Low Carbon Pathways: Market Expanding Opportunities

Ethanol Emerging Issues Forum
Omaha, Nebraska
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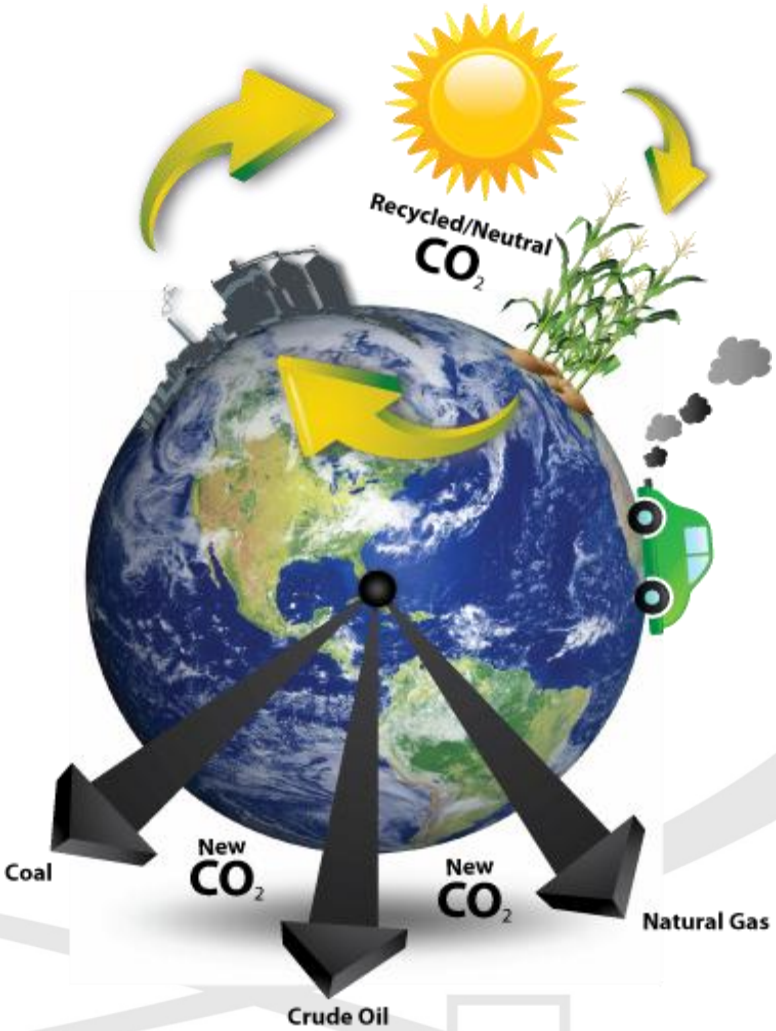
Overview

- Carbon Dioxide and Global History
- Energy Independence & Security Act (new gallons)
- 2014 Proposed Volumes
- RIN Trading History (recent)
- D-6 Corn Ethanol Requirements
- D-3 Cellulosic Ethanol
- D-5 Advanced Ethanol
- Key Markets
  - ✓ Brazil
  - ✓ California
  - ✓ Europe
- Figure Out California Pathways and Premiums
- Ship to EU
- Plant RIN Reporting Obligations
- Summary

Understanding Carbon Dioxide

The carbon cycle is where carbon is cycled and re-cycled through air, ground, plants, animals and fossil fuels.

- "Neutral Carbon" is re-cycled through air, ground, plants and animals through photosynthesis, respiration and decay. These processes keep the atmosphere in balance.
- "New Carbon" is introduced from fossil fuels such as coal, crude oil and natural gas.
- Carbon accounting (per Kyoto) is only for "new" carbon.



CO2 can only be "new" or "neutral"

Global CO2 History (background CO2…..NOAA Research)

(Mauna Loa, Hawaii)	ppm CO2 (mean)
2013	397
2012	396
2011	394
2010	390
1958	315
(no pre 1958 monitoring data)	Since 1958 CO2 increasing at 1.5 ppm/yr

Antarctic ice cores (2007)	ppm CO2 (mean)
1832	284
	1832 to 1958 increasing at 0.25 ppm/yr

Energy Independence & Security Act…..ethanol volumes required to meet EPA mandates.

