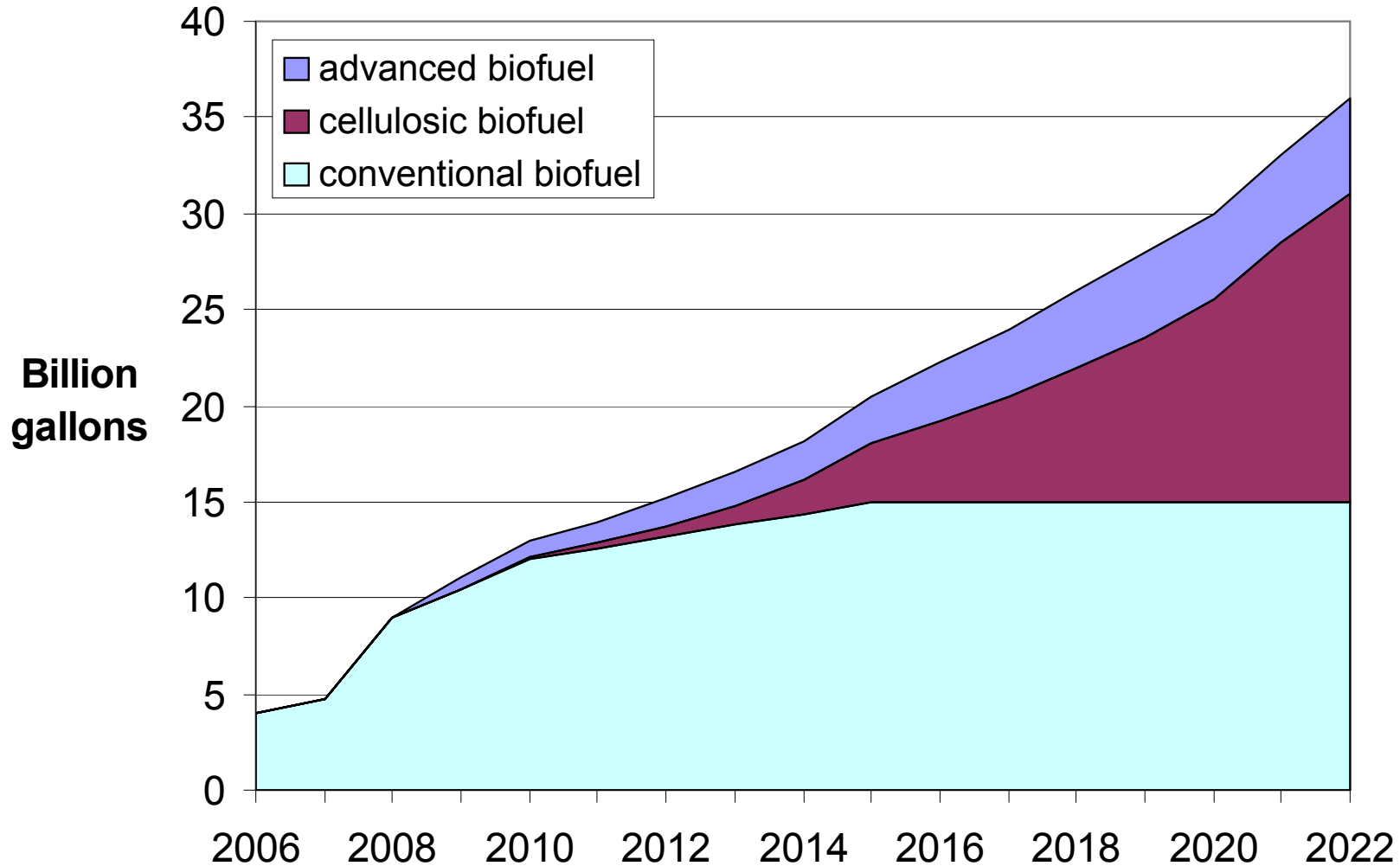


# Potential of Sweet Potato and Sweet Sorghum as Advanced Biofuel Crops for Low Input Production on Small Farms

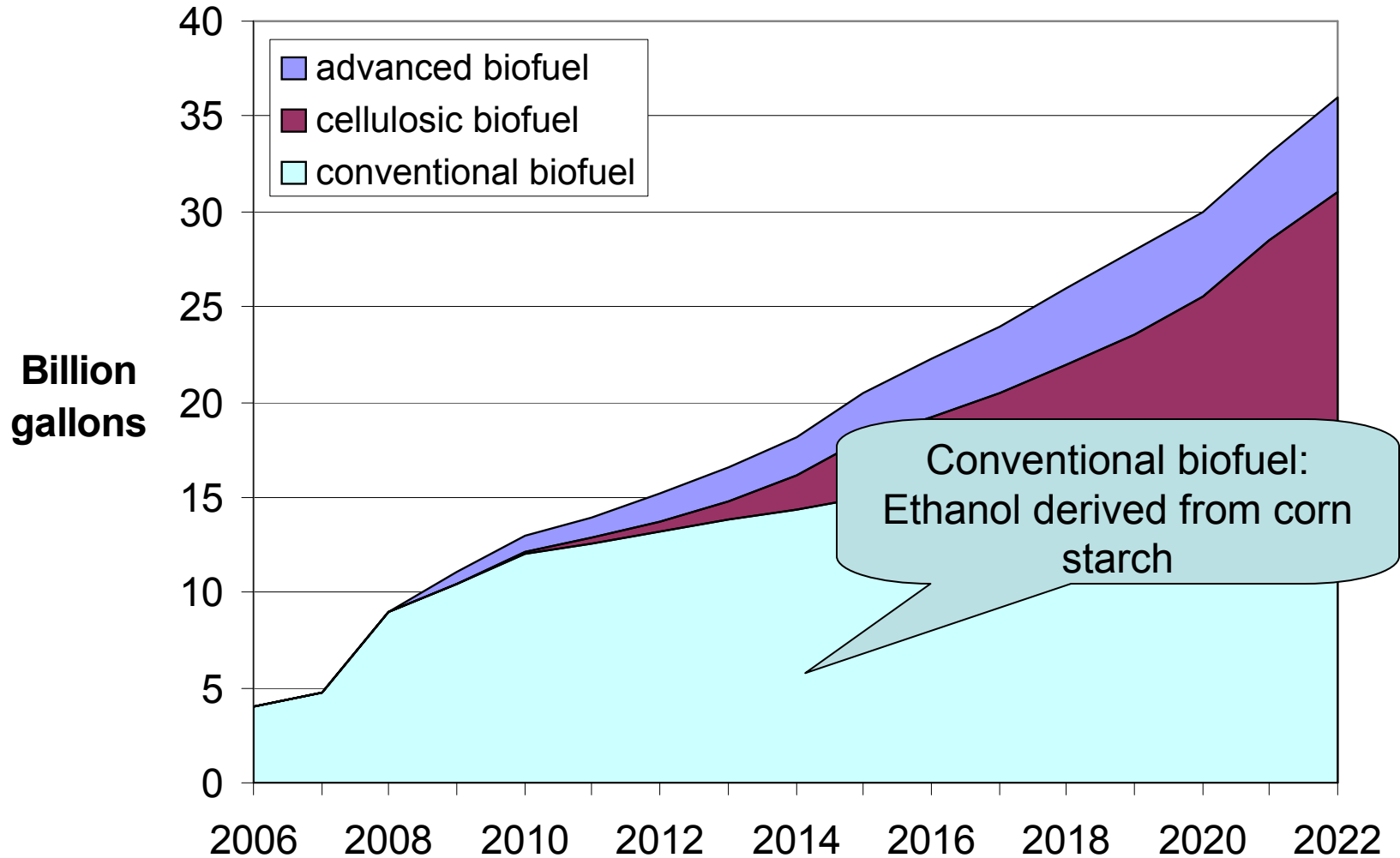
Michael Bomford  
