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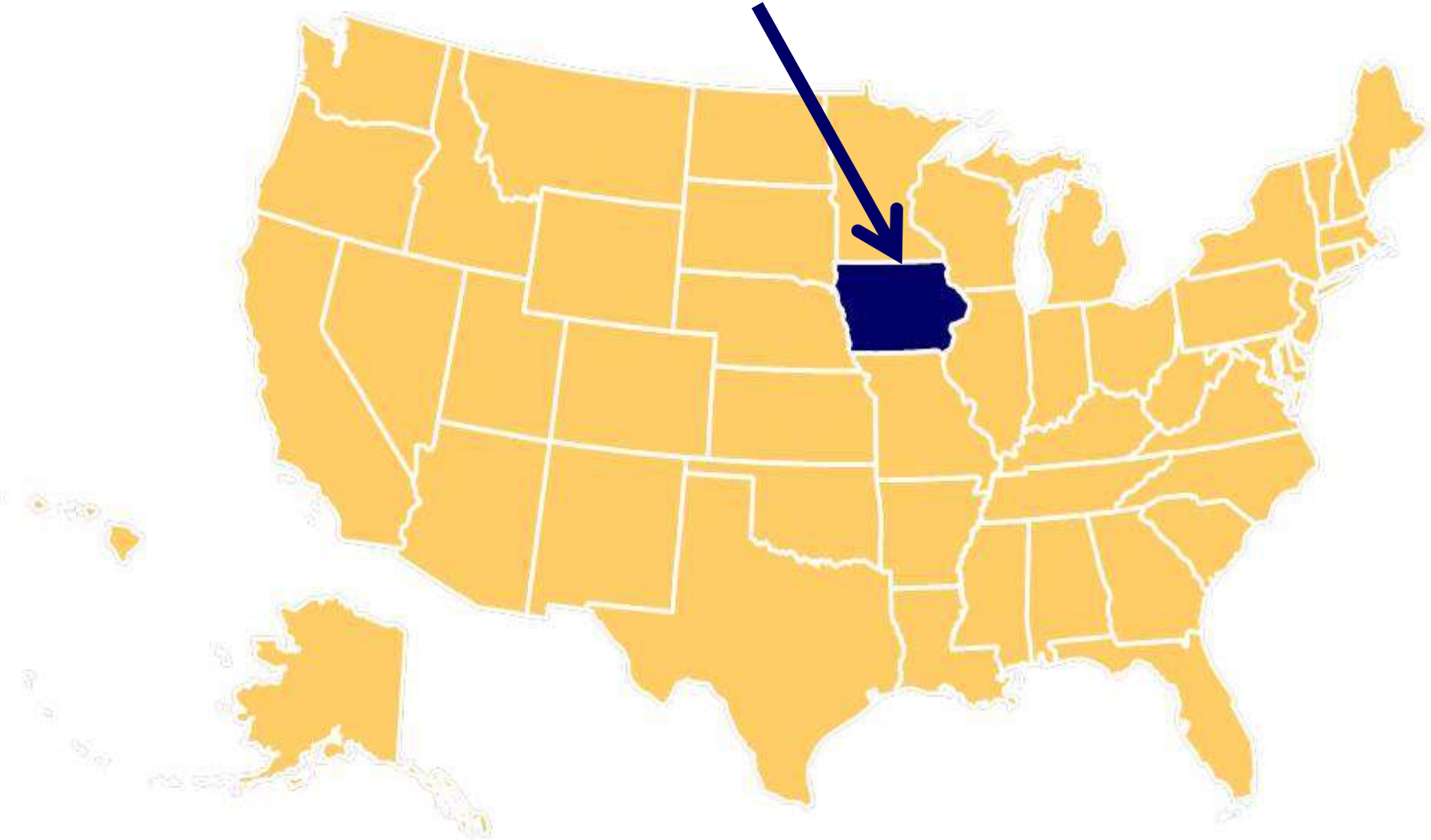
Past, Present and Future: U.S. Biorenewables Industry

Jill Euken, Deputy Director

Iowa



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Iowa Agriculture

Number of farms	92,000
Total farmland	30.7 Million acres
Annual acres of corn for grain	13.7 Million acres
Annual acres of soybeans	9.5 Million acres
Annual cattle/calves marketed	2.5 Million head
Annual hogs marketed	41 million head

Euken Farms, Inc.

- 2500 acres of corn, soybeans and alfalfa
- 150 cows
- Beef feeding operation ~2000 head/year

Bioeconomy Institute (BEI)

Goal: Securing sustainable supplies of energy and carbon from biomass

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BEI Mission

Research

Education

Outreach

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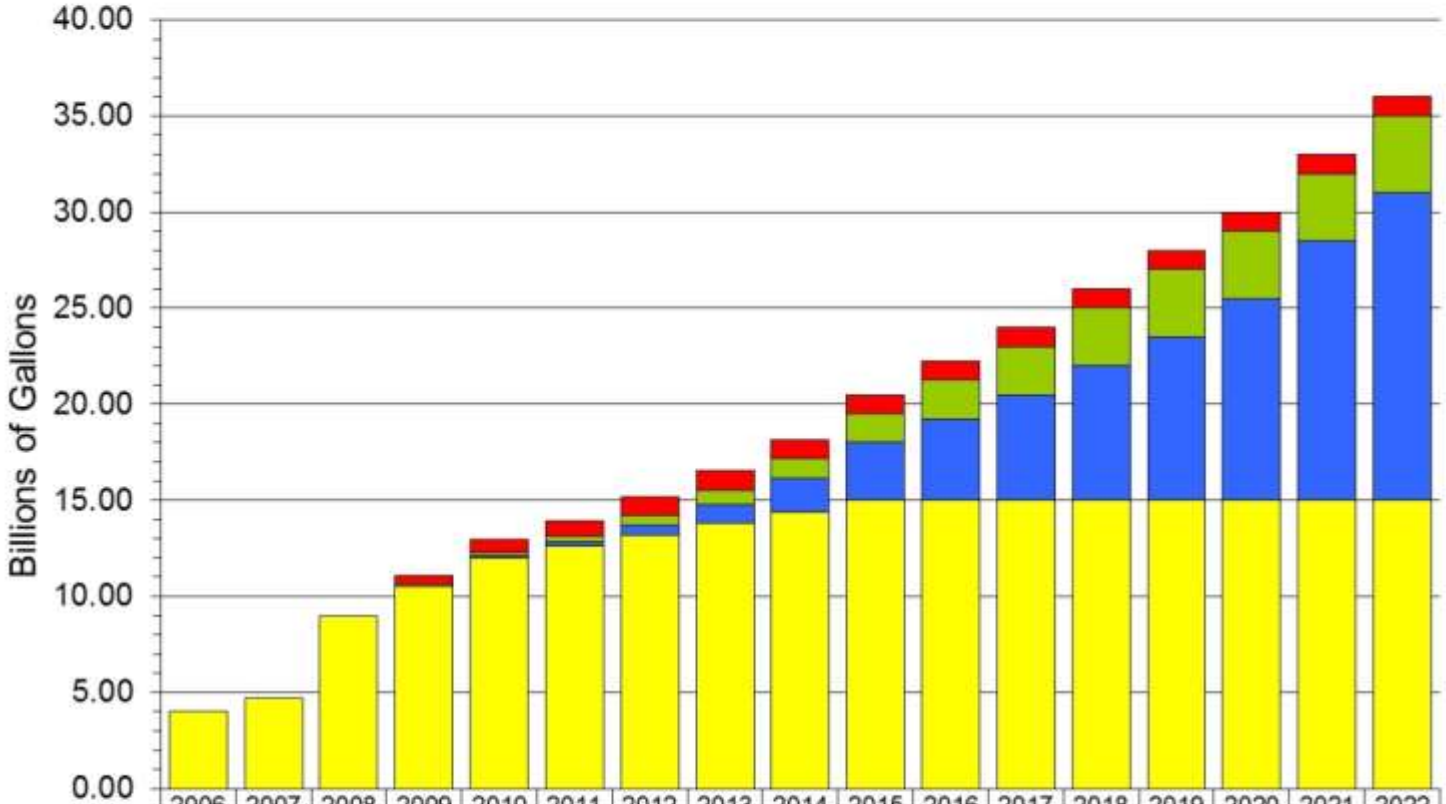
Overview

- Recap of Biorenewables for decade 2001-2010
- Major Challenges for Biorenewables for decade 2011-2020
  - Public Support
  - Regulation
  - Policy

Why are we producing biofuels?

