

# The Future of Biofuels

## An Agricultural Perspective

A man wearing a yellow t-shirt, blue jeans, and a white baseball cap with a logo is smiling and holding several ears of corn. He is standing in a field of tall, green corn plants. In the background, there are trees and a red building. The rear of a black pickup truck is visible on the left side of the frame.

Beth J. Calabotta  
Monsanto Company



# POPULATION GROWING AT 1.1% EACH YEAR



*population growth*

Source: UN Population Division, Monsanto analysis

# INCOMES GROWING AT 3.5% PER YEAR... \$5 BILLION PER DAY



Source: IHS Global Insight, Agriculture Division, Monsanto analysis



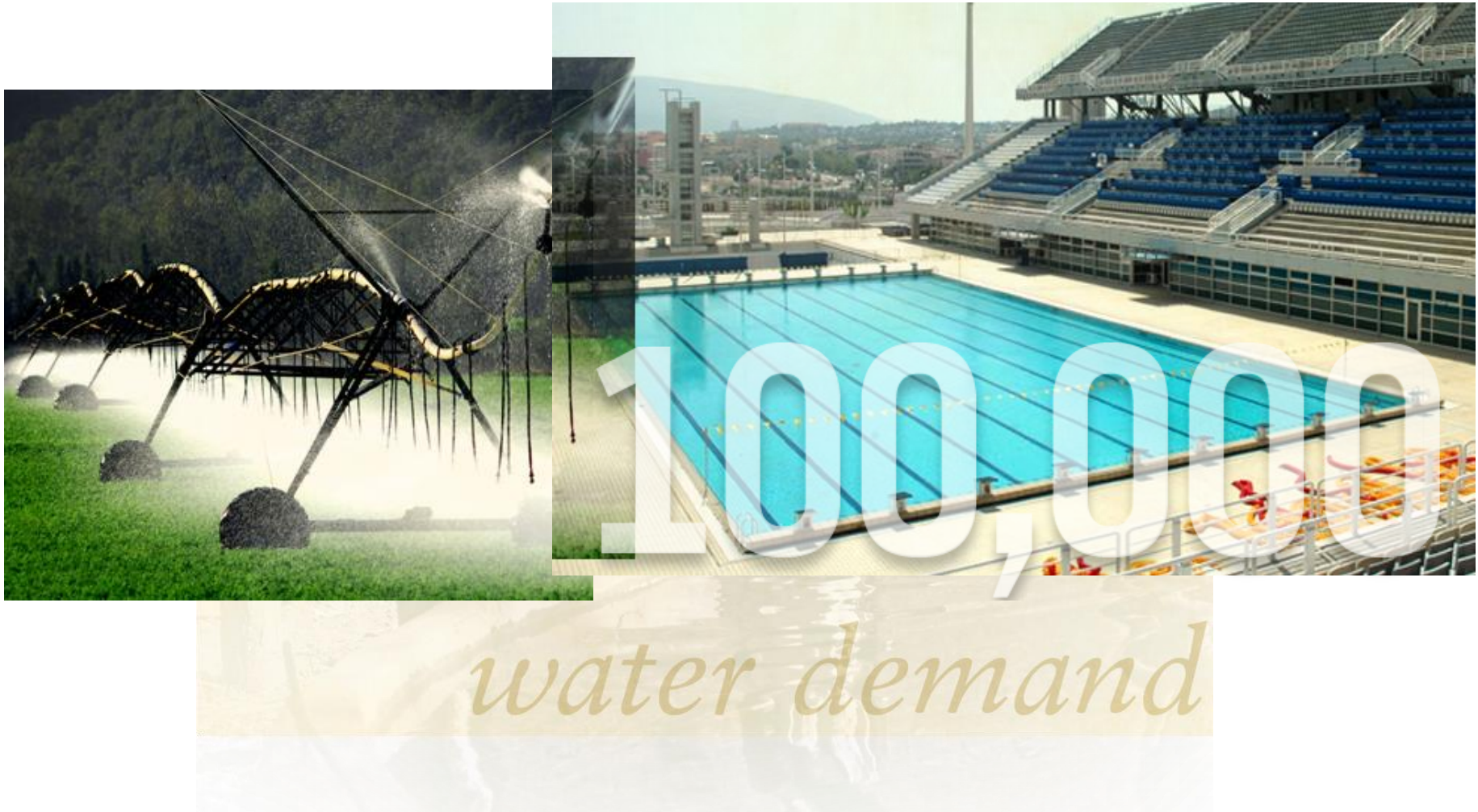
# FOOD DEMAND GROWING AT ~1.75% EACH YEAR



