Reducing Dependence on Feed Grains for Biofuels

PIONEER
A DUPONT COMPANY

TECHNOLOGY THAT FUELS

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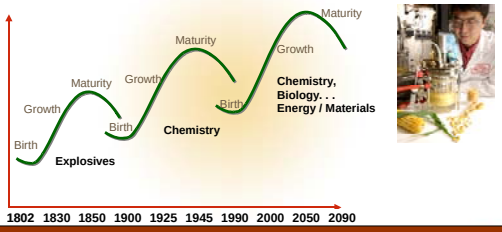
DuPont & Pioneer Technology Focus

- $1.4 billion in R&D
- Leveraging diverse science for biofuels
- Pioneer: $100MM new investment, 400 scientists



2015 Sustainability Goals

- Double our investment in R&D programs with direct, quantifiable environmental benefits
- Grow annual revenues by $2 billion from products that create energy efficiency and/or significant greenhouse gas emissions reductions (40MM tons of CO2 equivalent)
- Reduce our greenhouse gas emissions at least 15% from a base year of 2004

DuPont & Pioneer Integrated Biofuels Strategy

Ag Inputs
Seed & Crop Protection

Seed & Crop Protection Solutions

Advanced Fuels
Butanol

Biobutanol, advanced biofuels

Biofuels From Biomass

Cellulosic Fuels

Biofuels and the Acre Productivity Challenge

- 1 acre of corn (160 bu) = 439 gallons
- 1 acre of corn stover (50% removal) = 140 gallons of ethanol
- 1 acre of sugar beets (23 tons) = 552 gallons of ethanol
- 1 acre of sugar cane = 600 gallons of ethanol
- 1 acre of soybeans (43 bu) =60 gallons of biodiesel
- 1 acre of canola (1557#) = 77 gallons of biodiesel
- 1 acre of palm trees (4400# oil) = 587 gallons of biodiesel

Grasses / Stover Per Acre:

- Assumption: 75 Gallons of ethanol / ton of dry matter
- Corn Stover: ~48 #DM/bu, @ 50% removal = **135 Gallons**
- Switch grass: ~5 -10 Tons/A = **375 - 750 Gallons**
- Miscanthus: ~10 tons / A= **750 – 1000 Gallons**

Traits that maximize grain yield per acre are a key part of the Pioneer biofuels strategy

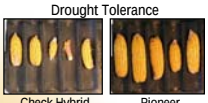
Drought tolerance
- Numerous early stage leads validated in multiple model crops
- Average annual drought loss $8 billion globally

Nitrogen Responsiveness
- Maintain yields using less nitrogen
- Increase yields at current nitrogen levels

Yield Enhancement
- Numerous corn leads undergoing inbred evaluation
- Promising leads in soybeans

Anthracnose Stalk Rot Resistance
- Estimated U.S. yield loss>$1Billion
- Increases yield, standability, grain quality
- Targeted commercialization in 2008

Drought Tolerance



Check Hybrid | Pioneer Experimental

Susceptible hybrid without trait | Resistant hybrid with trait

Grain Quality is Increasingly Important. Mycotoxins concentrate by a factor of 3X in distillers grain

Herculex® I – The Better Bt

Because Herculex I has a broader spectrum of insect protection, it can be more effective in helping to prevent kernel damage and the possibility of mycotoxin presence

Western Bean Cutworm Pressure

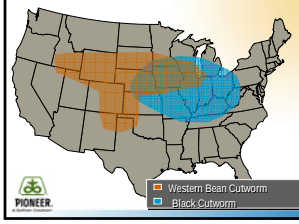
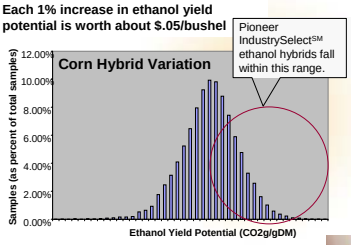