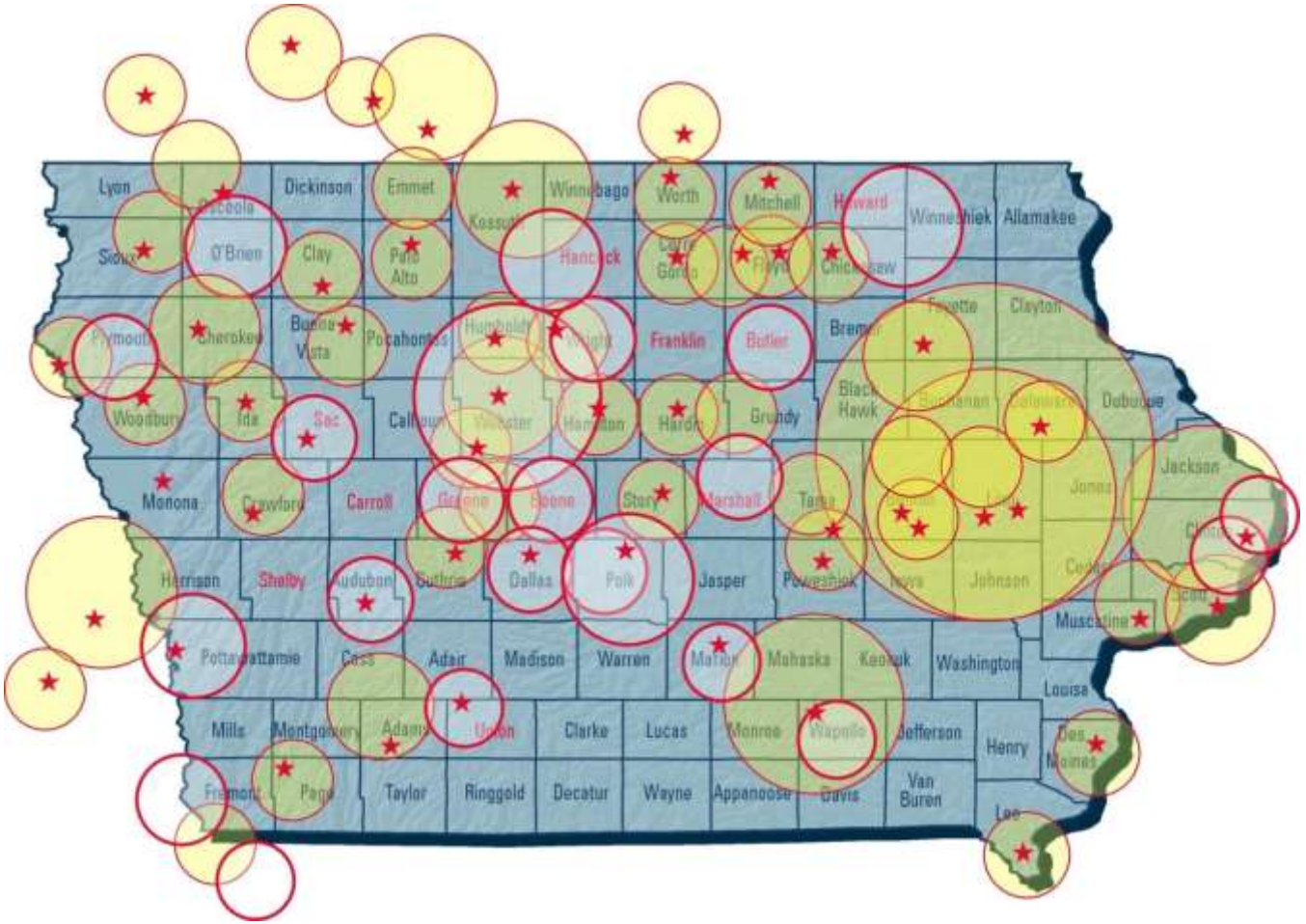
Motivations for Biofuel Production in 2002:

Renewable Fuel Standard 2 (RFS2)



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Biomass-based Diesel				0.50	0.65	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Other Advanced				0.10	0.20	0.30	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	3.50	3.50	4.00
Celulosic Advanced					0.10	0.25	0.50	1.00	1.75	3.00	4.25	5.50	7.00	8.50	10.50	13.50	16.00
Conventional Biofuels	4.00	4.70	9.00	10.50	12.00	12.60	13.20	13.80	14.40	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00

Ethanol Plants in Iowa



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Positive Outcomes in Iowa

- EtOH adds $10 billion to Iowa's economy; consumes more than 60% of Iowa's corn
- Advanced biofuels have potential to contribute additional $18 billion to Iowa's economy and add hundreds of jobs
- Harvesting corn stover will add a billion dollars to Iowa farm income

Major Challenges to RFS2

- Public Support
- Policy – proposed RFS volumes released by EPA November 15, 2013
- Perceived and real environmental issues re: corn production

