Biofuel Discussion – Where are we headed and what are the implications for nitrogen and environmental quality?

Integrated Nitrogen Committee
Science Advisory Board
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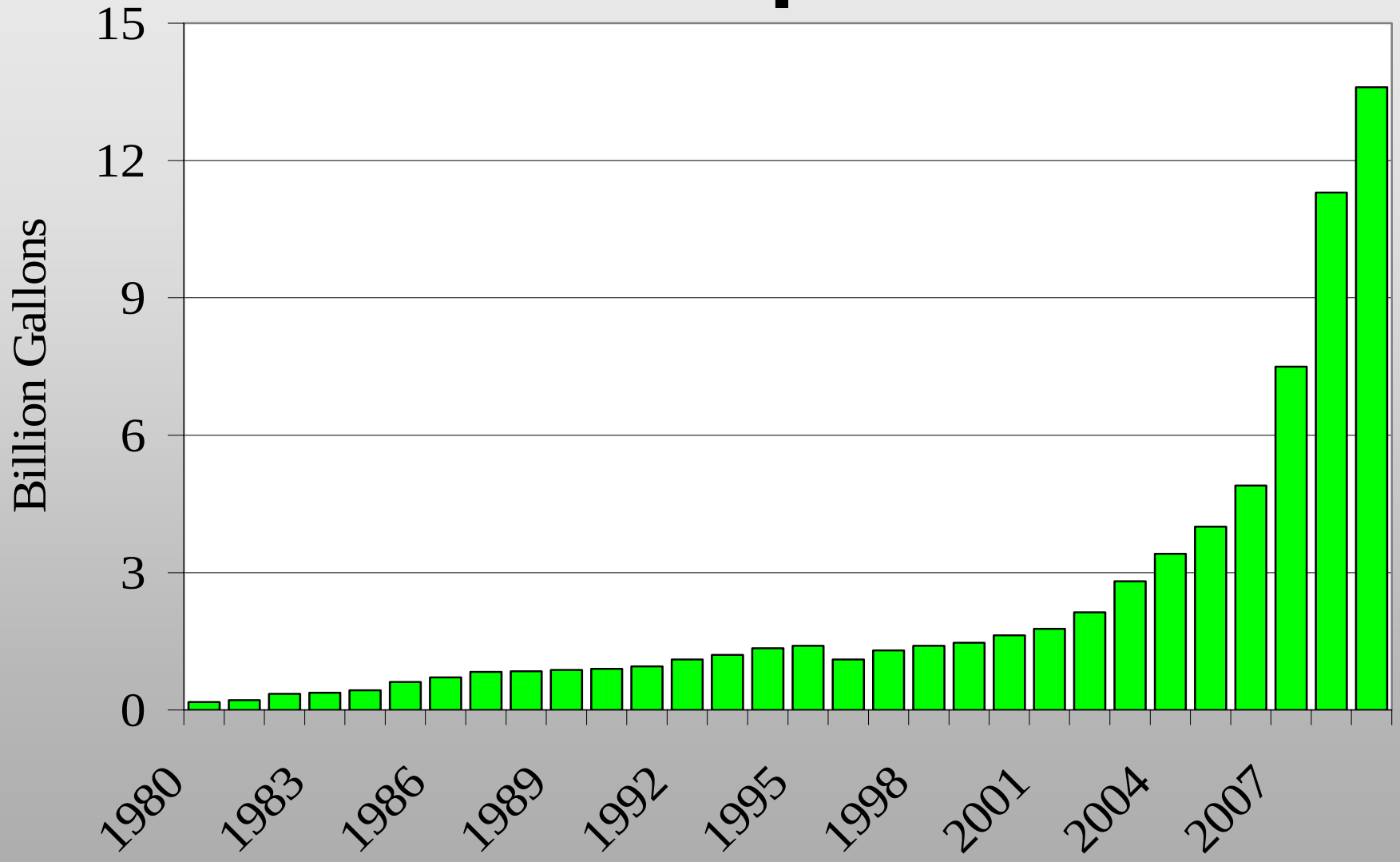
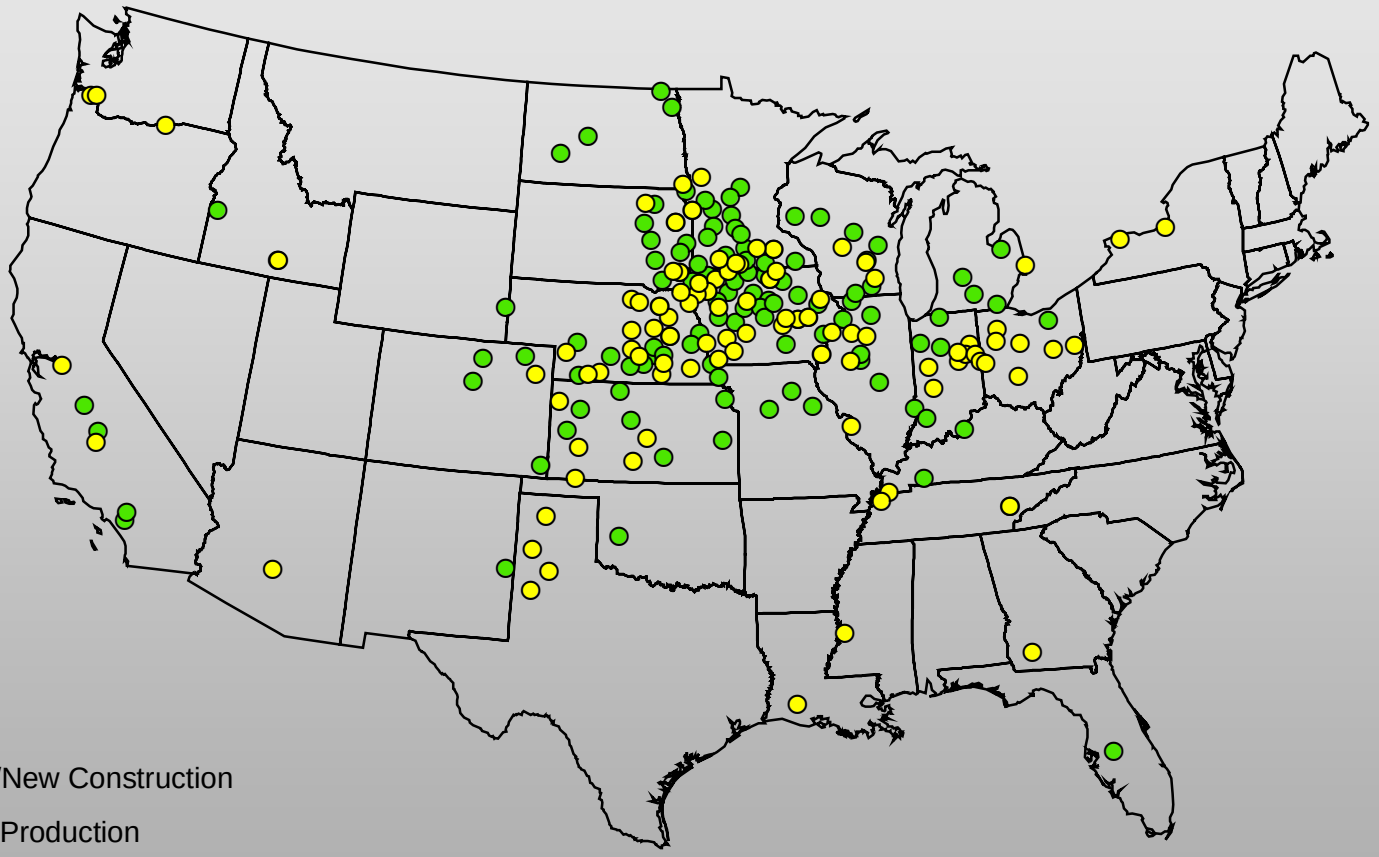
Ethanol Explosion



