



Dupont Danisco Cellulosic Ethanol

Commercializing Cellulosic Ethanol Technology

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Overview

- ▶ Introduction
- ▶ Market
- ▶ Sustainability
- ▶ Technology
- ▶ Demonstration Plant
- ▶ Commercialization Plan

Introduction to DDCE

- 50/50 JV of DuPont and Danisco initiated in May 2008
 - \$140 million investment over 3 years
 - Legacy IP to develop and deploy CE technology
- Commercial deployment
 - 25-50 MGY cob plant in Midwest in 2013
 - Energy Crop Biorefinery in 2014
- Demonstration plant operational in Vonore, TN
- License comprehensive solutions for CE
 - Engineering package with on-site biocatalyst production



Market Drivers – RFS

EISA thresholds:

- Cellulosic biofuels must achieve 60% reduction in GHG compared to baseline 2005 petroleum lifecycle emissions

Final rules published in Feb 2010

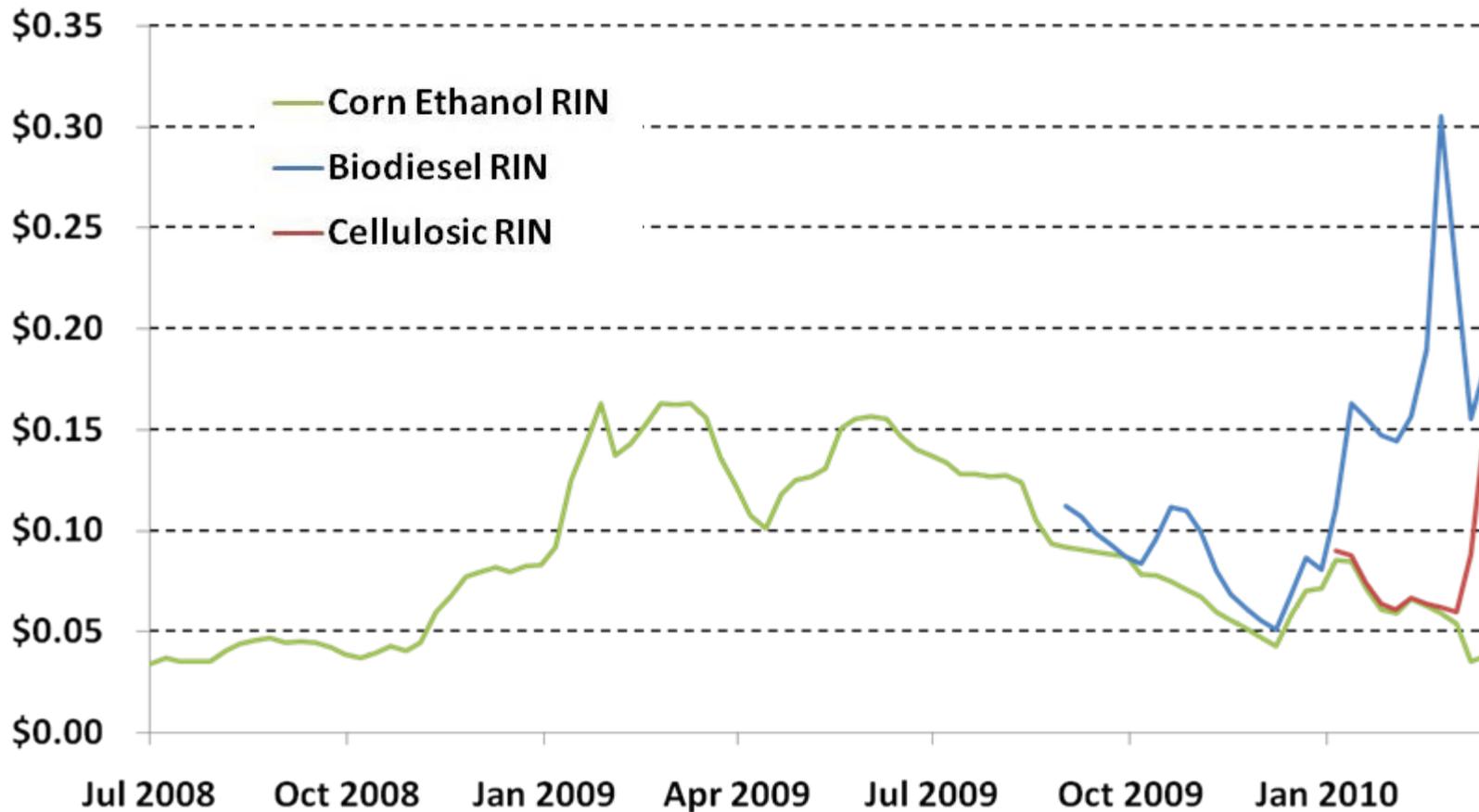
- Biochem conversion results in:
 - 110% reduction using Switchgrass
 - 130% reduction using Corn Stover