Battle for Public Support

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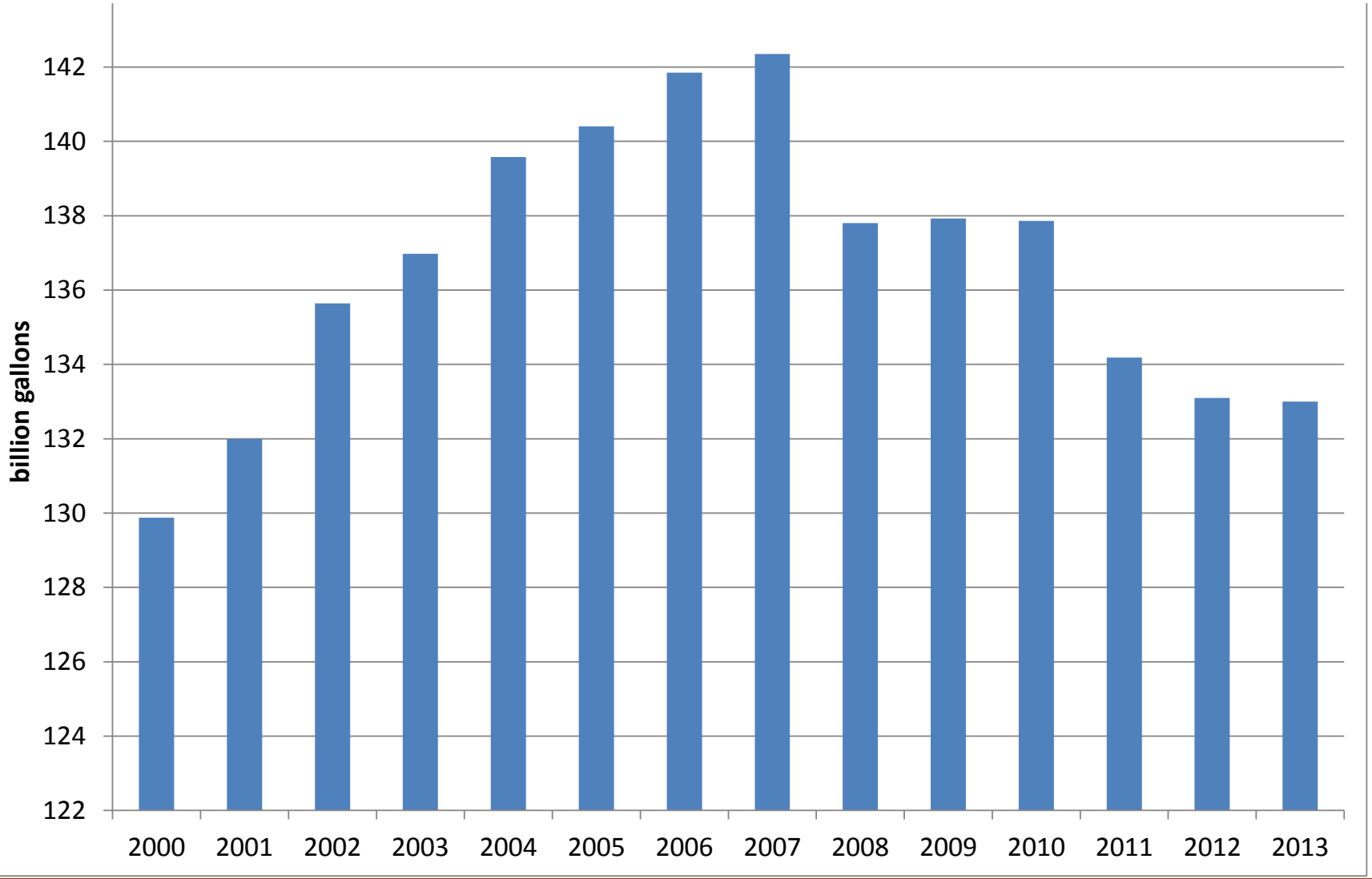
Other Oil Industry Claims About the RFS

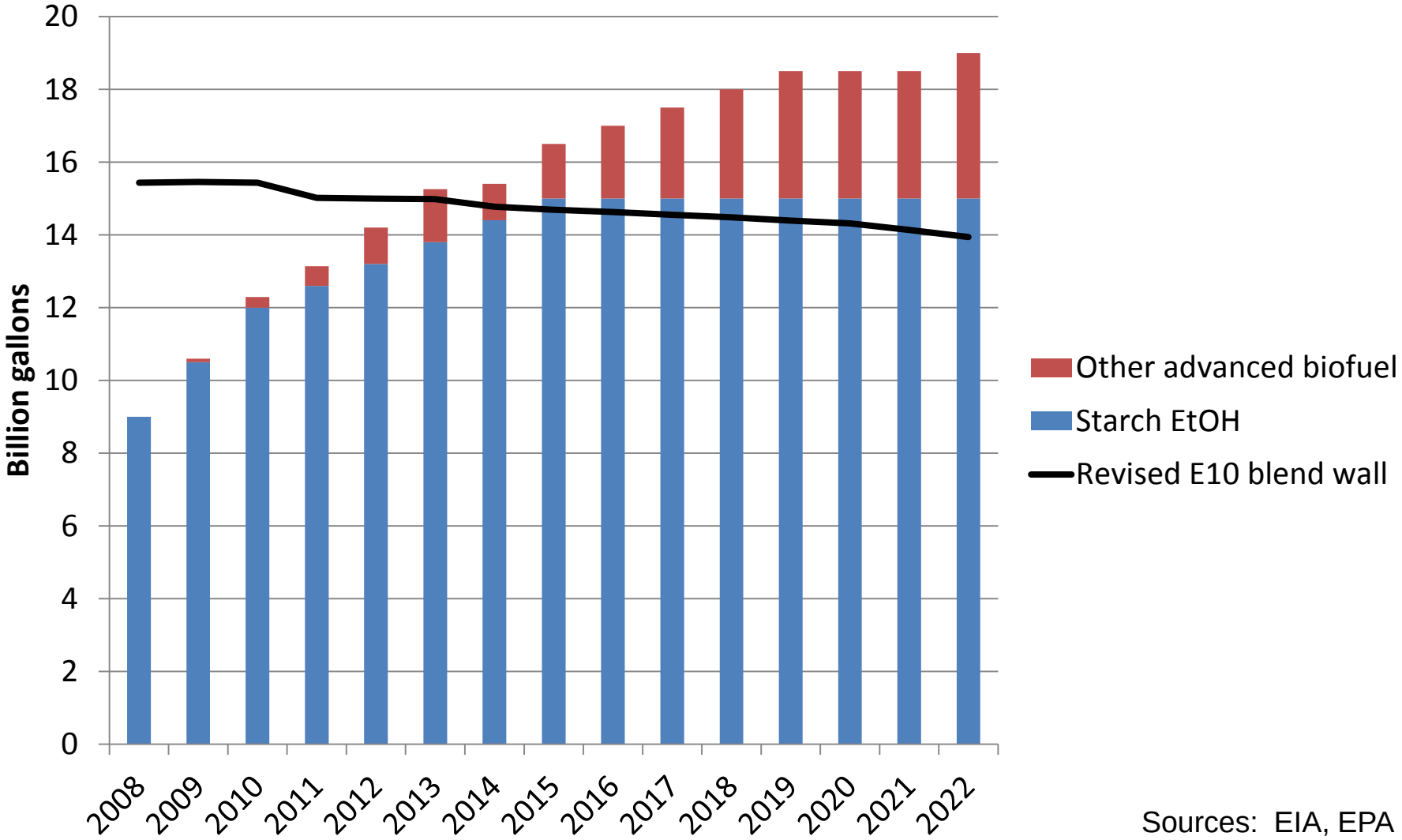
1. Compliance with the RFS will ruin the U.S. economy
2. Compliance is physically impossible after 2015 even after ruining the economy
3. Corn ethanol is harming the environment

Will the RFS "ruin the economy?

