

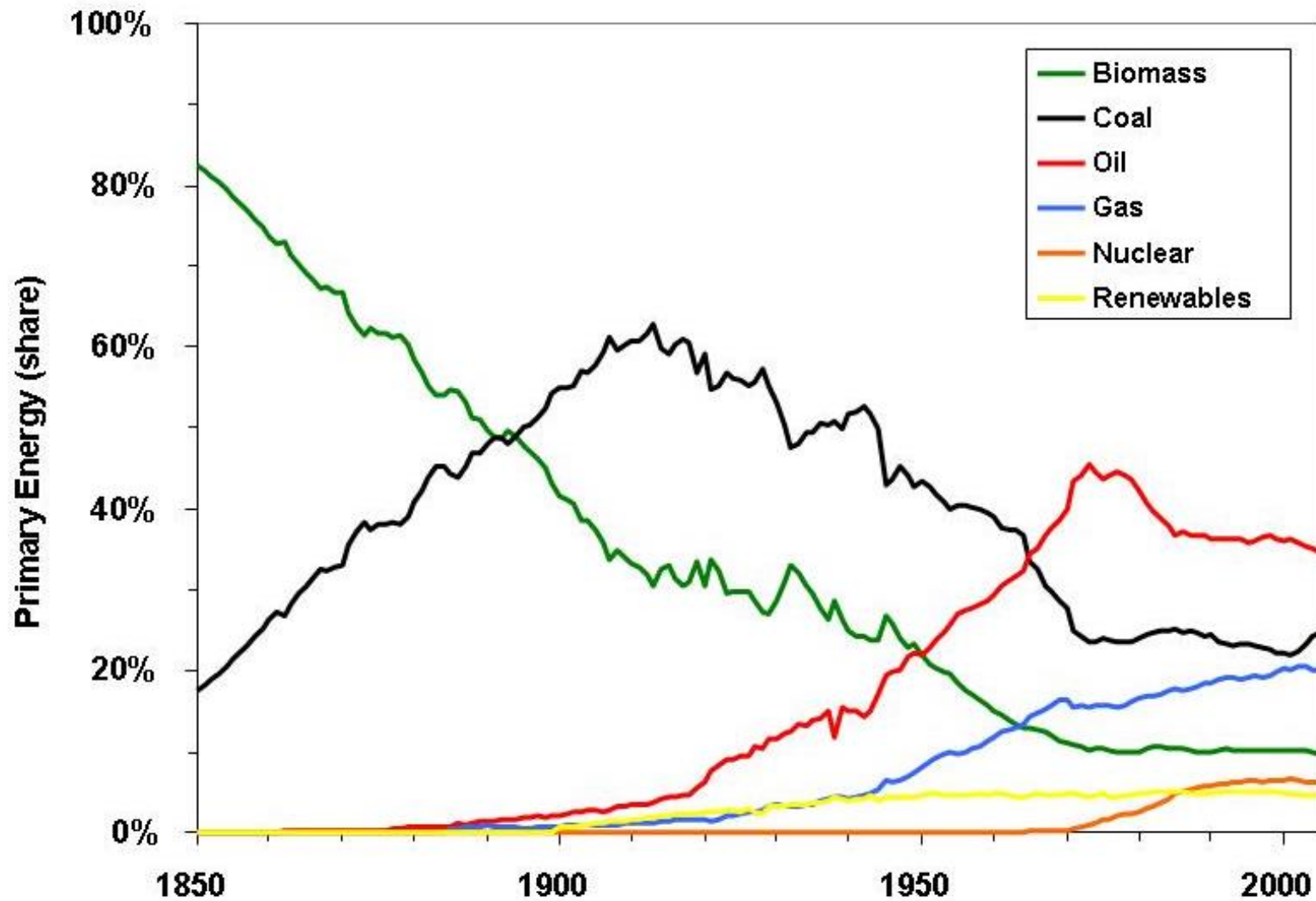
SCOPE

Professor José Goldemberg

USP

14/04/2015