and Tony Silvernail



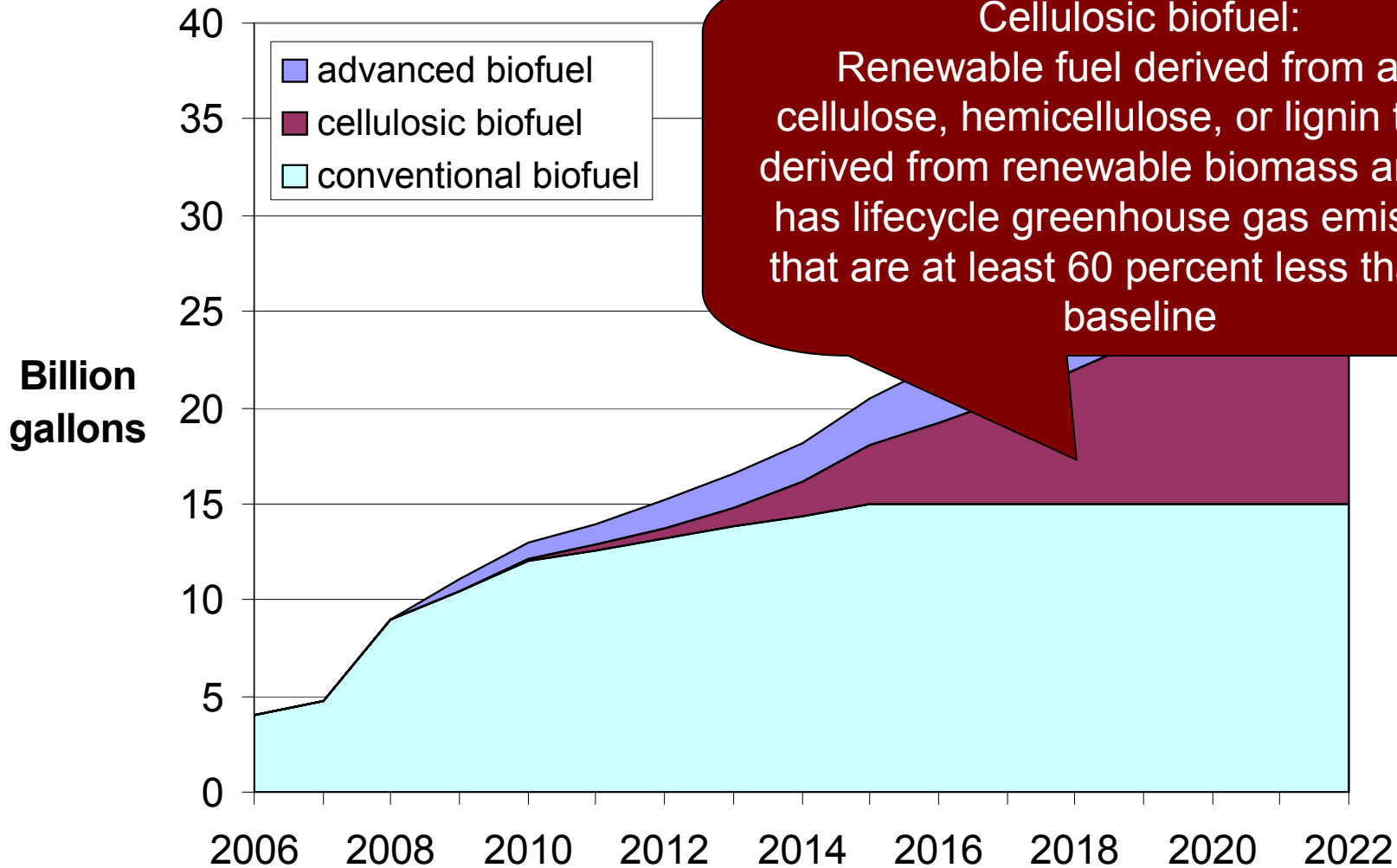
# US Biofuel Mandates



# US Biofuel Mandates

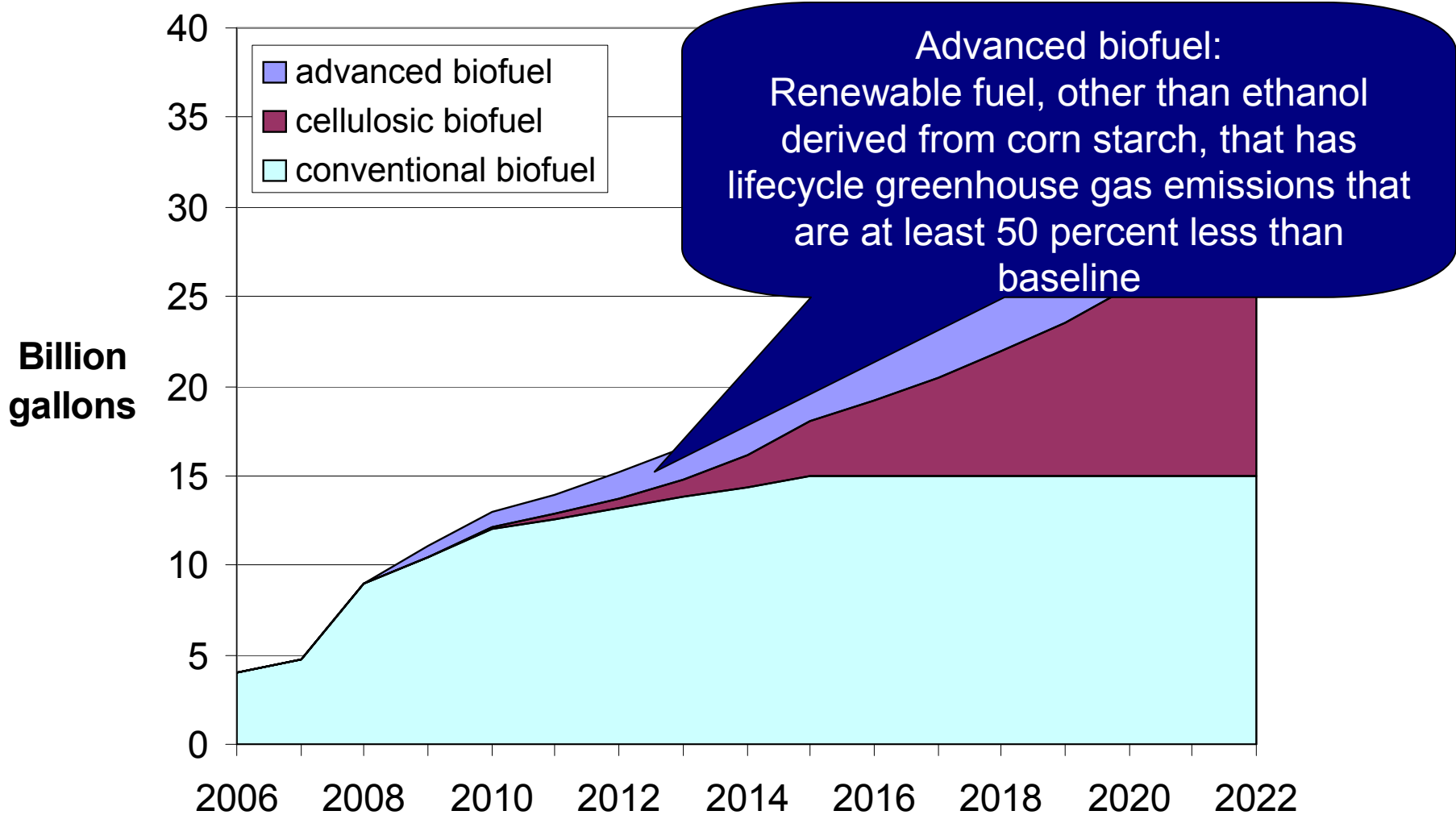


# US Biofuel Mandates



Cellulosic biofuel:  
Renewable fuel derived from any cellulose, hemicellulose, or lignin that is derived from renewable biomass and that has lifecycle greenhouse gas emissions that are at least 60 percent less than the baseline

