



# Sustainable Aviation Energy Conference | NREL

The Role of the OEM, Farmer, and  
Agricultural Biomass in the Bioeconomy

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Bioenergy / Biofuels  
Biobased Materials & Chemicals  
Feedstocks  
Biotechnologies



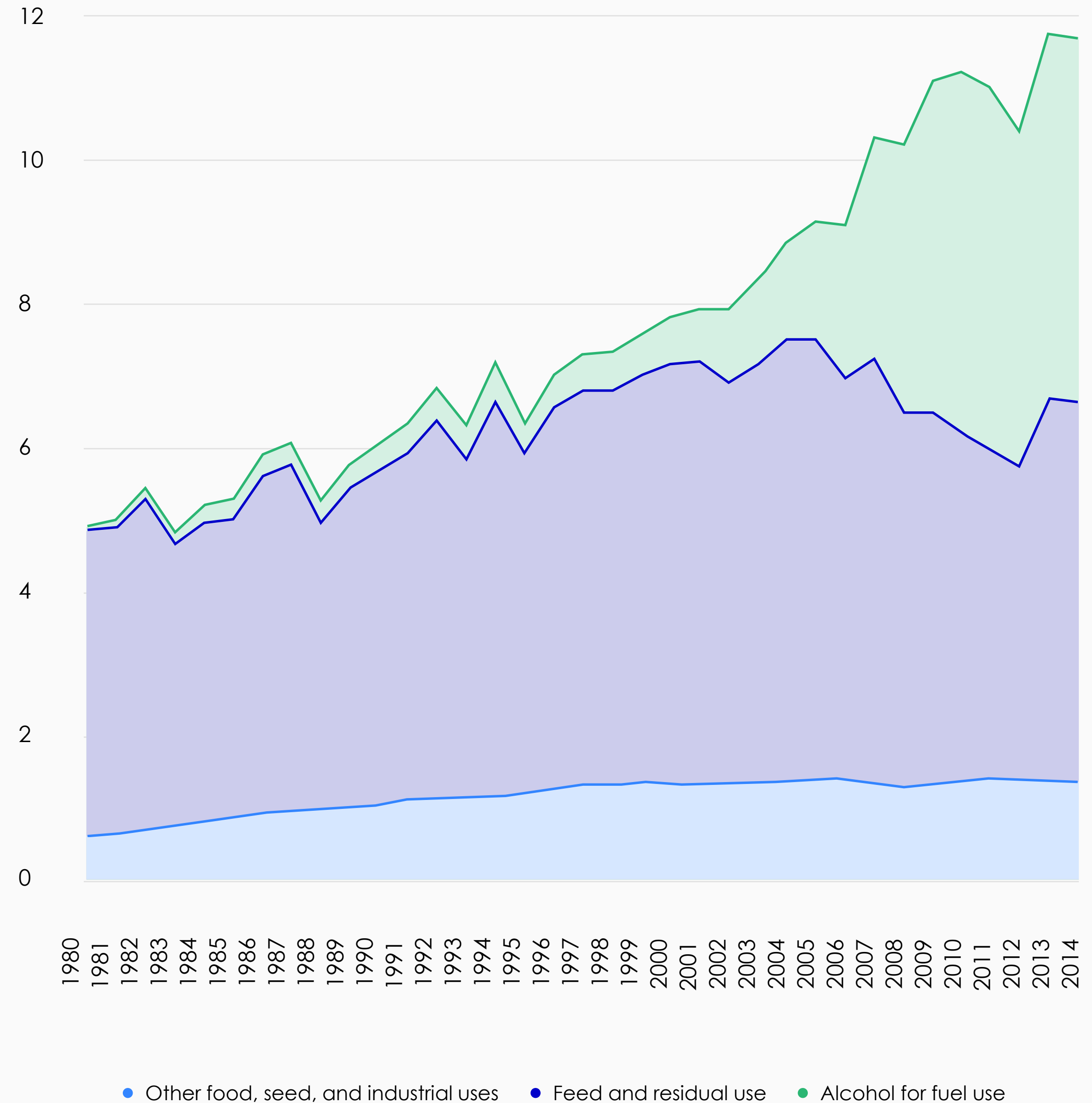
# The are Many Necessities for a Successful Biomass Project

