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Impact of RFS Rules on Rural America: Will demand for CO2 offsets grow?

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GHG LCA Results: State of the Art

	Iowa NG	NE Wet	NE Coal	NE - Closed Loop
Dry DGS (%)	22	0	100	0
Modified DGS (%)	23	0	0	0
Wet DGS (%)	55	100	0	100
Net Energy Ratio (MJ/MJ)	1.76	1.79	1.29	2.23
GHG Intensity (gCO2e/MJ)	42	37.5	76	43.8
GHG Reduction (%)	54	59	17	52

Source: Liska et al. “Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol.” *Journal of Industrial Ecology* http://dx.doi.org/10.1111/j.1530-9290.2008.00105.x

Biofuels Impacts

- Feed Grains: 60 billion liters of ethanol represents 12% of world production
- Oilseeds: 15 billion liters of biodiesel represents 11% of world production of vegetable oil
- Sugarcane: 30 billion liters of ethanol represents 6% of oilseeds land potentially displaced

Market Price Impacts

- Assuming no change in aggregate production
  - 17% reduction in available vegetable oil would increase price by 84%
  - 12% reduction in feed grain supplies would increase price by 60%

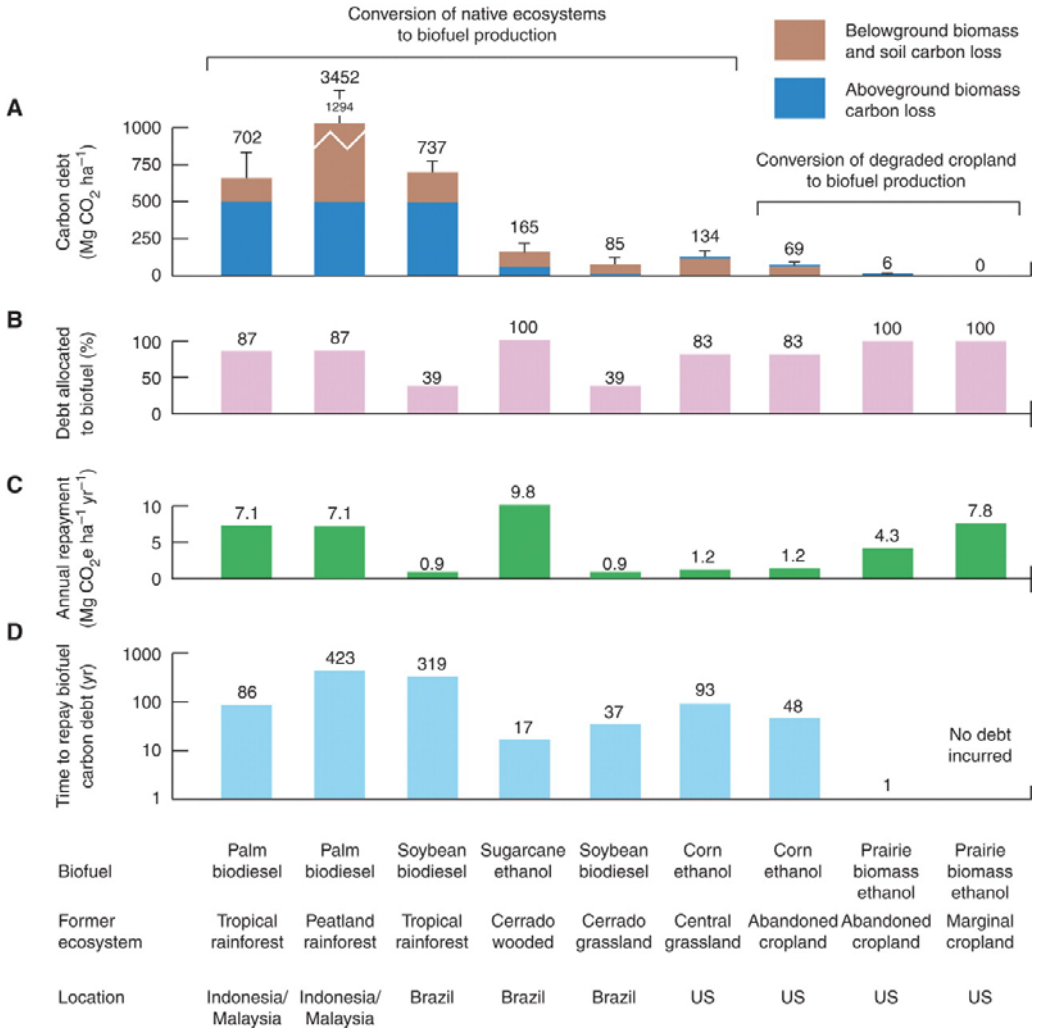
Market Adjustments

1. Land planted to wheat, rice, and other crops will be switched to oilseeds and feed grains
   - Price increases for oilseeds and feed grains will be lower than without the adjustment. Prices for other crops will be higher.
2. New land will be brought into production
   - Market prices for all crops will increase by a smaller amount.

Some arithmetic

- Fargione, et al:
  - Calculates CO2 debt per acre of land cleared because of biofuels

Fig. 1. Carbon debt, biofuel carbon debt allocation, annual carbon repayment rate, and years to repay biofuel carbon debt for nine scenarios of biofuel production



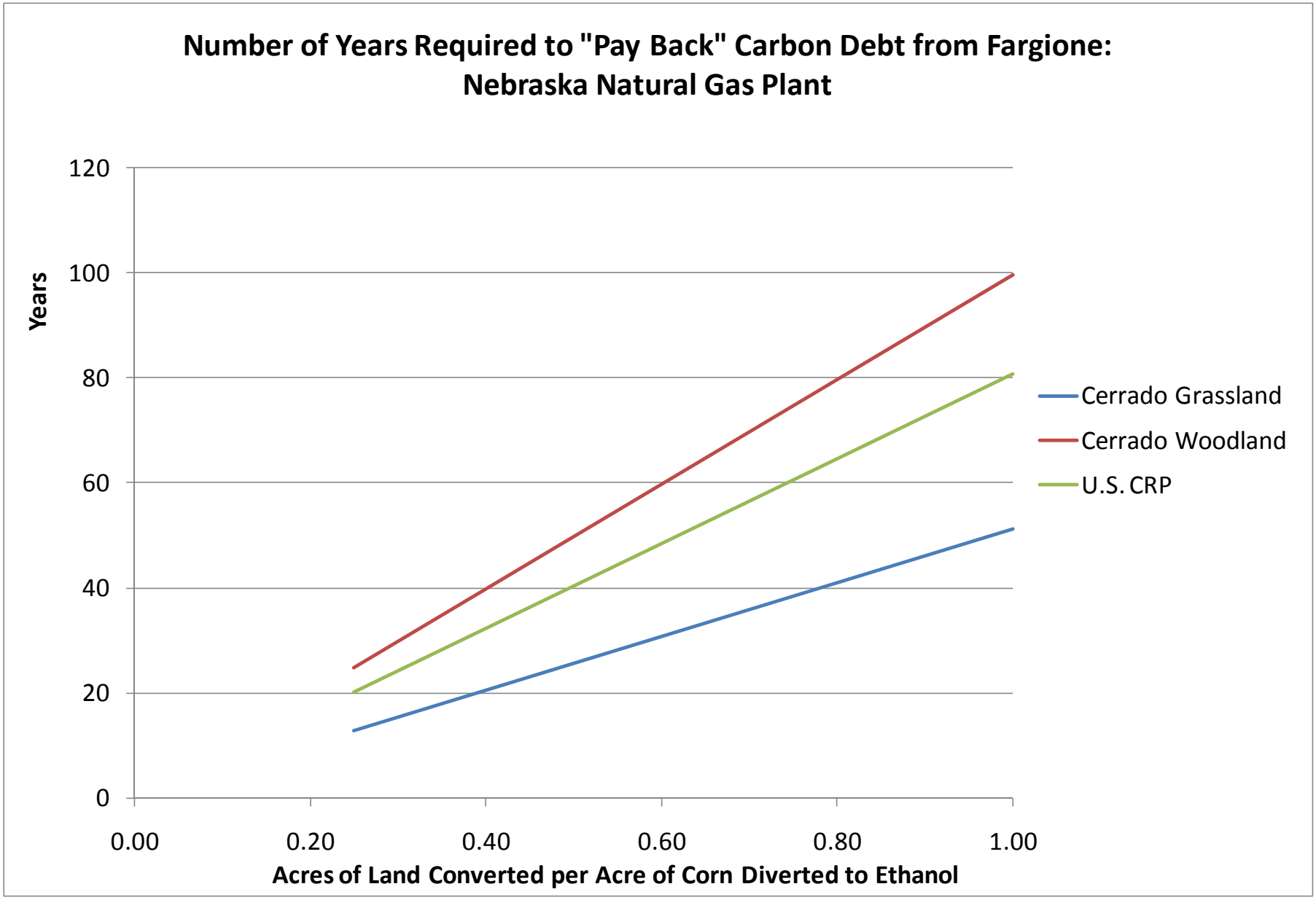
J. Fargione et al., Science 319, 1235 -1238 (2008)

