Ethanol and Greenhouse Gas Emissions

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Issues to discuss

- Direct lifecycle emissions of GHG from ethanol
- The value of GHG reductions associated with ethanol
- Indirect land use emissions
- Conclusions

“On average, corn ethanol reduces GHG emissions by 19%”

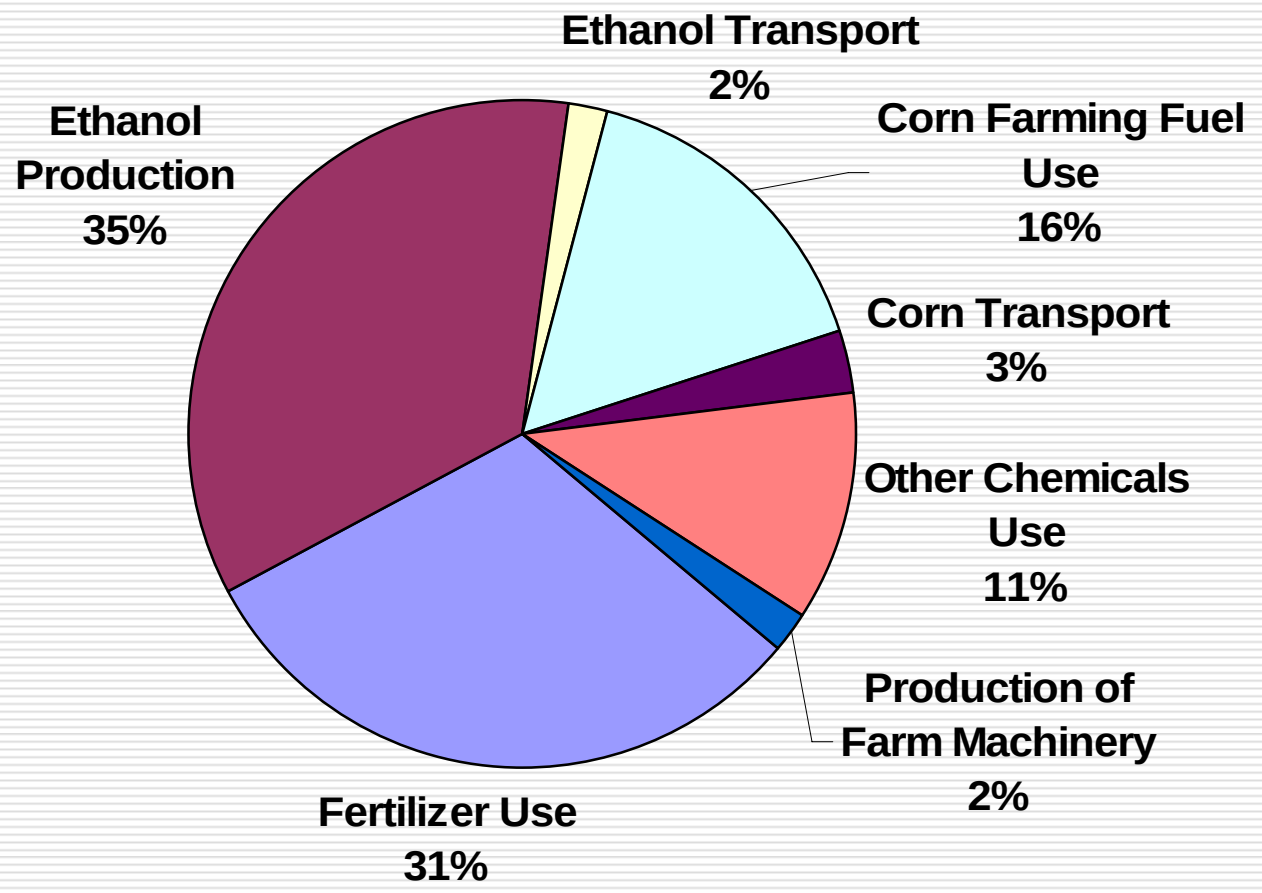
Wang, Wu, Huo 2007

* on an energy equivalent basis

* Includes co-products

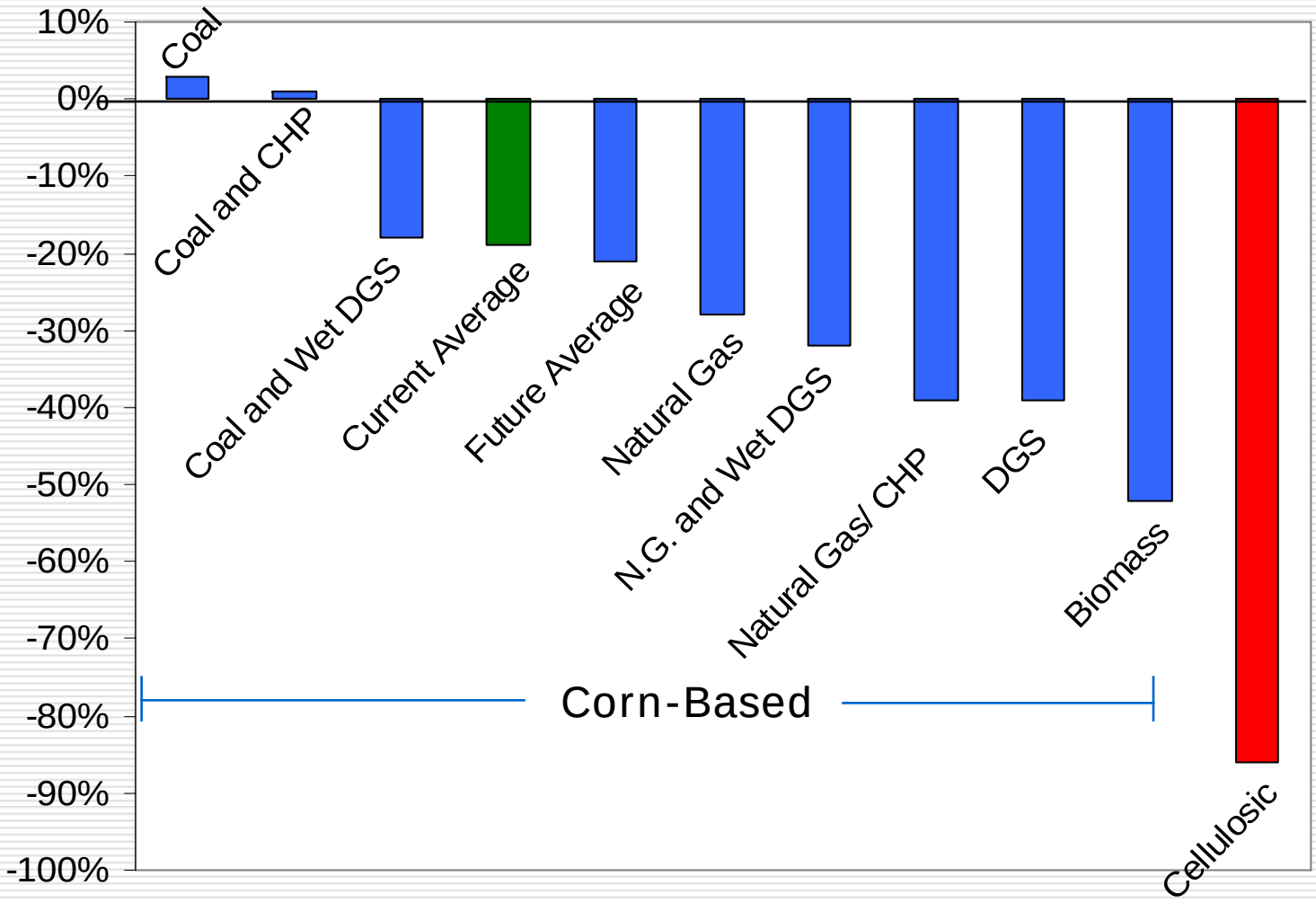
* Does not address indirect land use emissions

Average Fuel-Cycle GHG Emission Shares: Corn-Based Ethanol (with co-product credits)



Source: GREET Model, Argonne National Laboratory

GHG Well-Wheel GHG Reductions from Ethanol Varies Greatly



Source: Wang, Wu, and Huo, 2007

Improving emissions profile from feedstock production

- Corn
  - Reduce fertilizer emissions by 20%
    - Reduces emissions by 0.8 lbs/gallon ethanol
  - Switch to conservation tillage
    - Reduces emissions by 4.7 lbs/gallon ethanol
- Switchgrass, hybrid poplars, and other perennial crops can restore degraded lands
- Harvesting small diameter wood can reduce fire risk

How much more will one pay for ethanol because it reduces GHG?