U.S. Gasoline Consumption

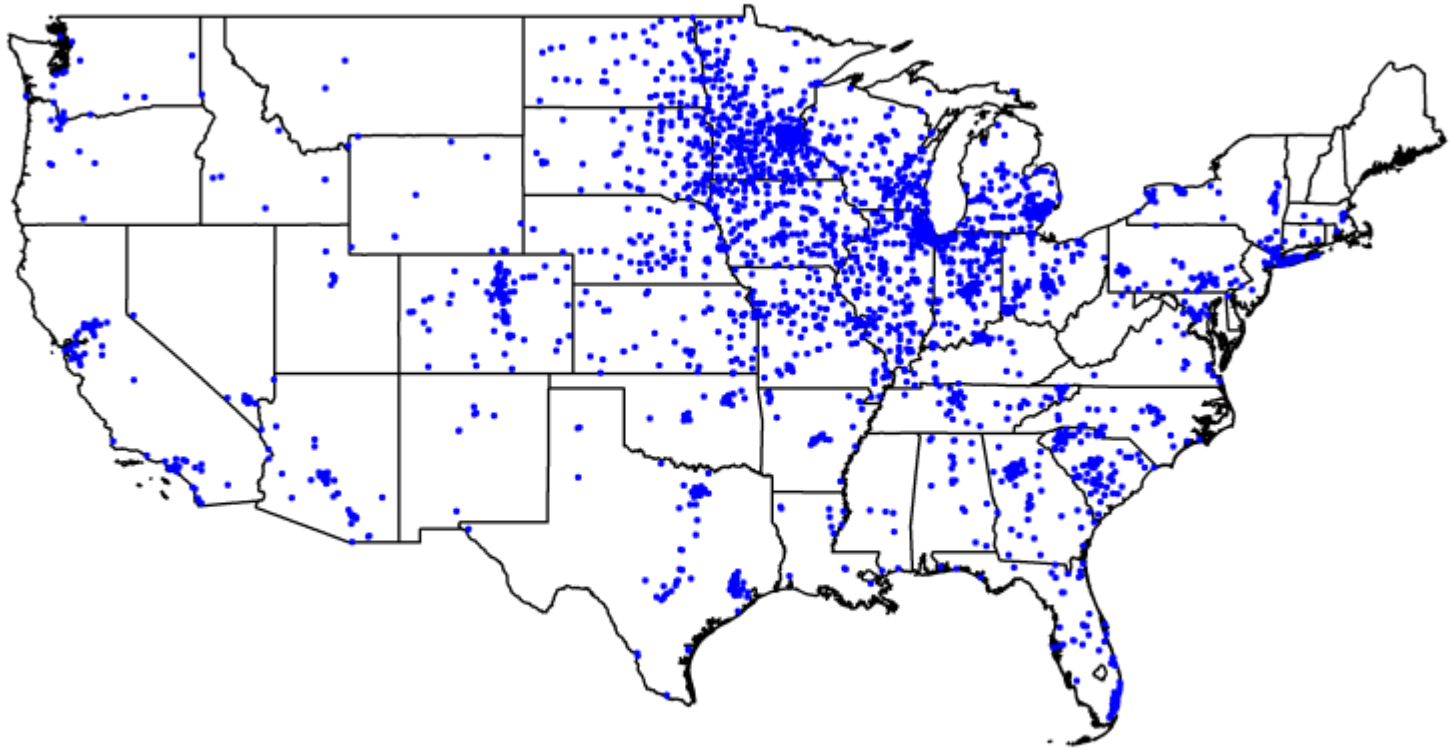


EPA released draft 2014 volumes November 15



Sources: EIA, EPA

Location of E85 Stations



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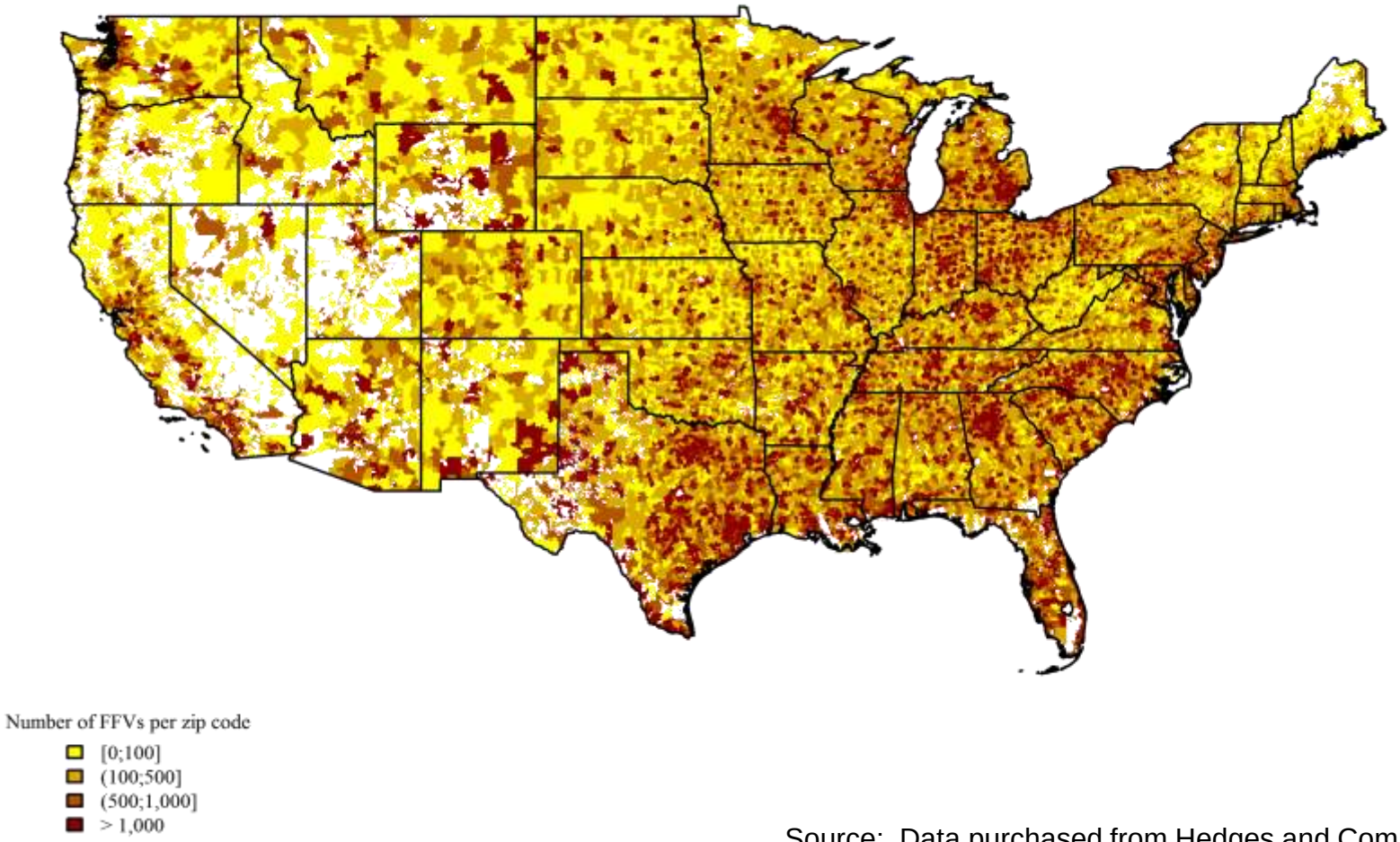
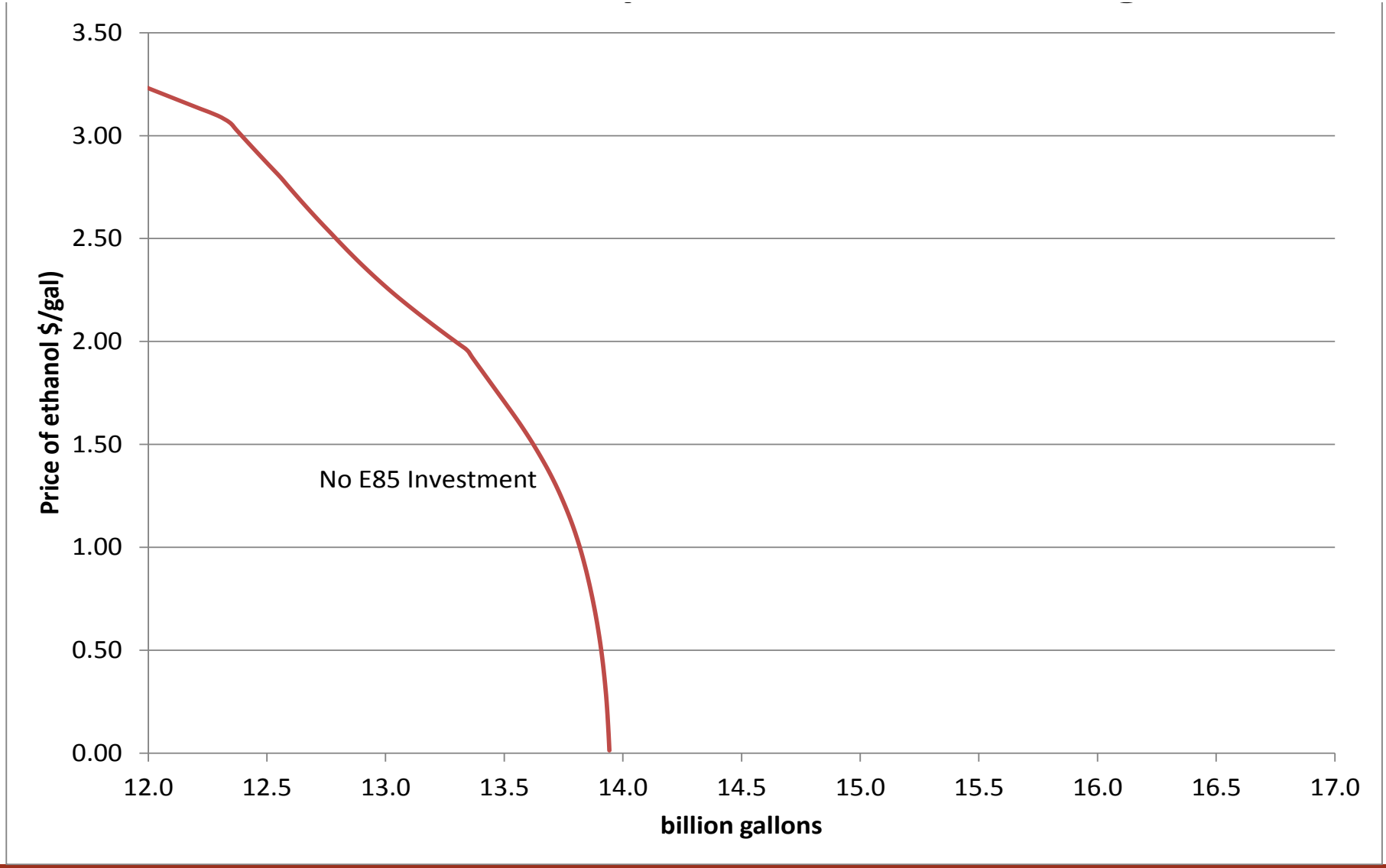
Source: E85Prices.com

