production itself

Consumer sentiment

World hunger groups

Conservation groups



One example



The bottom line is that when the core of the duck factory becomes a corn factory, nesting habitat and wetlands disappear, and ducks lose.

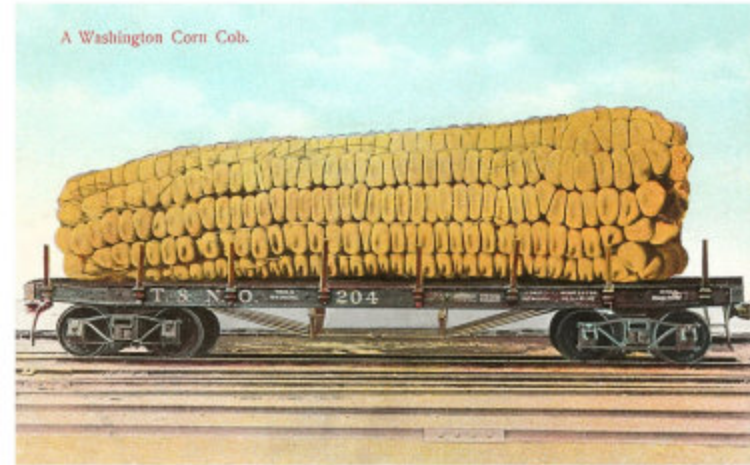
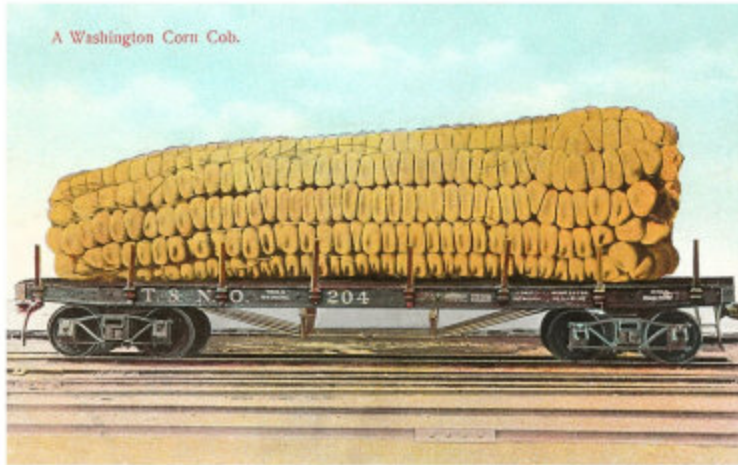
--Ducks Unlimited



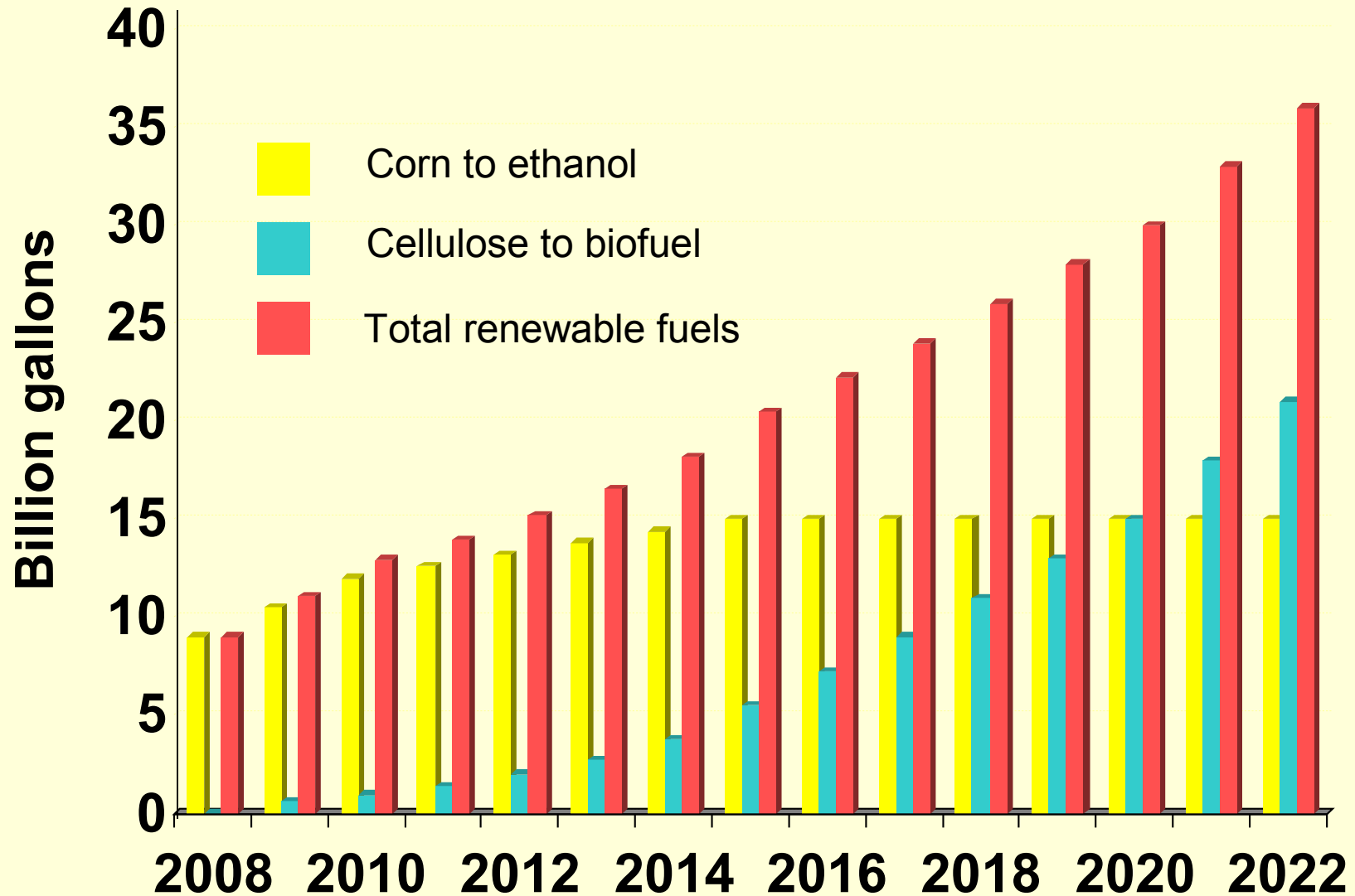
ABA estimates that as much as one-third of the farm land idled through the CRP could be returned to production without sacrificing environmental goals.