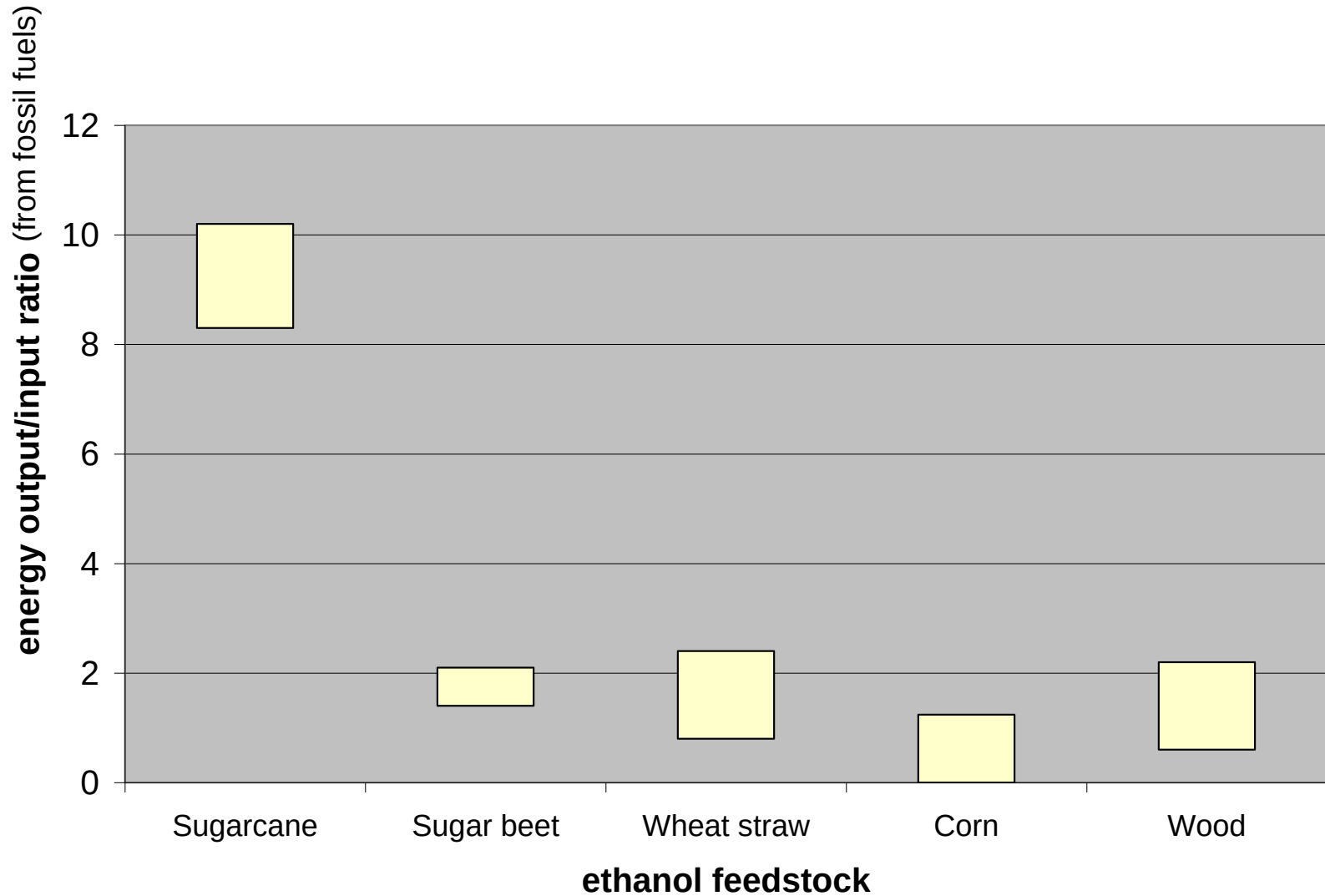
Evolution of primary energy shown as shares of different energy sources