- 1 Appropriate Land
- 2 Water
- 3 A Secure and Sustainable Source of Feedstock
- 4 Offtake Agreements
- 5 Permitting
  - Air permit
  - Environmental resource permit
  - Local/special use permit
- 6 Community Support for Project



# What the Historical Perspective Tells Us

- To this point, ag biomass has been heavily weighted towards the use of corn for ethanol
  - Strongly influenced by the Energy Policy Act of 2005
- Energy Independence and Security Act (EISA) of 2007 started a move towards cellulosic ethanol
- Exports are a major influence on ethanol production and profitability
- Corn ethanol is effectively capped
- Technological advancement is moving the industry rapidly towards other products such as drop in fuels and chemicals
  - Much better demand and profitability
- As demand for renewable fuels grows the feedstock will be materials such as MSW, woody biomass, ag waste and purpose grown crops
  - Influenced by EISA, EU Renewable Aviation Fuel Standard, DOD Renewable Requirements and Societal Demands



# Rapidly Evolving Conversion Technology Will Accelerate Planting of High Yielding Crops

- Conversion technology is rapidly evolving for the production of higher value products such as chemicals and drop in fuels
- Alternate uses apart from energy and chemicals is becoming more attractive and creating demand for these crops
- This will accelerate the planting of high yielding crops such as miscanthus, switchgrass, energy cane and sorghum
  - A project can be supplied by much fewer acres compared to waste materials
  - These plants can be grown on marginable lands that are not currently productive
  - The perennial nature of many of these crops makes for a longer economic cycle



# Ag Waste and Purpose Grown Crops\*



**Switchgrass**



**Corn Stover**



**Energy Cane**



Ag biomass is required to feed projects like this to reach the DOE target of A One Billion Ton biomass driven bioeconomy



**Biomass Sorghum**



**Wheat Straw**



**Miscanthus**

\*Not an exhaustive list

# Some of the Competing Uses for These Materials

- Corn stover is used for animal feed and bedding
- Miscanthus is used in building materials such as insulation board and bio-concretes and bio-plastics, and is becoming a popular pet food ingredient
- Wheat straw can be used for making paper, as thatching material, basket making, fuel and animal bedding.



# Creating a Successful Feedstock Operation

What will drive farmers to produce the feedstocks necessary for a growing bioeconomy?

**A profitable market for the feedstock**

Cellulose has been a source of non-soluble dietary fiber in pet foods for generations and is produced as a byproduct of the paper-making process.

For many reasons, the pulp and paper industry has become an unreliable source of cellulose for the pet food industry.

Research conducted by Kansas State University found Miscanthus contains xylooligosaccharides (XOS), a prebiotic that can support digestive health, while powdered cellulose does not.

It also found that fibers from Miscanthus performed on par with powdered cellulose from a functional nutrition perspective, in palatability, and during processing.

This has led to the growing of several thousand acres of miscanthus for use in as a pet food ingredient