2014 EPA proposed:

- 15.21 bgy (renewable)
- 2.20 bgy (advanced D5)
- 0.017 bgy (cellulose D3)
- 1.28 bgy (biomass diesel D4)
- leaves 13.0 bgy (corn D6)

Why (per EPA)?: volume limits (blend wall) for obligated parties
ethanol plants ability to produce the volumes

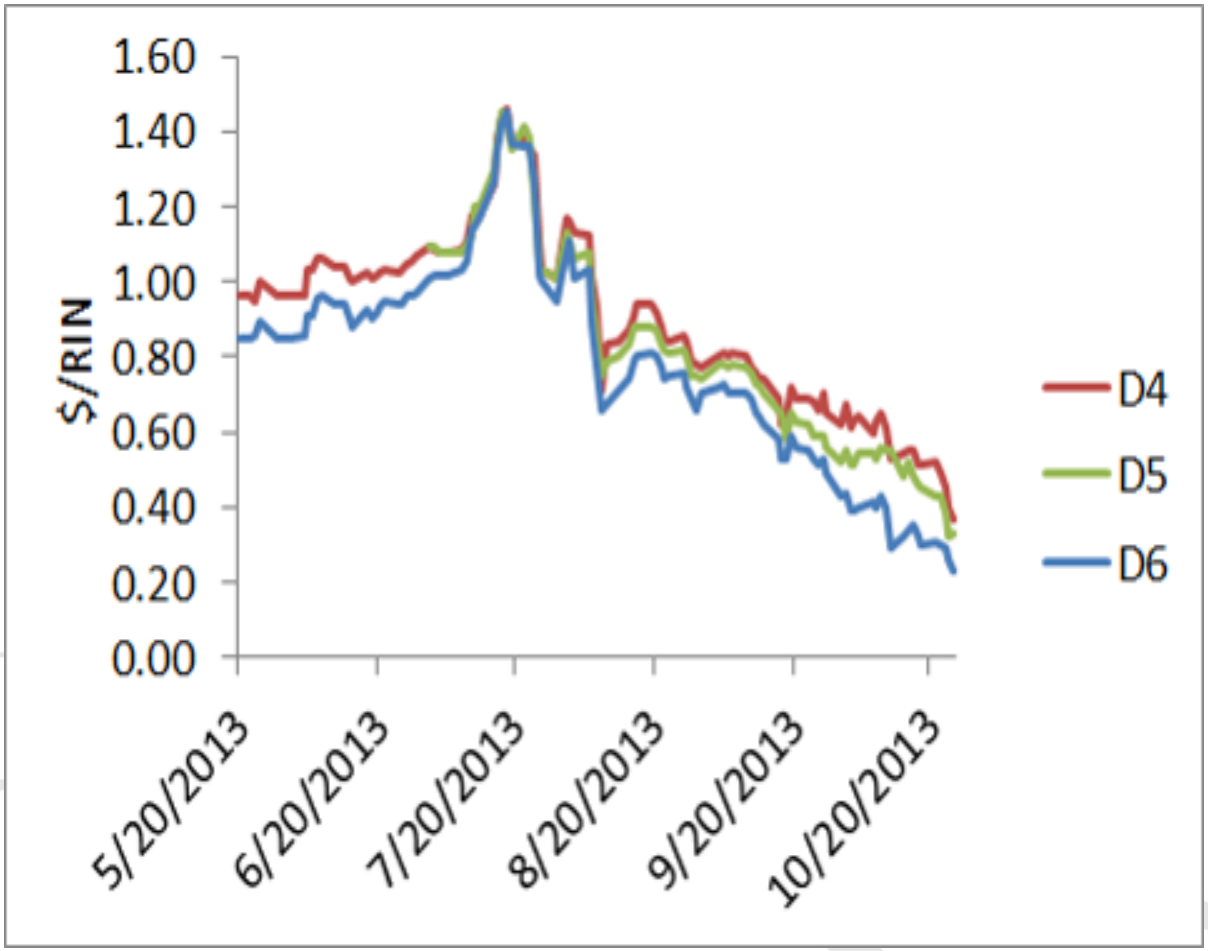
RIN Separation and RIN Markets

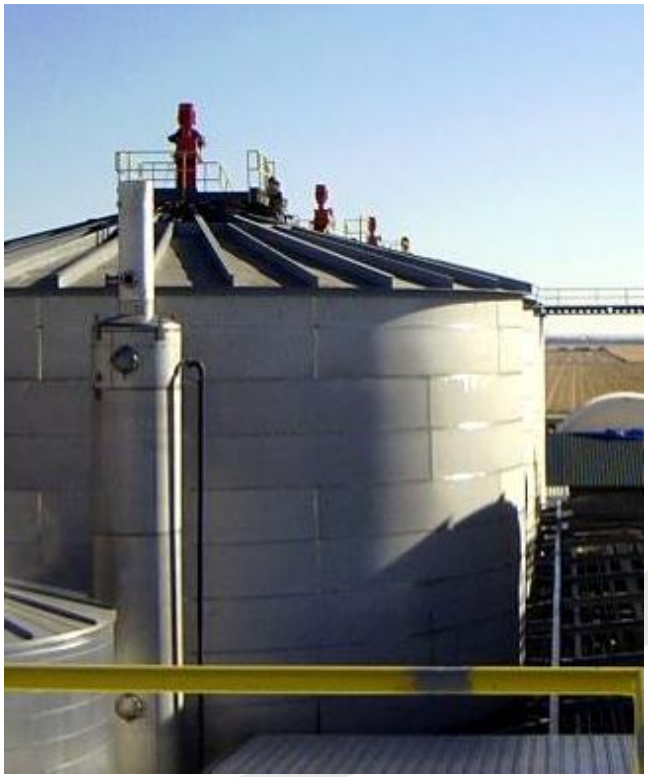
- When ethanol is sold to an obligated party (e.g., oil company), the RIN is separated, surrendered to regulators, or sold
- The blender is obligated to surrender sufficient RIN certificates to meet their regulatory mandate of blending a set amount of ethanol
- If an obligated party buys more ethanol than it needs, those surplus RINs can be sold to other obligated parties, e.g., E85 & E15 generates excess RINs for states requiring E10
- **Obligated parties holding excess RINs may use those surplus "paper gallons" in lieu of buying physical ethanol……**

Conclusion: RIN credits may cause market disruptions

Recent RIN Trading History

D4 Biodiesel, D5 Advanced Ethanol, D6 Corn Ethanol





50 States: EPA Ethanol RIN Classifications

New gallon opportunities for existing plants:

- D-3 Cellulose
- D-5 Advanced
- D-6 Corn

First……

D-6 RINs (corn ethanol)

New Gallons require 20% CO_2 reductions by…

1. 2 advanced technologies = 20% (see below)
2. 1 advanced technology with < 65% DDGS