MYTHS ON BIOFUELS

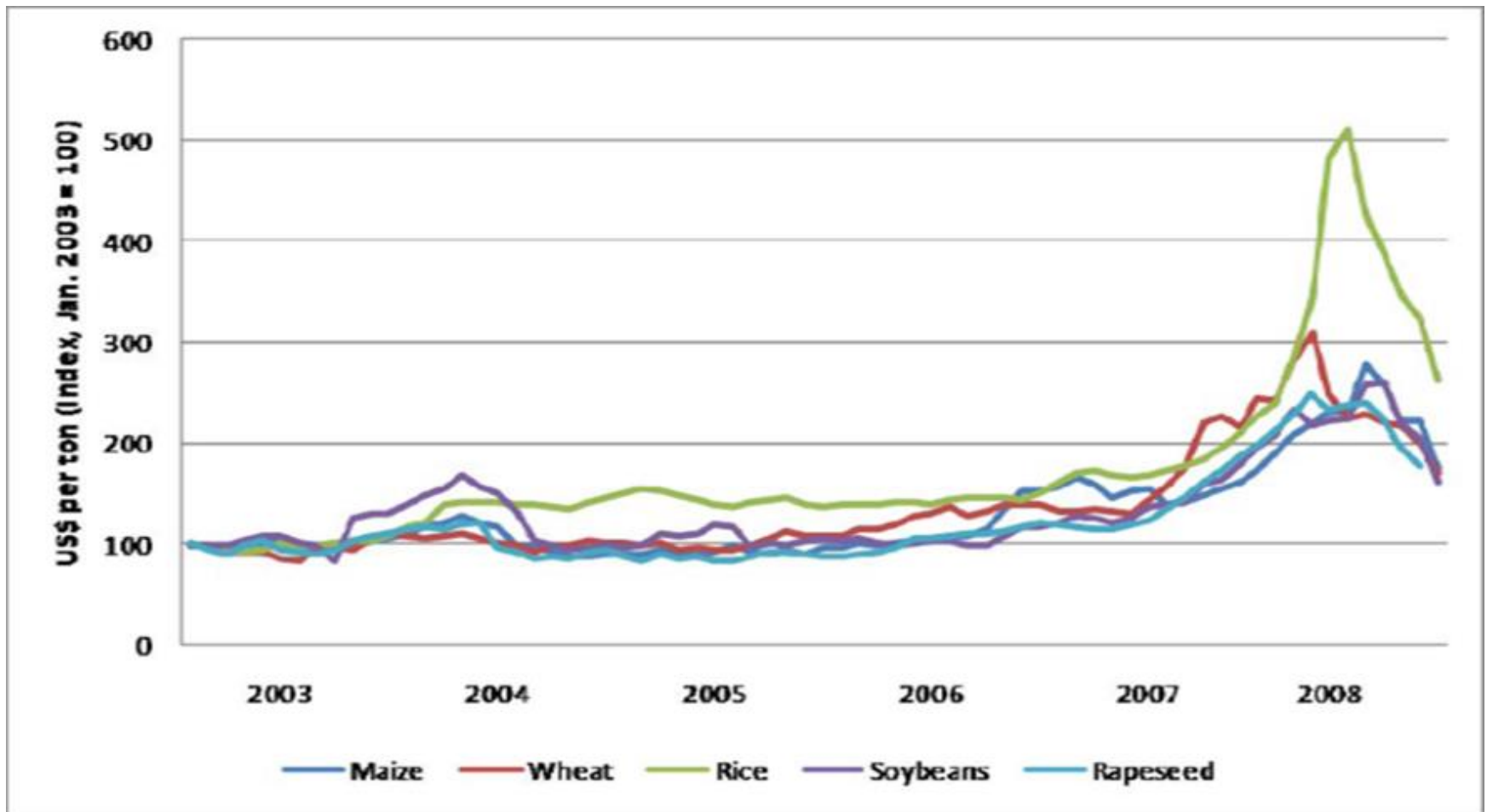
- i. Biofuels do not reduce greenhouse gas emissions
- ii. Biofuels are causing famine in the world
- iii. Biofuels are only viable in “niches” (such as Brazil)
- iv. Biofuels are leading to deforestation
- v. 2nd generation technologies are problematic