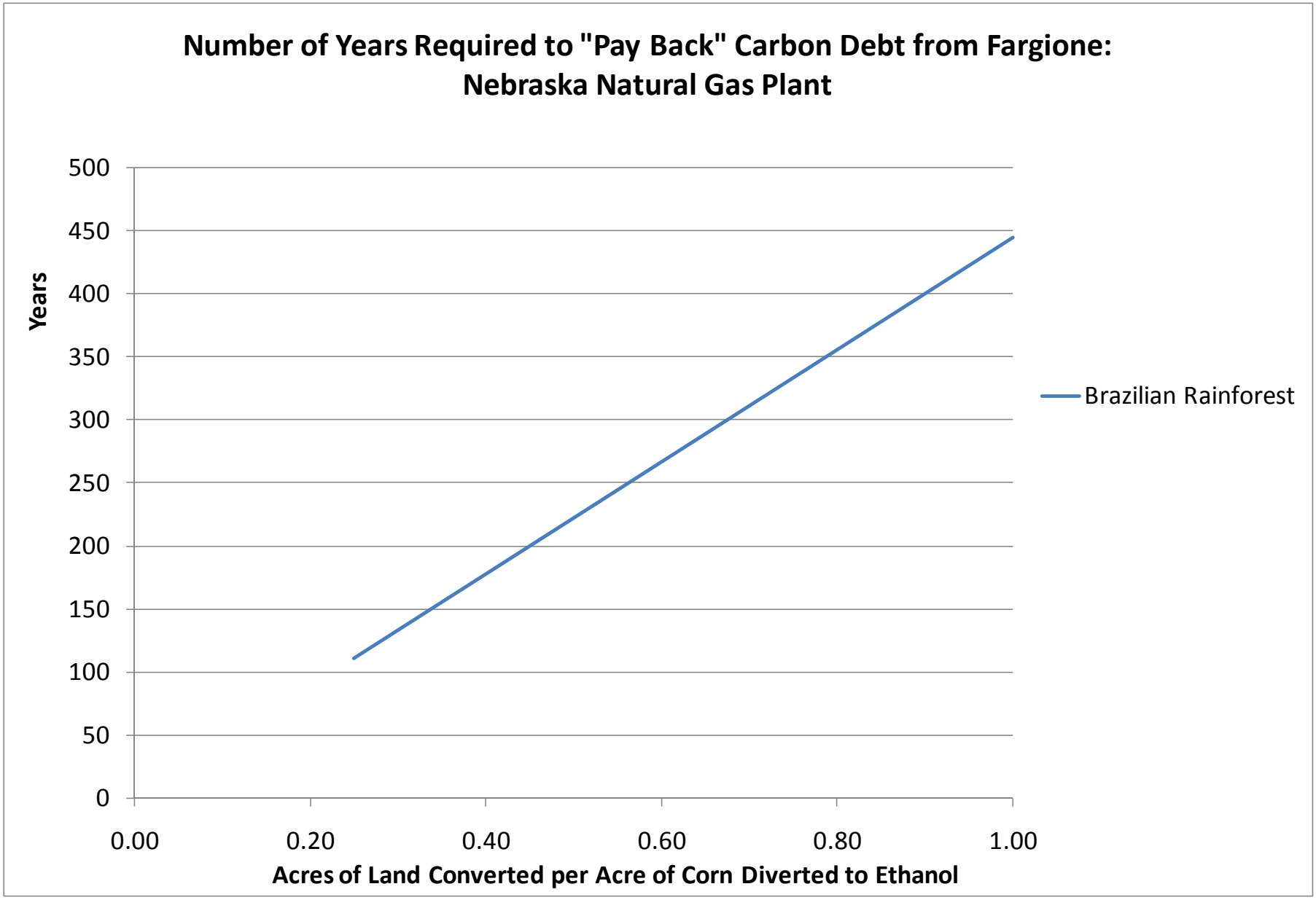
Published by AAAS

Science
AAAS

Some arithmetic

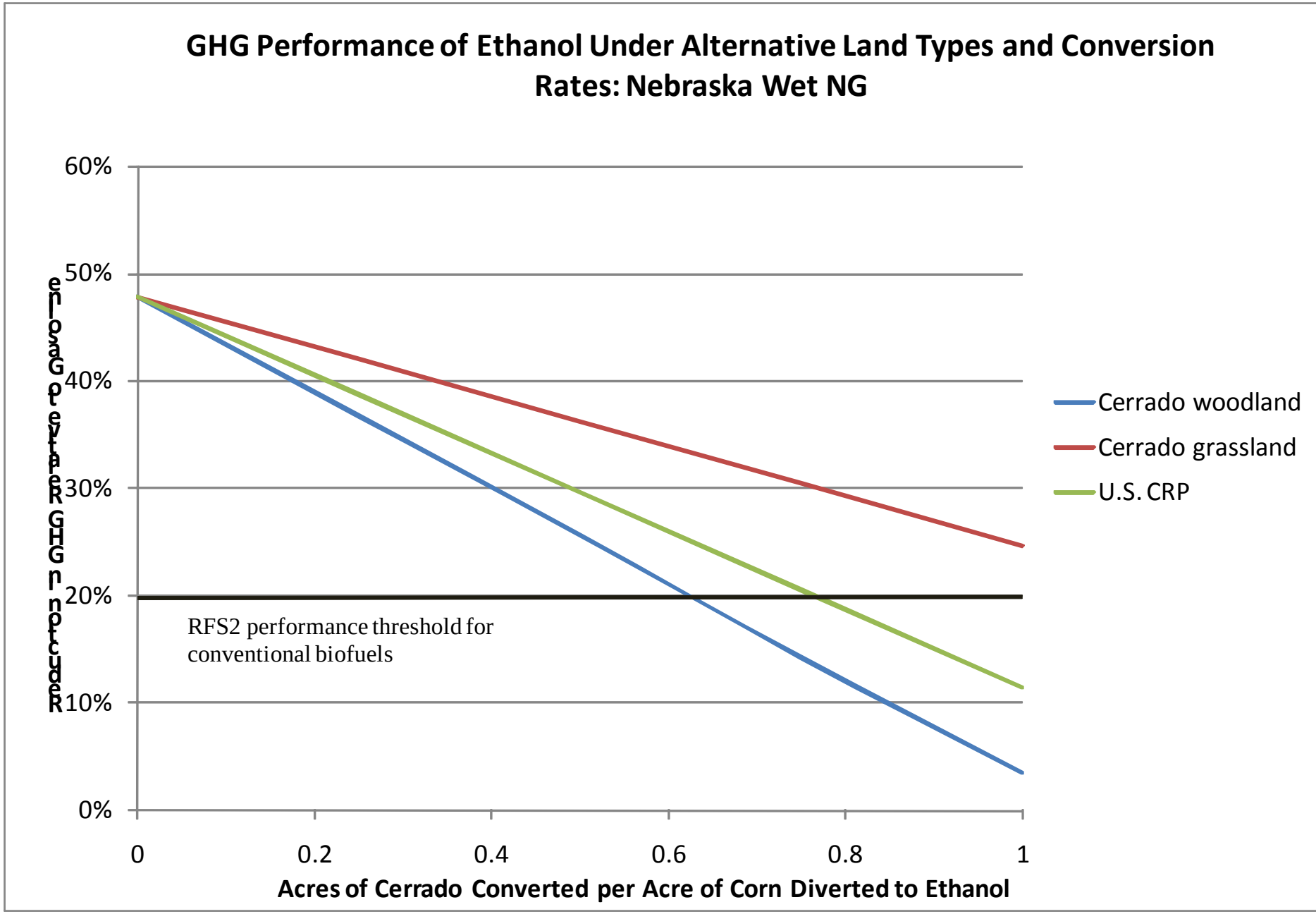
- Fargione, et al:
  - Calculates CO2 debt per acre of land cleared because of biofuels
- Cassman:
  - Ethanol reduces GHG emissions by between 16 and 47 grams per MJ or between 0.6 and 1.66 Mg per acre of corn used for ethanol.
- Key question: How many acres of cropland are brought into production per acre of corn diverted for ethanol?