--American Bakers Association

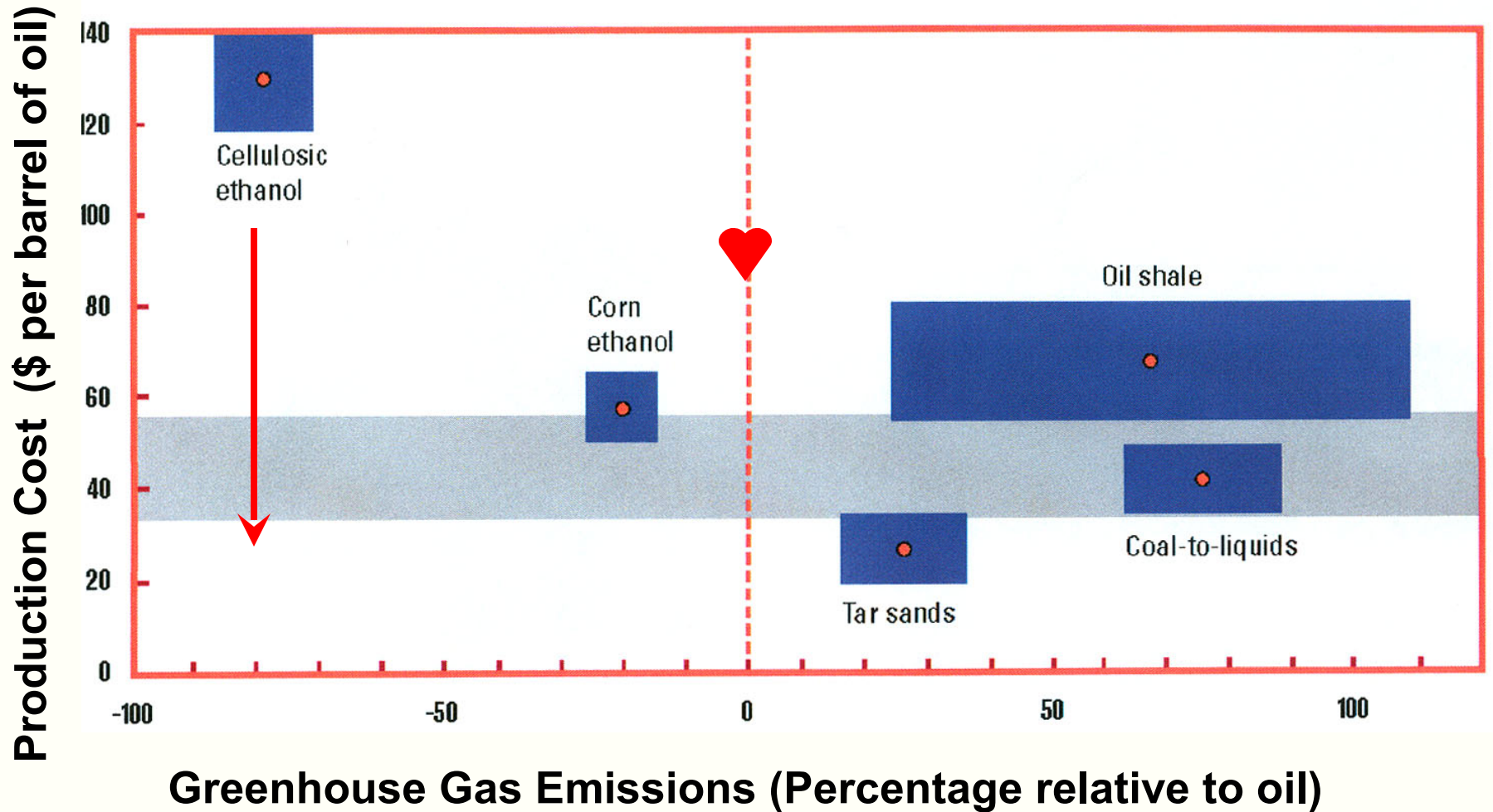
What's the next wave?