Energy balance of alcohol production from different feedstocks



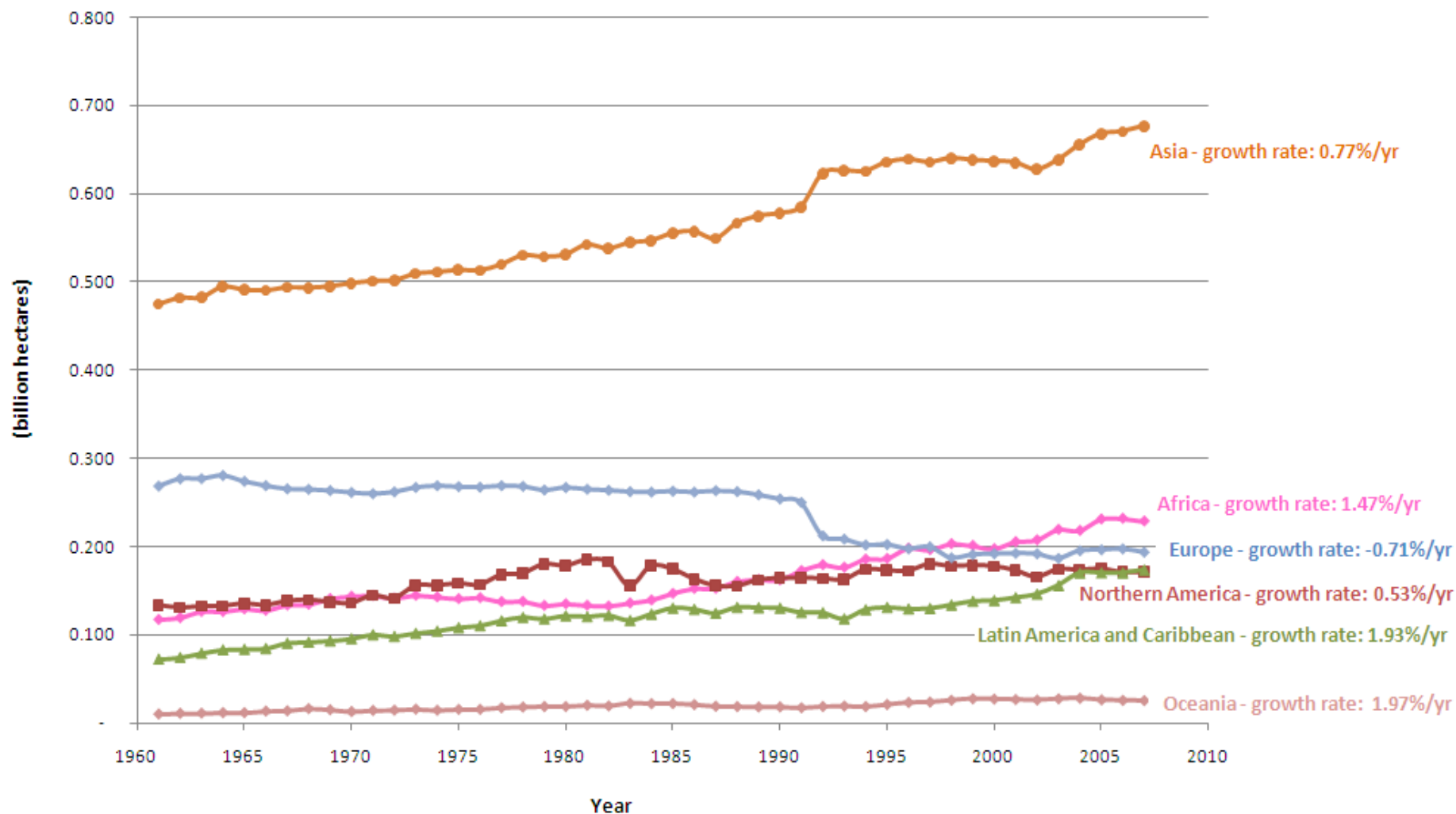
Sources: (Macedo et alii, 2004; UK DTI, 2003 and USDA, 1995)