# The Future of Ag Waste and Purpose Grown Crops

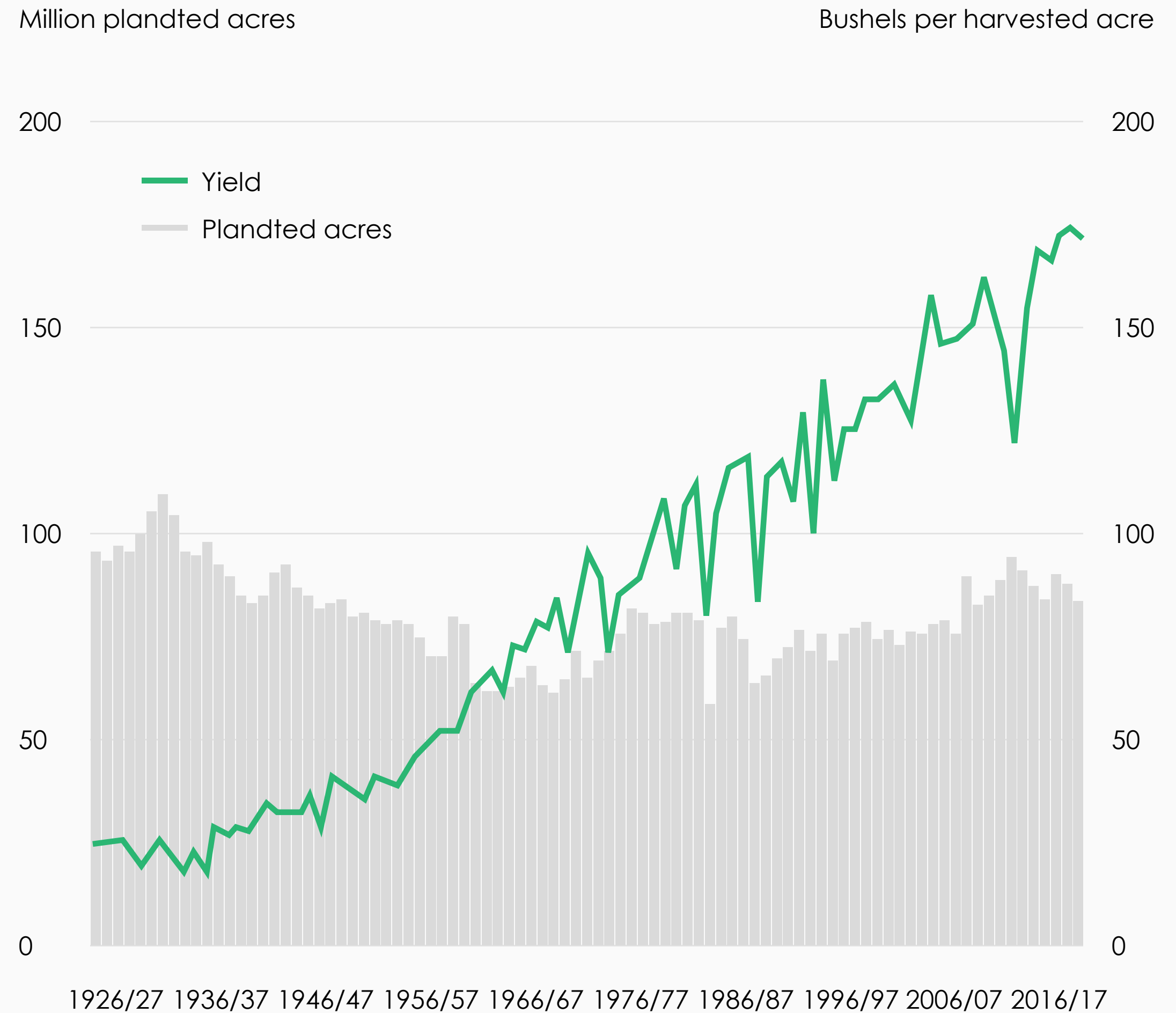
- Corn hovers between 85 and 95 million acres in the US
- Yields are steadily rising and estimated to be 300 bushels per acre by 2035
  - This is driven by the need for food and animal feed as populations grow
- Corn stover will grow as well
  - Stover mass and grain mass are directly related

The benefits of partial removal of corn stover from the land are well known

- Faster warming of land in the spring
- Better soil to seed contact
- Healthier early growth
- Less tillage necessary
- Less early nitrogen applications needed

All this creates higher yields such that there could be a supply push rather than a demand pull for projects that use corn stover.

