

Biomass from a Plant's Perspective

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Overview



- Market for Renewable Fuels
- Introduction to Dupont Danisco Cellulosic Ethanol (DDCE)
- Risk Management
 - Feedstocks
 - Supply Chain
 - Business Models

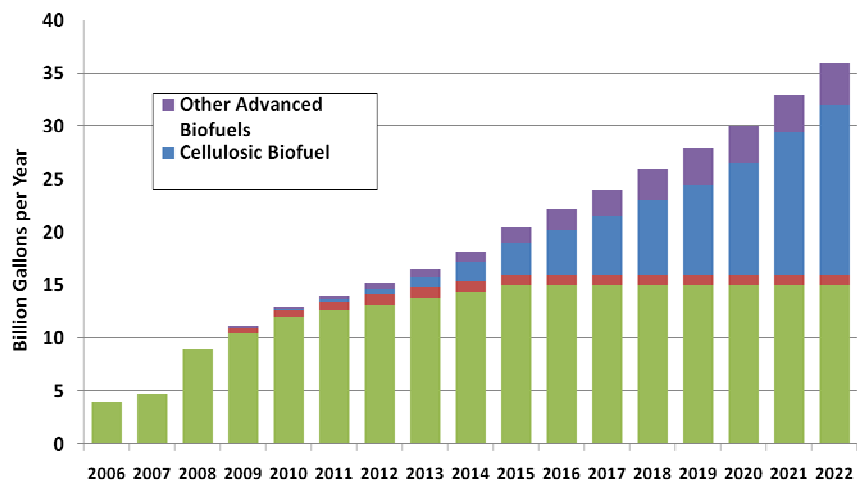
Market for Cellulosic Biofuels

- ▶ 2007 Energy Bill mandates specific levels of blending for renewable fuels
 - Renewable fuel defined by feedstock source and lifecycle greenhouse gas (GHG) reduction
 - Implementation may occur in beginning or middle of 2010

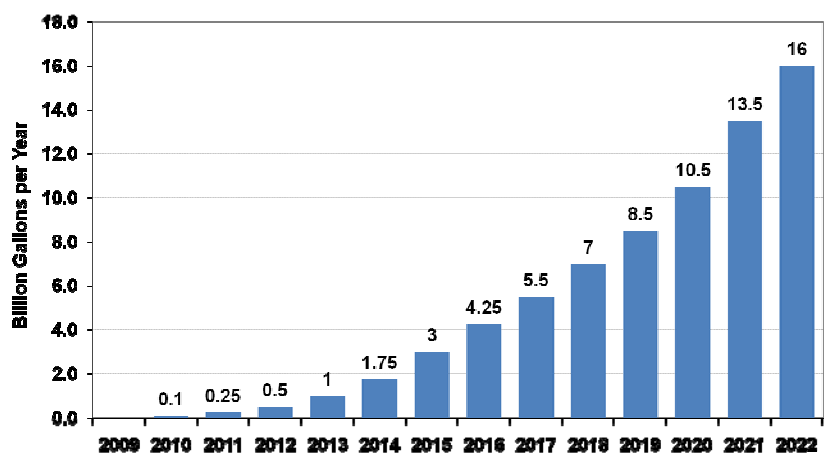
Feedstock	GHG Reduction	Biofuel
Corn starch	>20%	Conventional
Renewable (non-corn)	>50%	Advanced
Renewable	>50%	Biomass-based biodiesel
Cellulose, hemicellulose, or lignin	>60%	Cellulosic

* >20% for corn applies to plants starting construction after December 2007

Renewable Fuels Standard



Cellulosic Biofuel




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Dupont-Danisco Cellulosic Ethanol (DDCE)


- 50/50 joint venture between DuPont and Danisco/Genencor
- \$140 million investment over 3 years
- Commercialize integrated technology to produce cellulosic ethanol
 - Full license & engineering package including:
 - on site biocatalyst production
 - future design improvements
- Feedstock-flexible demonstration plant in December 2009
 - Cob & switchgrass, Eastern Tennessee
- Commercial deployment
 - 2012: 25 MGY cob plant in Midwest
 - 2013: 15 MGY switchgrass plant in TN


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DDCE's Cellulosic Biomass Technology





Pretreatment






Enzymatic hydrolysis






Mixed sugar ethanologen




- ▶ >\$100 million invested prior to formation of DDCE
- ▶ DOE & NREL support & collaboration
- ▶ Significant enabling patent estate
- ▶ Demonstrated capabilities in scale up & design