The evolution of the cost of different crops since 2002

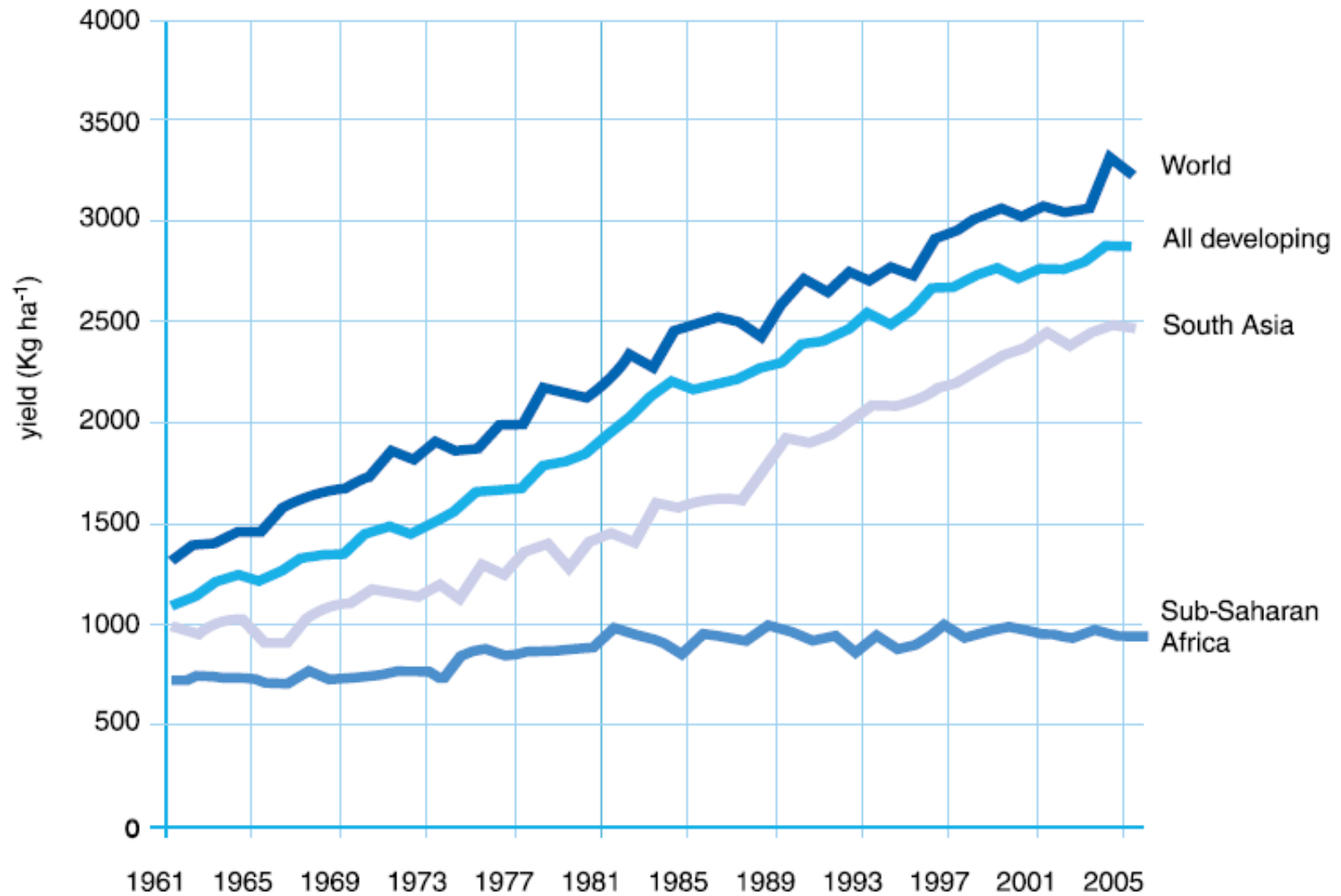