Location of 14.6 Million Flex Vehicles



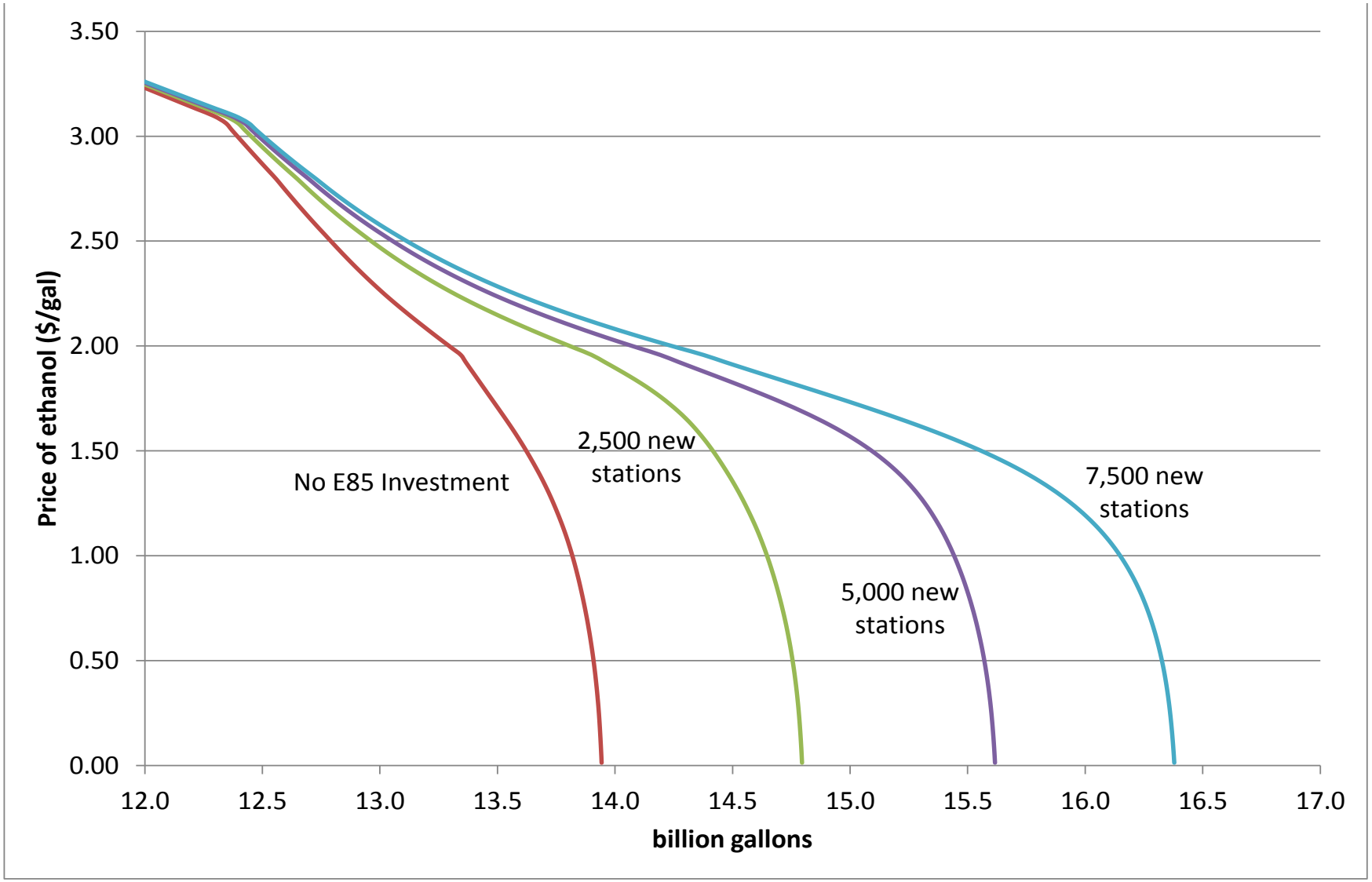
Source: Data purchased from Hedges and Company