*food demand*

Source: IHS Global Insights, Agriculture Division, Monsanto analysis

# WATER DEMAND IS GROWING AT ~2% PER YEAR



Source: McKinsey Resource Revolution 2011, Monsanto Analysis

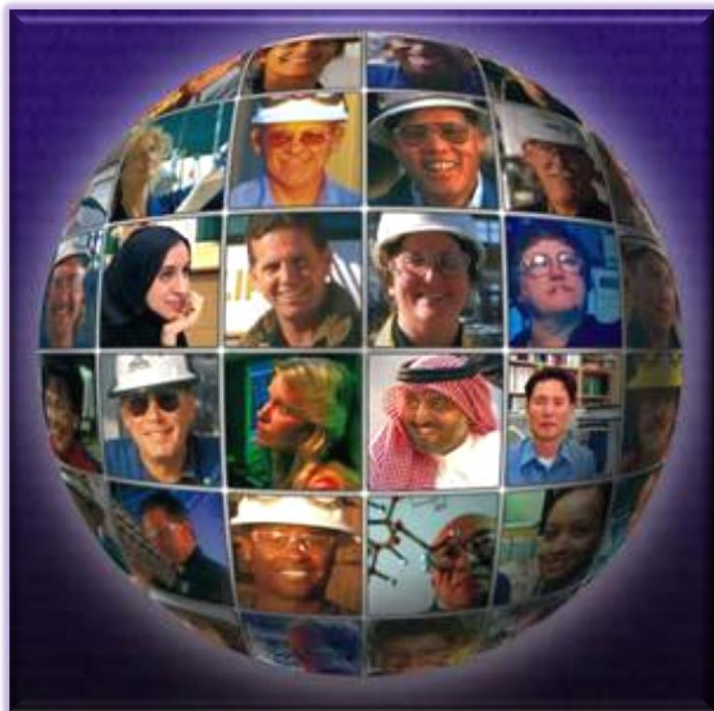


# ENERGY DEMAND IS GROWING AT 2.5% PER YEAR



Source: McKinsey Resource Revolution 2011, Monsanto Analysis

# GLOBAL ENERGY DEMAND EXCEEDS GLOBAL FOOD DEMAND



**9.2 Billion People**



## ENERGY Consumption

917.2 quad BTUs / yr

2.3 E 17 kcal / yr

**23X GREATER**

## FOOD Consumption

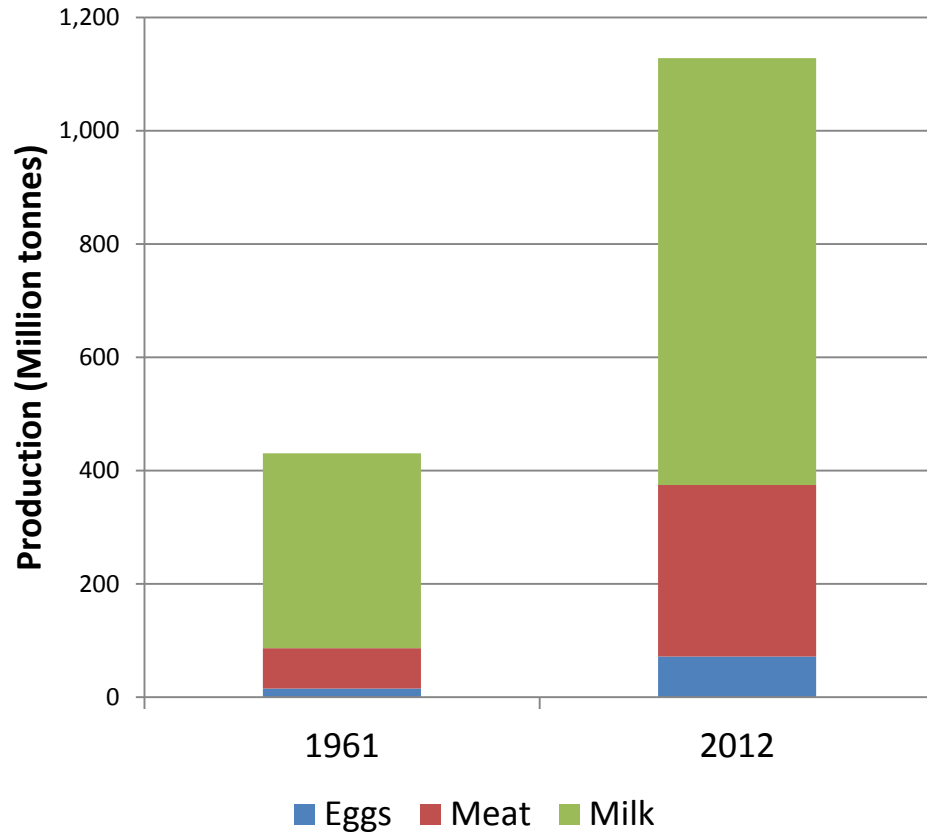
3050 kcal / day

1.0 E 16 kcal / yr

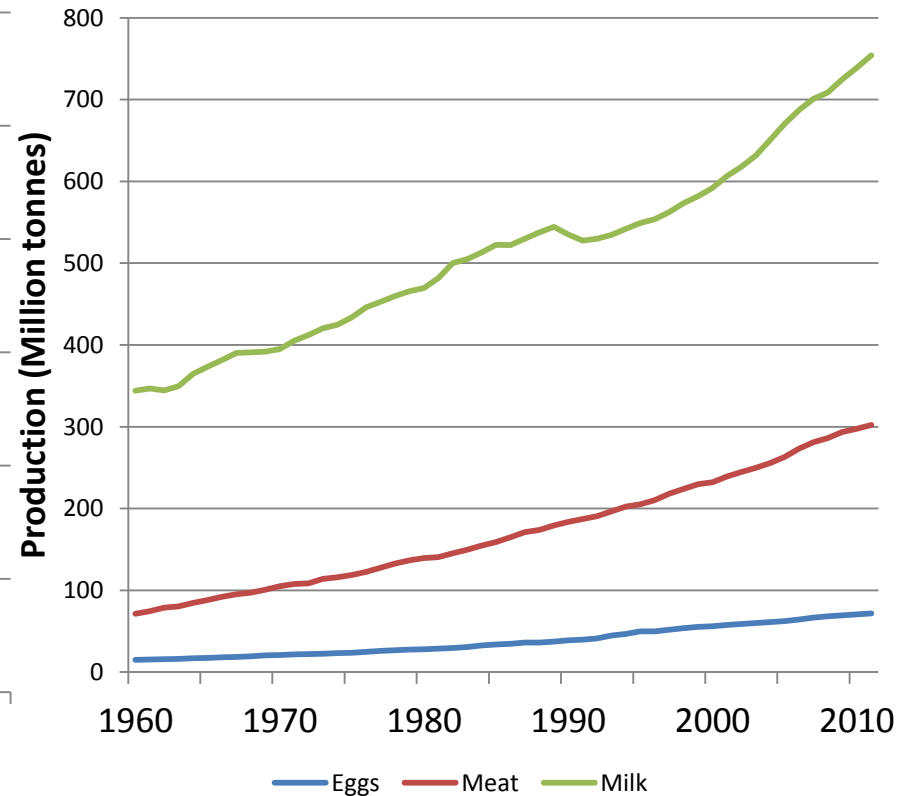
***BIOENERGY Will Only Be A Small Part Of The Global Energy Supply***