Source: Renewable Fuels Association and preliminary CARD projections

Ethanol Plants



- Expansions/New Construction
- Currently in Production

LR processor's break-even price for corn?

- Corn price/bu = 2.80 x ((price of gasoline*0.667) + tax credit + octane credit) + DDG price – cost of capital – operating cost
- Long Run Breakeven Corn Price: $4.25/bu
- $60 per gallon price of crude oil translates into $2.07/gallon price of gasoline.
- Sensitivity to current tax credit of $0.51/gallon ($1.40/bu)
- FAPRI: Long run ethanol production of 29B gallons from corn grain

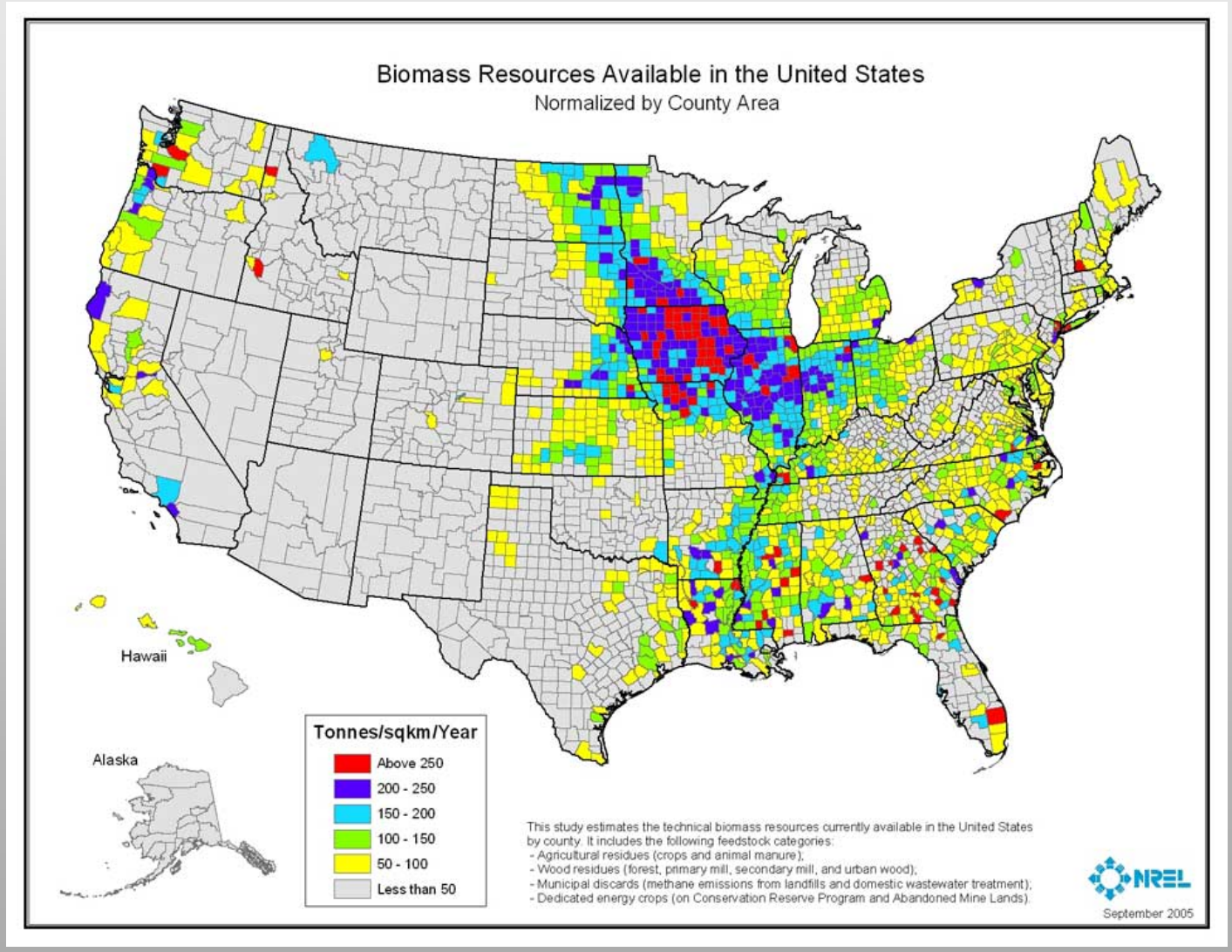
What does this mean for other agricultural commodities?

- Corn price related to ethanol price related to oil price
- Crops and livestock products competing for same domestic and global cropland base – all prices increase
- Growing global demand for oil, agricultural commodities, and nitrogen (and weak dollar exaggerates impacts)
- Food, feed, fuel debate accentuated by all the above as well as short run shocks versus long run patterns
- Growing opportunity cost of cropland and biomass fuels

Is Biomass Feedstock the Answer?

- Significant economic and R&D challenges
- Conversion process and biofuel form
- Carbon and GHG emission reductions relative to corn ethanol
- Commercial scale about 2017?

Iowa the Saudi Arabia of Biomass



Source: U.S. DOE

Biomass processor's MWTP and biomass producer's MWTA

- $P_{RBIOMASS} = \{(P_{Oil}/29)EE + T + V_{BP} + V_O - C_I - C_{PV} - C_O - C_E\}(Y_E)$
- $P_{RBIOMASS}$ = MWTP
- $P_{PBIOMASS} = C_{NR} + C_{HM} + C_T*D + C_S + (C_{ES} + C_{OPP})*(1/Y_B)$
- $P_{PBIOMASS}$ = MWTA
- Market Equilibrium: MWTP = MWTA or subsidize difference

Is biomass ethanol the answer?

- Maximum breakeven processor price for biomass is $80/ton
- Minimum farmer price for delivered biomass is $120/ton
- Transport and storage costs - $50-100/ton
- Opportunity cost of corn land for biomass crop is $250-400/acre
- Social benefit of biofuel ≥ social costs of subsidy?

  Or what is implicit cost/ton of carbon reduced?

