Balancing the Needs of a Growing Global Economy

Producing

Feed, Food and Fuel

Sustainably

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ACES 501, Seminar Series on Bioenergy Topics

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GTL resources plc

Premise

•Our national and economic security are compromised by our "four wheeled dependence".

•Oil is a fossil fuel. There will not be anymore created in our lifetime..or our children's lifetime…or their children's lifetime and we continue to use more of it.

•Production and consumption of all fuels has a negative impact on our environment.

•Spending money domestically to produce our own fuels, with our own renewable resources, creates jobs and economic development across America, reduces our federal deficit, and reduces the flow of funds to fund actions against us.

Solution

•Reduce fuel consumption.

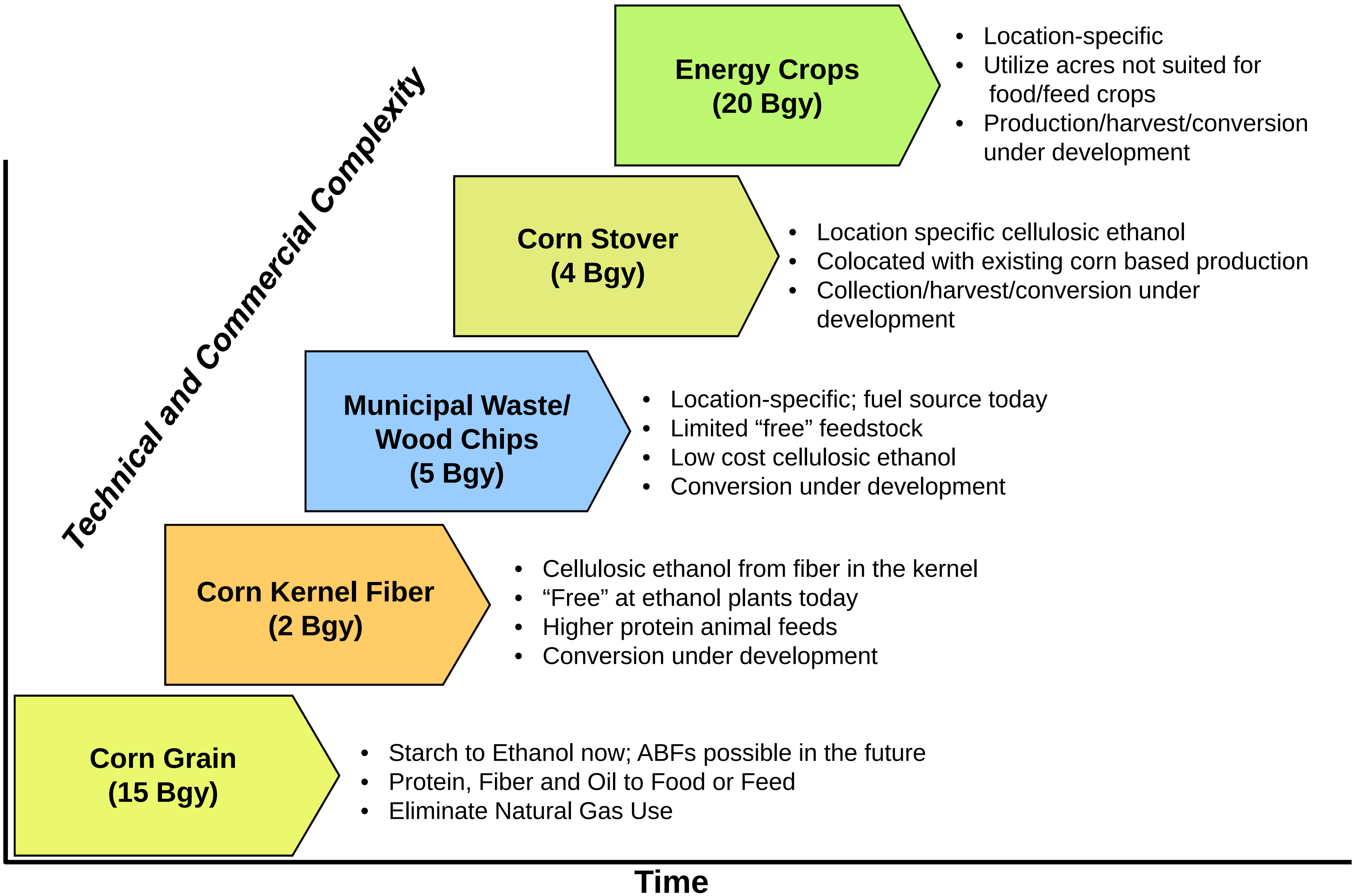
•Provide alternatives – ensuring diversity of fuel sources and products:

- Across inputs – waste, existing crops, new crops
- Across outputs – ethanol, butanol, natural gas, methane, electric
- Across geographies
- Across time

•Remain committed.

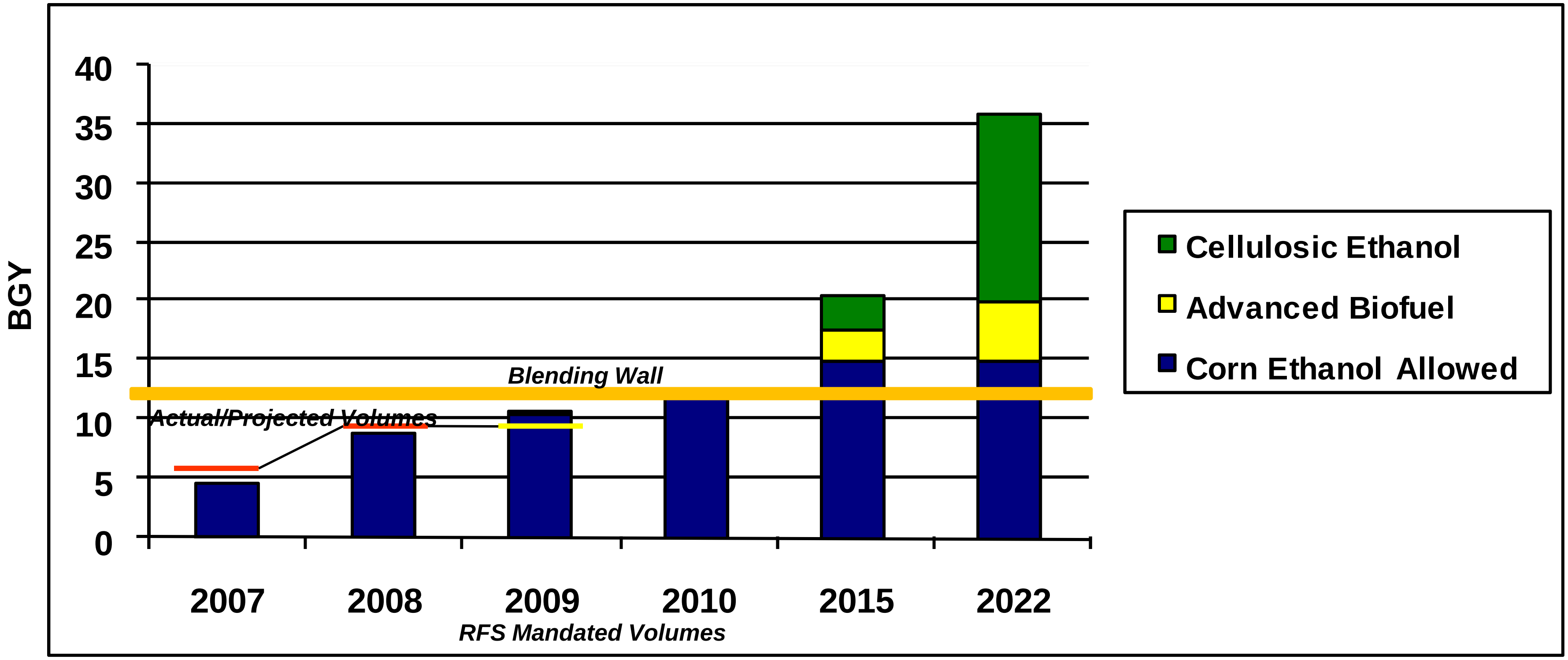
- Advancements will be an evolution, not a revolution
- Solutions won't be perfect out of the gate
- Commercialization is needed to identify the good and that needing improvement