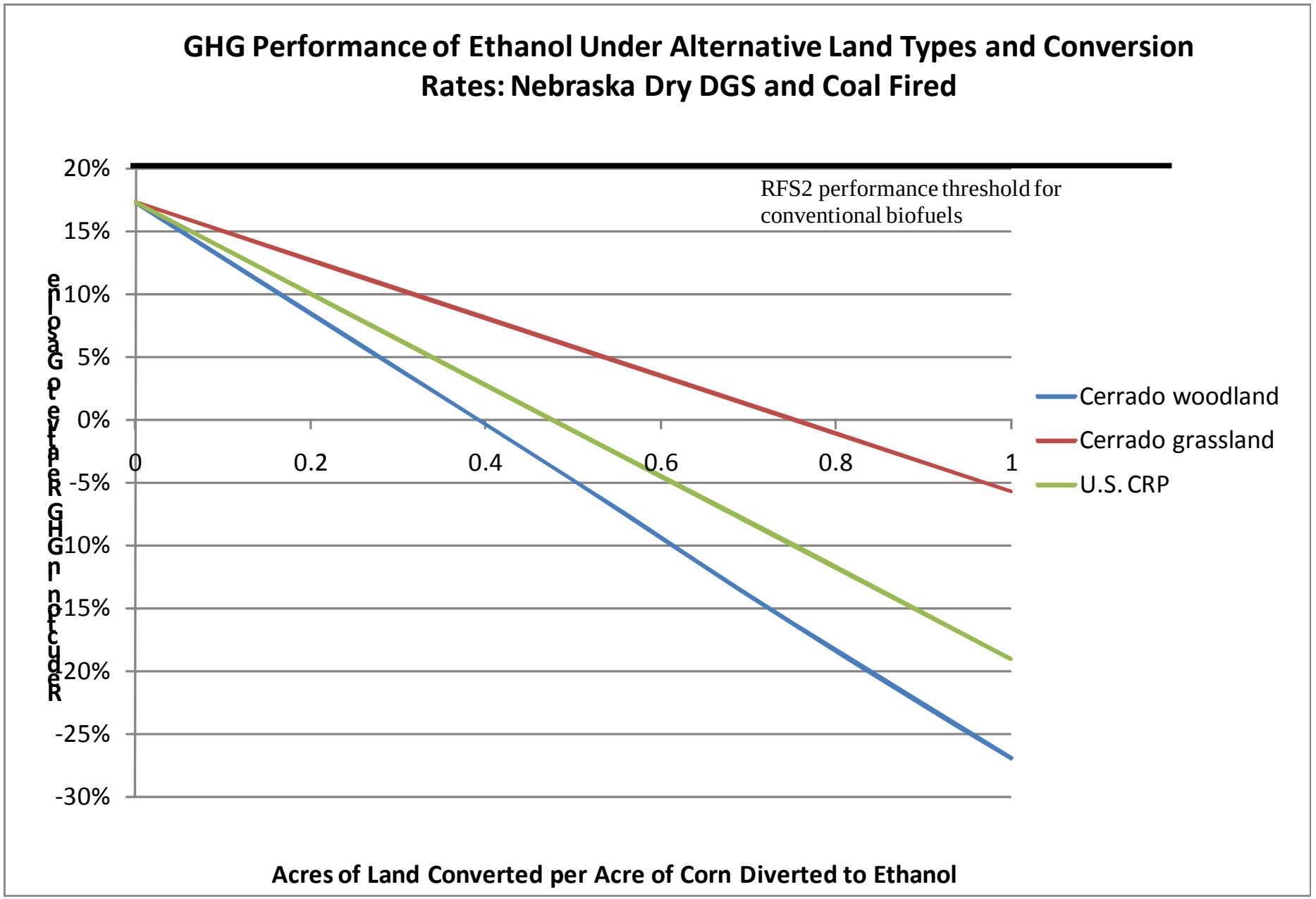

Number of Years Required to "Pay Back" Carbon Debt from Fargione: Nebraska Natural Gas Plant
Years
120
100
80
60
40
20
0
0.00
0.20
0.40
0.60
0.80
1.00
Acres of Land Converted per Acre of Corn Diverted to Ethanol
Cerrado Grassland
Cerrado Woodland
U.S. CRP