Photo is Representative of Corn Under Western Bean Cutworm Pressure

Not all corn hybrids are the same for ethanol yield

Each 1% increase in ethanol yield potential is worth about $.05/bushel



- Pioneer Hybrids have about 7% variation in ethanol yield
- Pioneer® has identified 182 HTF ethanol hybrids in our 2007 lineup,
- Most are leader products with the traits growers want (17 of our top 20 hybrids)

Pioneer has a well developed pipeline of traits targeting the ethanol industry….and feed markets

Increased functionality through optimization of genetic variation	Increase total starch and its fermentation properties, higher oil	Higher oil, improved oil, better digestibility, higher starch	Oil and starch elevation, digestibility, fermentation transgenes, protein quality

Today → 2014

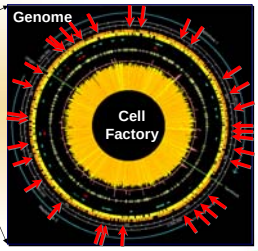
- Increase ethanol yield through improved starch
- Increase feed energy value through oil increase and modification
- Reduce unwanted / low value kernel components such as fiber
- Minimize DDG co-product amount but maximize protein quality
- Accommodate new processing technologies such as fractionation

The next generation of industrial biotech….
DuPont & Pioneer are expanding the uses for corn through industrial biotechnology – fermentation microbe modification

Louden, TN Site First commercial Shipment November 27,2006

- DuPont and Tate and Lyle have partnered to create the first facility to produce Bio-PDO™, the key ingredient to make the Sorona® polymer
- Sorona® will be used in carpets, fabrics, films, filaments and engineering components
- Sorona® fabrics have unique properties, such as softness, stretch/recovery, stain resistance and high color retention
- 100 million pounds per year will be produced at the Louden facility

Enabling Technology – Modifying Cell "Software" to produce biomaterials and improved biofuels



Metabolic Engineering

- **DuPont is a Technology leader**
- **Engineering the cell to economically produce high value products with fermentation**

Cell modified to increase PDO production 500X

DuPont's technology to modify fermentation microbes is enabling development of improved biofuels - Biobutanol

BioButanol: a 4 carbon alcohol molecule made from corn in existing ethanol facilities

Ethanol	Biobutanol
Limited blend flexibility	→ 0-100% flexibility
Vehicle modification issues	→ No modification needed
High vapor pressure	→ Comparable to gasoline
Water absorption tendencies	→ No Water absorption issues
Pipeline transport issues	→ Pipeline transport possible
Reduced fuel mileage - 77,000 BTUs/gallon	→ Comparable to gasoline - 110,000 BTUs/gallon

President Bush Visits DuPont – January 2007

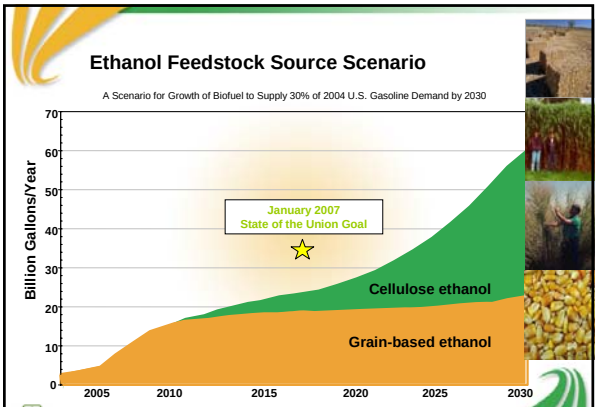
State of the Union Address

- **"Twenty in Ten" – reduce gasoline usage by 20% in ten years**
- **35 B gallons of renewable and alternative fuels by 2017**

"I came wondering whether or not cellulosic ethanol was one of these things down the road that may be happening, may not, could end up being science or science fiction. It's going to be science. It's working."
-President George W. Bush, 1/24/07 at DuPont Research Labs

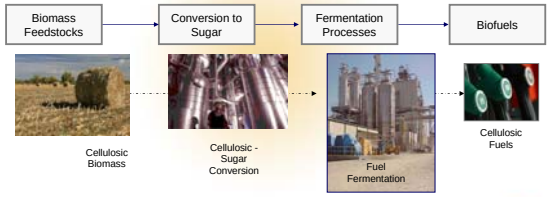
Ethanol Feedstock Source Scenario

A Scenario for Growth of Biofuel to Supply 30% of 2004 U.S. Gasoline Demand by 2030