Demonstration Plant Vonore, Tennessee

- ▶ Joint investment including \$40.7 from TN
- ▶ Nominal nameplate capacity 250kgal/yr
- ▶ Facility on-line 4Q 2009

- ▶ Process development unit, pelletizer and demo plant on site
- ▶ Demo Unit provides scale-up data for commercial facilities
- ▶ Applications lab/ support capability
- ▶ Manufacturing prototypical (40 - 100x scale-up)





Risk Management



- ▶ Define the goal
 - Achieving sustainable production of cellulosic ethanol that can be competitive in today's energy markets and achieve national goals

- ▶ Evaluate the Risks
 - Development of Supply Chain
 - Technology
 - Government Programs
 - End-use Markets

- ▶ Determine business models that can mitigate these Risks and achieve Goal

Supply Chain Risk Management



- ▶ Feedstock Price
 - Biomass is not a commodity today
 - Contract options
 - ▶ Multi-year contracts
 - ▶ Pooling cooperative structure
 - ▶ Integrated control

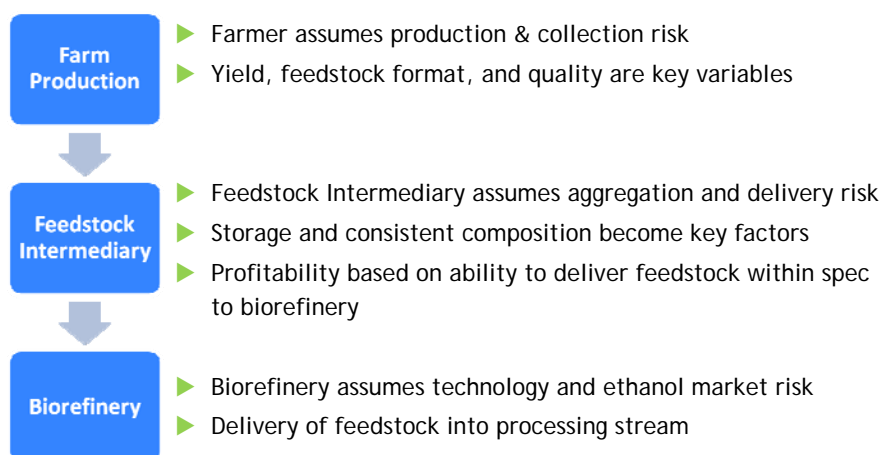
- ▶ Feedstock Supply
 - To site a plant, there must be reasonable assurances supply will be available at startup