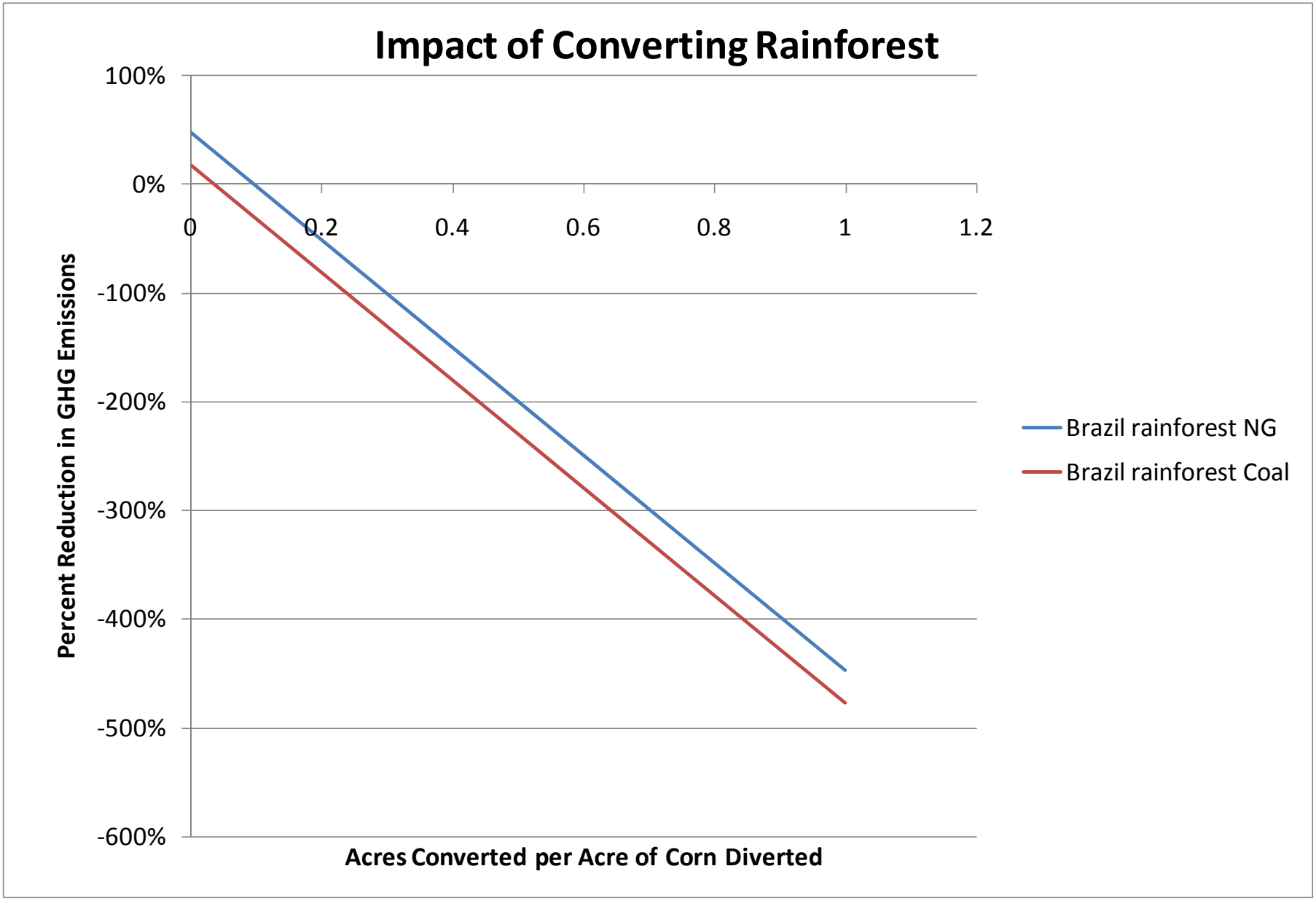

Number of Years Required to "Pay Back" Carbon Debt from Fargione: Nebraska Natural Gas Plant
Years
500
450
400
350
300
250
200
150
100
50
0
0.00
0.20
0.40
0.60
0.80
1.00
Acres of Land Converted per Acre of Corn Diverted to Ethanol
Brazilian Rainforest

The Problem for Ethanol Even with a 100 Year Time Horizon

- EPA discounts CO2 emissions so future reductions count less than current emissions
- EPA then compares present value of emissions to figure out the percent reduction


GHG Performance of Ethanol Under Alternative Land Types and Conversion Rates: Nebraska Wet NG
60%
50%
40%
30%
20%
10%
0%
0
0.2
0.4
0.6
0.8
1
Acres of Cerrado Converted per Acre of Corn Diverted to Ethanol
RFS2 performance threshold for conventional biofuels
Cerrado woodland
Cerrado grassland
U.S. CRP


GHG Performance of Ethanol Under Alternative Land Types and Conversion Rates: Nebraska Dry DGS and Coal Fired
RFS2 performance threshold for conventional biofuels
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
-30%
0
0.2
0.4
0.6
0.8
1
Cerrado woodland
Cerrado grassland
U.S. CRP
Acres of Land Converted per Acre of Corn Diverted to Ethanol


Impact of Converting Rainforest
100%
0%
-100%
-200%
-300%
-400%
-500%
-600%
0
0.2
0.4
0.6
0.8
1
1.2
Percent Reduction in GHG Emissions
Acres Converted per Acre of Corn Diverted
Brazil rainforest NG
Brazil rainforest Coal

Key Questions

1. If CARB and EPA rules result in corn ethanol as not meeting low carbon fuels standards or GHG performance thresholds, what offset options would farmers and ethanol plants have?
2. How much incentive does the industry have to try to offset land use emissions?

Idea of Offsets

- The burden of emissions from imputed land use changes due to biofuels could be reduced through reductions in emissions
  - at the plant
  - on farms that deliver feedstock