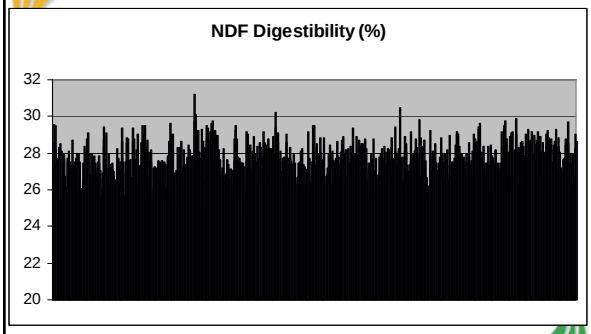


Integrated Corn Biorefinery (ICBR) Technology

Total Technology Package (lignin separation, saccharification, fermentation)
$38MM project - 2003
Multiple collaborations

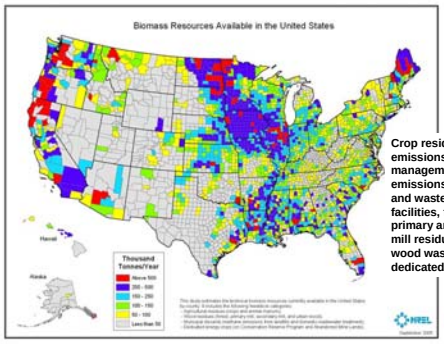


Fiber Digestibility Data Shows Large Variation in Hybrids



27% variation

NREL's View of Biomass Availability



Crop residues, methane emissions from manure management, methane emissions from landfills and wastewater treatment facilities, forest residues, primary and secondary mill residues, urban wood waste, and dedicated energy crops.

DuPont / Poet Emmetsburg Project

- $385MM in 6 contracts, combined investment of $1.2B
- Poet: $80MM, uses DuPont pre-treatment / fermentation technology to break down complex sugars in stalk material
- Uses corn fiber from the grain, and cobs / husks
- Results: 27% more ethanol per acre, using 83% less energy and 24% less water to operate the plant

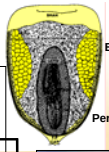
Development of a single pass, dual stream harvest system

- Transport implications (Labor and capital)
- Harvest speed
- Plant portion harvested
- Proximity to processing – economics of longer distances
- Material handling / storage
  - 100 acres, 25 feet deep for a 50MM gallon facility

Source: Stuart Birrell, Iowa State University

Corn Has Huge Potential for Biofuels

	10	15	20
Grain Starch			
Bu/Ac	180	200	250
Gal/Bu	2.7	2.9	3.0
Gal/Ac	486	580	**750**
Grain Pericarp			
Ton/Ac	.45	.500	.625
Gal/Ton	40	60	90
Gal/Ac	18	30	**56**
Stover			
Ton/Ac	2.5	2.75	3
Gal/Ton	40	60	90
Gal/Ac	100	165	**270**

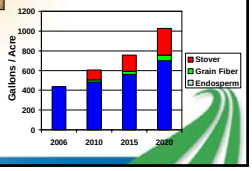


Ethanol Productivity

Endosperm → **435 Gal/Acre**

Pericarp → **18 Gal/Acre (2010)**

Stover → **100 Gal/Acre (2010)**



1,000 gallons / acre by 2020?

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Implications / Issues Summary

- The science may not be as challenging as the logistics/systems issues
- New market arrangements / relationships between growers and processors
  - More virtual supply chain integration
  - Evolving role of grower participation in the downstream
- New input supplier acre management thought processes, technologies
  - Emergence of more sophisticated ag information systems
  - Biotech targeting new crops
- No guarantees for Midwestern agriculture

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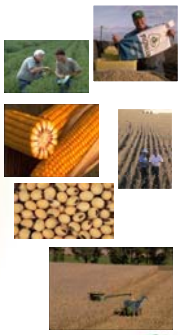
Thanks



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