RFS2 will reduce GHG emissions by more than 138 million metric tons per year by 2022

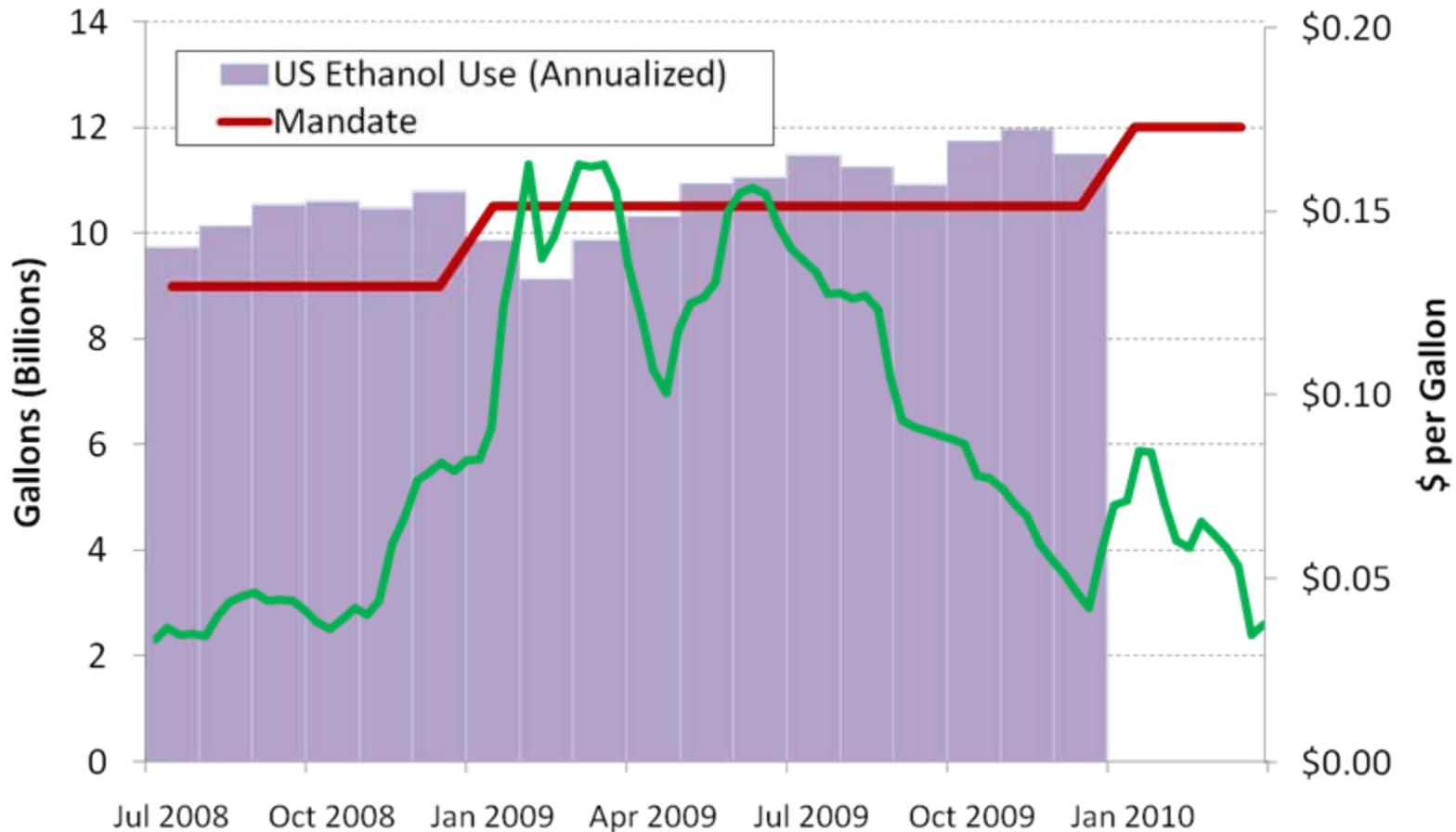
Market for Cellulosic Biofuels

RINs will be key driver

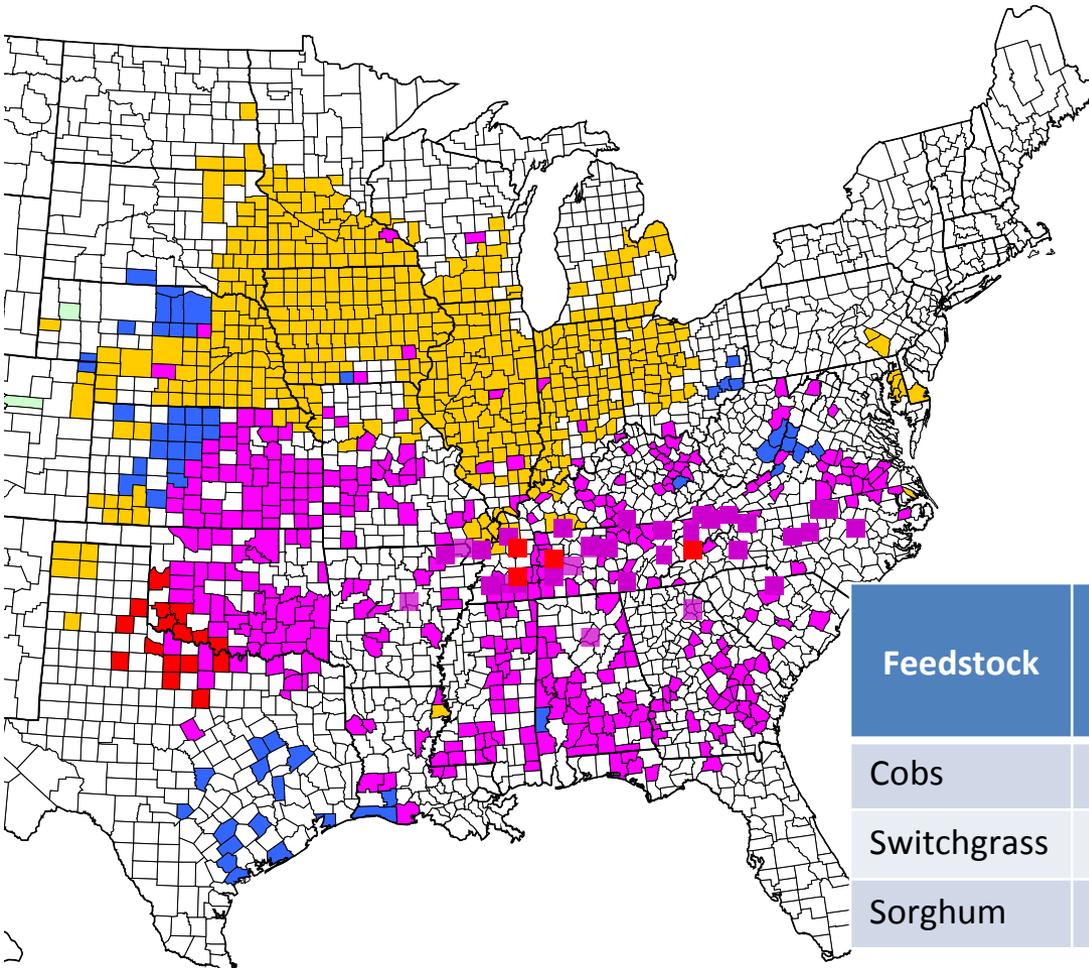


Market for Cellulosic Biofuels

RINs will be key driver



Feedstock Availability & Process Compatibility



- Corn Cob
- Switchgrass
- Sorghum
- Sorghum or Switchgrass

Feedstock	Tons/Acre	BGY Potential	Area (sq. miles)	DDCE Pretreat Performance
Cobs	0.7	2	60,000	✓
Switchgrass	10	6	12,000	✓
Sorghum	15	5	6,250	✓