# GLOBAL PROTEIN DEMAND IS INCREASING

## Animal Primary Products

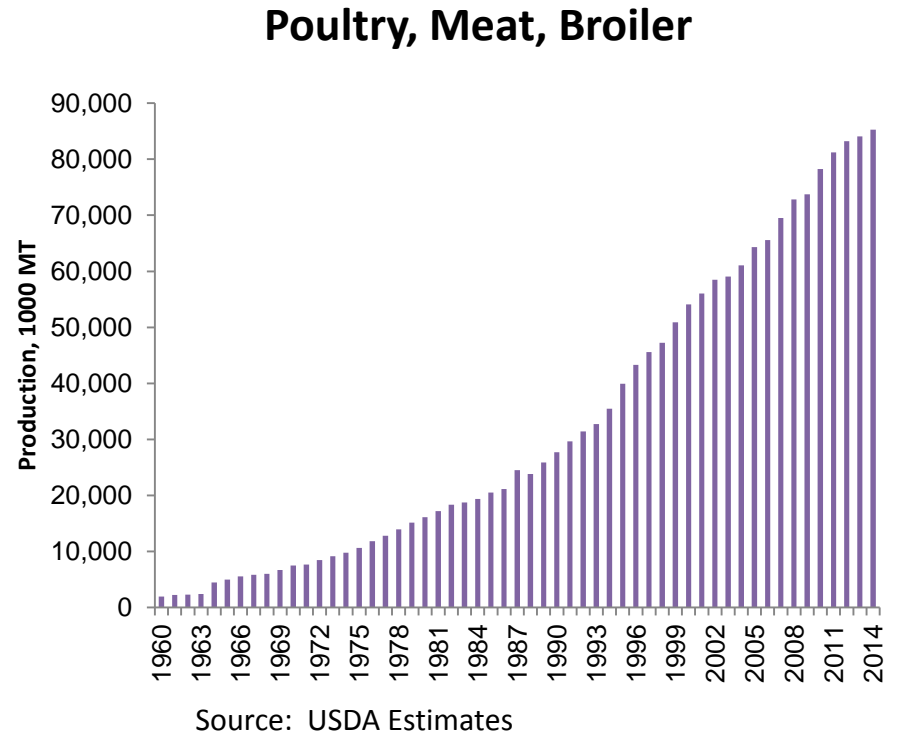
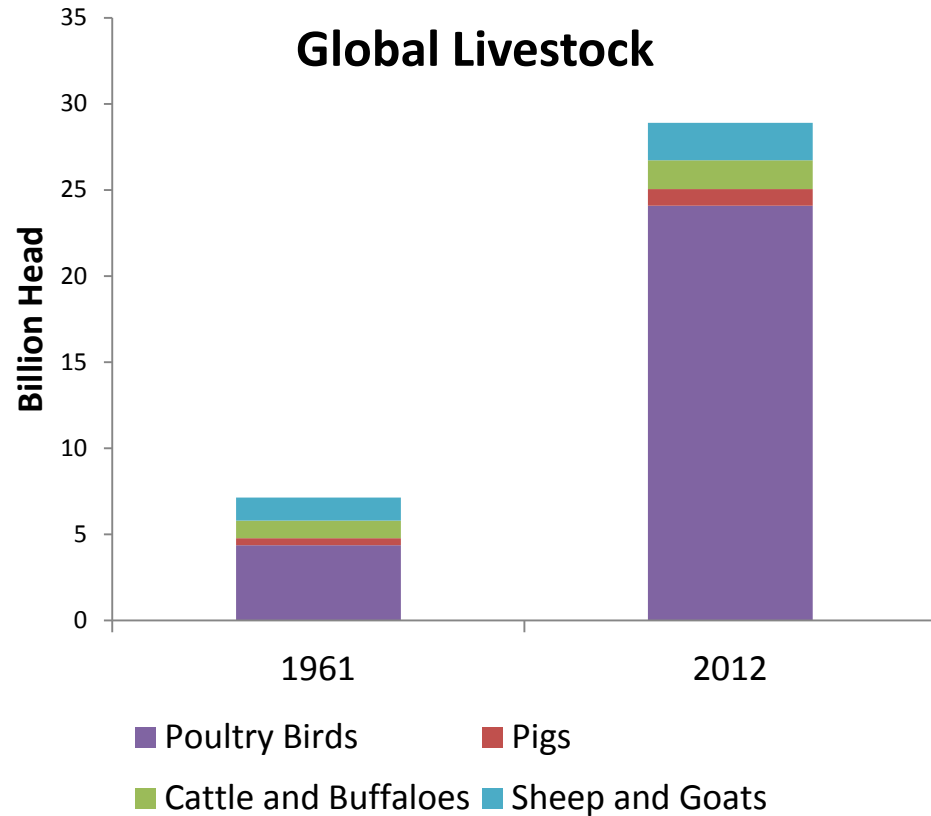


## Animal Primary Products





# POULTRY DOMINATES GLOBAL LIVESTOCK



# MANY TOOLS ARE USED TO INCREASE AGRICULTURAL PRODUCTIVITY

## BREEDING



Highest yielding genetics for the environment: conventional breeding gains and natural disease resistance

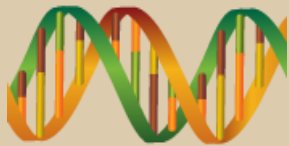


## BIOLOGICALS



Derived from natural materials to support plant health and pest protection

## BIOTECHNOLOGY



Complementary agronomic and yield-enhancing traits

## PRECISION AGRICULTURE



Optimizing farm management practices, including rotations, soil management, cover crops