  - elsewhere

Plant Offsets

- Reduce drying of distillers grains
- Capture CO2 emissions
- Power plant from renewable energy sources
  - Methane from manure
  - Wind generated electricity
  - Biomass-generated electricity

On-Farm Offsets

- Greater efficiency of nitrogen use in combination with adoption of higher yielding hybrids
- Greater adoption of no-till

Offsets Elsewhere

- Increase crop yields overseas
  - Reduce financial constraints that keep yields low
- Reduce deforestation rates
- Buy them at the market price

Economics of Offsets

- Only invest in offsets if benefits exceed their costs
- Benefits:
  - If EPA or CARB rules allow plants to improve their own scores, benefit equals ability to build a new plant and sell at RFS price or to sell in California at a possibly higher price

Key Role of Carbon Market

- If a market for CO2 reductions develops, the cost of offsets will be made clear
  - First rule: Buy them if their price is lower than the cost of developing them
  - Second rule: Sell them if their price is greater than the cost of development
- Invest in offsets if the benefits from making biofuels eligible are greater than the costs

Industry Demand

- Market for corn ethanol is scheduled to grow beyond existing capacity.
- If 20% GHG target not met for existing plants, RIN value would have to increase enough to cover cost of offsets and capital costs of a new plant
- Eventual shortage of conventional biofuels likely to be met with imported sugarcane ethanol

Biofuels or CO_2 Regulation?

- Demand from biofuels industry for offsets will be dominated by economy-wide CO_2 market
- Supply of U.S. agricultural offsets will be determined by the market price of CO_2
- Biofuels industry may be one player in a large market
  - As a buyer if price is low relative to benefits
  - As a seller if price is high