Table 3. Sensitivity of Biorefinery's MWTP to Various Scenarios				
Scenario	**Biomass price per ton with tax credit**	**Percentage change from baseline**	**Biomass price per ton without tax credit**	**Percentage change from baseline ($81.35)**
Baseline*	$81.32	-	$45.62	-44%
$110 crude oil	$161.82	99%	$126.12	55%
$90 crude oil	$129.62	59%	$93.92	15%
$70 crude oil	$97.42	20%	$61.72	-24%
$50 crude oil	$65.22	-20%	$29.52	-64%
EE = 0.8	$100.58	23%	$64.88	-20%
EE = 1	$129.55	59%	$93.85	15%
$V_{Byproduct}$ = $0/gallon	$75.02	-8%	$39.32	-52%
$V_{Byproduct}$ = $0.18/gallon	$87.62	8%	$51.92	-36%
C_E = $0.10/gallon	$88.32	9%	$52.62	-35%
C_E = $0.50/gallon	$60.32	-26%	$24.62	-70%
$Y\text{-}_E$ = 80	$92.94	14%	$52.14	-35%
Y_E = 100	$116.18	43%	$65.18	-20%
Interest rate at 15%	$74.40	-9%	$38.70	-52%

* P_{Oil} = $60/barrel, EE = .667, T= $0.51, $V_{Byproduct}$ = $0.09, V_O = $0.05, $C\text{-}_E$ = $0.20, Y_E = 70

Table 3. Sensitivity of Corn Stover Supplier's MWTA to Various Scenarios		
Scenario		**Percentage change from baseline ($122)**
Baseline*	$122	-
D = 10 miles	$113	-7%
D= 60 miles	$128	5%
C_T = $ 0.10/mile/ton	$114	-7%
C_T = $ 0.50/mile/ton	$130	7%
C_{NR} = $5/ton	$117	-5%
C_{NR} = $20/ton	$132	8%
C_{Opp} = $50	$97	-20%
C_{Opp} = $200	$172	41%
Y_B = 1	$172	41%
Y_B = 4	$97	-20%

*C_{-NR} = $10, C_{HM} = $35, C_T = $0.30, D = 40, C_S = $15, C_{ES} = $0, C_{Opp} = $100, Y_B = 2

Table 4. Sensitivity of Switchgrass Supplier's MWTA to Various Scenarios

Scenario		Percentage change from baseline
Baseline*	$172	-
C_{NR} = $5/ton	$167	-3%
C_{NR} = $15/ton	$177	3%
C_{HM-} = $25/ton	$162	6%
C_{HM-} = $45/ton	$182	6%
C_T = $0.10/mile/ton	$164	-5%
C_T = $0.50/mile/ton	$180	5%
D = 10 miles	$163	-5%
D = 60 miles	$178	-7%
C_{ES} = $100/acre	$147	-15%
C_{ES} = $250/acre	$184.50	7%
C_{Opp} = $0/acre	$122	-29%
C_{Opp} = $400/acre	$222	29%
Y_B = 2	$272	58%
Y_B = 8	$122	-29%

*C_{-NR} = $10, C_{HM} = $35, C_T = $0.30, D = 40, C_S = $15, C_{ES} = $200, C_{Opp} = $200, Y_B = 4

Table 5. Sensitivity of Miscanthus Supplier's MWTA to Various Scenarios

Scenario		Percentage change from baseline
Baseline*	$124.78	-
C_{NR} = $5/ton	$119.78	-4%
C_{NR} = $15/ton	$129.78	4%
C_{HM-} = $25/ton	$104.78	-16%
C_{HM-} = $45/ton	$144.78	16%
C_T = $0.10/mile/ton	$116.78	-6%
C_T = $0.50/mile/ton	$132.78	6%
D = 10 miles	$115.78	-7%
D = 60 miles	$130.78	5%
C_{ES} = $200/acre	$116.44	-7%
C_{ES} = $400/acre	$138.67	11%
C_{Opp} = $0/acre	$102.56	-18%
C_{Opp} = $400/acre	$147	18%
Y_B = 6	$151.17	21%
Y_B = 18	$98.39	-21%

*C_{-NR} = $10, C_{HM} = $35, C_T = $0.30, D = 40, C_S = $15, C_{ES} = $275, C_{Opp} = $200, Y_B = 9

What are the nitrogen implications?

- Higher corn price relative to other crop prices, more corn acres and higher nitrogen applications
- Higher the price of corn, larger return to nitrogen ($P_N = VMP_N = P_C * MP_N$)
- Higher nitrogen prices may reduce use
- Higher biomass (switchgrass and miscanthus) yields require more nutrients. If biomass produced on poorer quality land, may increase nutrient use on these lands
- No silver bullet for energy nor for environmental impacts

Thank You!

Questions, comments, or suggestions?

Role of corn and biomass in the nitrogen and environmental quality picture?