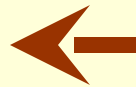
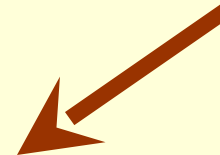
Cellulose to ethanol



Why cellulose?



An initial cellulose strategy

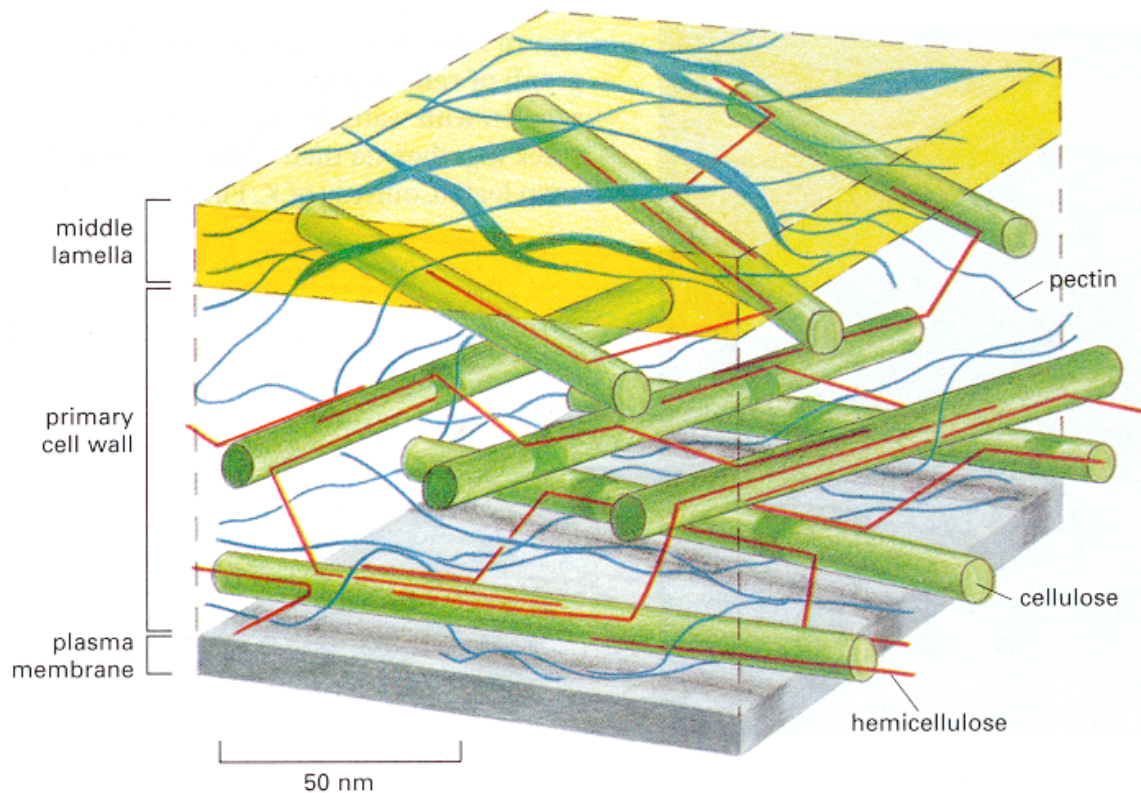


cellulose

Complexities

Technical

**Raw material is structurally heterogeneous,
dirty, cellulose difficult to degrade**



Nontechnical