The Path


Energy Crops
(20 Bgy)
• Location-specific
• Utilize acres not suited for food/feed crops
• Production/harvest/conversion under development
Corn Stover
(4 Bgy)
• Location specific cellulosic ethanol
• Colocated with existing corn based production
• Collection/harvest/conversion under development
Municipal Waste/ Wood Chips
(5 Bgy)
• Location-specific; fuel source today
• Limited “free” feedstock
• Low cost cellulosic ethanol
• Conversion under development
Corn Kernel Fiber
(2 Bgy)
• Cellulosic ethanol from fiber in the kernel
• “Free” at ethanol plants today
• Higher protein animal feeds
• Conversion under development
Corn Grain
(15 Bgy)
• Starch to Ethanol now; ABFs possible in the future
• Protein, Fiber and Oil to Food or Feed
• Eliminate Natural Gas Use
Technical and Commercial Complexity
Time

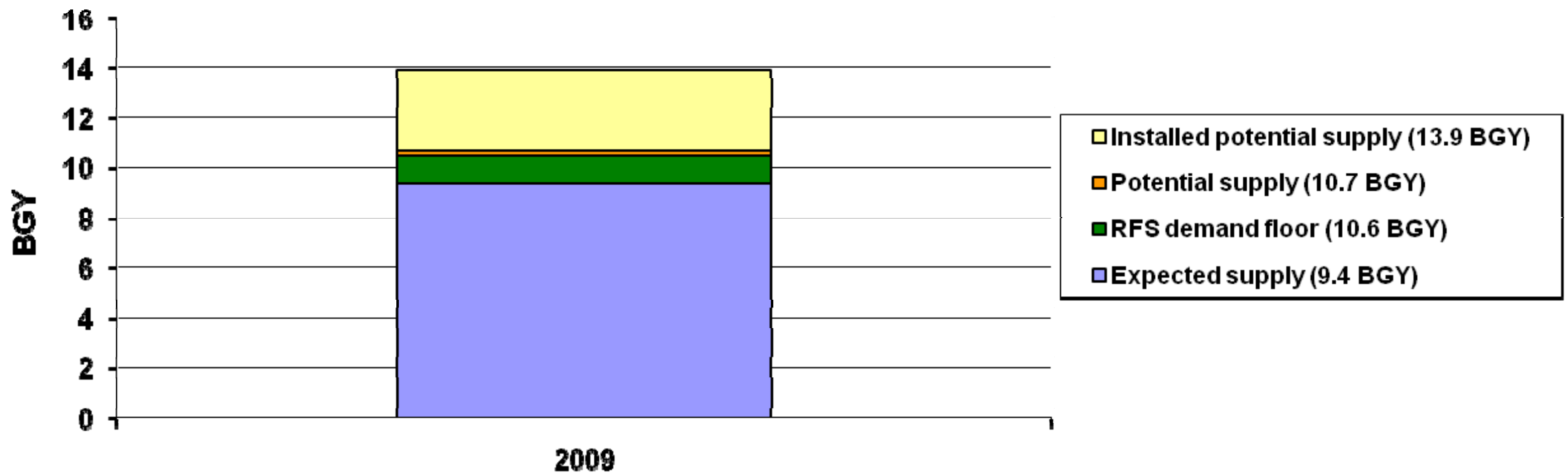
Context: Historic Ethanol Supply and Demand

- Utilization exceeded mandates owing to favorable blending economics
- Plenty of “room” for ethanol to be blended up to 10%
- Favorable margins for ethanol producers
- Private/public investment in ethanol capacity
- VC/government investment in cellulosics/advanced biofuels



Near Term Implications – Ethanol Supply and Demand

The expected balancing of supply and demand based on low margins was dramatically accelerated with the market volatility/risk management difficulties of 2008



<u>Current/Future State:</u>

- **Corn based ethanol:**
  - **Ethanol prices > gasoline, market volatility, blending wall, available margins, support for corn ethanol: new capacity stalled; existing capacity shrinking**
- **Cellulosic ethanol:**
  - **State of financial markets, lack of cellulosic advancements: new capacity lags RFS, federal funding available to continue development**

We Met the Glass Wall before the Blending Wall

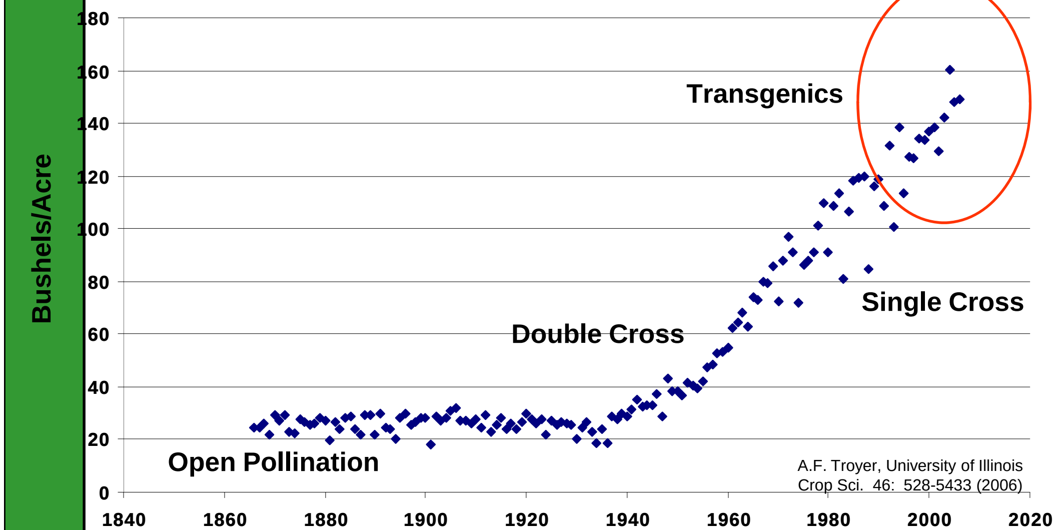
- Restoring confidence in corn based ethanol is critical to the future viability of *all* renewables – regardless of feedstock source
  - Food, feed *and* fuel
  - A better choice for the environment than gasoline today with significant upside
  - Economically viable
  - Environmentally sustainable

- This confidence is needed to:
  - Allow increased blending levels
  - Foster the adoption of generation and a half technologies
  - Restore the economic viability of existing producers

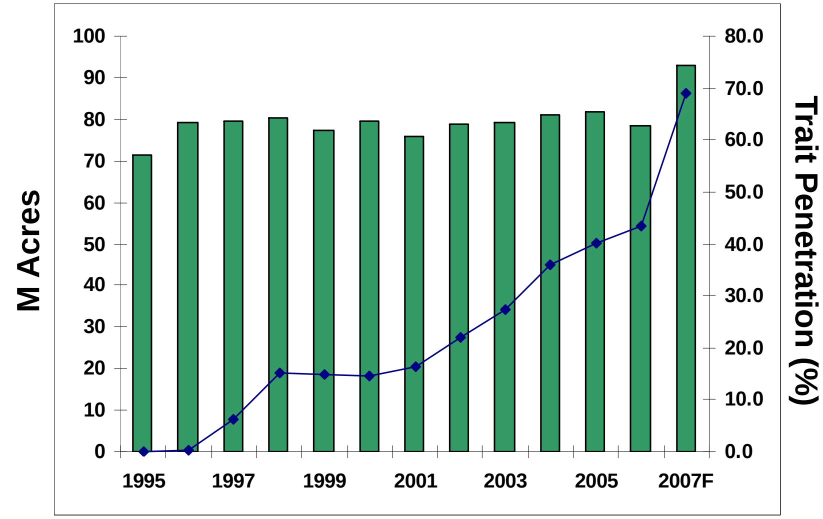
How Did we Get Here?