## CROP PROTECTION



Seed treatments and selective chemistries protect the crop from pests, weeds and diseases




# THE FUTURE: CORN FARMERS WILL LEVERAGE TECHNOLOGY AND INFORMATION TO IMPROVE YIELDS


**A**   
**Software:**  
Agronomy Apps to enable Hybrid Selection & Mapping


**Breeding**  
Orders of magnitude more data points per year to increase genetic gain

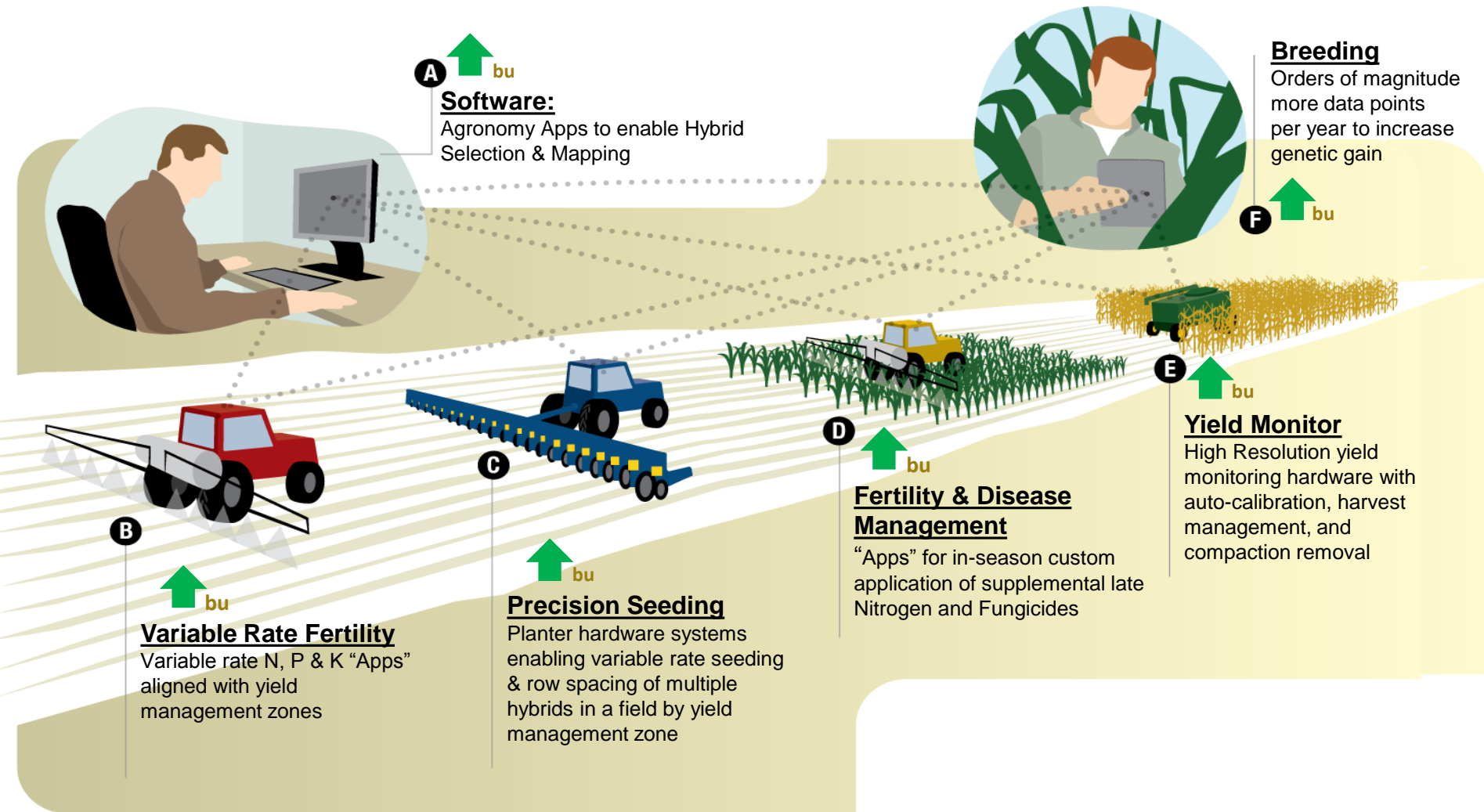
**F** 

**E**   
**Yield Monitor**  
High Resolution yield monitoring hardware with auto-calibration, harvest management, and compaction removal