	Lifecycle GHG Savings/Gallon*	$5/ton CO2	$25/ton CO2	50¢ gallon value
Corn Ethanol (current average)	5 lbs per gallon	$0.0125/gal	$0.06/gal	$282/ton CO2
Cellulosic Ethanol	22.5 lbs per gallon	$0.056/gal	$0.28/gal	$73/ton CO2

- Energy equivalent gallon
- Including co-products
- Not including indirect land use effects

Why should we care about indirect land use emissions?

- Deforestation is responsible for about 20% of current CO2 emissions;
- As demand for commodities increases (corn and soybeans) rates of deforestation increase;
- Searchinger (2007) estimates that corn ethanol actually increases CO2 emissions by 93%

Why Searchinger might be right:

- “Everything has to go somewhere”
- There are clear links between commodity prices and deforestation rates;

Why Searchinger might not be right:

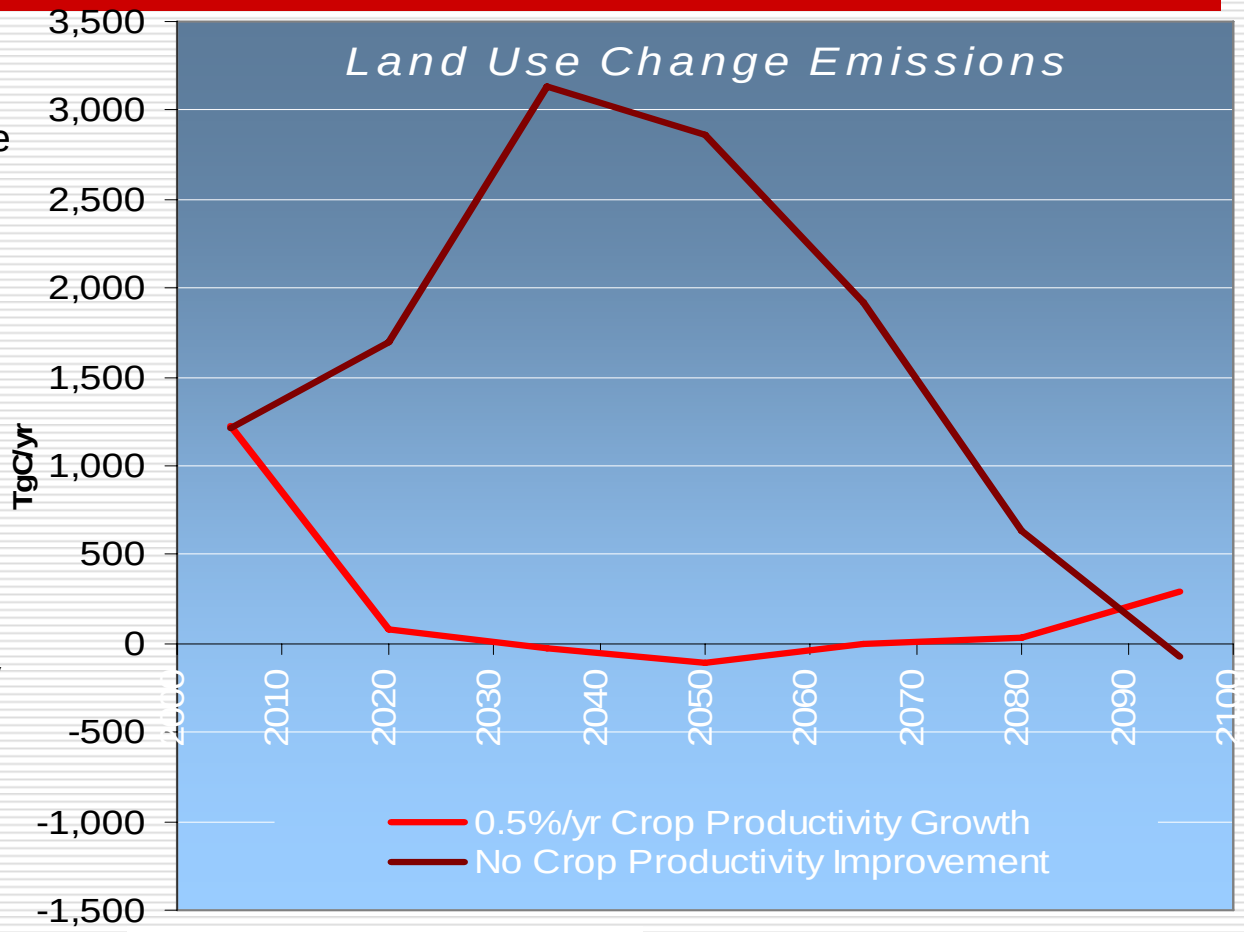
- Higher prices spur innovation;
- Countries can impose policies to reduce deforestation;
- Degraded lands could be “rehabilitated”