Prolongs food vs. fuel

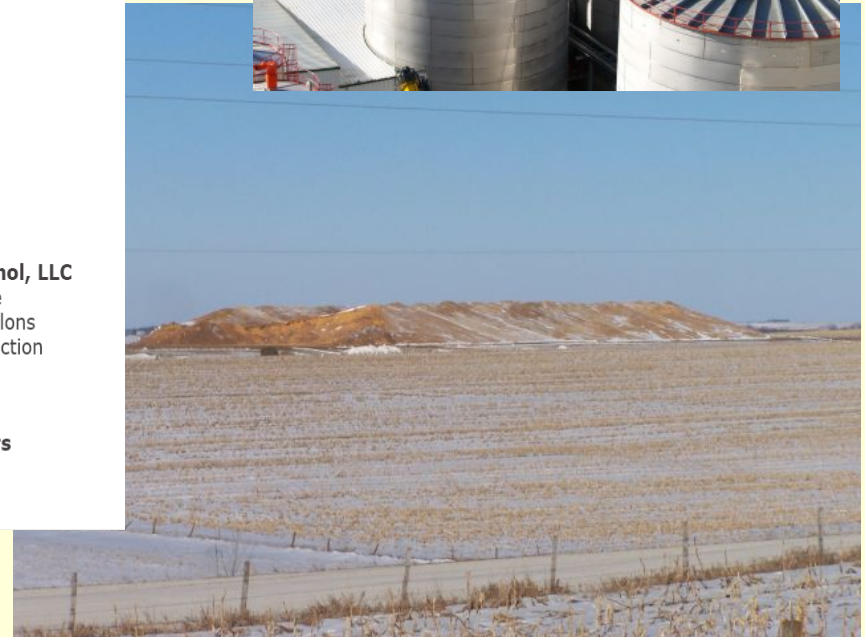
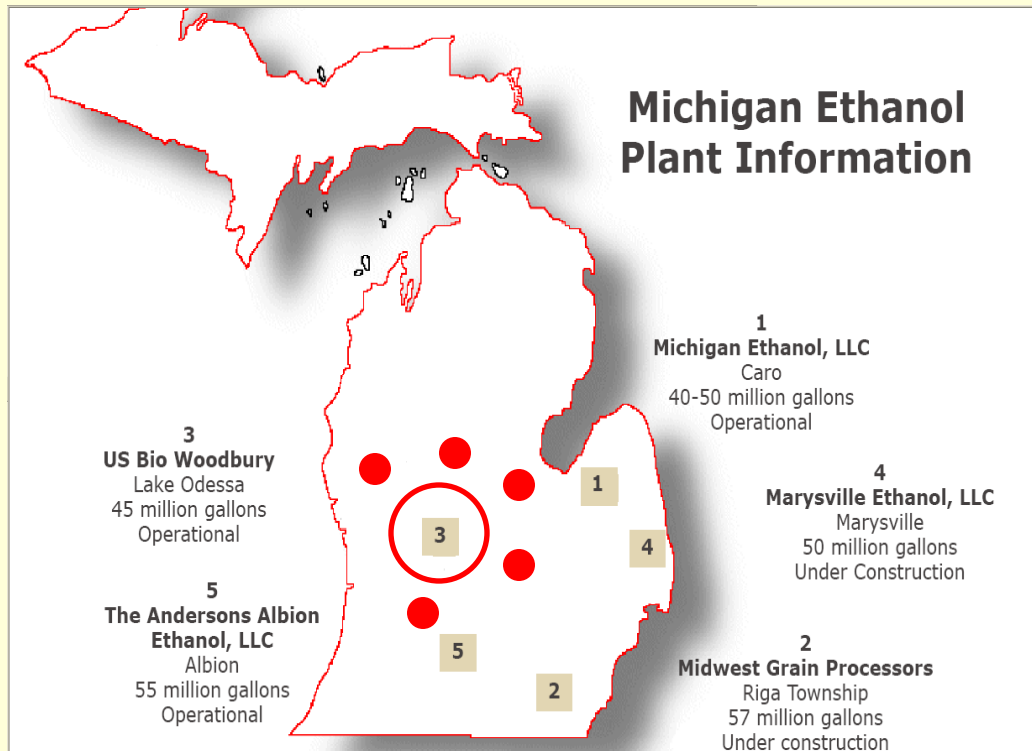
**Sustainability of carbon
removal?**

Not energy-dense

Logistics of nondense biomass

**3,000 tons of biomass a day, 182 semis a day, 360 days a year
(One every 8 minutes, 24 hours/day)**

Harvest: 3 weeks in the fall



Another cellulose strategy?