3. no advanced technology required, < 50% DDGs

EPA's Listed 5 Advanced Technologies…

1. Corn oil fractionation; 90% of corn (dry frac)
2. Corn oil extraction (1.33 lb/bu)
3. Membrane separation (90% of ethanol)
4. Raw starch hydrolysis (cold cook)
5. Combined Heat and Power (90% of plant steam)

D-6 RINs (continued)

or, up to 20% CO_2 reductions by EPA petition for:

1. bolt-on technology (e.g. Agrebon thin stillage digestion)
2. feedstock (e.g., blending Enogen corn w/#2 yellow dent corn)
3. advanced chemical package (lowers energy consumption)

above achieving (per March 2014 EPA conversations)

- **< 25.3 scf nat gas/gal ethanol (preliminary)**
- **< 0.64 kWh grid power/gal ethanol (preliminary)**
- **minimum yield gal/bu (undecided maybe 2.7+)**
  - ✓ **requires EPA approval (tbd maybe a letter, but no petition)**
  - ✓ **updated RFS2 Engineering report (for new gallons)**

Due to back log of 35 petitions, EPA has suspended review of all corn ethanol petitions until about October, 2014 (likely beyond)

D-3 RINs (cellulose)

New Gallons: Requirements

- Agricultural residues (e.g., stover)
- Switchgrass
- Cellulosic components of separated foodwaste (fiber/bran)
  - ✓ Recent ERI interpretation of regs that "any" cellulose ethanol process meets 60%
  - ✓ EPA may limit starch carryover from imperfect milling

Achieving reductions?