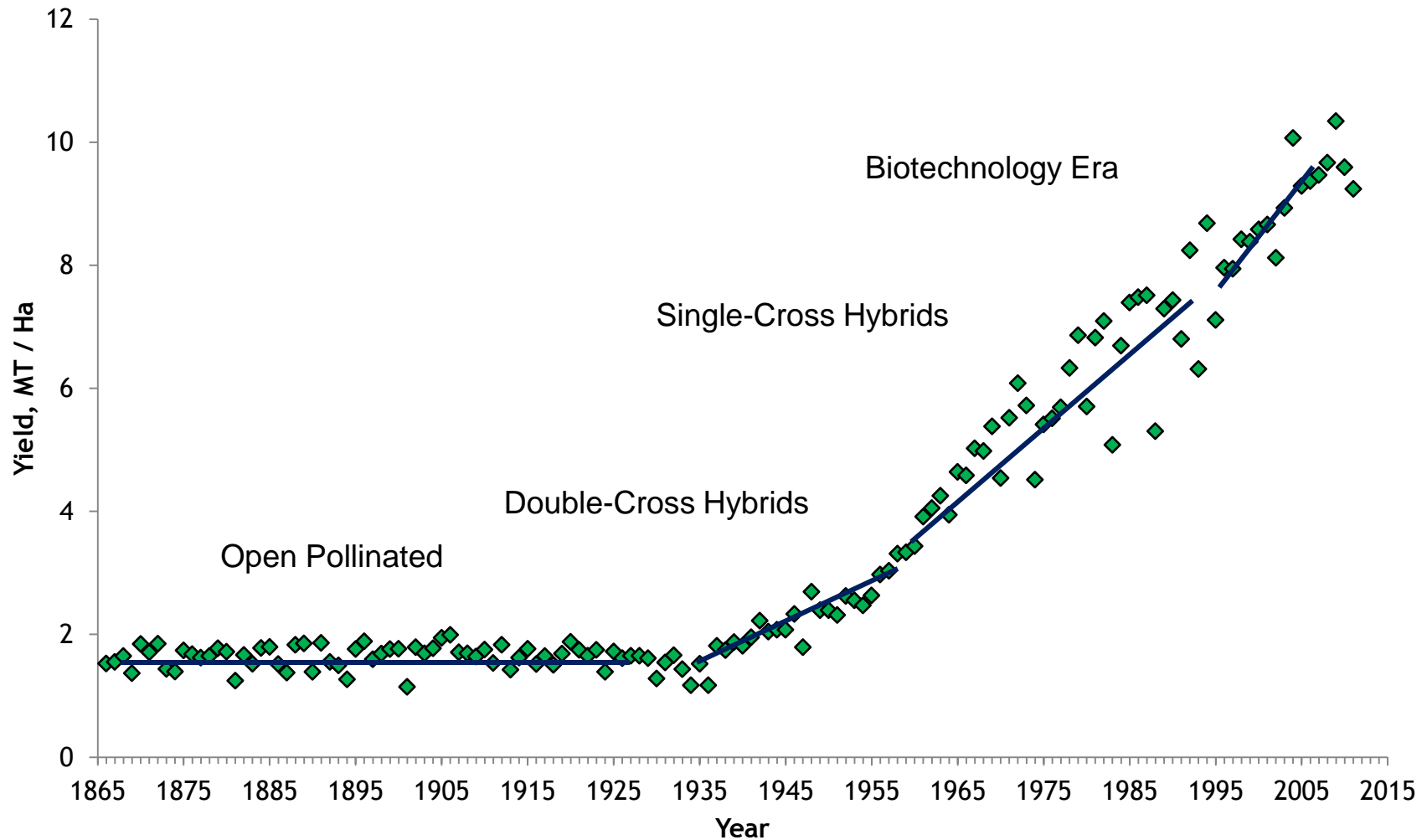
**D**   
**Fertility & Disease Management**  
“Apps” for in-season custom application of supplemental late Nitrogen and Fungicides

**C**   
**Precision Seeding**  
Planter hardware systems enabling variable rate seeding & row spacing of multiple hybrids in a field by yield management zone

**B**   
**Variable Rate Fertility**  
Variable rate N, P & K “Apps” aligned with yield management zones



# CORN YIELDS, ENABLED IN PART BY INNOVATIONS IN TECHNOLOGY, CONTINUE TO ACCELERATE







# **AGRICULTURE'S CHALLENGE** *to grow more feed and fuel safely and sustainably.*

**GROW MORE FOOD**  
from less land

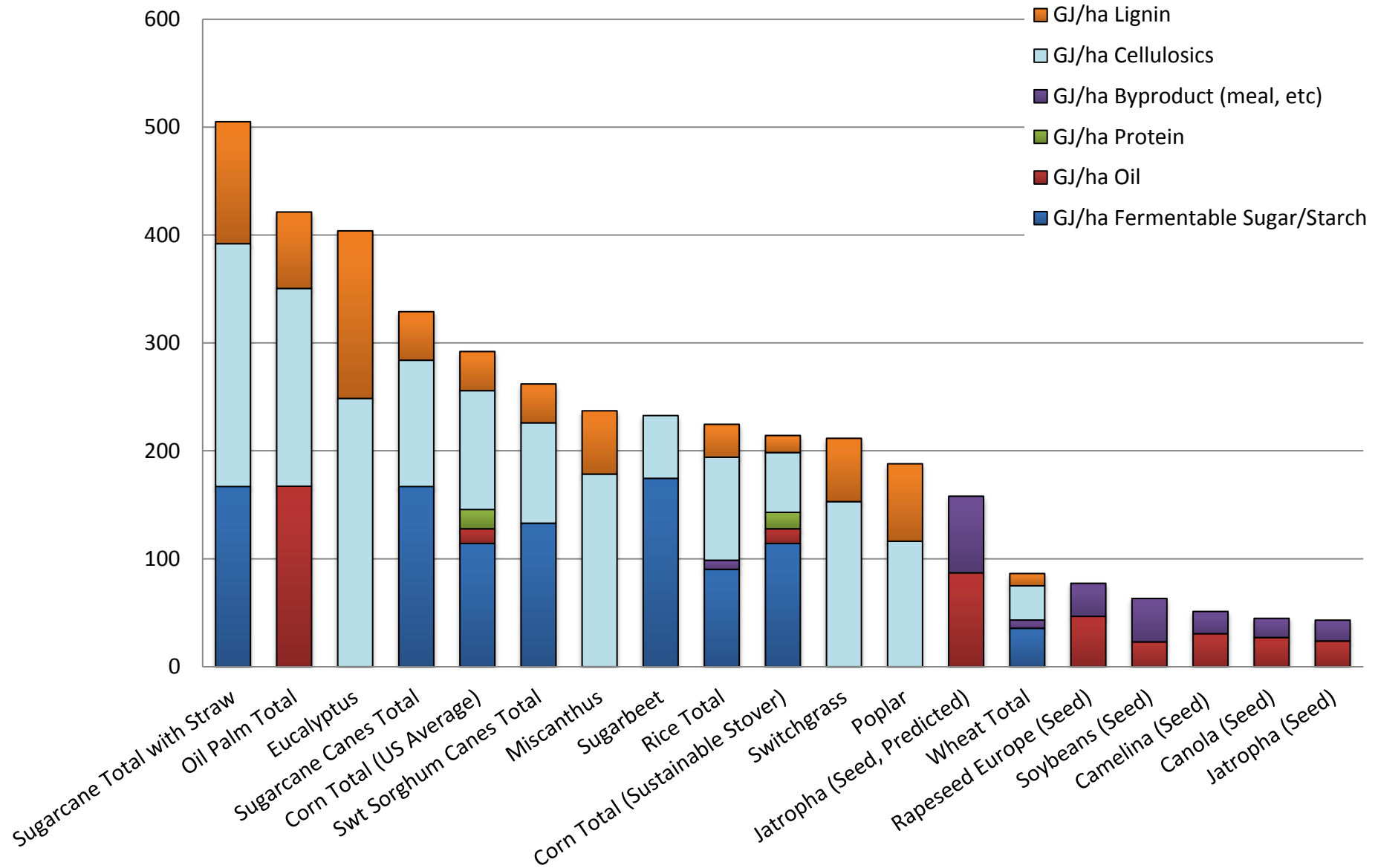
**SUSTAINABLY REDUCE**  
water and chemical use