Hindrances

No experience

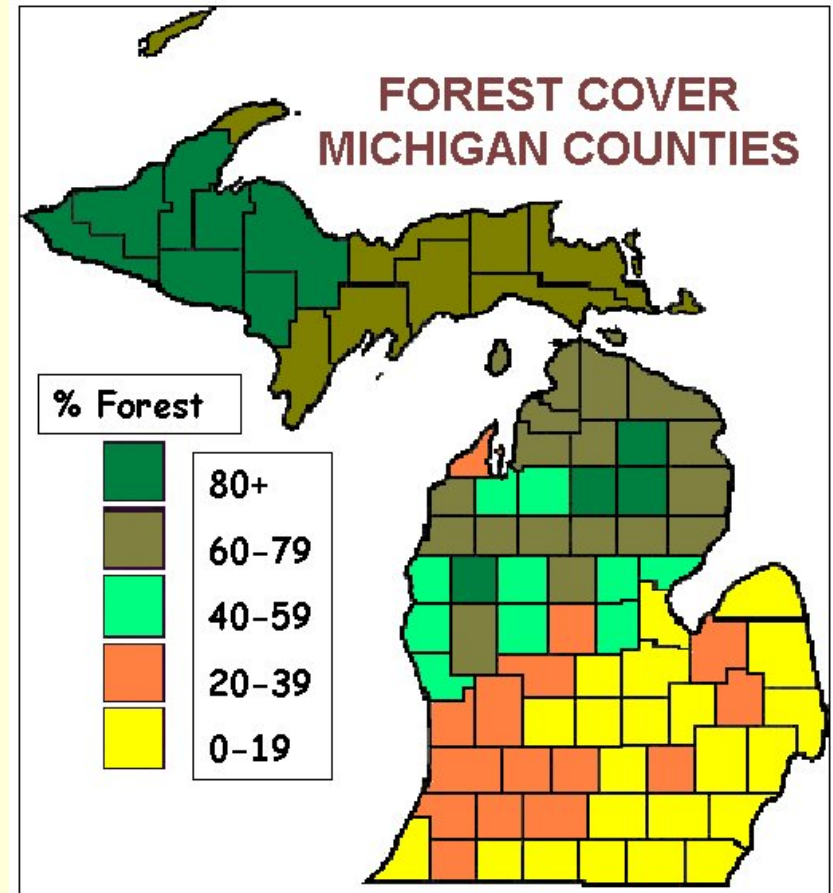
Food fuel at level of land

Chicken/egg market

Low input, how long?

Michigan's long term cellulose strategy?

- millions of acres of trees
- harvest one-third
- inputs?
- food vs fuel?



Abandoned farmland



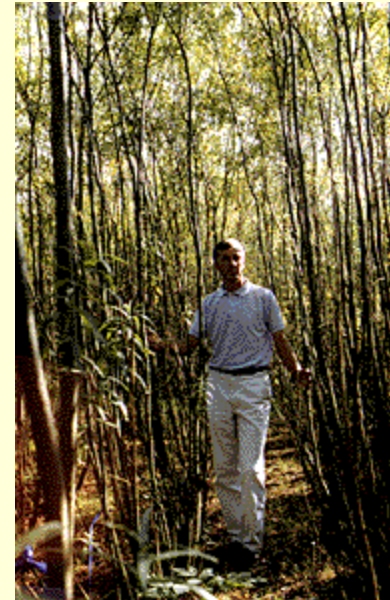
Hindrances

No experience

— Food fuel at level of land —

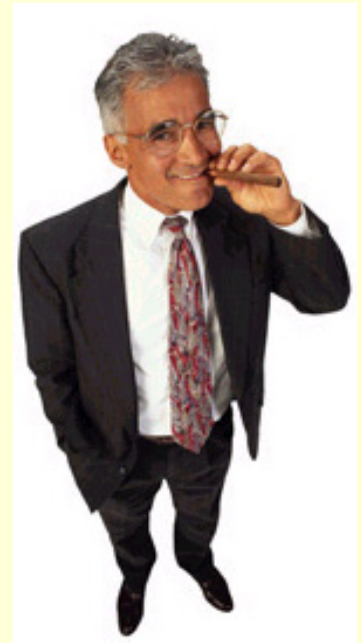
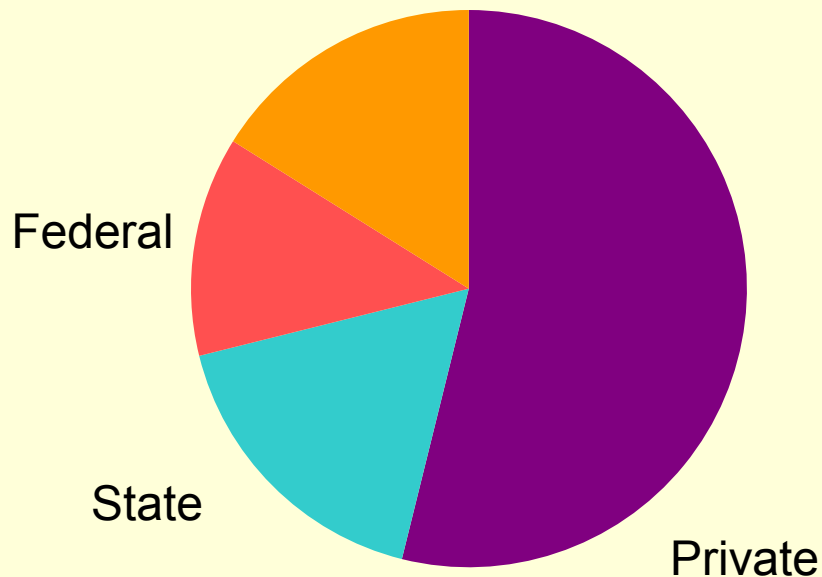
Chicken/egg market

Low input, how long?



Companies ask: How much at what price?

Who owns the trees?
Do they want to sell biomass?