- Biogas for combustion (e.g., landfill gas, syngas)
- Non fossil fuel power (e.g., hydro, wind, nuclear)…new
- Scrubber Sequestration (geological study and power implications). Potential for 30 grams CO2/MJ reductions

D-5 RINs (advanced ethanol)

Advanced Requirements *

- Milo
- Foodwaste (e.g., wheat starch water)
- Other non corn starch (e.g., barley)

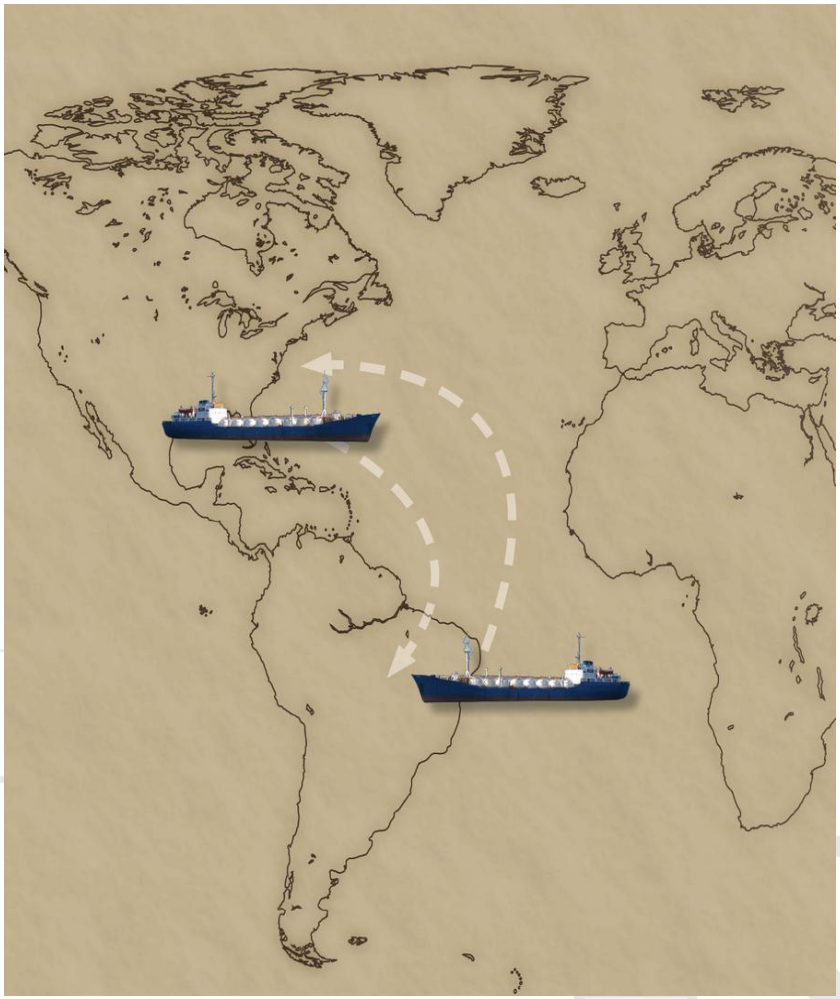
* 50% reduction in carbon emissions (from US gasoline baseline)

Achieving 50% reductions (EPA's current position)?

- Biogas CHP* and 100% wet DGS

*carbon neutral steam and power (big hurdle)

Ethanol Markets: Ship to Brazil?



Ships passing at night….