Potential Consumption of Ethanol Using E85



Source: Babcock, CARD

Potential Consumption of Ethanol Using E85



Source: Babcock, CARD

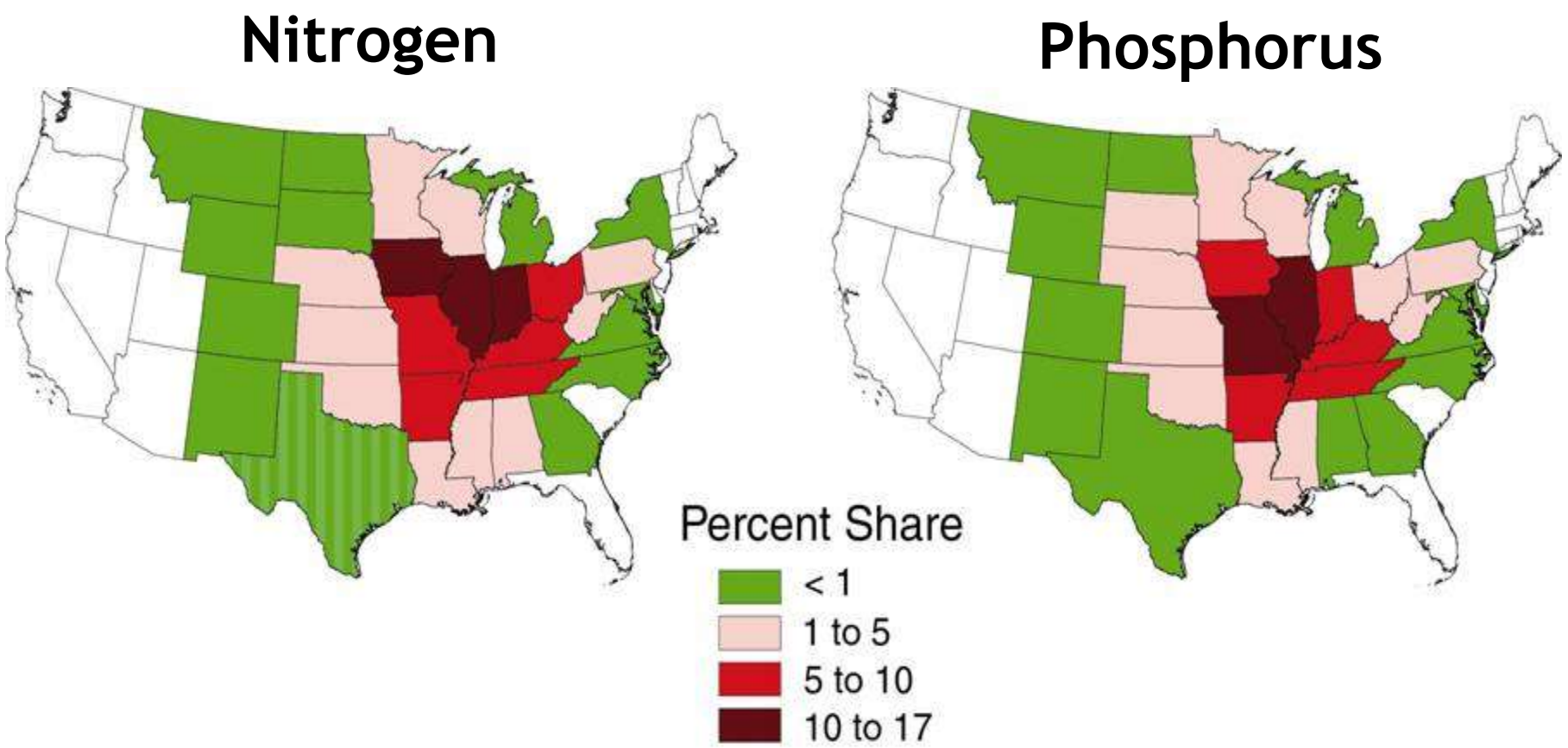
What Would 7500 Stations Cost

- EPA: $130,000 per station
- $130,000 X 7500 = $1.125 billion
- $1,125 billion/130 billion = $0.0086 per gallon of E10
- **Political will**

So, what about environmental issues?

Nutrient delivery to the Gulf of Mexico

State shares of the total nutrient flux



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Source: Alexander et al, *Environ. Sce. Tech. , in press*

Iowa Nitrogen Reduction Practices

	Practice	% Nitrate-N Reduction [Average (Std. Dev.)]
Nitrogen Management	Timing (Fall to spring)	6 (25)
	Source (Liquid swine compared to commercial)	4 (11)
	Nitrogen Application Rate	Depends on starting point
	Nitrification Inhibitor	9 (19)
	Cover Crops (Rye)	31 (29)
Land Use	Perennial – Land retirement	85 (9)
	Living Mulches	41 (16)
	Extended Rotations	42 (12)
Edge-of-Field	Drainage Water Mgmt.	33 (32)*
	Shallow Drainage	32 (15)*
	Wetlands	52
	Bioreactors	43 (21)
	Buffers	91 (20)**

Iowa Phosphorus Reduction Practices

	Practice	% Phosphorus-P Reduction [Average (Std. Dev.)]
Phosphorus Management	Producer does not apply phosphorus until STP drops to optimal level	17 (40)
	Source (Liquid swine compared to commercial)	46 (45)
	Incorporation	36 (27)
	No-till (70% residue) vs. conventional tillage (30% residue)	90 (17)
	Cover Crops (Rye)	29 (37)
Land Use	Perennial – Land retirement	75 (-)
	Pasture	39 (42)
Edge-of-Field	Buffers	58 (32)

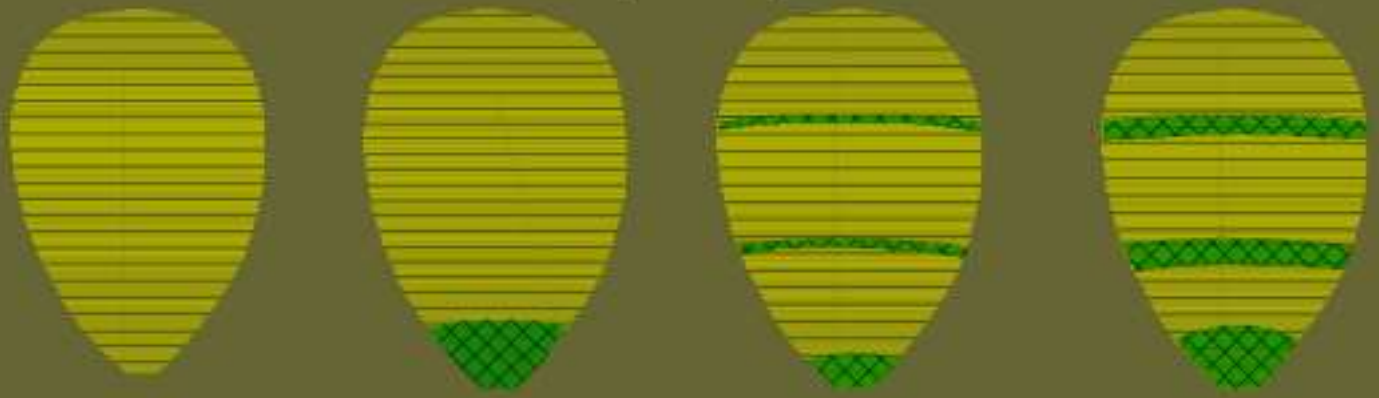
12 experimental watersheds, 1 to 8 acres each, Neal Smith National Wildlife Refuge, Prairie City, IA

Four treatments:
100% crop (no-till)
10% buffer, toe slope
10% buffer, contour strips
20% buffer, contour strips

Photo: Matt Liebman

Experimental Watershed Treatments
Neal Smith NWR, Prairie City, IA

(n = 3)