Corn Surpluses from Technology Advancements

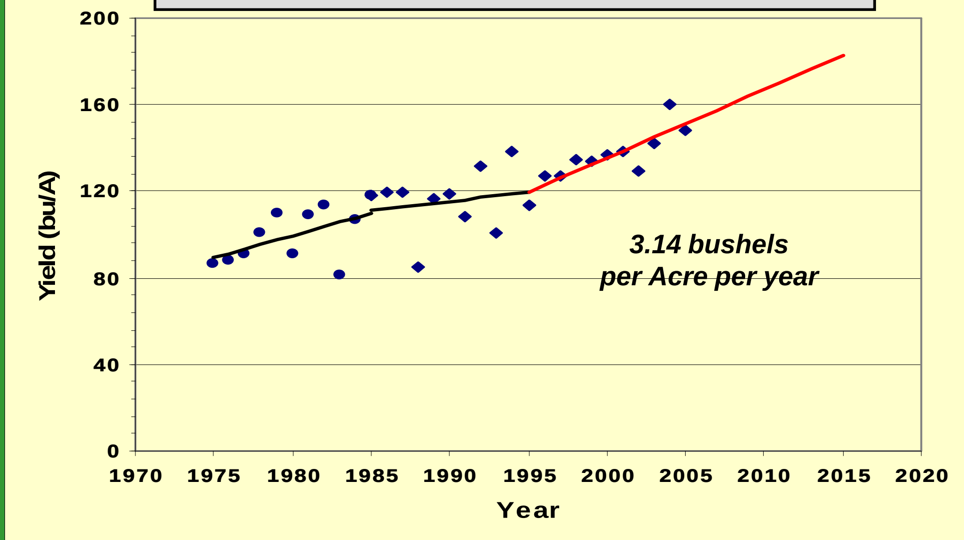
Technical Impact Corn Yield per Acre



Technology Penetration



Historic and Projected Corn Yields



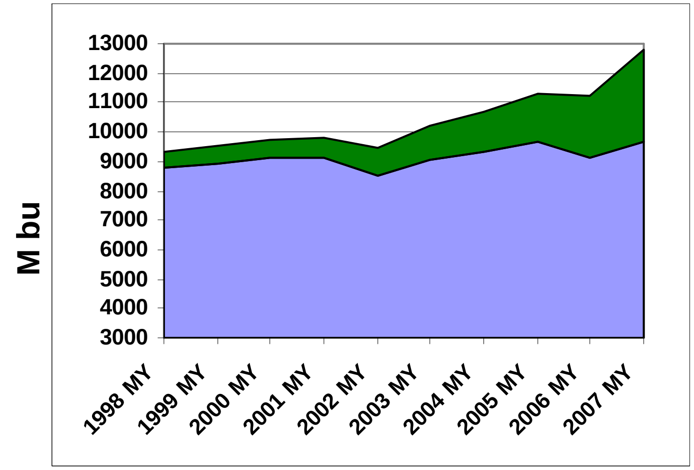
2015 Corn Yield Projections:

	bu/A
ProExporter:	185
NCGA:	187
Extrapolated:	193
2008 actual:	154

Year after Year of Flat Demand for Food and Feed

	Million Bushels			
	98-99	**99-00**	**00-01**	**01-02**
Supply	11085	11233	11640	13238
Feed Use	5494	5682	5850	5891
Food/Industrial Use	1824	1896	1950	2025
Exports	1981	1937	1941	1899
Carry In	1308	1787	1718	1899

10 Year Growth Demands 3.9%



NCGA

Historic and projected corn demand for other uses has been flat for the last ten marketing years

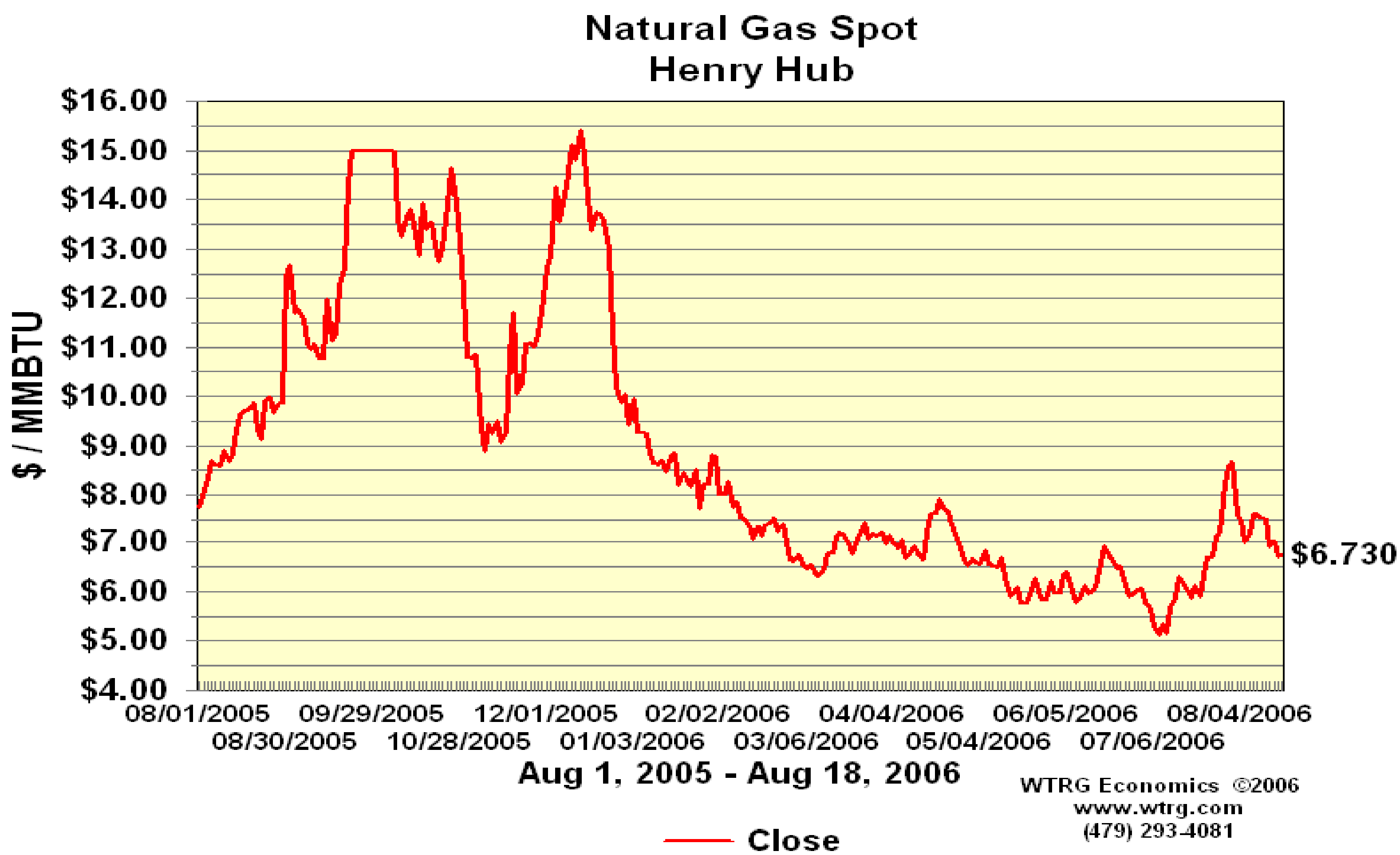
Projected Future Demand from two largest uses (ProExporter):