## U.S. corn acreage and yield

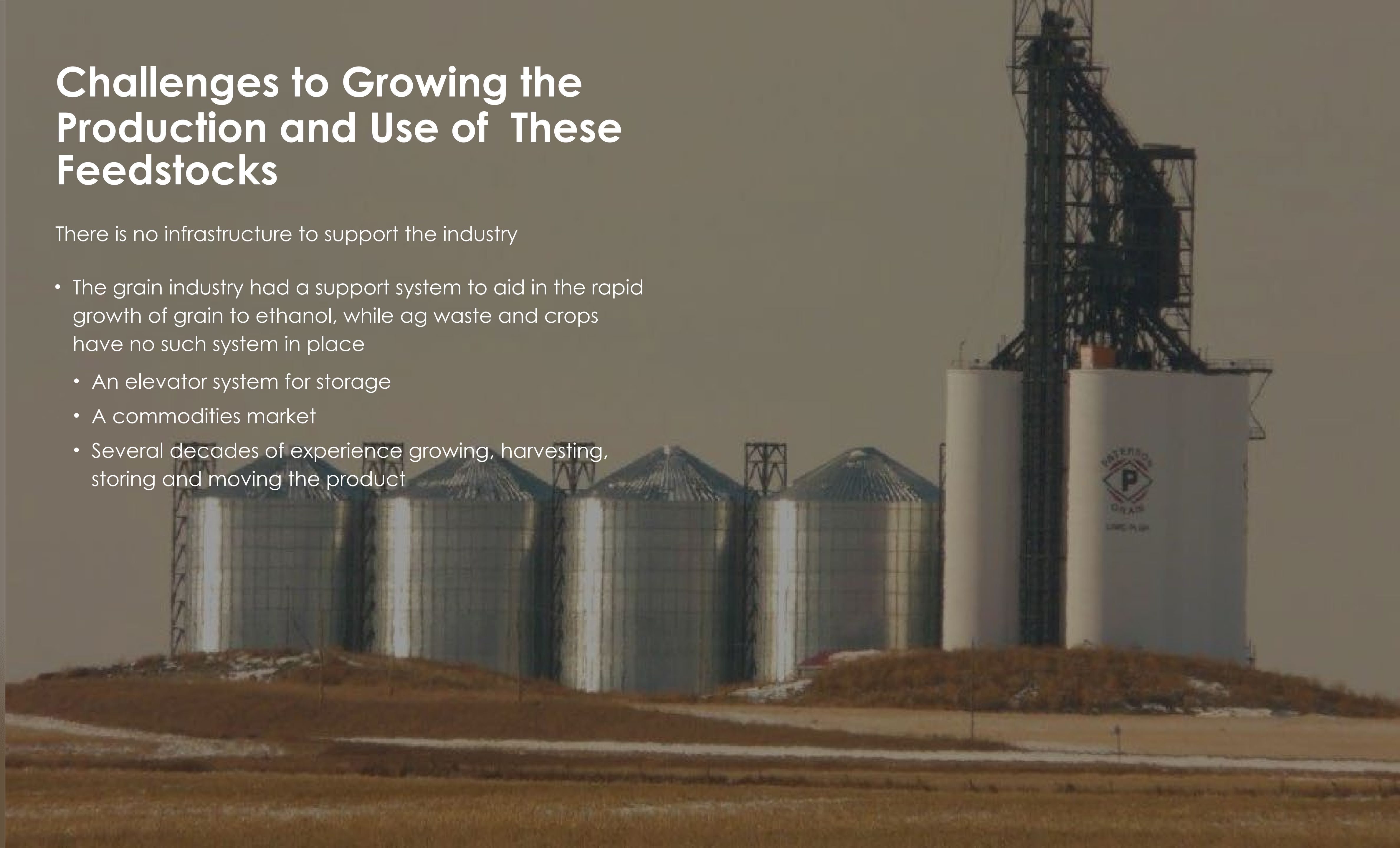


Source: USDA, World Agricultural Outlook Board, World Agricultural Supply and Demand Estimates. Updated: June 2018.

# Challenges to Growing the Production and Use of These Feedstocks

There is no infrastructure to support the industry

- The grain industry had a support system to aid in the rapid growth of grain to ethanol, while ag waste and crops have no such system in place
  - An elevator system for storage
  - A commodities market
  - Several decades of experience growing, harvesting, storing and moving the product



## Additional Challenges



Very few farmers have ever seen much less grown crops like miscanthus, energy cane or switchgrass



Tough economics for the farmer in pre-harvest years; need new financing mechanics



Farming community is conservative when adopting new concepts

# Indirect Challenges – Role of the OEM





# Thank you!

Ready to get started? Have any questions?  
Let's schedule a call to learn how we can help you.

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