**MAINTAIN AND BUILD**  
healthy soil

**MITIGATE THE IMPACT**  
of drought

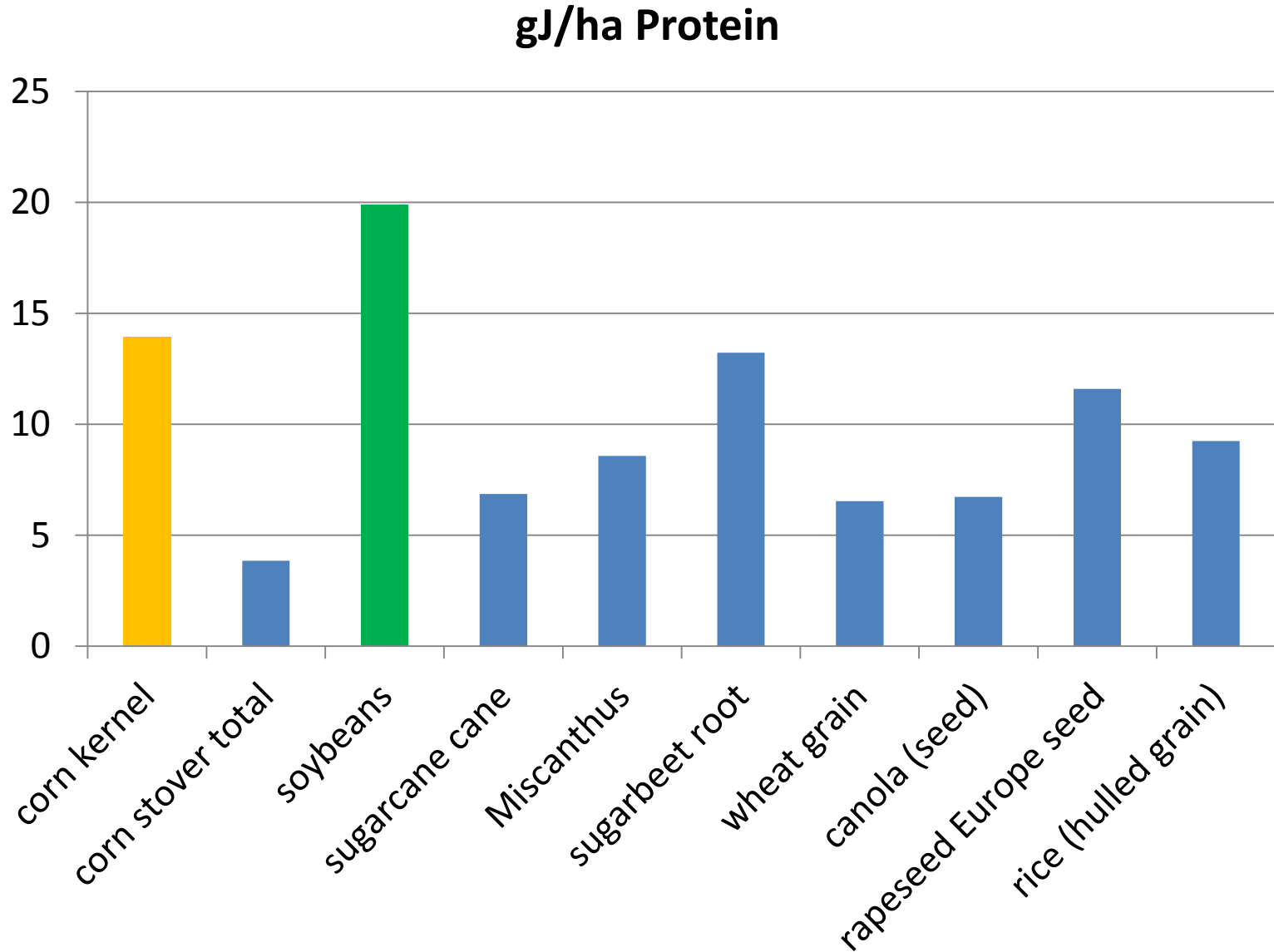
**REDUCE THE AMOUNT** of energy  
and emissions per unit produced