•Domestic livestock: **4.8 M bu to 4.1M bu (2007 - 2017)**
•Export : **2.5M bu to 2.2M bu (2007 - 2017)**

Best Value for Corn was to Burn It

Corn farm price: $2.20/bushel

2.6 bushels of Corn equals 1 MMBtu - *@$6.73/MMBtu, Corn is worth $2.59 /bu*



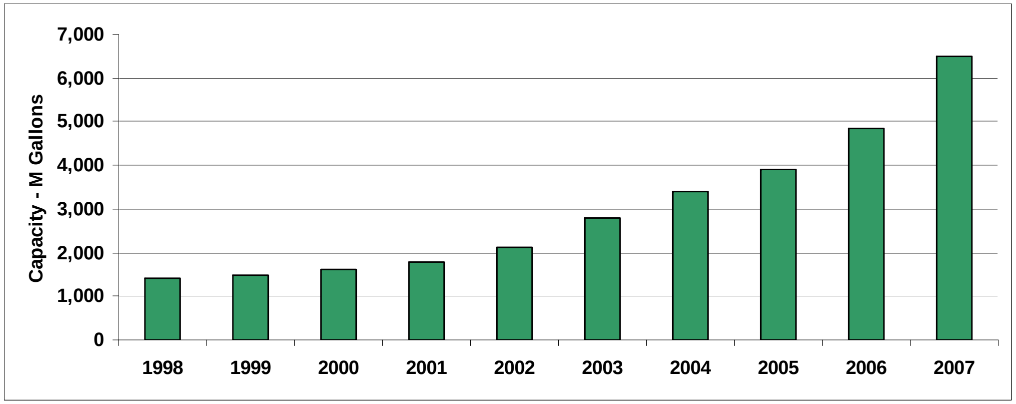
Corn Based Ethanol Capacity Profile

2000	2004
56 plants	81 plants
Wet mills **Waste products** **Local ownership** **Local corn contracts** **Local financing** **No plant level R&D**	**Plug and play** **Low cost model** **Dry mill growth** **Limited plant control** **Local ownership** **Local corn contracts** **Local Ag financing** **Low cost model** **Limited R&D**
1.8 BGY	3.4 BGY

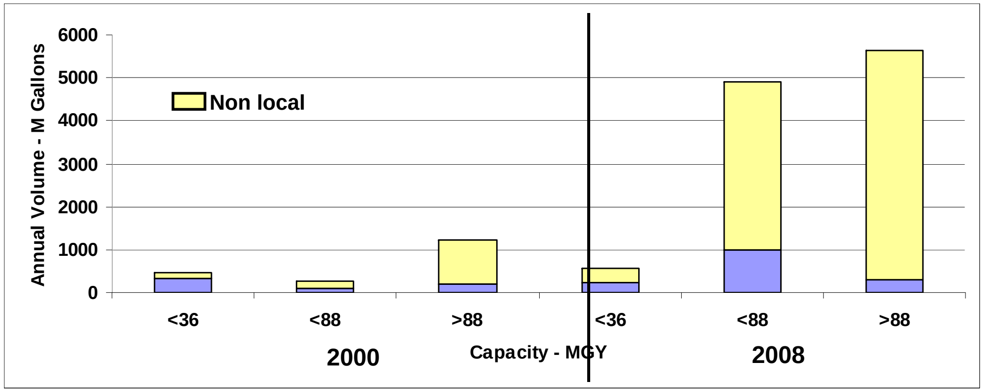
Small plant
No debt
No contracts
Higher operating costs
Higher distance transportation costs

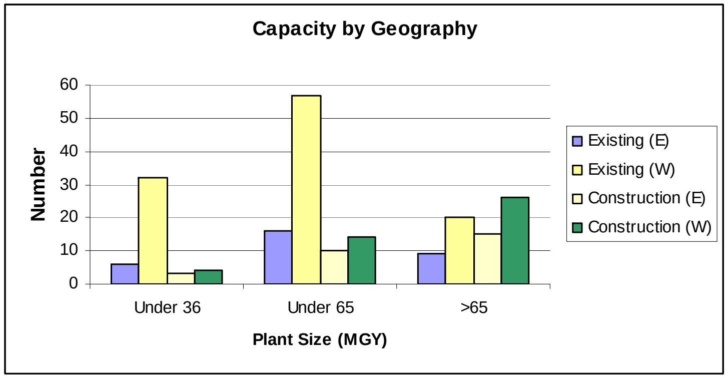
The 2005 Energy Bill Had a Dramatic Impact

MTBE phase out caused irrational construction at $4.00 ethanol



- Five fold growth
- Local to global business
- Smaller, locally owned plants, moved to centralized ownership of larger plants





Corn Based Ethanol Capacity Profile

2000	2004	2006	2008
56 plants	81 plants	110 plants	180+ plants
Wet mills Waste products Local ownership Local corn contracts Local financing No plant level R&D	Plug and play Low cost model Dry mill growth Limited plant control Local ownership Local corn contracts Local Ag financing Low cost model Limited R&D	Ethanol euphoria Irrational returns Dry mill growth Multiplant ownership NY debt Financing handcuffs Contracts req'd Capital limits	No returns Commodity swings Lightening rod Industrial capabilities Dry mill bankruptcy Big vs diverse Technology adoption Smart systems
1.8 BGY	3.4 BGY	4.8 BGY	10 BGY

Small plant
No debt
No contracts
Higher operating costs
Higher transportation costs

Large plant
Significant debt
Investment limitations
Input and output contracts
Lower operating costs
Advantaged transportation - maybe

Supply/Demand Imbalance Impacts Plant Net Price

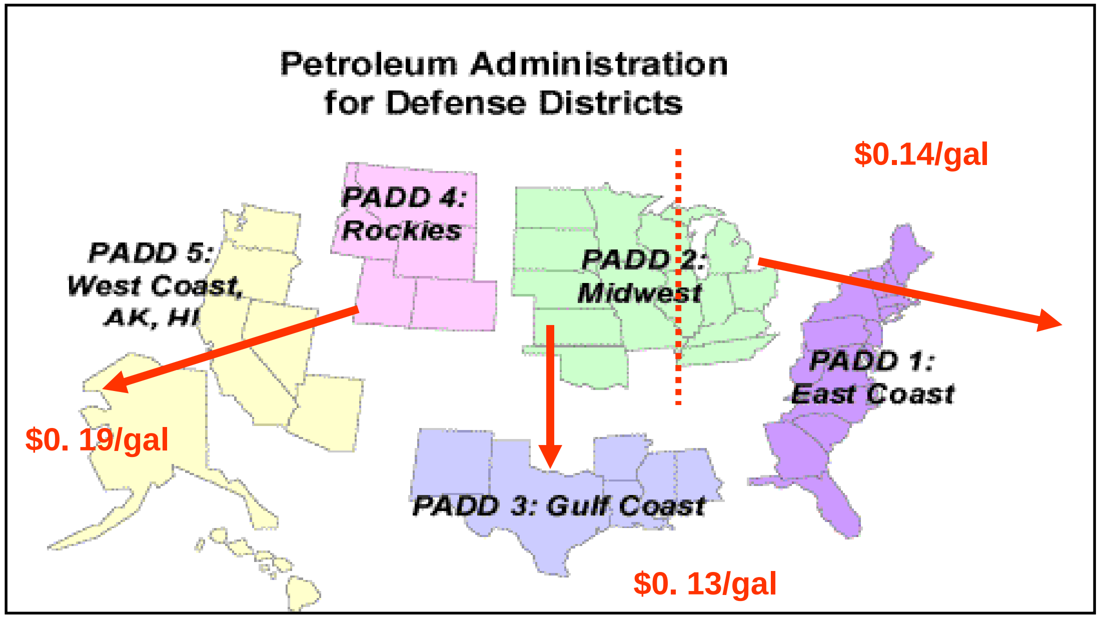
Production West
New Demand East

Western plants require:

- Advantaged basis
- Natural gas
- Premium wet feed markets
- California acceptance

Eastern plants require:

- Certainty of corn supply
- Rail access

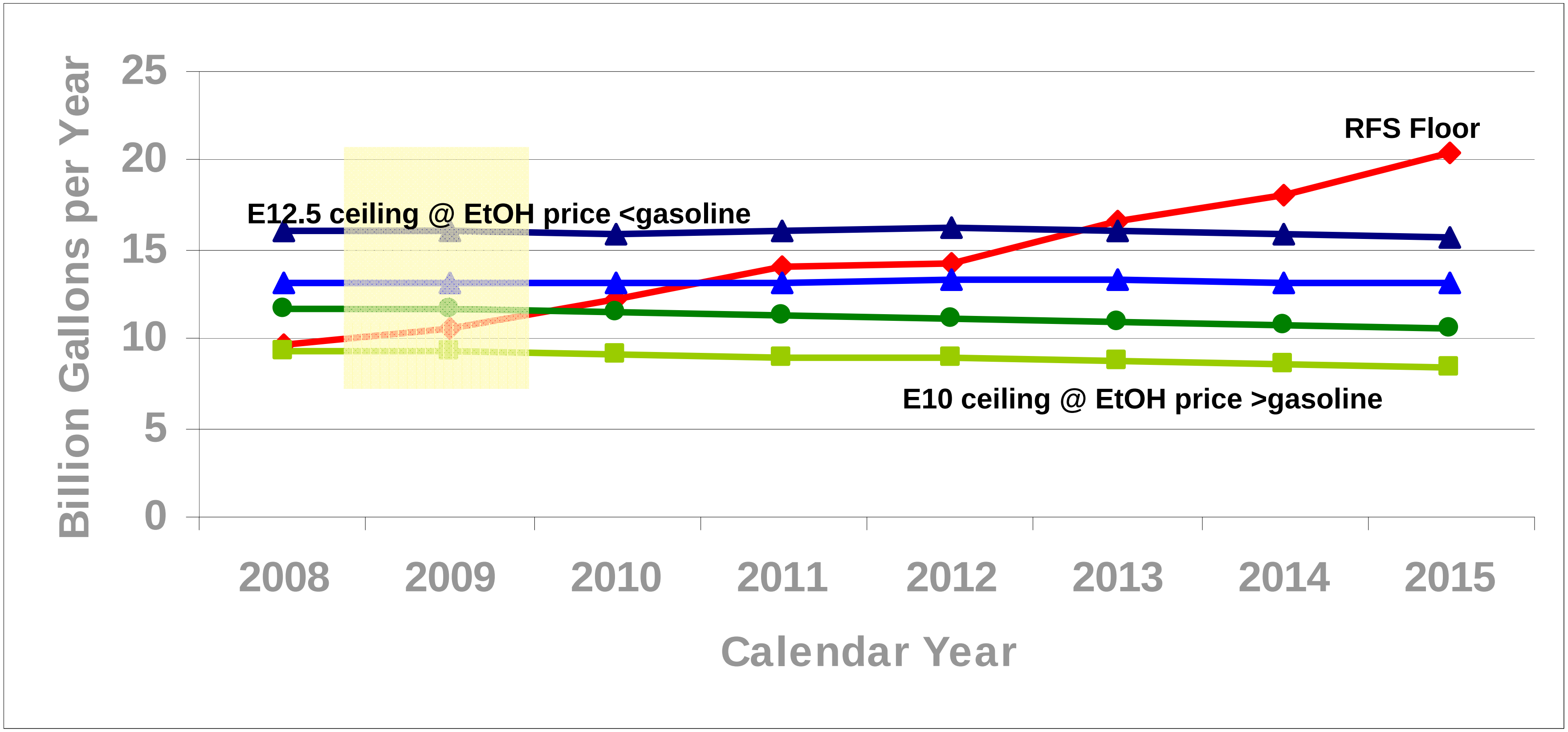


Gasoline Demand and Ethanol Production by PADD (MGY)

B gallons/year	Ethanol Demand at 10%	Yr End EtOH Capacity			Production in Excess of Demand
		2007	2008	2009	
Total East	8.3	1.7	3.4	3.8	-4.5
Total West	5.5	5.7	8.3	9.6	4.1

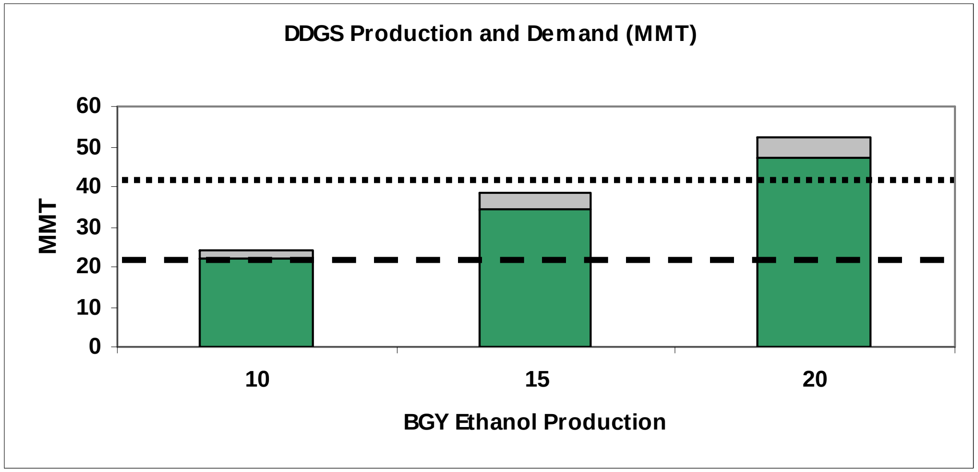
Higher Blends and FFVs/E85 Critical to Renewable Fuels Growth

$/barrel crude	$30	$50	$65	$80	$100
Max $/gal Ethanol	$0.83	$1.31	$1.67	$2.20	$2.50
Max $/bu Corn	$1.33	$3.09	$4.42	$5.49	$7.04



DDGS Wall – Near Term Supply and Price Pressure

- **US demand wall looming with increased fuel ethanol production**
- **Increased domestic and international livestock adoption critical**
- **Generic production standards depress cost equivalency or premium to corn**
- **Direct customer relationships and offtakes pegged to nutritional value provide critical fuel ethanol hedge**



Maximum Inclusion Rate; 100% Market Penetration

Conservative Inclusion Rate; 100% Market Penetration

Corn Pricing Created Ethanol Backlash

- Ethanol expansion and overestimate of expansion
- Global demand for meat – and thus feed - demand much higher than estimated
- Ex-US weather difficulties led to crop shortfalls requiring higher US exports
- Speculation
- Energy prices

Components of Food Price

18 oz box of corn flakes contains 12.9 oz of corn

Yet, compromises only 2% of the price

	Ethanol Production	Corn ($/bu)	Corn Flakes (24 oz)	Corn Contribution
June 2007	6.5 BGY	$4.16	$3.85	$0.05
May 2008	8.6 BGY	$6.50	$4.19	$0.08
Nov 2008	9.8 BGY	$3.94	$4.79	$0.05