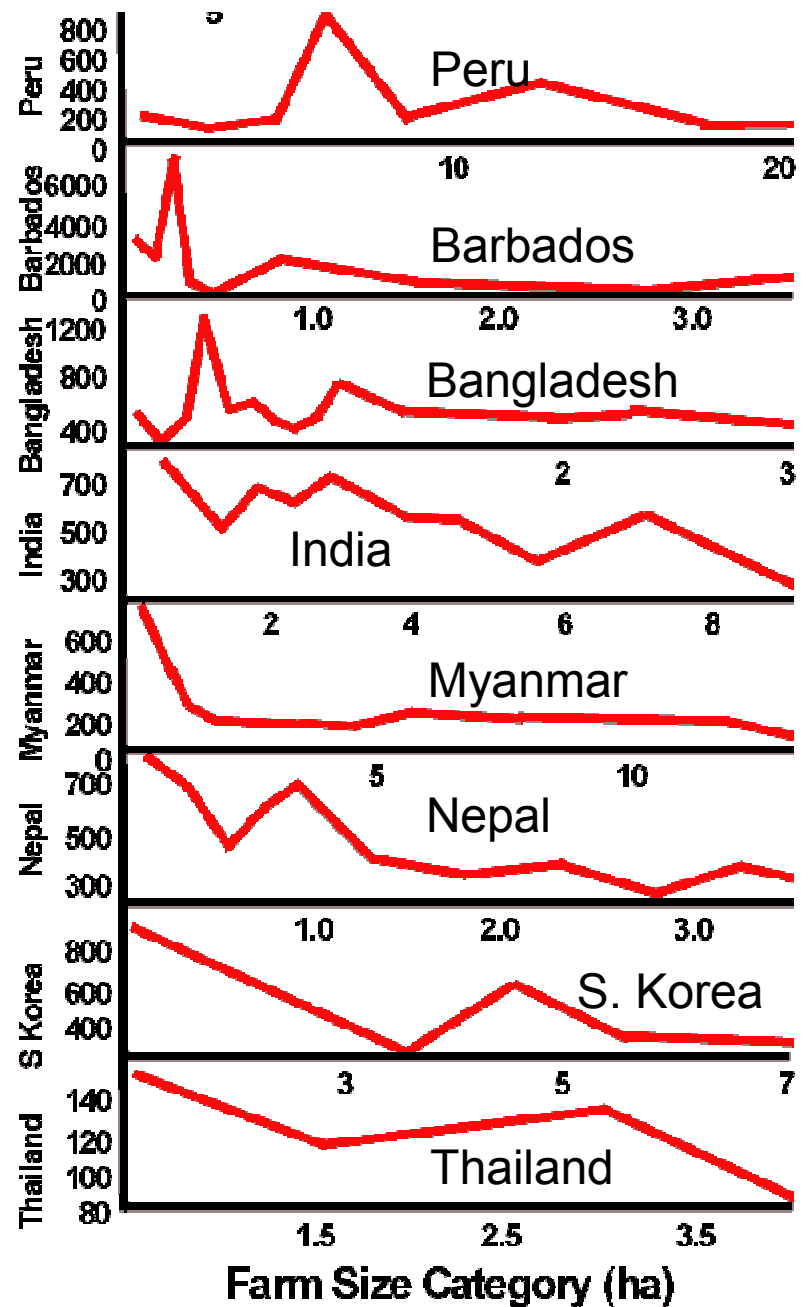
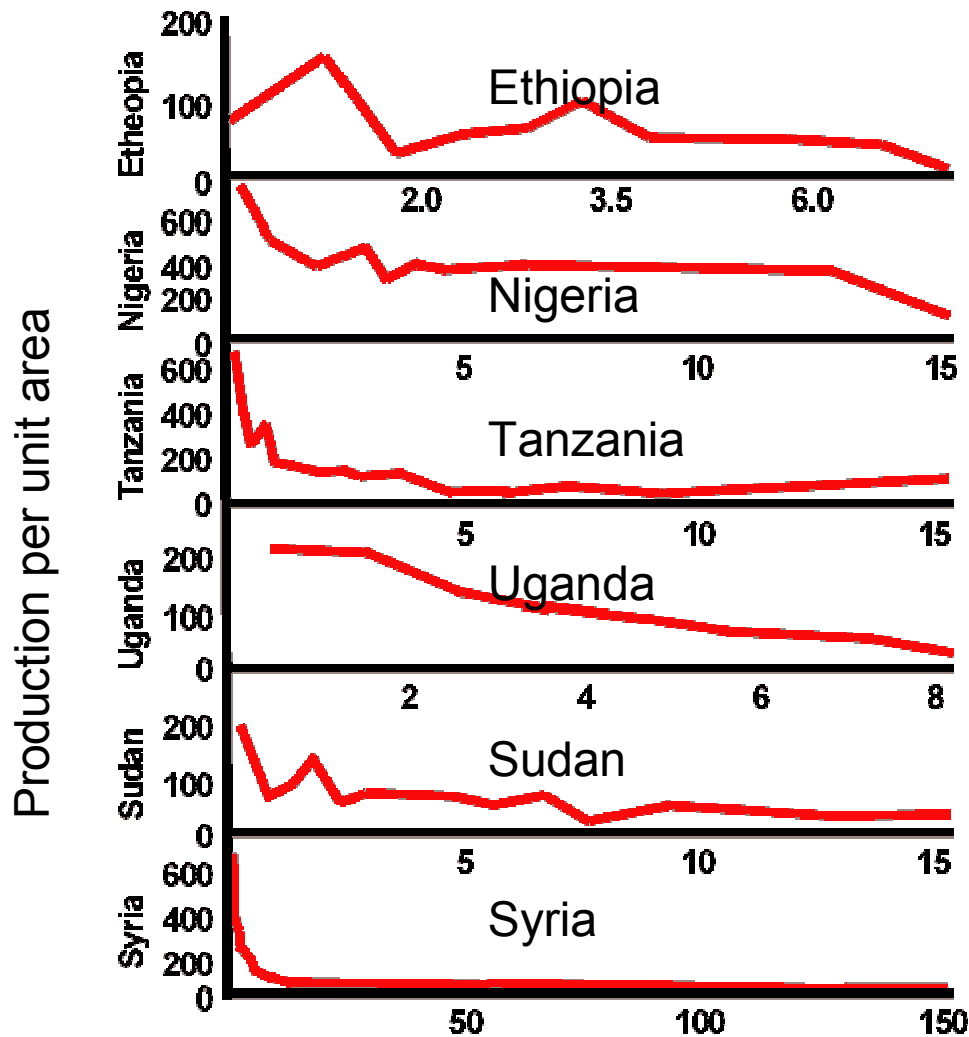
# US Biofuel Mandates



# Small, organic, sustainable

- Smaller farms tend to use land more efficiently
- Organic farms tend to use energy more efficiently
  - Synthetic fertilizers and pesticides can account for 30-50% of energy involved in grain production
- Need alternative feedstock crops
  - Compatible with small farms, organic farms, southern farms
  - Higher ethanol yield than corn
  - Compatible with decentralized processing

# Small farms are more productive



Cornia, Giovanni Andrea. 1985. "Farm Size, Land Yields and the Agricultural Production Function: An Analysis for Fifteen Developing Countries." *World Development* 13(4):513-534.