100% row crops

10% perennial, bottom

10% perennial, strips

20% perennial, strips

= corn and soybean row crops

= perennial vegetation

Source: Matt Liebman

Sediment Loss from Watershed

100% crops

10% perennial cover

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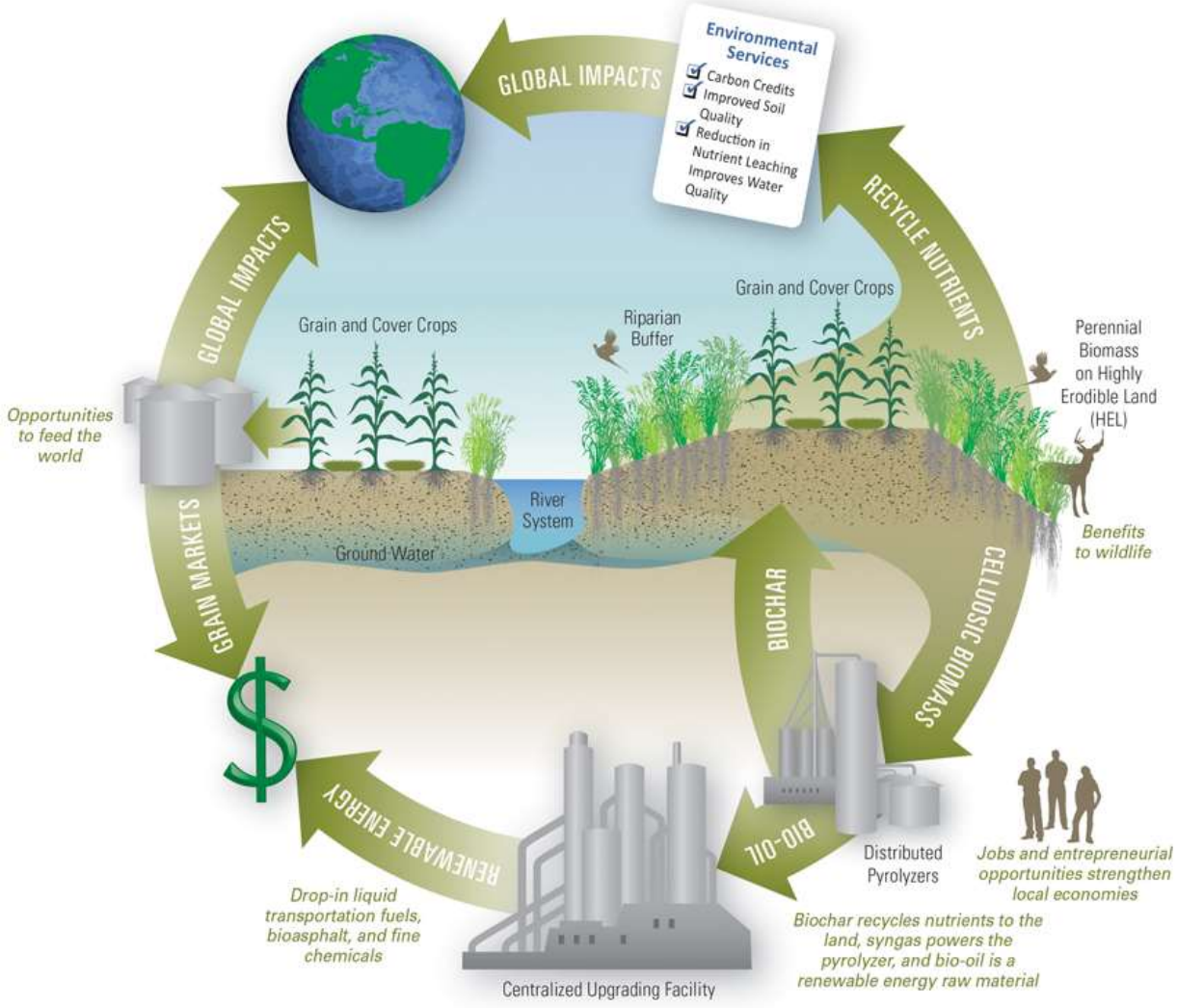
Source: Matt Helmann, ISU

Source: Matt Liebman, ISU

CenUSA Bioenergy Project

- Funded by USDA
- Five year regional project to develop perennial grasses as energy crops
- Considers all aspects of the bioenergy value chain



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Pyrolysis Process

Corn stover
(~1.5 GJ m^{-3})

500° C
Low oxygen

Bio-oil

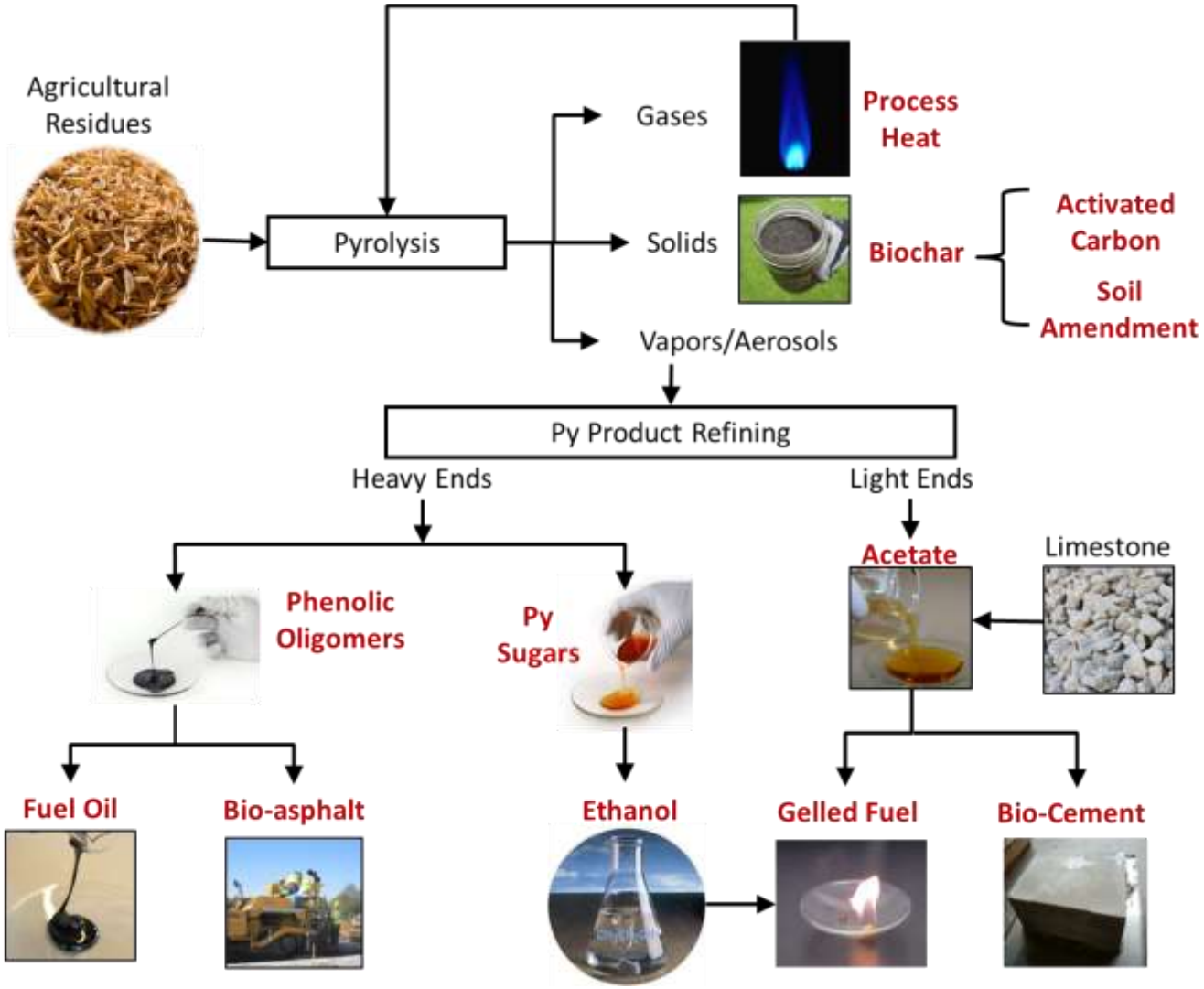
+

Syngas
(~6 MJ kg^{-1})