- US demand to meet RFS2
- CA demand to meet LCFS
- Brazil shipping to US and EU
- Brazil backfilling exports with lower cost US ethanol
- 107 of Brazil's mills are registered to ship to US
- 44 of Brazil's mills are registered to ship to California

Brazil's Ethanol Specifications

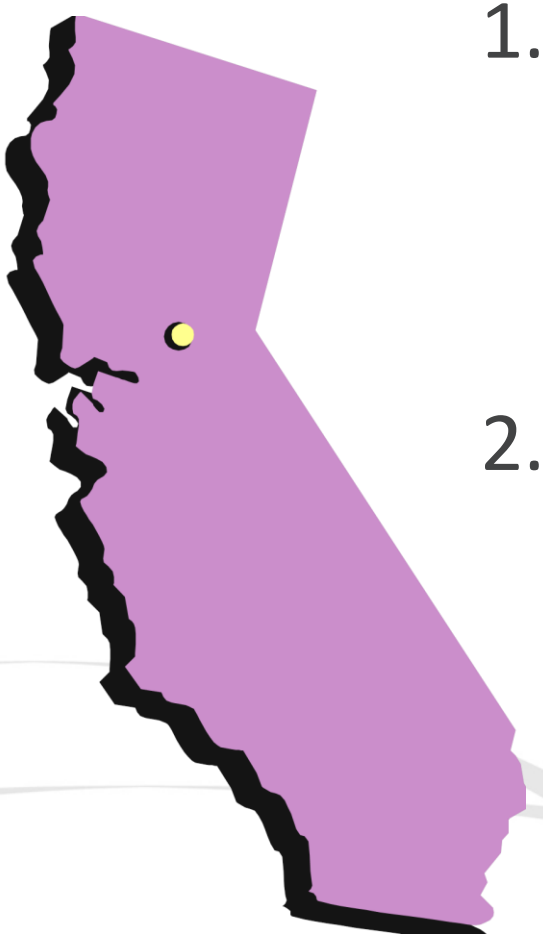
Specifications (per Law 11.097):

- Anhydrous: 0.4% water by volume
  - ✓ Anhydrous alcohol content: 99.6% volume
- Hydrous: 4.9% water by volume
  - ✓ Hydrous alcohol content: 95.1% volume
- Denaturant: 0% (none)

Comments:

- Must be from renewable biomass (i.e., not synthesized from natural gas)
- No carbon intensity limit or LCA requirements (unlike EU)
- US plant may need more mole sieve capacity (reduce water)
- Spot Brazil Ethanol Prices (source: Progressive Farmer, March 12, 2014)
  - Anhydrous $2.41/gal
  - Hydrous $2.17/gal

Ship to California?



1. Check CARB Table
   - Find a “pathway” that best describes your facility
     - Midwest, Dry Mill, WDGS, NG (90.1)
2. Is the CARB number for a specific pathway less than CA Gasoline?
   - CARBOB is 99.18 grams CO2e/MJ
   - If no, you need to get a pathway with a lower number
     - Midwest, Dry Mill, DDGS, NG (98.4)

California: CARB Table (CA-GREET Model)

ILUC penalty 30 (corn), just proposed at 23.2 g CO2/MJ
ILUC penalty 46 (cane, Brazil), just proposed at 26.5 g CO2/MJ

Pathway: Excerpted from CARB's Lookup Table (natural gas fired, unless otherwise noted)	w/o ILUC grams CO2/MJ	w/exsit ILUC grams CO2/MJ
California CARBOB (basis: Kern Heavy Crude and Canadian Oil Sands)		**99.18**
Midwest Dry Grind (100% DDGS)….existing CARB pathway	68.40	98.40
Midwest Dry Grind (100% DDGS).....1 plant's specific pathway	57.30	87.30
Midwest Dry Grind (100% WDGS)…existing CARB pathway	60.10	90.10
Midwest Dry Grind (100% WDGS)….1 plant's specific pathway	49.90	79.90
Midwest Dry Grind (100% DDGS) 10% LFG.....1 plant's specific pathway	53.60	83.60
Brazilian Sugarcane Ethanol (bagasse): any Brazilian plant	27.40	73.40

CA Premiums (how to figure it out)?