*“Because of its reduced energy inputs, organic agriculture is the ideal production method for biofuels.*

*[...]*





*As the aim of biofuels is to reduce dependency on non-renewable energy sources and to mitigate environmental damage of fossil fuel emissions, organic production of biofuels furthers these goals in a way that conventional agriculture does not.”*



# Objectives

- Compare sweet sorghum and sweet potato to corn in terms of
  - Potential ethanol yield (land use efficiency)
  - Energy use efficiency
  - Labor use efficiency
- Compare efficiencies at three small organic farm scales
  - Biointensive
  - Market garden
  - Small farm

# Crops

Common name	Corn	Soybean	Sweet sorghum	Sweet potato
Image				
Latin name	<i>Zea mays</i>	<i>Glycine max</i>	<i>Sorghum bicolor</i>	<i>Ipomoea batatas</i>
Food	Sweet corn, grain	Edamame, grain	Sorghum syrup, grain	Sweet potato
Fuel	Ethanol	Biodiesel	Ethanol	Ethanol

# Small Farm Scales

- Biointensive
  - Human-powered; no fossil fuels
  - Smallest scale
- Market garden
  - Walk-behind tractor is largest fossil fuel powered machine
- Small farm
  - Conventional 4-wheeled tractors



# Biointensive mini-farming

“Biointensive mini-farming techniques make it possible to grow food using

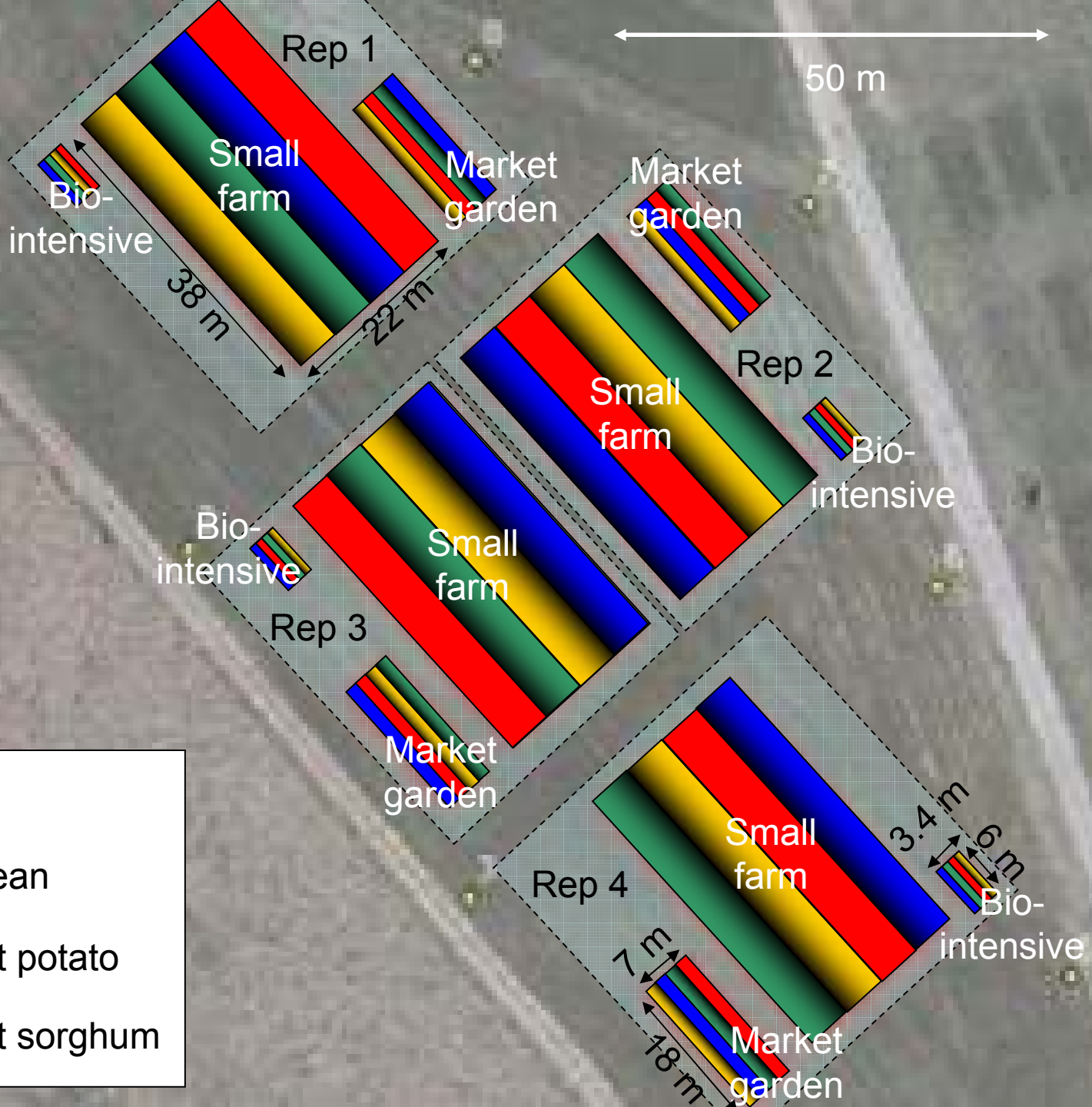
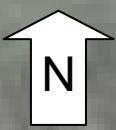
- 99% less energy in all forms - human and mechanical,
- 66-88% less water, and
- 50-100% less fertilizer, compared to commercial agriculture.

They also produce two to six times more food and build the soil.”