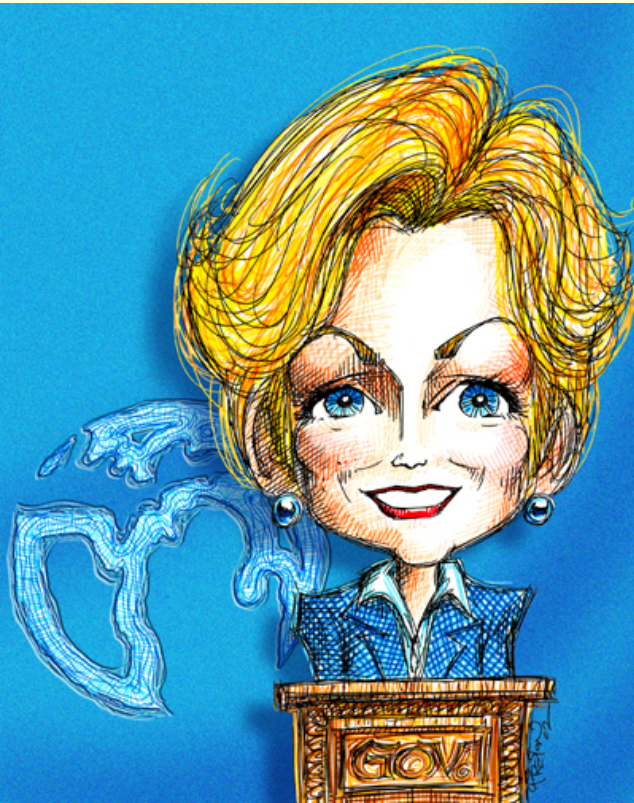
CAPEX
\$150 million

**How do I get it
delivered?**

**What about the
sawmills and paper
mills?**



Policy Drivers



November 14,
2007: Governor
Granholm takes
actions to address
climate change

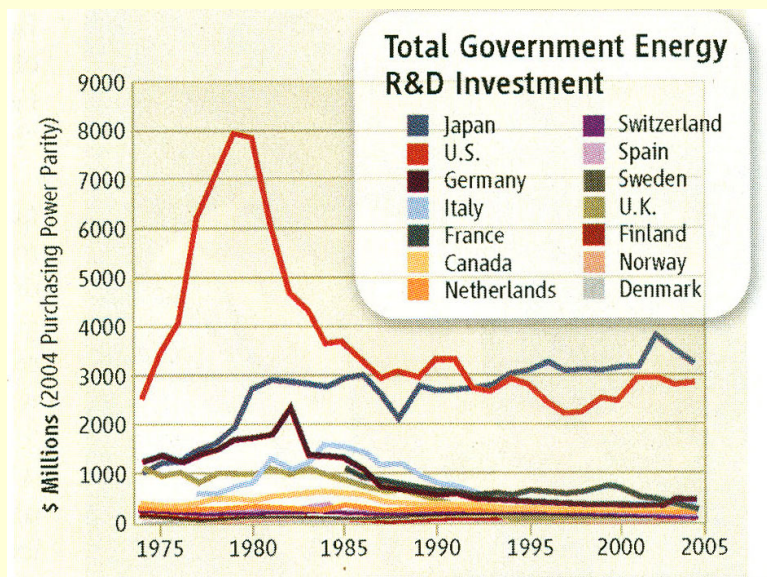
December 21, 2007: Mr.
Bush OKs Energy Bill



Policy Drivers: A Word of Caution



**Politics is the art
of looking for
trouble, finding it
everywhere,
diagnosing it
incorrectly and
applying the wrong
remedies.**



From the Collections of The Henry Ford

Image ID#: P.189.16351

Robert Boyer and Henry Ford with the Soybean Car.



From the Collections of The Henry Ford

Image ID#: P.O.15121

Soybean Car assembly image showing production of plastic panels.

Policy drivers not likely to change (Informa Study)

1. Clean air policies

- Demise of MTBE boosting that market
- Specific oxygenate requirements end May 2006

2. Farmer support

- Very strong driver; unlikely to diminish
- Could be undercut by feedstock shortage, high cost