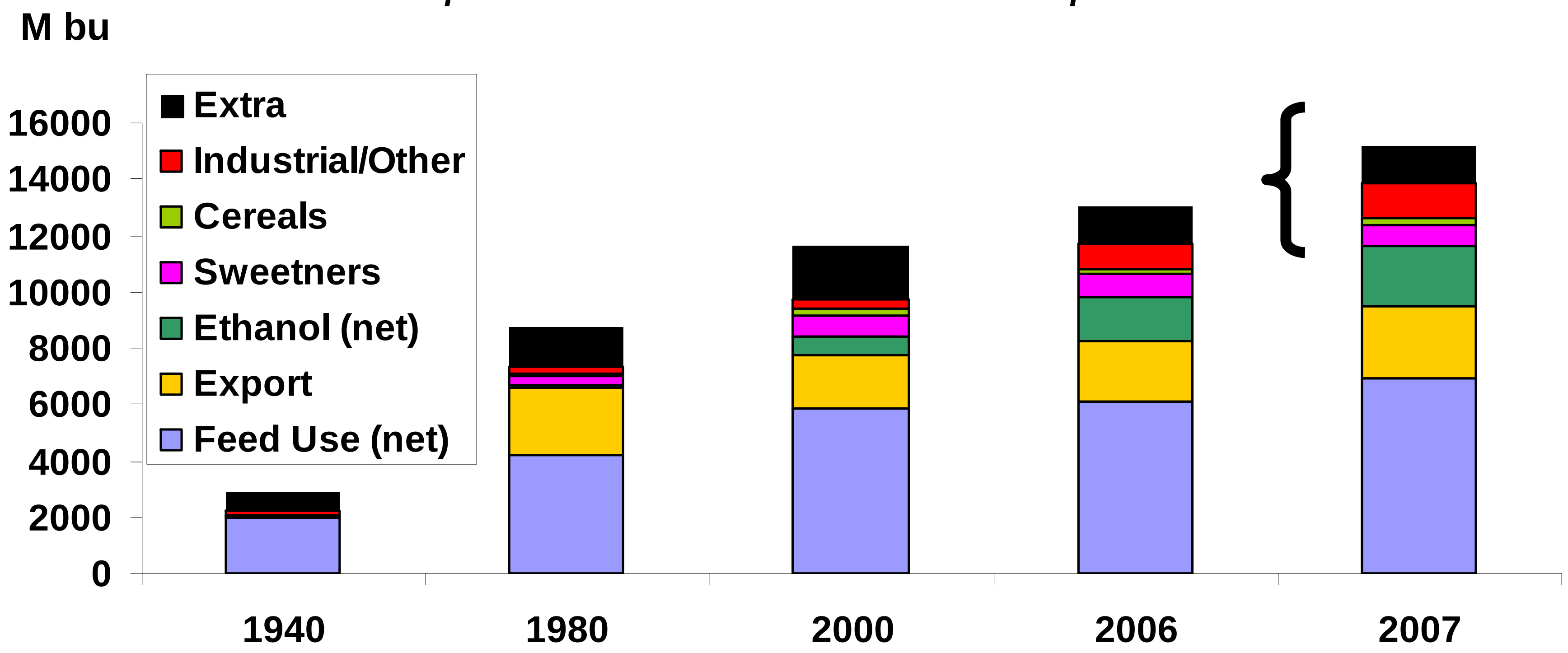
Kraft CEO: "crop based biofuels are contributing to tremendous increases in food prices – we are sharing our views with lawmakers and regulators….. petitioning for policy adjustments…"

Corn Available for Feed, Food and Export

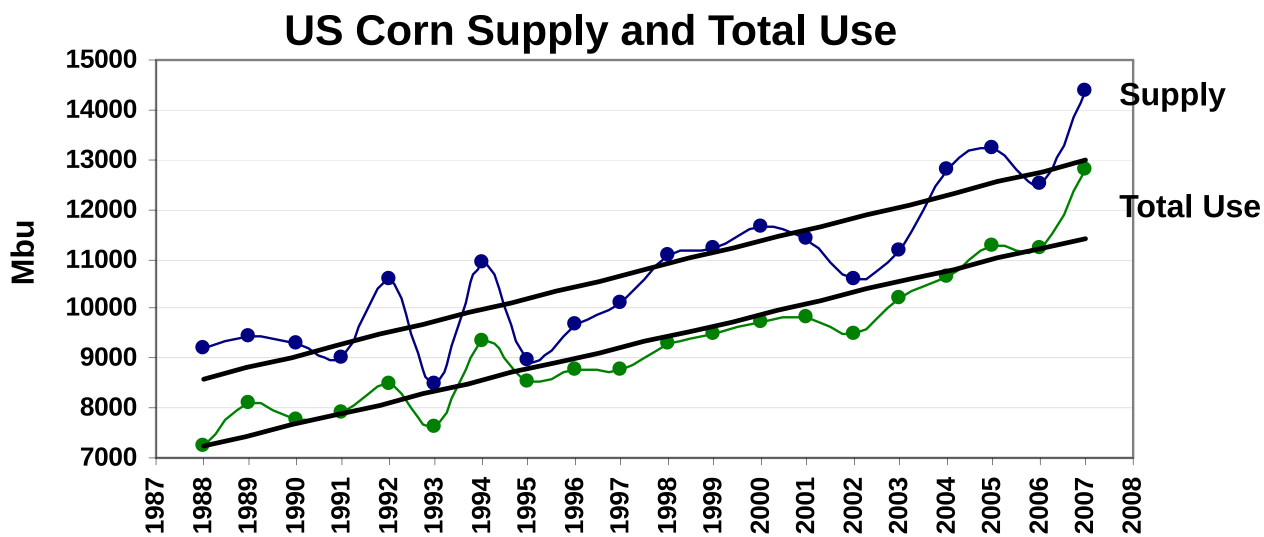
	2002	2006	2007	2008	2015 (Projected)
Harvested corn acres & yield	69.3M (129.3 bu/A)	70.6M (149.1 bu/A)	86.5M (151.1bu/A)	78.3M (153.9 bu/A)	85.0M (180 bu/A)
Total Corn Supply Available (prod + carry in)	10,573 Mbu	12,512 Mbu	14,393 Mbu	13,673 Mbu	17,232 Mbu
Ethanol per Acre	350 gal/A	404 gal/A	415 gal/A	428 gal/A	575 gal/A
Ethanol produced	2.9B gal	4.9B gal	6.5B gal	9.4B gal	15.3B gal
Net Corn reqd for ethanol	904M bu (9%)	1,265M bu (10%)	1,568M bu (11%)	2,743M bu (20%)	3,958M bu (23%)
Corn Remaining for Food/ Feed/Export:	9,669 M bu	12,247 M bu	12,825 Mbu	10,930 Mbu	13,274 M bu

Yet – Corn Production Could Still Accommodate the Growth

The 2007 incremental supply (2325 Mbu) was enough to provide for 98% of the 6.5B gallons of ethanol produced and 4x the supply required for the 2007 incremental ethanol production



2007 Corn Tally



- In 2007:
  - More corn was available for animal feed
  - More corn was available for export
  - More corn was available for food use

  Than at any other time in the history of US corn production

While additionally creating:

- 6.5 B gallons of fuel ethanol
- Having excess corn of 1.4B bushels to carry into 2008

Use for Ethanol does not Eliminate Use for Feed

Field Corn
150 bushels/acre
4.2 tons

Corn Used as Feed Only (tons/acre)