2008

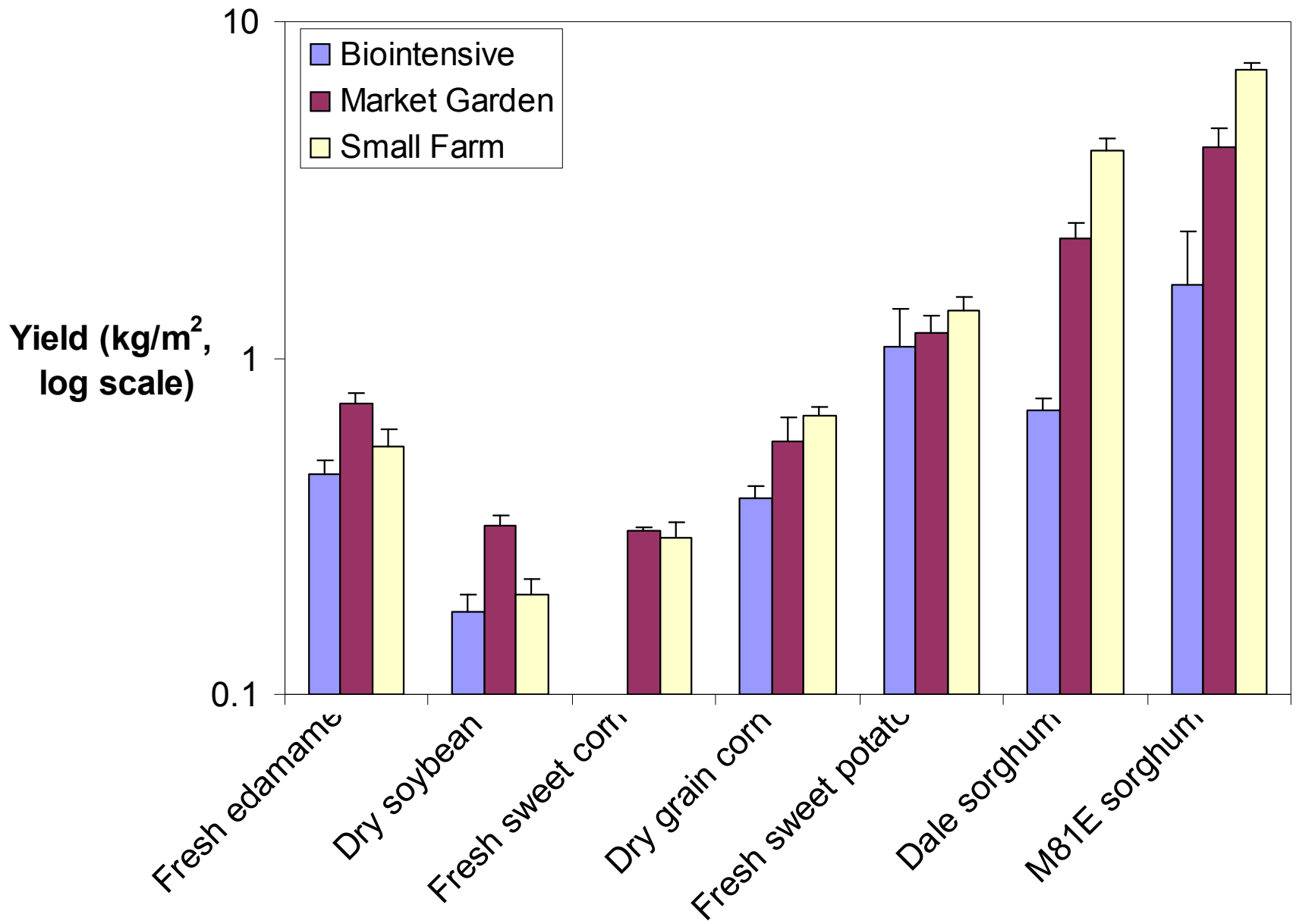
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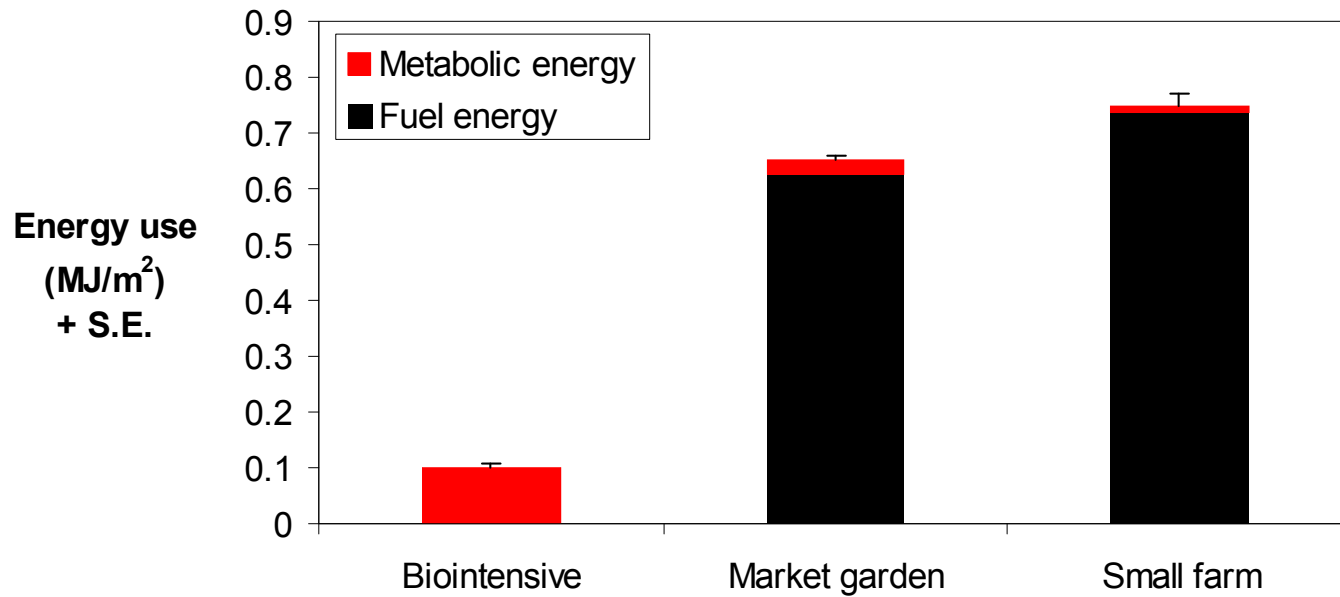
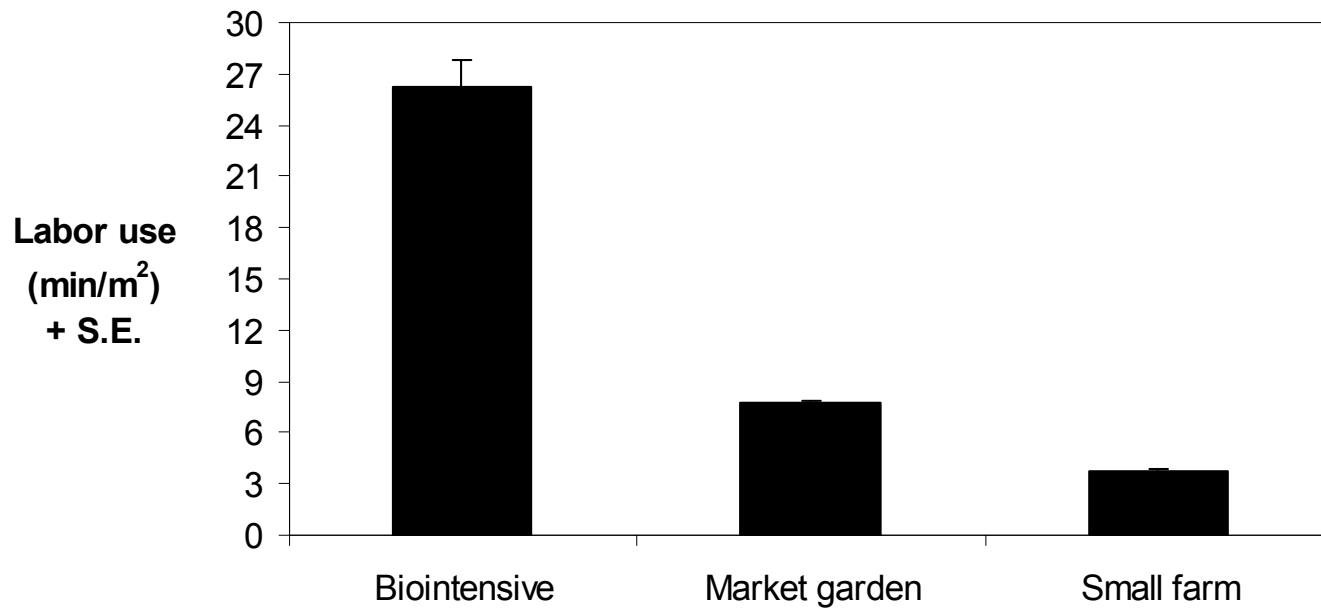