The debate over “indirect land use” highlights a more important point

If we are serious about addressing climate change…. We need to be serious about addressing land productivity

Land Use Change Emissions and Crop Productivity

- Edmonds, et. al. (Draft) evaluated the importance of crop productivity improvements in addressing GHG emissions globally
- Cumulative Emissions 2005 to 2095
  - 0.5%/yr crop productivity growth:
    - *11 PgC*
  - No crop productivity growth:
    - *162 PgC*



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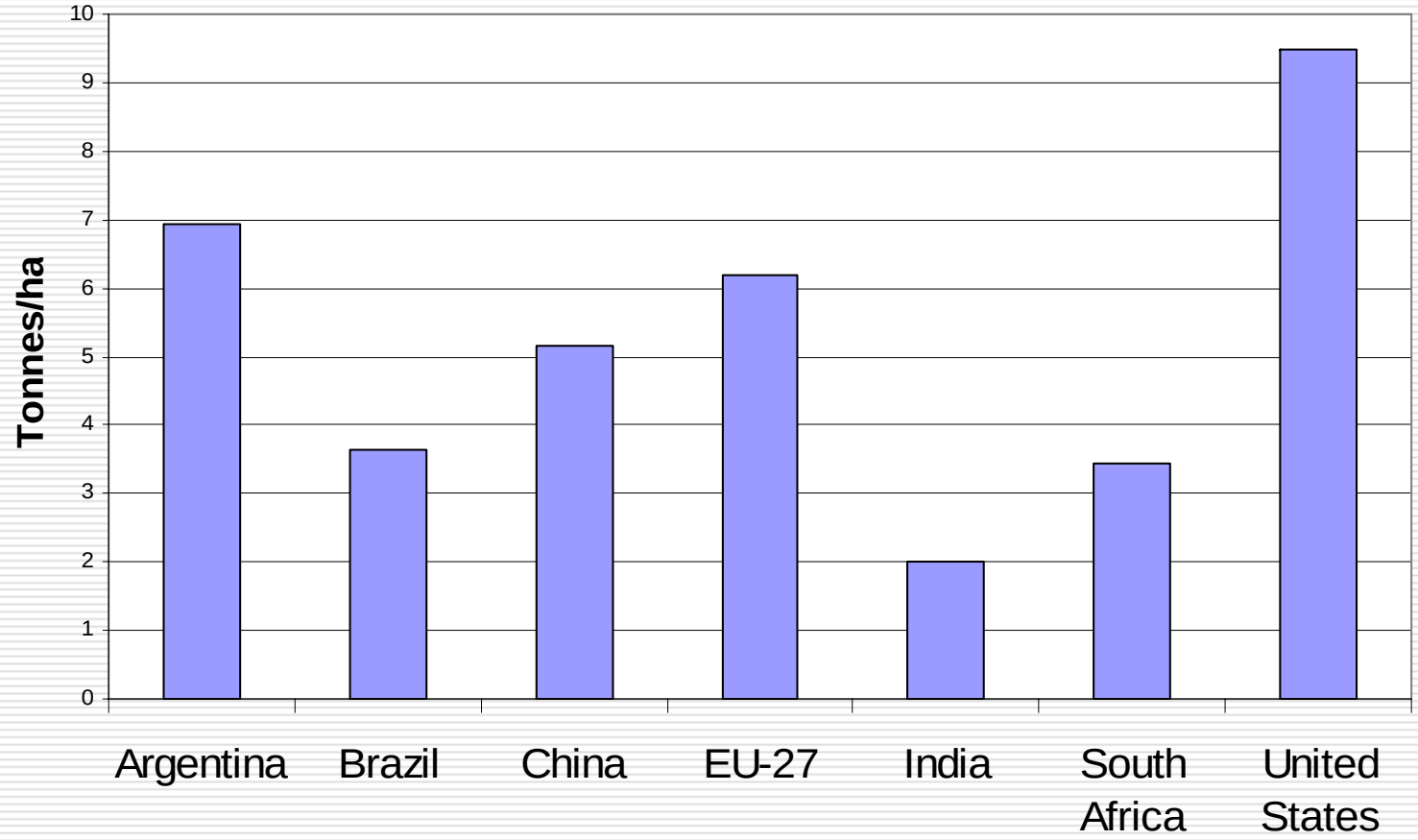
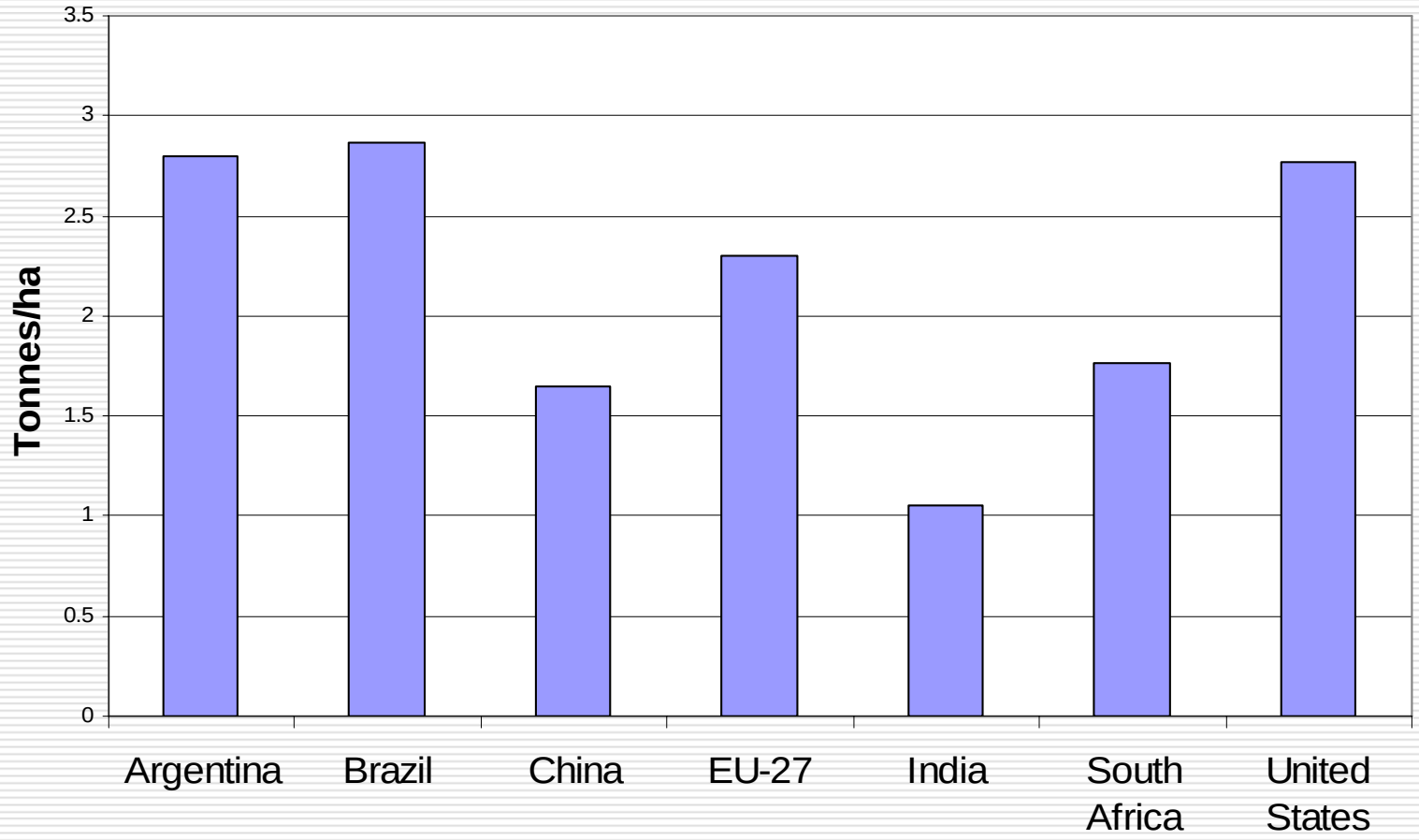
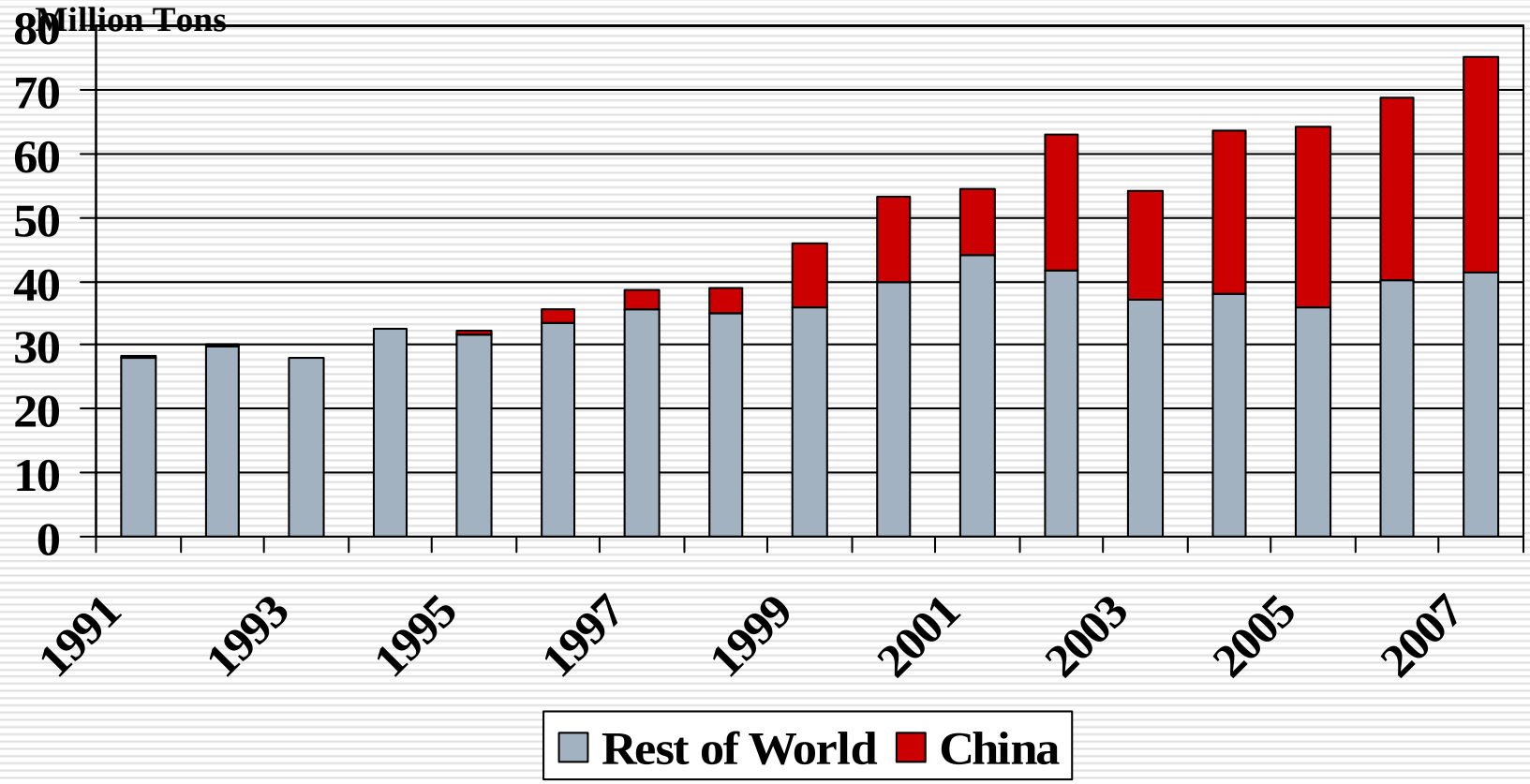
2007/08 Corn Yields for Key Countries