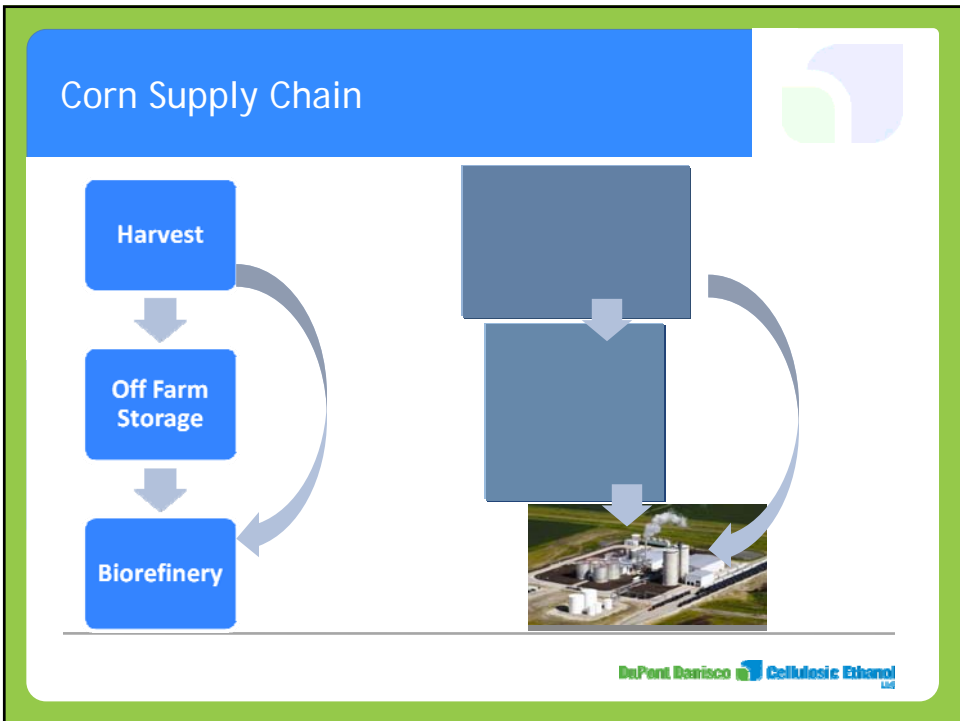
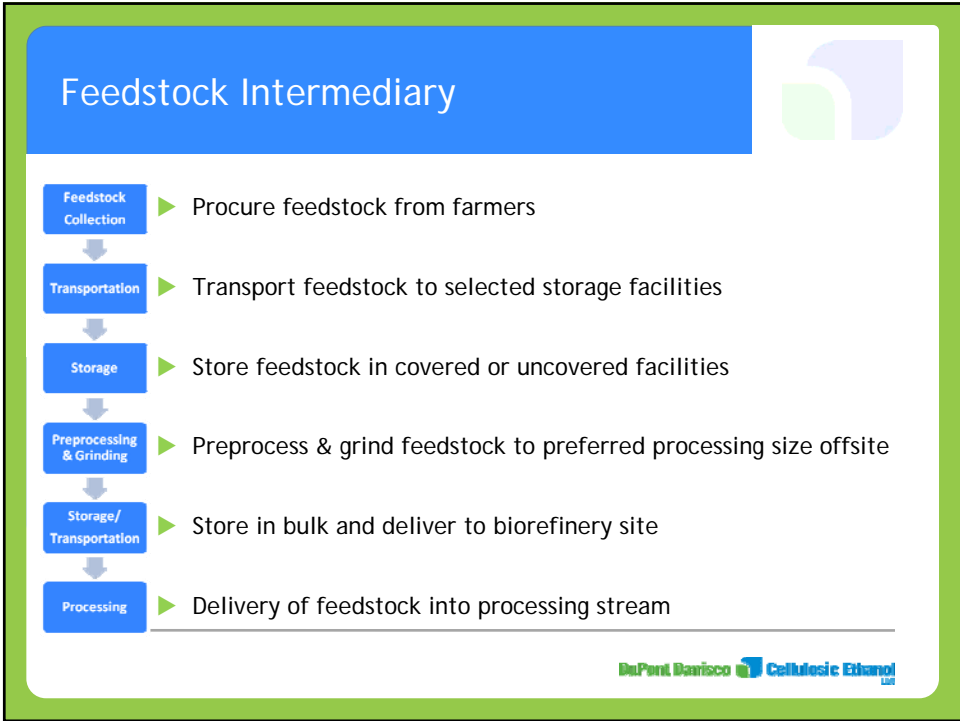
Feedstock supply must be aligned with goals of the biorefinery to achieve success.