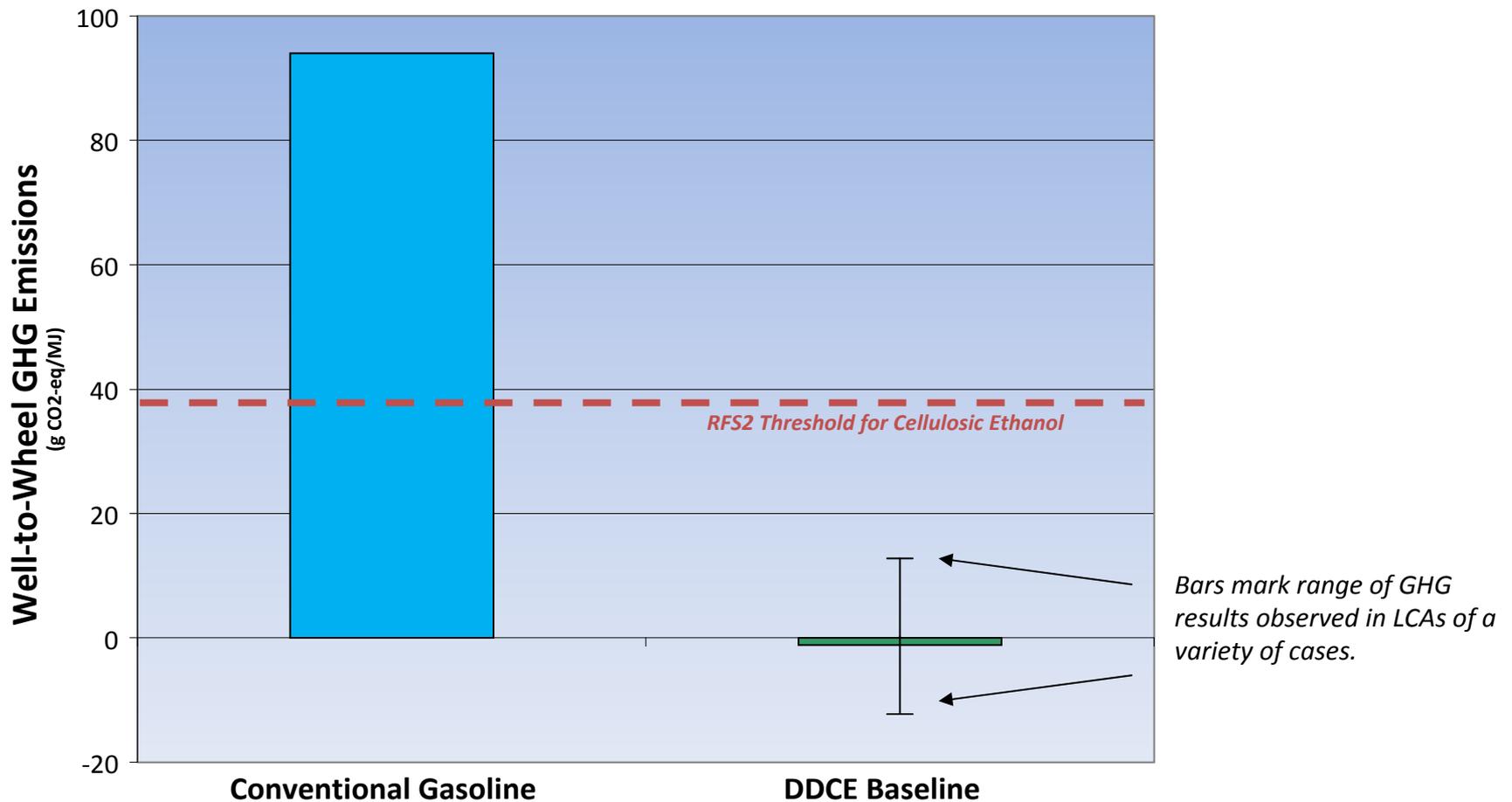
Tennessee Biofuels Initiative

- Demonstrating the establishment of a dedicated biomass energy crop supply chain with farmers
- Demonstrating the pre-commercial production of ethanol from switchgrass
- Developing a viable sustainable, long-term path to commercialization of cellulosic biofuels in Tennessee
- Establishing premier long-term research capability in bio-energy and bio-products