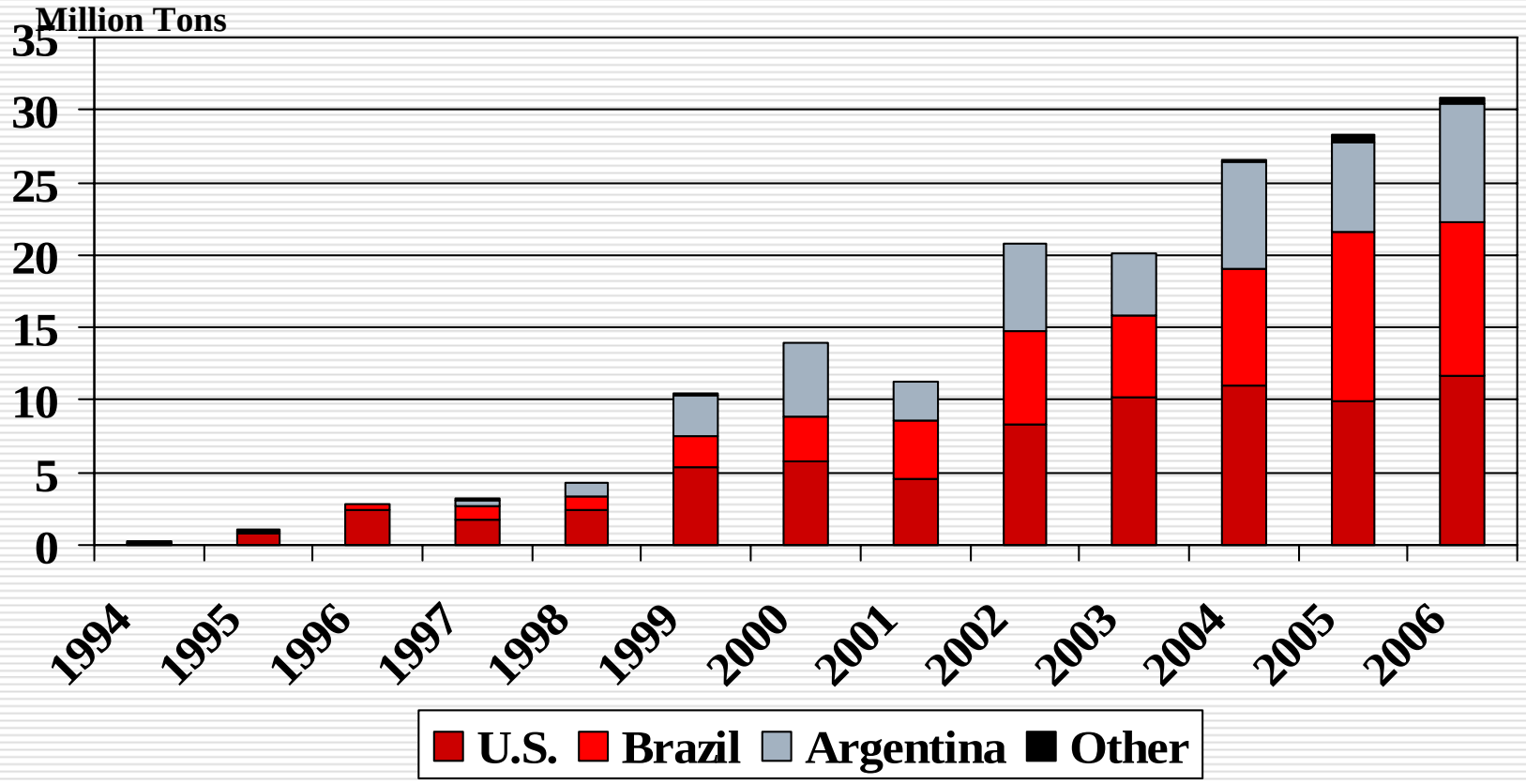
2007-08 Soybean Yields for Key Countries