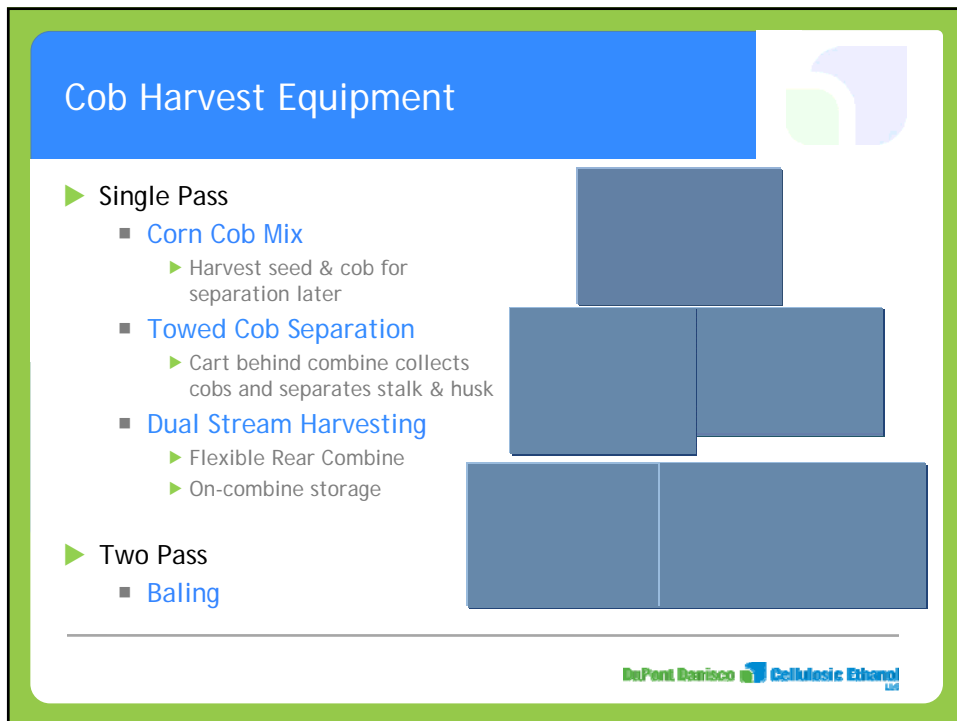
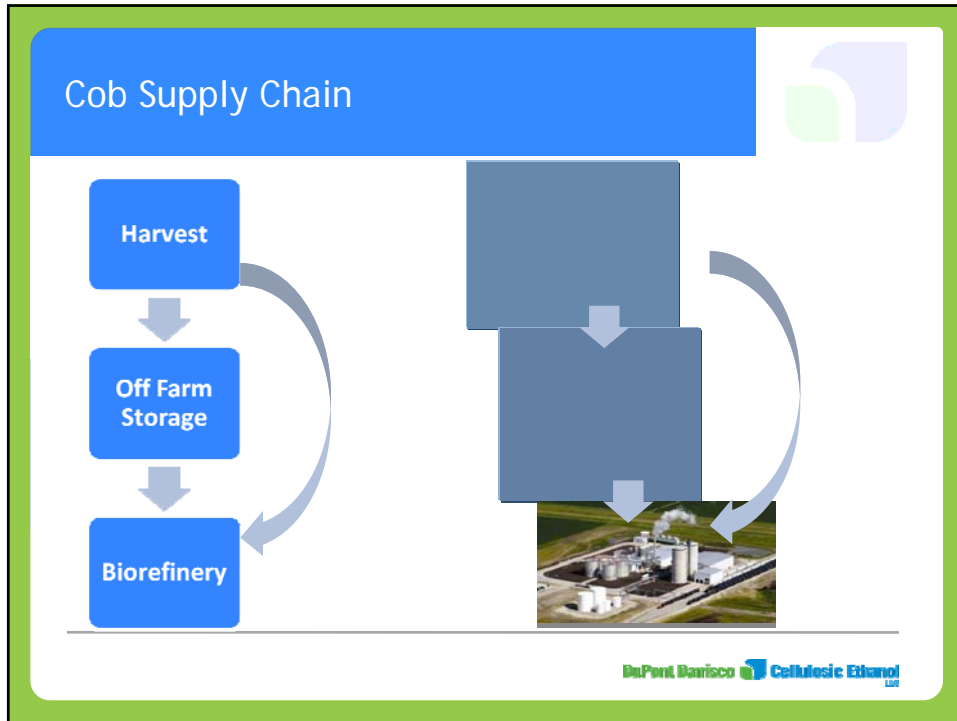
Supply Value Chain Formation

- ▶ New Supply Chains will need to be Developed
 - On Farm - In the field
 - ▶ Equipment to planting, harvest, and densify feedstock
 - Off Farm
 - ▶ Transportation equipment, storage methods, pre-processing options
 - Biorefinery
 - ▶ Offloading, grinding and feedstock preparation

Feedstock Supply Chain







Switchgrass Development

- ▶ University of TN / Genera Program
 - ~2600 acres planted to date
 - Aiming for 6,000 total acres by spring 2010
- ▶ Planned research: agronomic practices, harvest, storage techniques
 - Proposed grants under multiple USDA/DOE programs



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Mitigating Risk throughout Value Chain

- ▶ Business model and government policies must incorporate risk management principles to support the industry's development
 - Business Relationship
 - ▶ Independent, Coop, Integrated control



- Government Policies
 - ▶ Initiation of new Supply Chains - BCAP
 - ▶ Crop Insurance to Protect Farmers
 - ▶ Treatment of Base Acres used for Dedicated Energy Crops

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Summary



- ▶ Energy policy will continue to have an increasing role on agriculture
- ▶ New Supply Chains are on the horizon to support the cellulosic ethanol industry
- ▶ Business model and government policies must incorporate risk management principles to support the industry's development