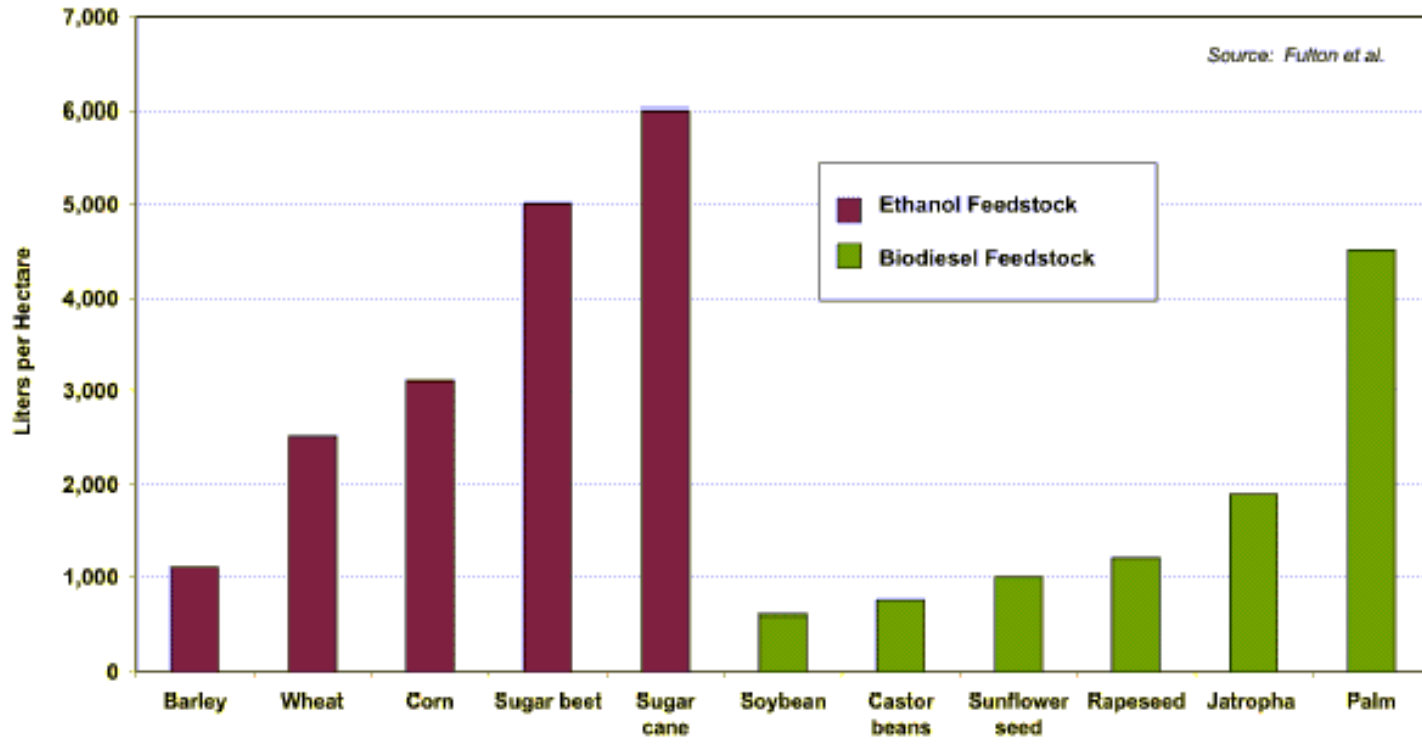
3. Energy independence

- Driven by high petroleum prices
 - Appears to be strengthening dramatically
 - Both in US and elsewhere

4. Global warming

- Key date for Kyoto implementation is 2010
 - Driving serious support for ethanol/biodiesel production
- US policy unclear
 - Cut intensity of energy use/unit of GDP
 - More restrictive alternative policies in the future?

Energy security at what price?



Ethanol production costs (2006)

From corn, US \$1.03 per gallon

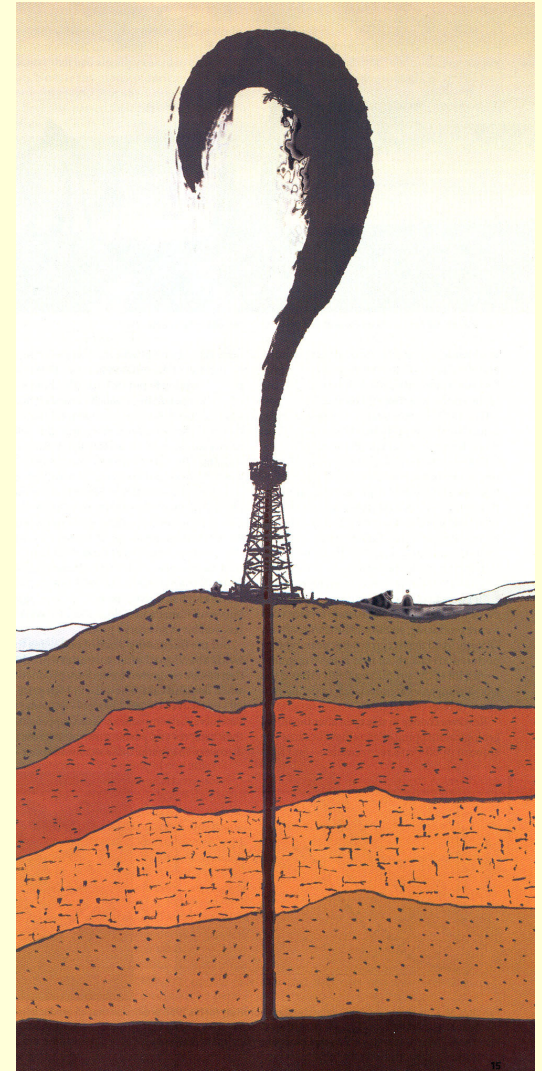
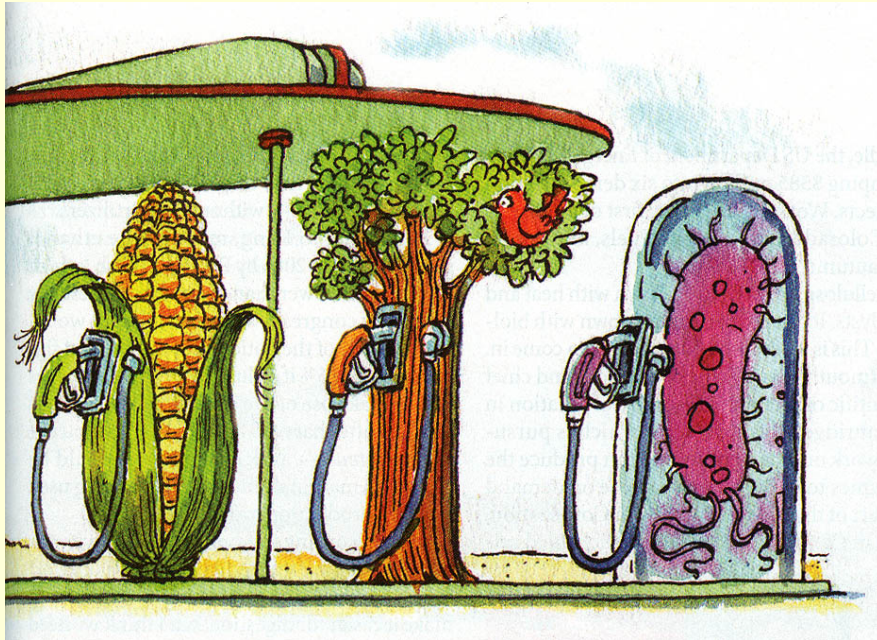
From sugarcane, Brazil \$0.81 per gallon