Lower CI pathways capture market premiums in CA:

Example:

- CI market of 0.63 cents/gram CI reduction
- Plant specific CI of 79.90 grams CO2/MJ (100% Wet)
- CARBOB CI = 99.18 grams CO2/MJ

Premium Calculation:

99.18 g CO2/MJ
-79.90 g CO2/MJ
19.28 g CO2/MJ (CI reduction from CARBOB)

19.28 x 0.63 cents/g CI reduction = 12.1 cents/gal (premium)
100 MMgpy x 12.1 cents/gal = $12.1 million/yr premium

CARBOB (California Reformulated Gasoline Blendstock for Oxygenate Blending) or simply California Gasoline

ILUC debate: All over the map

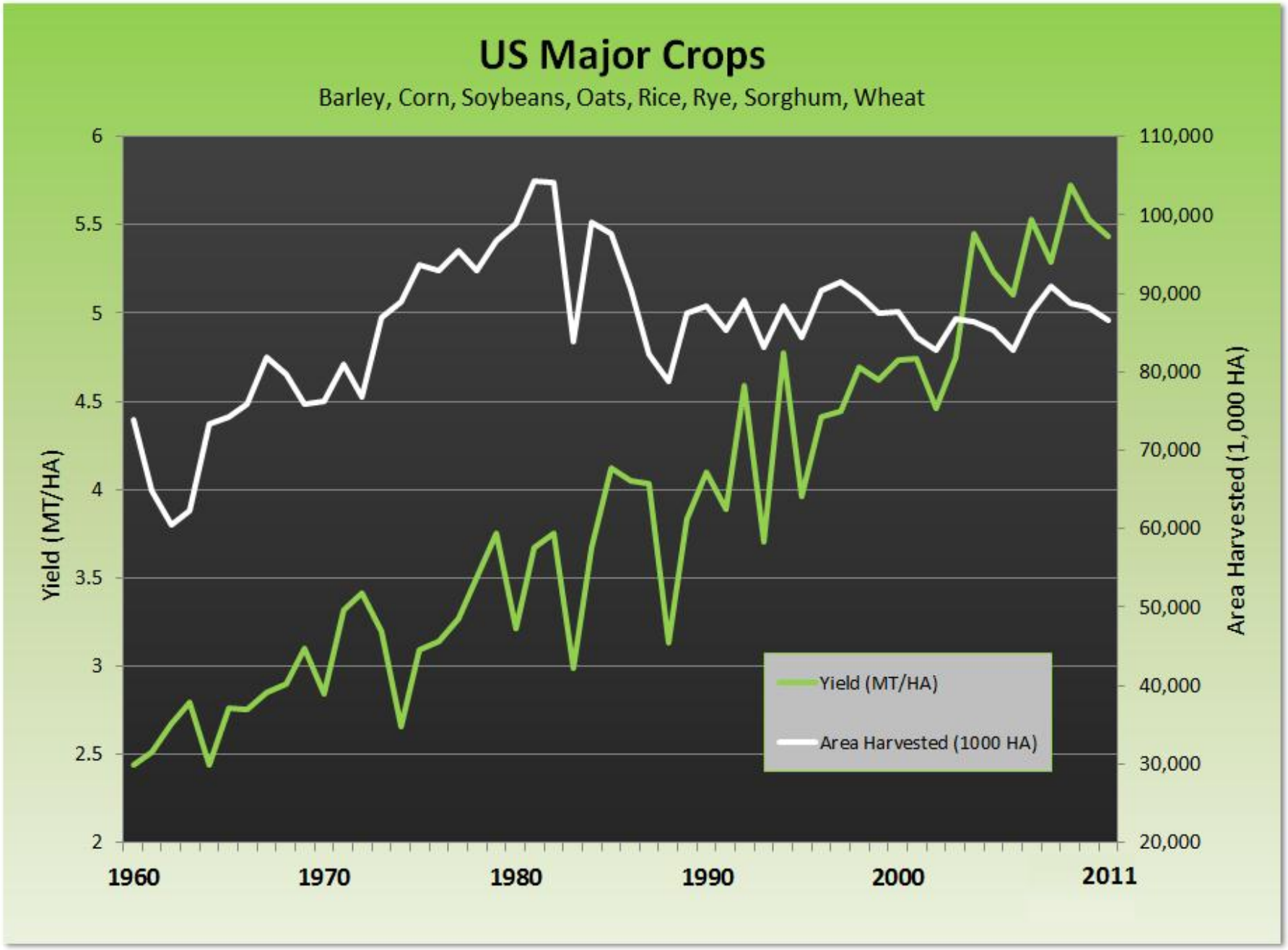
Corn ILUC adder (grams CO2/MJ):