Food	Corn
Fuel	
Food	Soybean
Fuel	
	Sweet potato
Food	Sweet sorghum
Fuel	

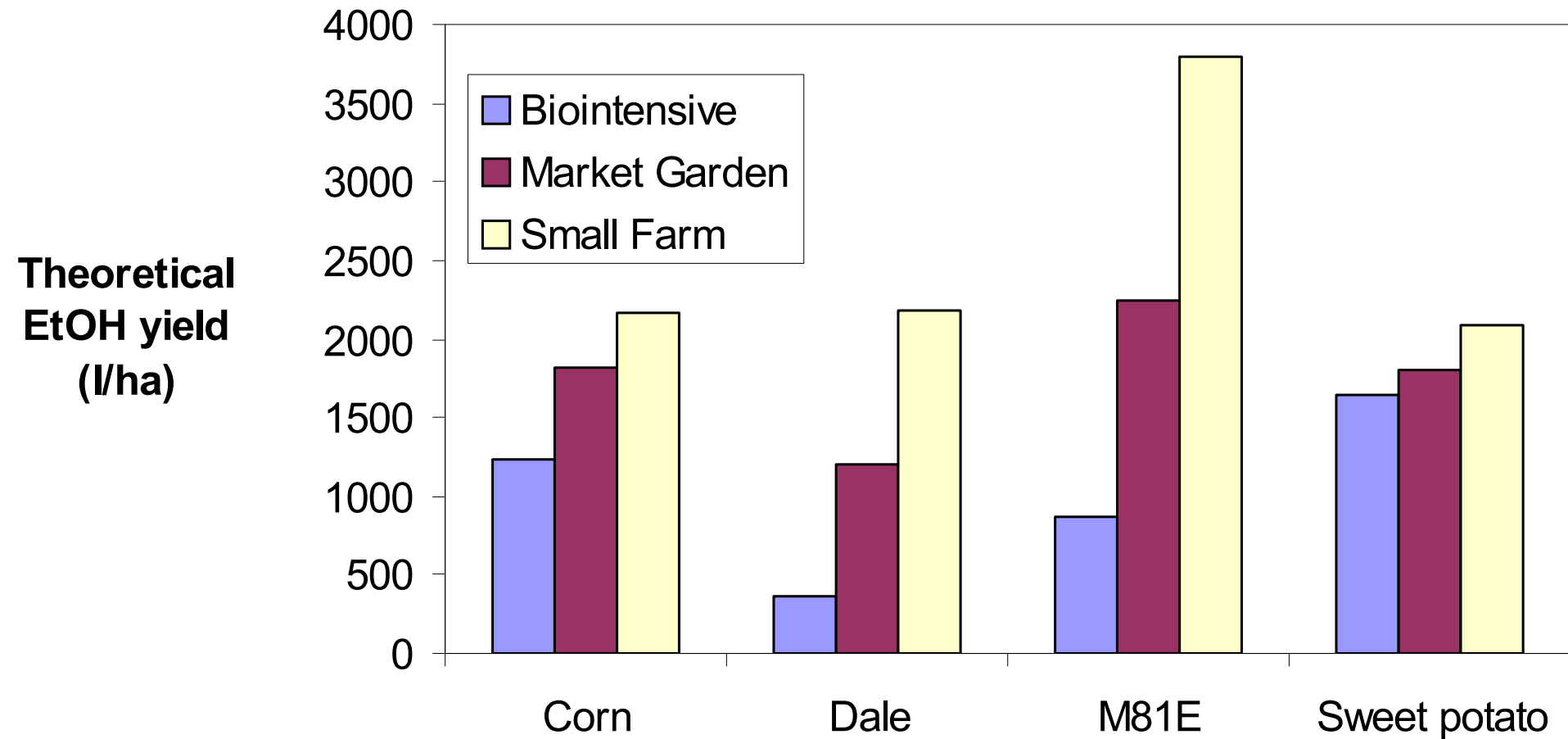




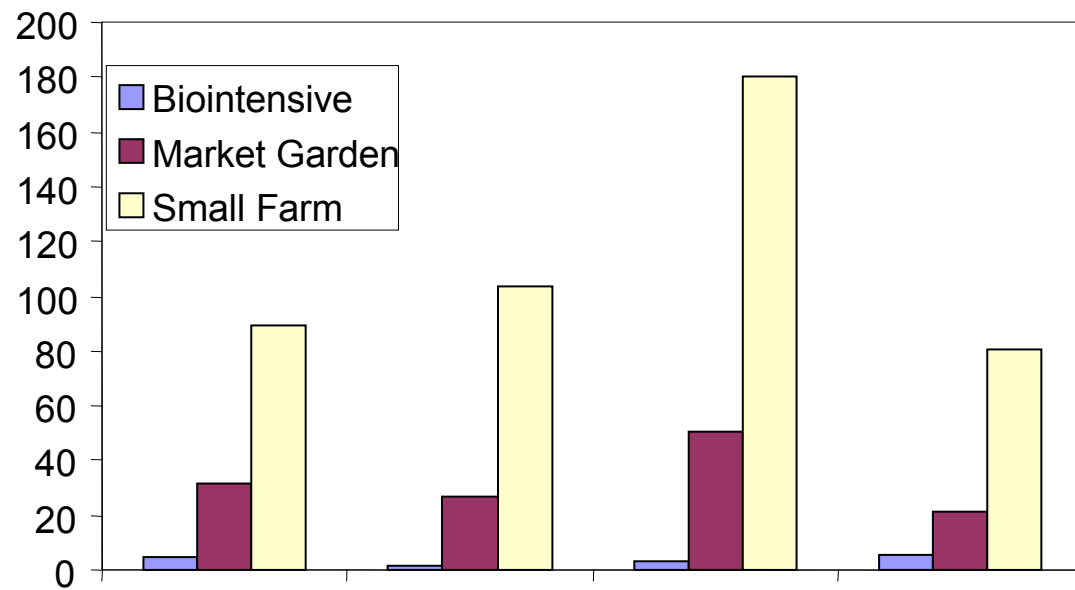




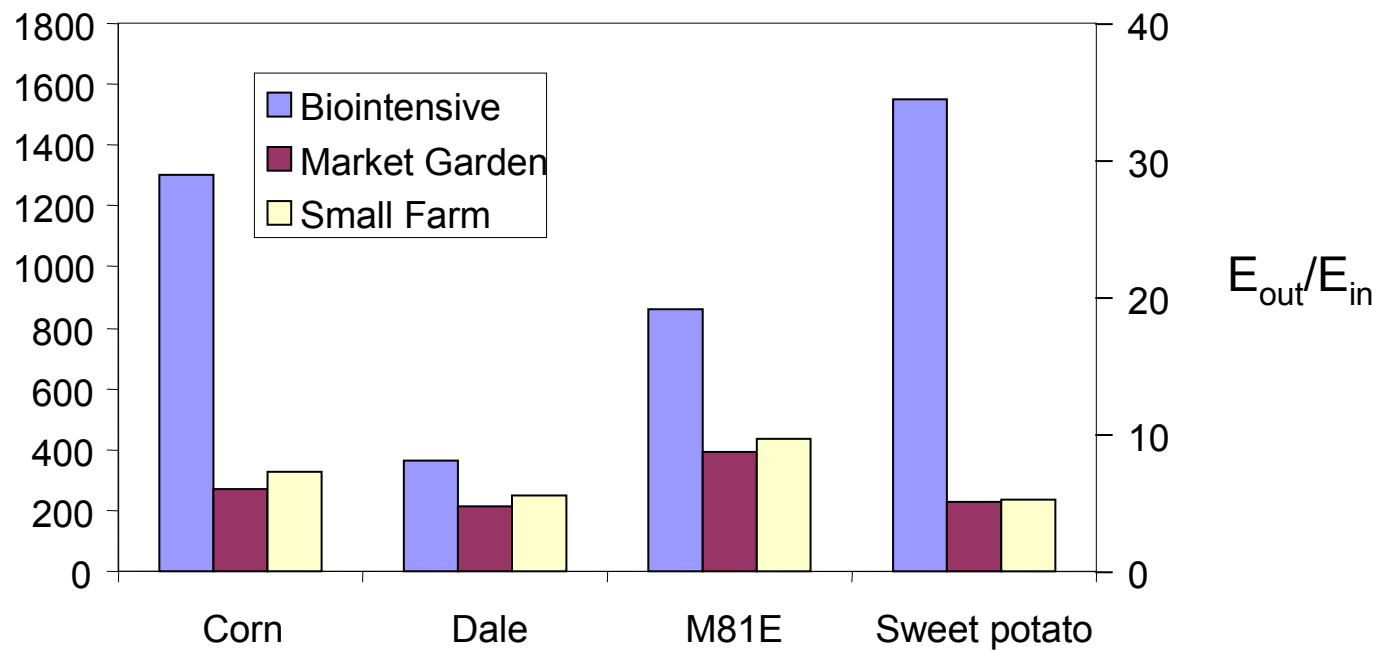
# Theoretical EtOH yield



**Theoretical EtOH yield (mL/min)**



**Theoretical EtOH yield (mL/MJ)**



# Conclusions

- Yields under low input, small-scale organic production systems
  - Field corn about 33% below average
  - Sweet potato about average
  - Sweet sorghum about 50% higher than average
- Field corn and sweet sorghum yields lower in Biointensive-scale system; sweet potato yields similar across scales
- Biointensive scale gives highest energy efficiency; small farm gives highest land and labor use efficiency
- Sweet sorghum and sweet potato more compatible with low-input small farm systems than corn





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Learn more:

[EnergyFarms.net](http://EnergyFarms.net)

[Organic.KYSU.edu](http://Organic.KYSU.edu)

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