•Protein	0.41
•Fat	0.18
•Fiber/Ash	0.62
•Starch	2.99

Dry Grind Corn Ethanol Feed and Fuel

Animal Feed (tons/acre)

•Protein	0.41
•Fat	0.18
•Fiber/Ash	0.62

Fuel (gal/acre)

•Ethanol	413gal

More Corn Acres Increased Available Nutrients

	2006	2007
Corn Acres	70.6M	86.1M
Soy Acres	74.6M	62.8M
Wheat Acres	46.8M	51.0M
Rice Acres	2.8M	2.7M

2006 to 2007:

Net increase in nutrients produced and available for food or feed

				M lbs			
	M Acres	bu/A	Mbu	Protein	Fat	Fiber/Ash	Carbs
Corn	70.6	149.1	10526	7474	463	1558	748431
Soybeans	74.6	42.7	3185	1274	637	32	1115
Total 2006	145.2		13712	8748	1100	1590	749546
Corn	86.1	151.1	13010	9237	572	1925	924990
Soybeans	62.8	41.2	2587	1035	517	26	906
Total 2007	148.9		15597	10272	1090	1951	925896
Corn for fuel			2364	-1678	-104	-350	168080
Plus DDGS				1678	104	350	
2007 Net			13233	10272	1090	1951	757816

Context

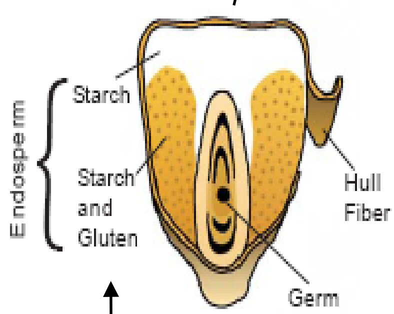
	1944	2007	% Change 1944-2007
Harvested Corn Acres	85M	86M	
Corn Supply	2.8 B bu	13.1 B bu	371%
Corn Yield	33 bu/A	151 bu/A	364%
Corn Price	$1.03/bu	$3.04/bu	195%
Gas Price	$0.21/gal	$2.85/gal	1257%

Corn data from NCGA

What the Corn Based Ethanol Platform Can Deliver

A biorefinery utilizing *NO* natural gas and producing:
- corn ethanol fuel, food and feed products
- cellulosic ethanol
- low carbon fertilizer
- water for plant reuse

Hull fiber to cellulosic ethanol >1B gallons



Endosperm

Starch to green ethanol*/chemical building blocks for biopolymers/specialty chemicals

Protein to animal feed/human feed value > corn

Germ to food grade corn oil

Thin stillage to methane to fuel plant

Corn Can Deliver Food, Fuel and Food

One Acre of Field Corn Fed as Feed	Dry Grind Corn Ethanol Production	Front End Fractionation And Green Ethanol
Provides Feed Only	**Provides Feed and Fuel**	**Provides Feed, Food and Fuel**
Annual beef consumption: 18 people	Annual beef consumption: 6 people	Annual beef consumption: 6 people
Vehicle days of operation: 0	Vehicle days of operation: 413	Vehicle days of operation: 413
Annual dietary vegetable oil: 0 people	Annual dietary vegetable oil: 0 people	Annual dietary vegetable oil: 3-6 people

Accurate Indirect Land Use Change Determinations Critical to Renewables

Table 1. Comparison of corn ethanol and gasoline greenhouse gasses with and without land use change by stage of production and use (Grams of GHGs CO_2 eq. per MJ of energy in fuel) (*29*).

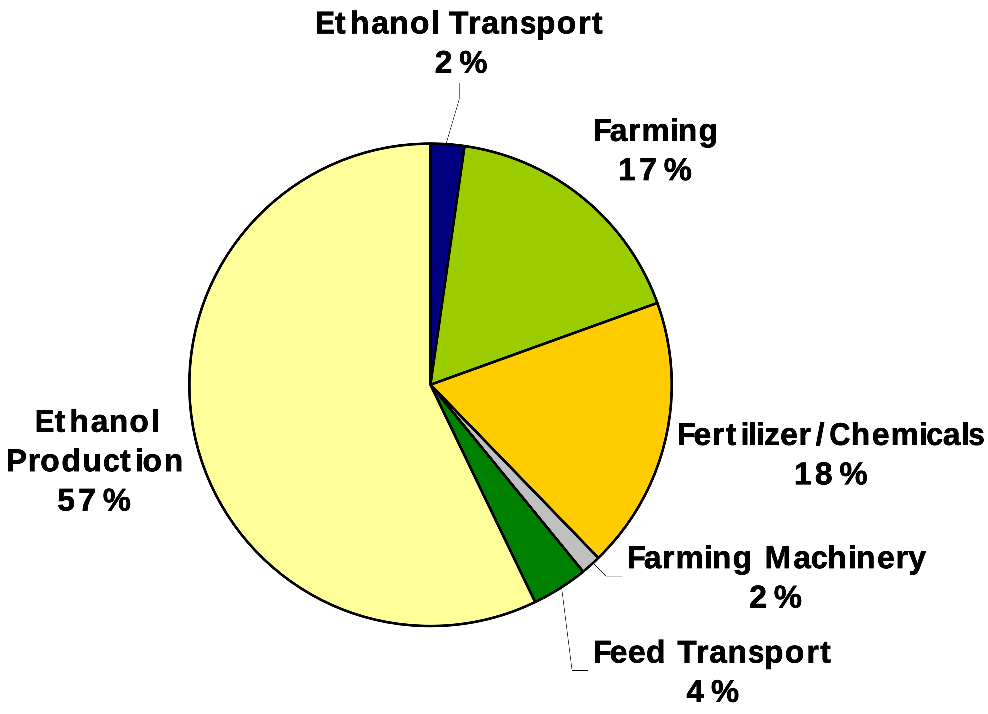
				Net Land Use Effects			
Source of Fuel*	**Making Feedstock**	**Refining Fuel**	**Vehicle Operation (Burning Fuel)**	**Feedstock Uptake from Atmosphere (GREET)**	**Land Use Change †**	**Total GHGs***	**% Change in Net GHGs vs. Gasoline**
Gasoline	+4	+15	+72	0	–	+92	–
Corn Ethanol (GREET)	+24	+40	+71	-62	–	+74 +135 without feedstock credit	-20% +47% without feedstock credit
Corn Ethanol + Land Use Change	+24	+40	+71	-62	+104	+177	+93%
Biomass Ethanol (GREET)	+10	+9	+71	-62	–	+27	-70%
Biomass Ethanol + Land Use Change	+10	+9	+71	-62	+111	+138	+50%

*Figures in total may not sum perfectly due to rounding in each column.
†Amortized over 30 years