\$0.54

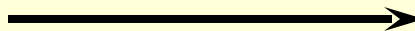
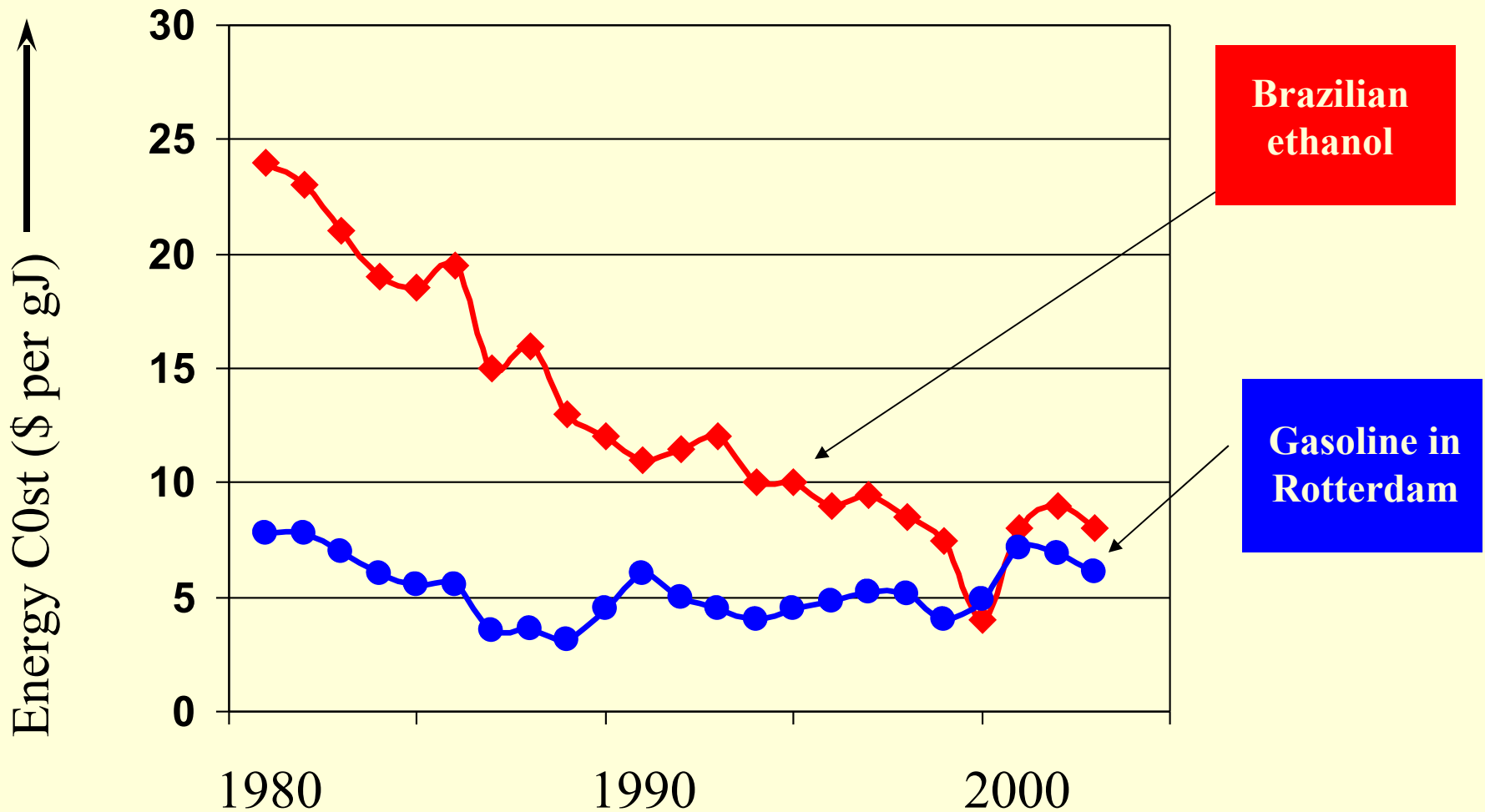
Why not more emphasis on conservation?

Why ethanol in the first place?

Is there a future for biodiesel?



Last Word: The Importance of Sticking to It



-- Goldemberg, 2003