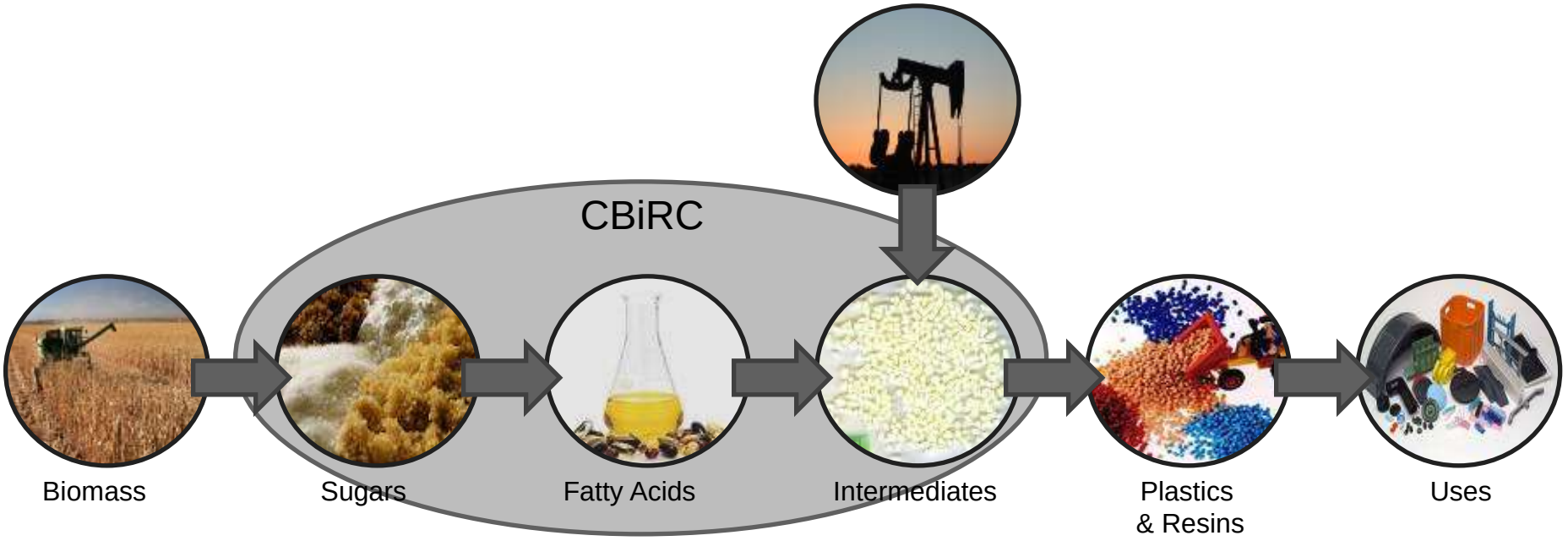
+

Biochar
(~21 MJ kg^{-1})

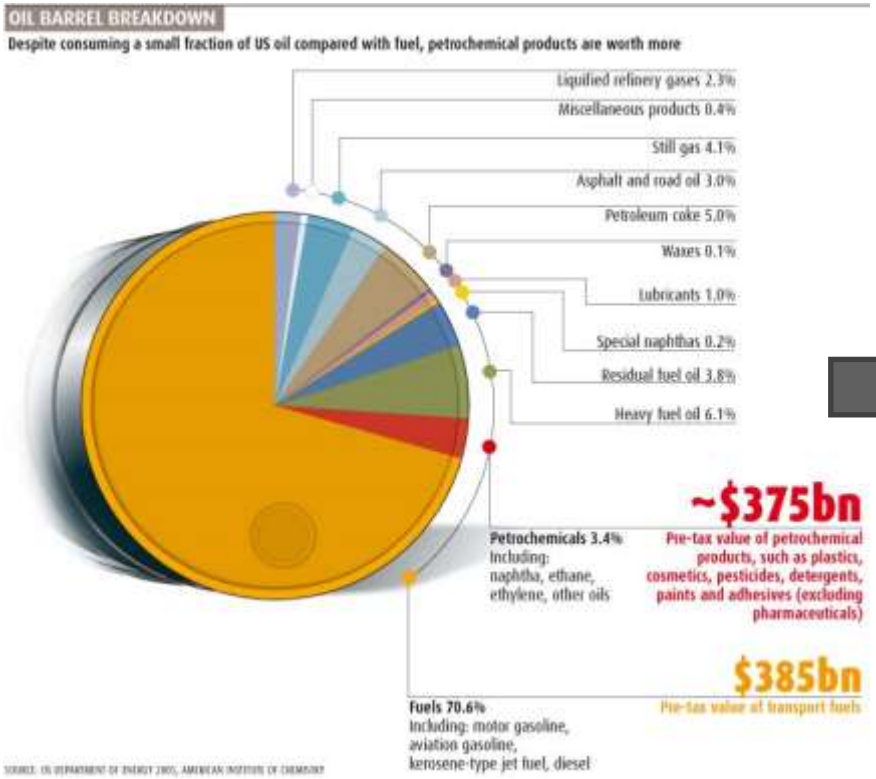
Concept for Py Refinery



Biorenewable Chemicals



Replacing the Whole Barrel



PetroleumOnline.com

Terra Preta Soils

The inspiration for land-applied biochar is the Terra Preta soils of Brazil – ancient soils modified by long-term char amendments.

Normal tropical soil

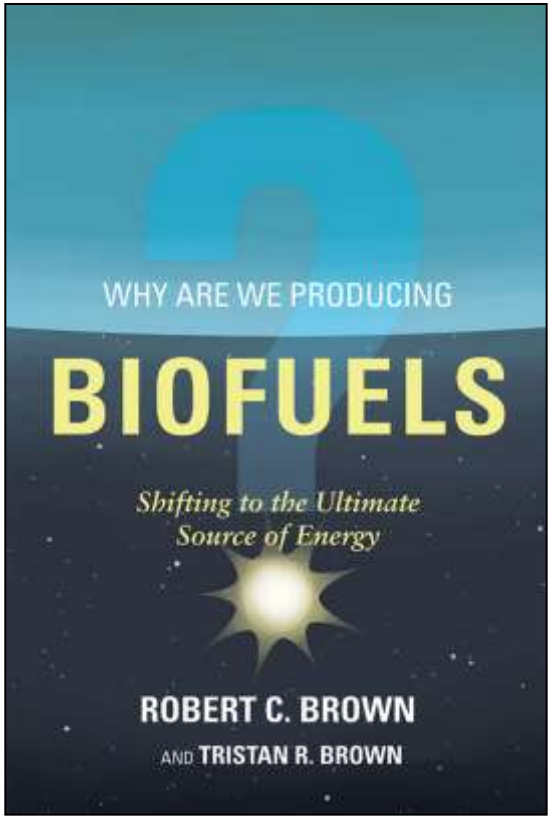
Char-amended soil

http://www.geo.uni-bayreuth.de/bodenkunde/terra_preta/

A new problem?
or
A new opportunity?

- Gulf Hypoxia Task Force requires reduction of N and P load to Gulf
- New bioprocesses can convert perennial crops to biofuels and bioproducts
- Can these two items be linked to create opportunities for farmers?

Additional Information



Available at Amazon.com