From Searchinger 2008

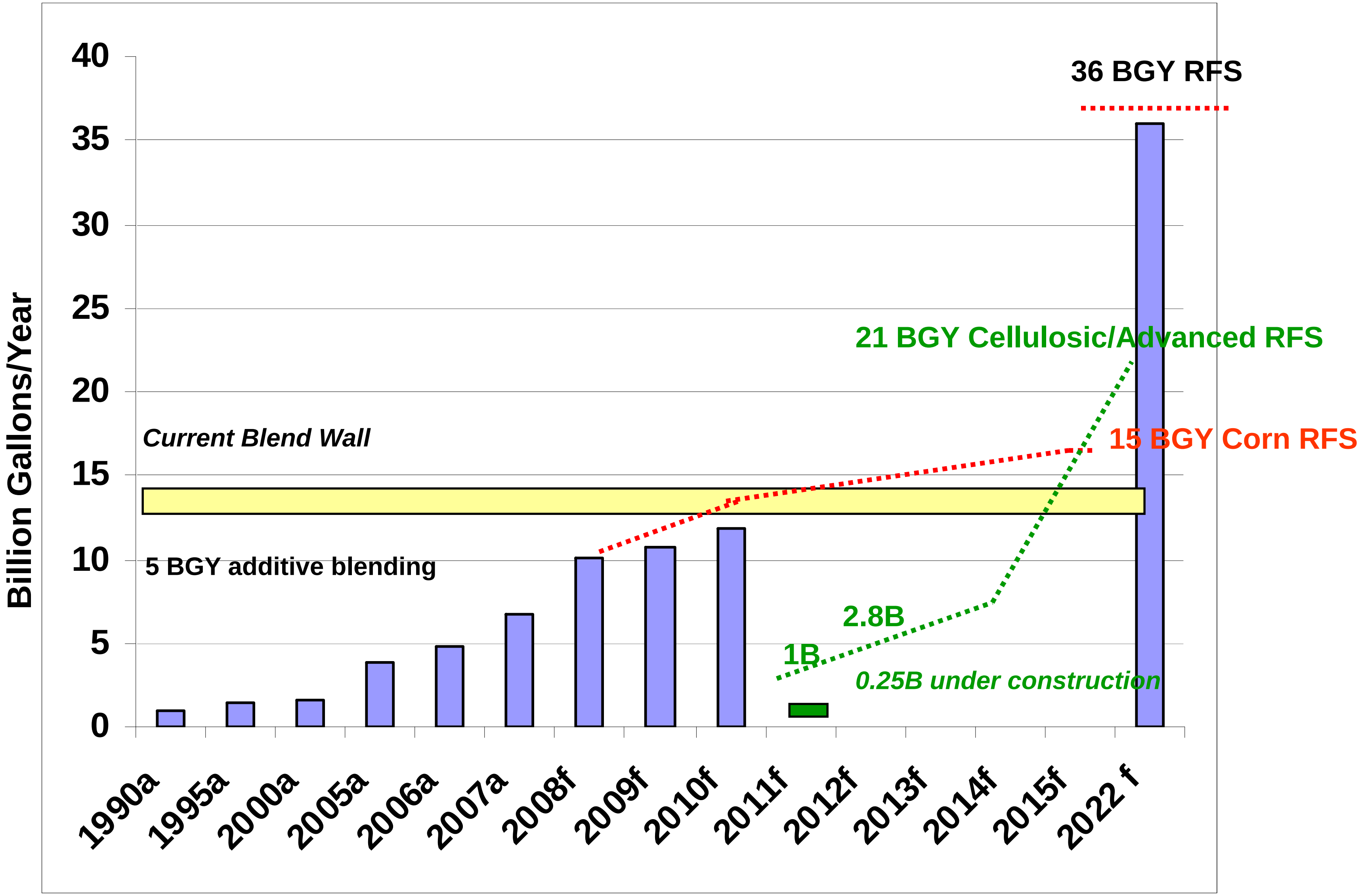
GHG Profile of Corn Dry Grind Production – Opportunities for Significant Improvement

- Conventional corn to ethanol GHG reduction of 19-24% relative to gasoline
- Agronomic production component continues to decline – corn yield/lb of fertilizer has increased 75% since 1970; continued seed co. focus
- Opportunity exists to eliminate ethanol process production component with alternatives to natural gas and grid electricity
- Opportunities exist to dramatically reduce the farming and fertilizer component with Lo-GHG fertilizer from ethanol plant
- Indirect land use – macro and micro determinations will be necessary



Source: Argonne National Laboratories

Ethanol Supply and Demand Dynamics



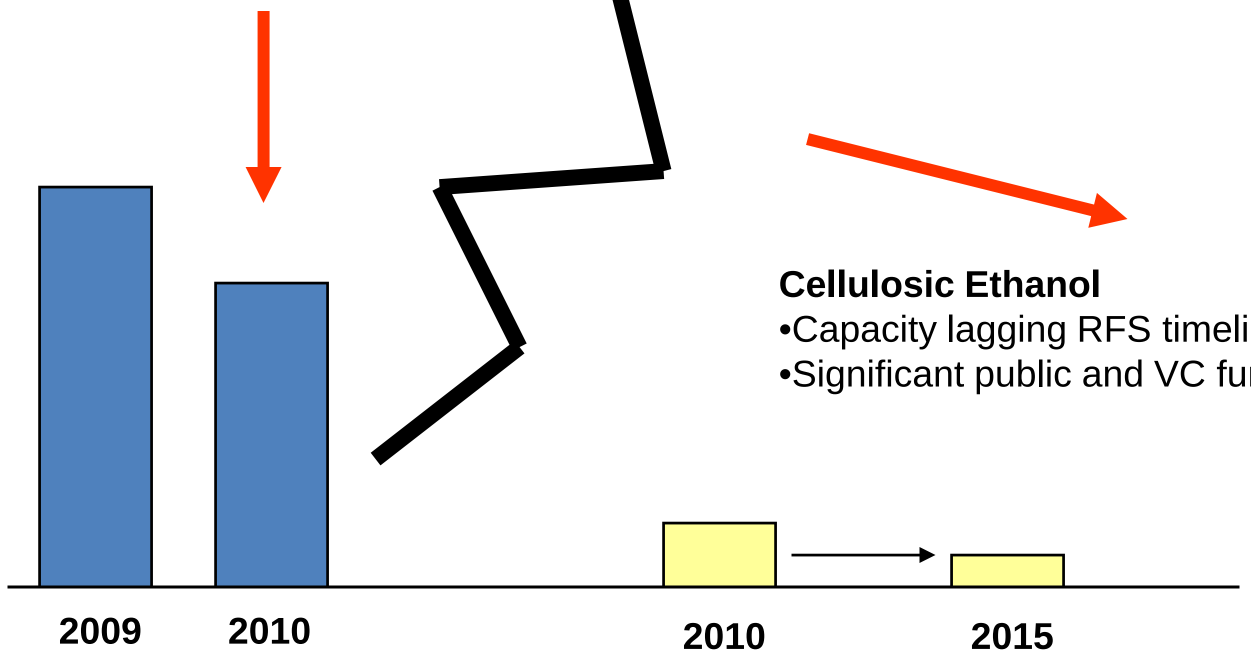
Growing Gap of Supply Threatens Future of Renewables

Corn Based Ethanol

- Certain supply/capacity base decreasing
- Access to capital/public funds to bridge time needed for cellulosics and to show "cellulosic like" benefits – non-existent
- Narrow margins/financing structure prevent self investment
- Uncertainty created around corn based benefits

Cellulosic Ethanol

- Capacity lagging RFS timeline
- Significant public and VC funds available



Corn Based Ethanol

- Can contribute to energy independence without disrupting the food supply. Available and economical now – with significant room for improvement if not abandoned.
- Critical to create the infrastructure and FFV fleet for cellulosic ethanol to have a viable and economic route to market.
- Is a useful lightening rod for attacks by those with alternative agendas
- Shares the “middleman in the value chain” pain with the livestock producer.
- Shares the burden of environmental sustainability proof with the cellulosic ethanol and butanol producer.
- Is a future cellulosic ethanol/butanol producer

What Needs to Happen Now:

Important regardless of the renewable…

1. **Reach alignment on higher blend levels, FFV production and E85 infrastructure and implement federally/by state**

2. **Ensure economical and GHG positive production of renewable fuels –support innovation of the *entire* pipeline – don’t exclude corn**

3. **Increase all agricultural production yields and reduce inputs**

4. **Improve value to livestock producers of coproducts and provide them with the same infrastructure support the oil industry receives**

5. **Reduce the environmental footprint of production – from field to fuel**