- Searchinger 104.0
- California (CARB) 30.0 (proposed 23.2)
- United States (EPA) 28.4 (rumored to drop to 9.1)
- Purdue 13.9
- European Union 12.0 (approved, not yet counted)
- Jones 6.9

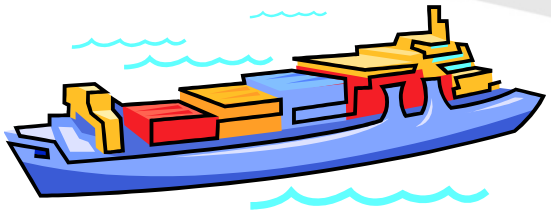
fyi….EPA: Milo 26.2, Barley 10.7

Presently in US and California CI of ethanol must have the ILUC adder (penalty) -- that in some cases makes the CI of a plant's etoh approach or even exceed gasoline (US and California)

Reference: Bill Roddy, Ethanol Across America Paper, Carbon Modeling and ILUC – Separating Fact from fiction, (Winter 2011)


US Major Crops
Barley, Corn, Soybeans, Oats, Rice, Rye, Sorghum, Wheat
Yield (MT/HA)
Area Harvested (1,000 HA)
6
5.5
5
4.5
4
3.5
3
2.5
2
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
1960
1970
1980
1990
2000
2011
Yield (MT/HA)
Area Harvested (1000 HA)

Ship to EU?



- Basic Information
  - As of 1/1/2013 "certification" required (no grandfather)
  - EU gasoline baseline: 83.8 grams CO2/MJ
  - CI must be < 54.47 grams CO2/MJ (35% reduction per RED) *
  - ILUC adder of 12 grams CO2/MJ (starting 2014)
  - w/ILUC, typical US ethanol CI = 60 grams CO2/MJ (29% red)
  - EC has imposed a 9.6% tariff on US ethanol (appx $0.25/gal)
  - Result of tariff, plants could sell at a loss to EU

US Embassy (Brussels) says US State Dept intervention is needed, or EU market may dry up due to EU's protectionist philosophy

* ERI's Carbon Model meets EU (ISCC #205 CI) calculation requirements

So, Markets:

Where is your market now?

Ship to California? EU? Brazil? Canada?

Other developing markets?

Plant RIN Compliance Summary

Ethanol plant reporting obligations (6 reports)

- Unified Report Form: RIN Activity Reporting (quarterly)
- Unified Report Form: RIN Transaction Reporting (quarterly)
- Unified Report Form: Supplemental Report, e.g., green power (quarterly)
- United Report Form: Co-products Report, e.g., DGS, corn oil (quarterly)
- CDX: Renewable Biomass Report (quarterly)
- CDX: Production Outlook Report (annually)

Noncompliance: failure to submit timely reports and inaccurate reporting

(EPA regulations allow civil penalty of $37,500/day/noncompliance)

Summary

- Atmospheric CO2 is increasing by 1.5 ppm/yr
- New gallons must meet EPA % carbon reductions
- RIN trading is driven by supply and demand
- California premiums are about 10 cents/gal +/-
- ILUC is headed in right direction, but not zero yet
  - 50 years increasing yields, 30 years decreasing acres
- Should I consider advanced or cellulosic?
- Should I ship to California for the premium?
- EU dries up (w/9.6% tariff & ILUC causing < 35% red)
- Do I know my carbon number?

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