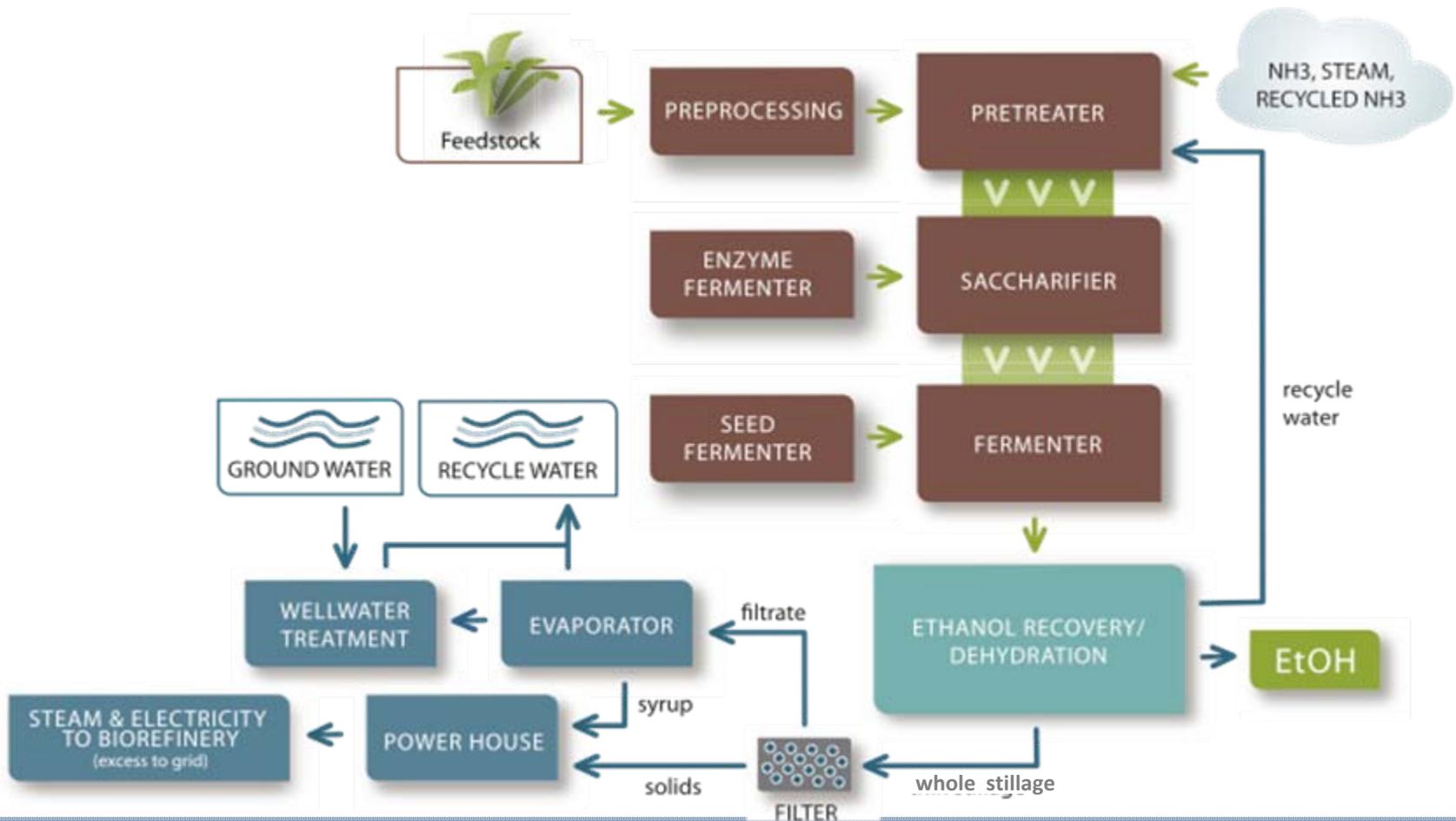


Established 2,600 acres of switchgrass to date and expanding to over 6,000 acres in 2010

GHG Benefits of Cellulosic Ethanol



The Overall Design of the Biorefinery





Pretreatment Overview and Focus

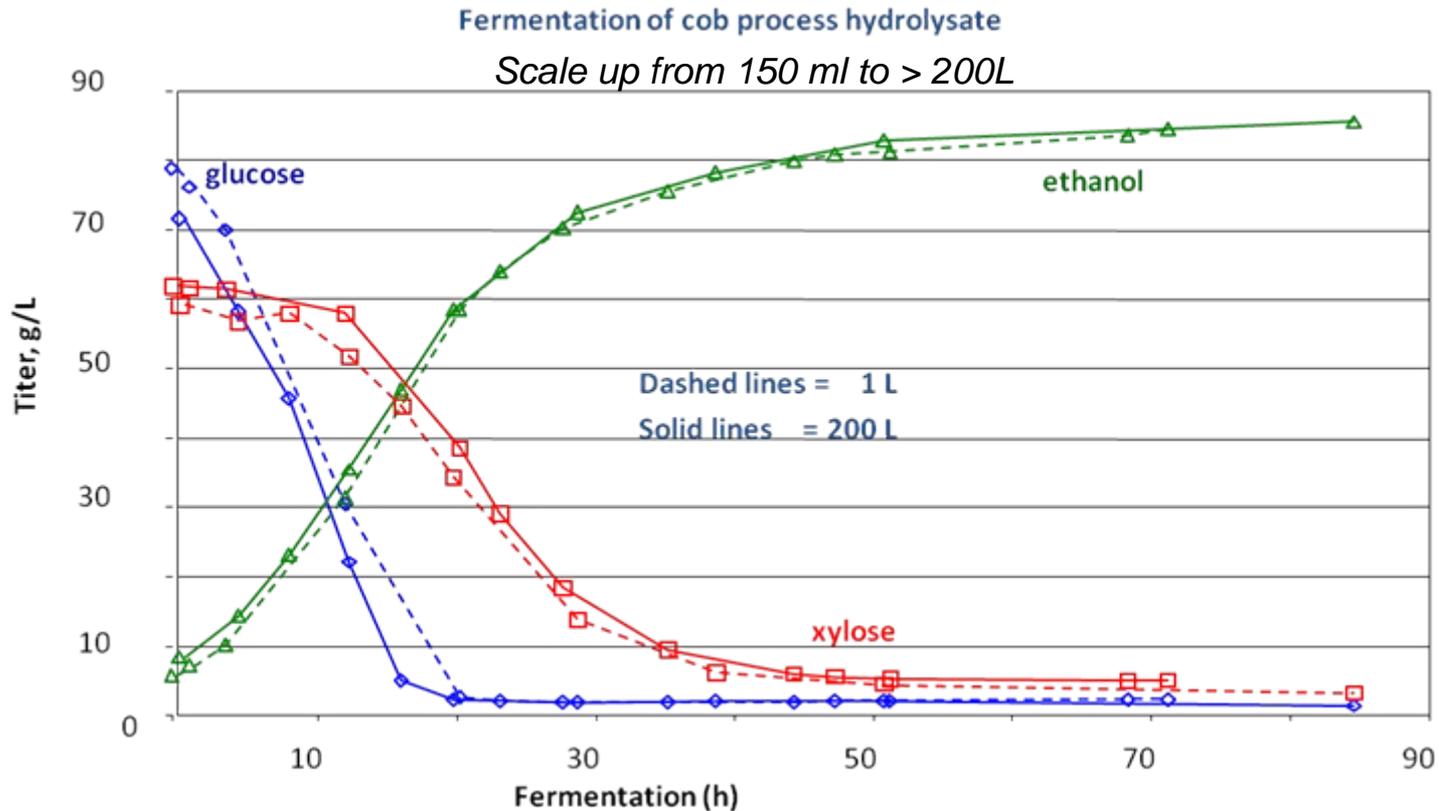
- Process rationale – low cost
 - Mild conditions
 - Minimal formation of inhibitory compounds
 - Reduction of acetic acid
 - No neutralization or “detox” steps required
- Process conditions
 - <12% Ammonia, <150 C, <10 atm , <30 minutes
- Current focus is on the development & optimization of the design for commercial plants