# ENERGY CROPS PRODUCE OIL AND / OR CARBOHYDRATES

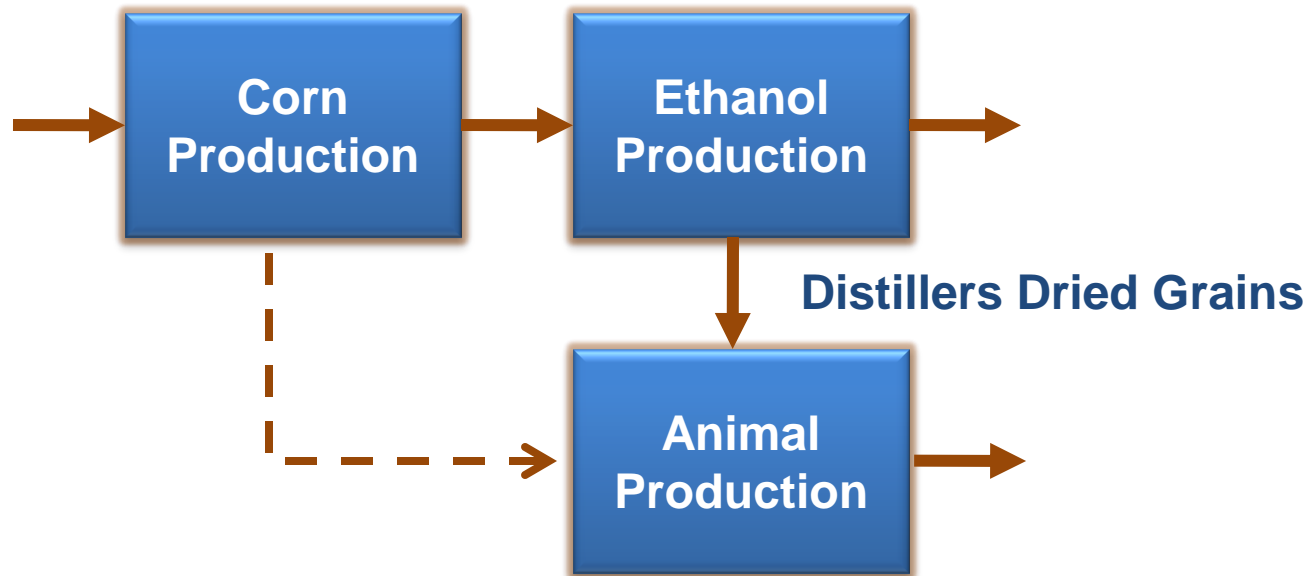




# THE AMOUNT OF PROTEIN PRODUCED PER UNIT LAND IS CRITICAL TO MEET FEED DEMAND



# CORN ETHANOL PRODUCTION HELPS TO CONCENTRATE CORN PROTEIN



	% Crude Protein	Metabolizable Energy, Poultry, kcal/kg
Canola Meal	36.9	1.75
DDGs	27.1	2.53
Corn, Grain	9.1	3.31
Soybean Meal	45.7	2.33

# DISTILLERS GRAINS SOYMEAL DISPLACEMENT IMPACTS LAND USE

Displacement Ratio, by Species (kg / kg)

	Dairy	Beef	Swine	Poultry
Corn	0.731	1.196	0.699	0.589
Soybean meal	0.633		0.295	0.446

Source: Shurson

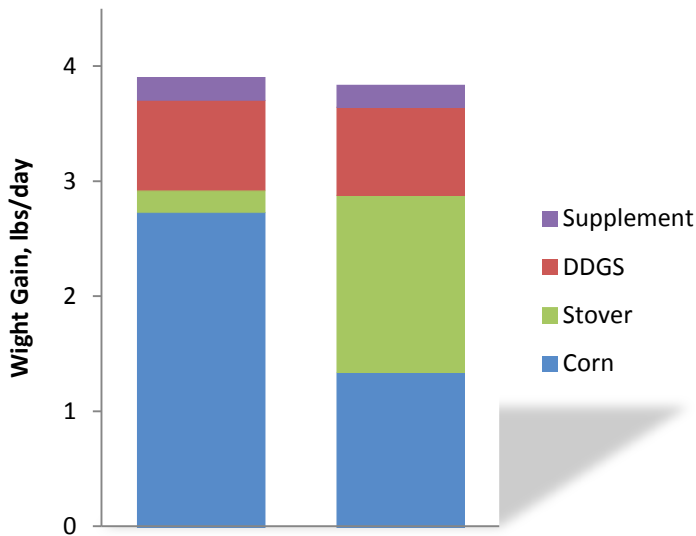
Net acres corn required for ethanol

	Total Area, M acres
Total US Corn Production	87.7
Production for Ethanol	29.26
Distillers Grain – Corn Area Credit	(8.64)
Distillers Grain – Soy Area Credit	(7.47)
Corn “Net Acres”	13.14



# TREATED CORN STALKS MAKE GREAT CATTLE FEED AND DEVELOP BIOMASS MARKETS

- Increased corn yield increases corn stalk yield
- Corn stalks can be sustainably removed
- Lime treated corn stalks displace a portion of corn in the diet
- Economics work – develops channel today
- Frees up 2.2 B bushels of corn for alternative use



Diet Percentage	Corn Ration 3.90 %	CRF Ration 3.84%
Return per Steer	\$90.54	\$118.58