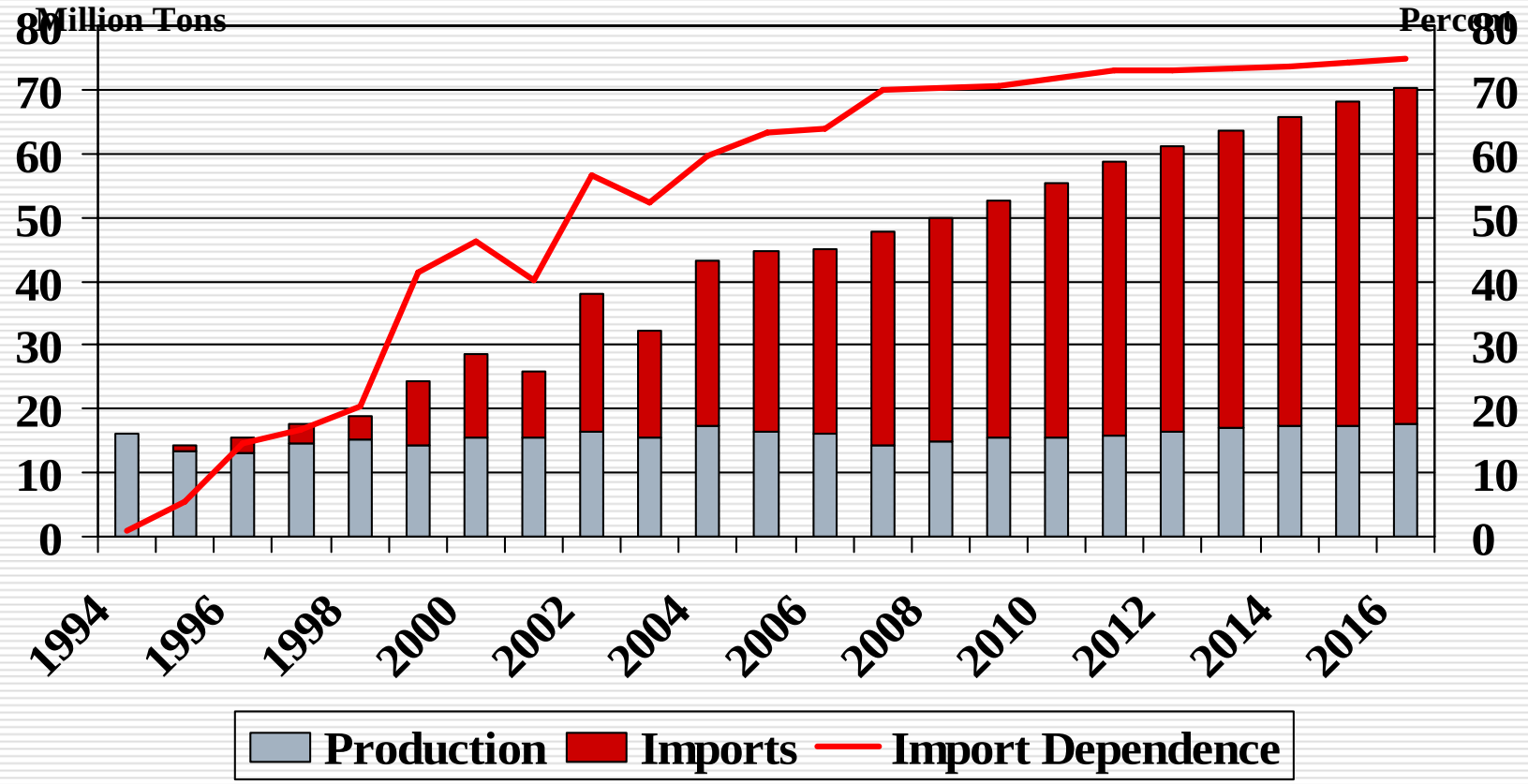
China Now Accounts for Almost Half of Global Soybean Imports



China Soybean Imports by Source



China Soybean Import Dependence Expected to Increase in the Next 10 Years



Conclusions

- **Excluding "land use change" biofuels can have positive GHG profiles:**
  - **Accounting for "indirect" land use changes will reduce these benefits.**
  - **Extent of these impacts are uncertain.**
- **The current suite of biofuel technologies was not designed for optimal GHG abatement.**
- **Improving feedstock production, choice of feedstock, and processing technologies can improve the GHG profile of biofuels.**
- **Biofuels are one of several factors influencing demand for land.**
- **Increasing productivity (especially in developing countries) can reduce pressures on land.**