Enzyme Improvements

- Objective: Improved sugar yield with reduced enzyme load
- Efficient conversion of cellulose and hemicellulose to fermentable sugars
- Enzyme advancements supported by Danisco's innovation ability – discovery, improvement and production
- Business model provides for lower cost with on-site enzyme production
- Progress to date:
 - 2X improvement in xylose release
 - 50% reduction in enzyme load

Scalability of Hydrolysate Fermentation



Process technology proven at pilot scale

Technology Status – Key Metrics

	Initial May 2008	Status Nov 2009	Commercial Target
SELECT INPUT VARIABLES			
Enzyme Cost (% of original)	100%	50%	22%
CAPEX - 2008\$ per Gal	\$8+	\$5 to \$7	~\$3 to \$5
PROCESS RESULTS			
Total process yield - Gal/T	67	85	90
Ethanol Titer - g/L	63	82	90
COM - \$/Gal	~ \$3.00	<\$2.00	\$1.50

Demonstration-Scale Plant Vonore, Tennessee

- Joint investment incl. \$40 M from TN
- 250,000 gal/yr nameplate capacity
- 74,000 sq ft
- PDU, pelletizer on site
- Applications lab/ support capability
- Focus on optimal US feedstocks: corn cob and switchgrass
- Functions:
 - Applications lab
 - Customer service
 - Troubleshooting
 - Customer training
 - Advance technology



Demonstration Plant: July 2009



Demonstration Plant December 2009



**Vonore Grand Opening
Jan 29, 2010**



**“Grassoline plant is
hatchery for big refineries”**

– Associated Press, Jan. 29, 2010

Commercialization & Deployment

- DDCE License strategy
 - Development of licenses
 - Broad experience in developing and implementing technology licenses
 - Licensing group is staffed with experience managers
 - Currently marketing Beta Licenses to obligated parties
 - Allows obligated parties to take advantage of existing incentives to de-risk their investment
 - Engineering packages in progress
 - Formal licenses ready in 2013
 - Market to all market segments
- DuPont and Danisco may partner with licensee's on investment
 - Provide equity and support to build out industry



DDCE strategy based on and supported by decades of DuPont & Danisco successes

DDCE Accelerating Progress Across the Value Chain

- Major technology components in place
- Demonstration unit operational
- Commercial-scale
 - Basic Engineering Design Package
 - Site selection
- Development of feedstock infrastructure
- Sustainability is an essential element of value proposition
- CE at cost parity to Gasoline on an energy basis provides market pull
- DDCE has strategic endurance and is committed to building this industry



Custom License packages allow early adopters to take advantage of incentives to de-risk investment



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Thank You!

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