Heifers enjoying CRF  
43M tons potential use

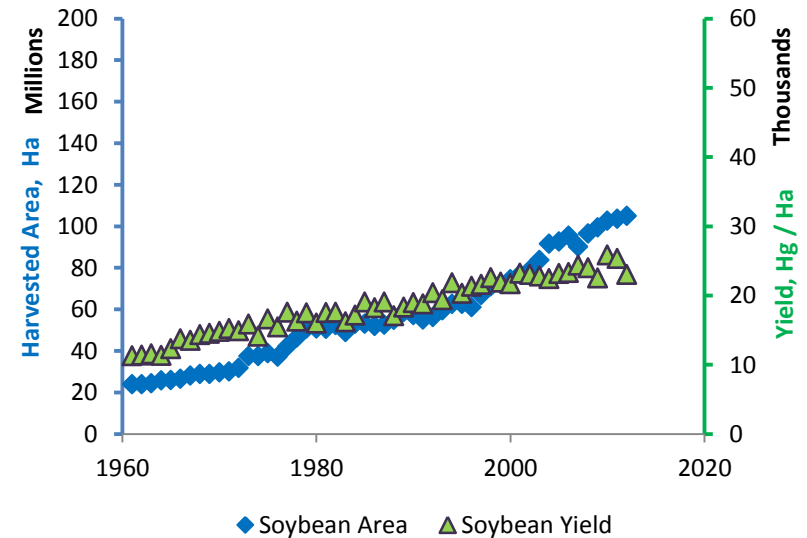
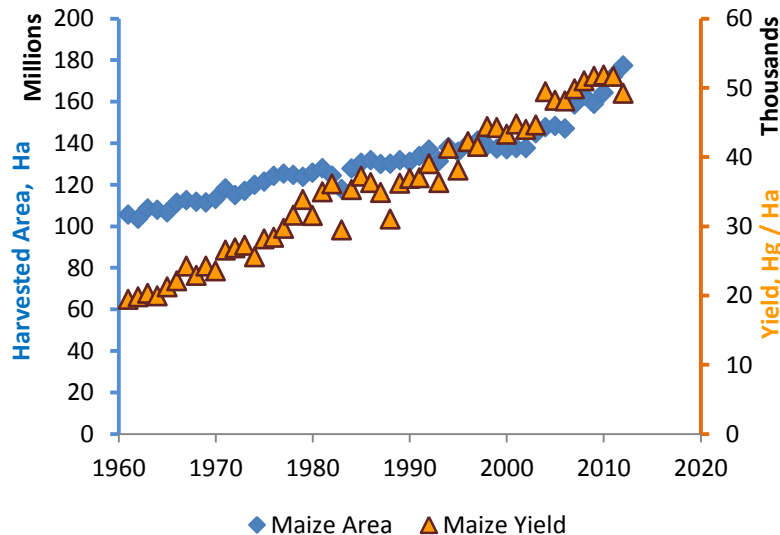
# TOTAL CORN AND SOY PRODUCTION GROWING AT FASTER RATE THAN CALORIE

## Corn CAGR

Yield	1.84%
Area	1.02%
Production	2.88%

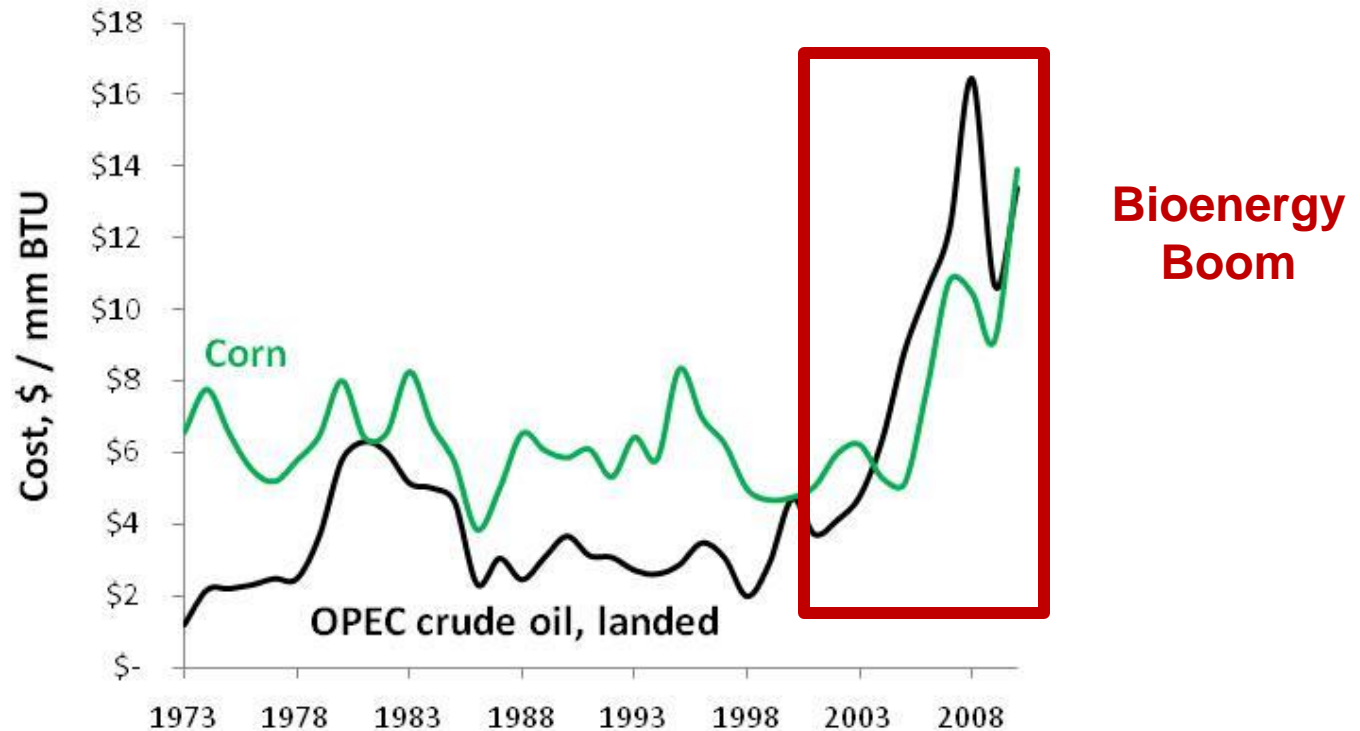
## Soybean CAGR

Yield	1.40%
Area	2.95%
Production	4.40%



Agricultural technology will continue to provide farmers with tools to increase yields

# ECONOMICS ARE THE PRIMARY DRIVER FOR BIOENERGY



	Annual Price Change 1900-2000	
Energy	0.3 %	Discoveries, OPEC
Food	-0.7 %	Grain yield increase
Water	0 %	Subsidies



**Innovations in agriculture, and particularly methods to improve yields of concentrated protein for animal feed are required to meet future feed and fuel demands**