World harvested area in different continents

**World Harvested Area
(1961 - 2007)**

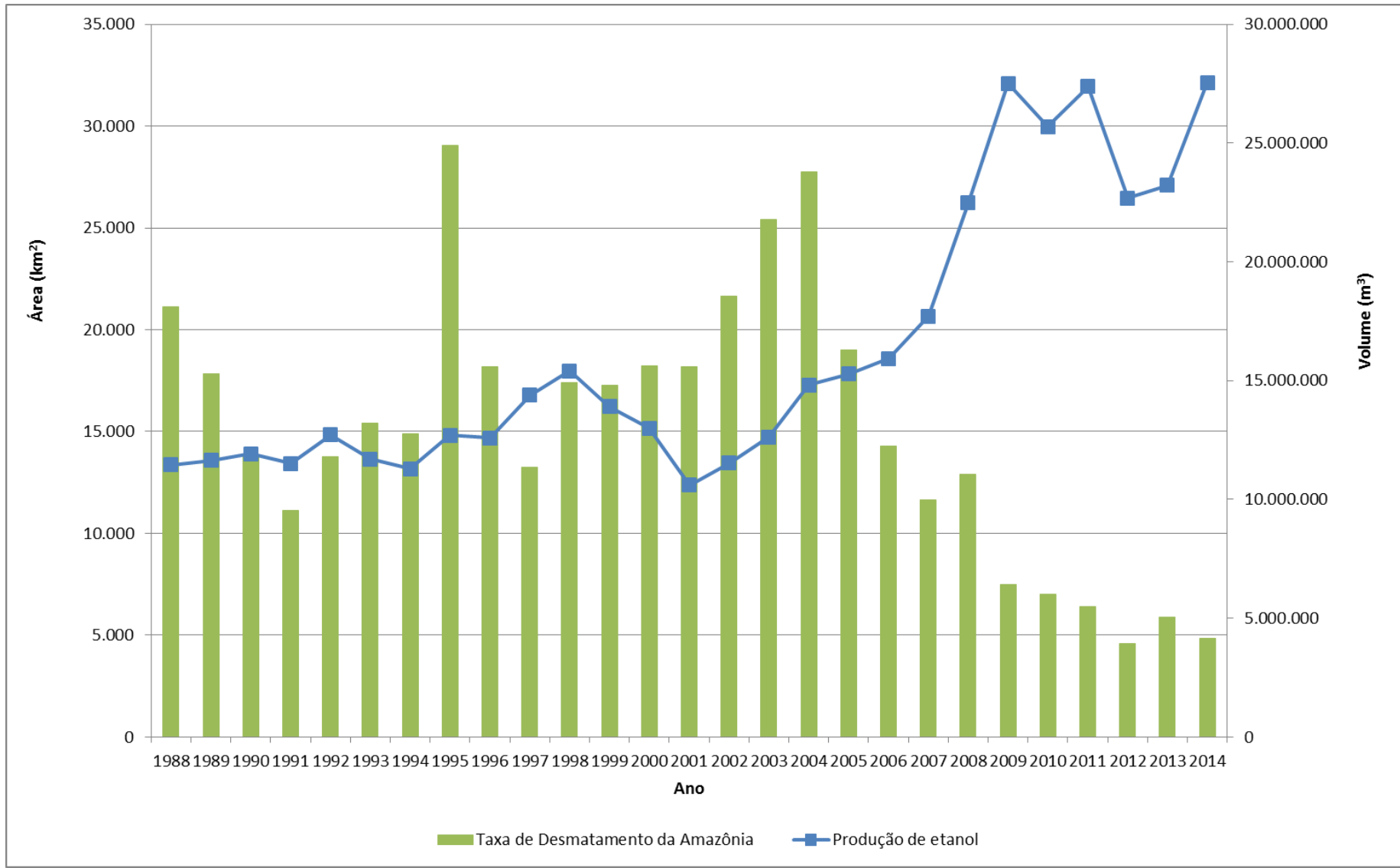


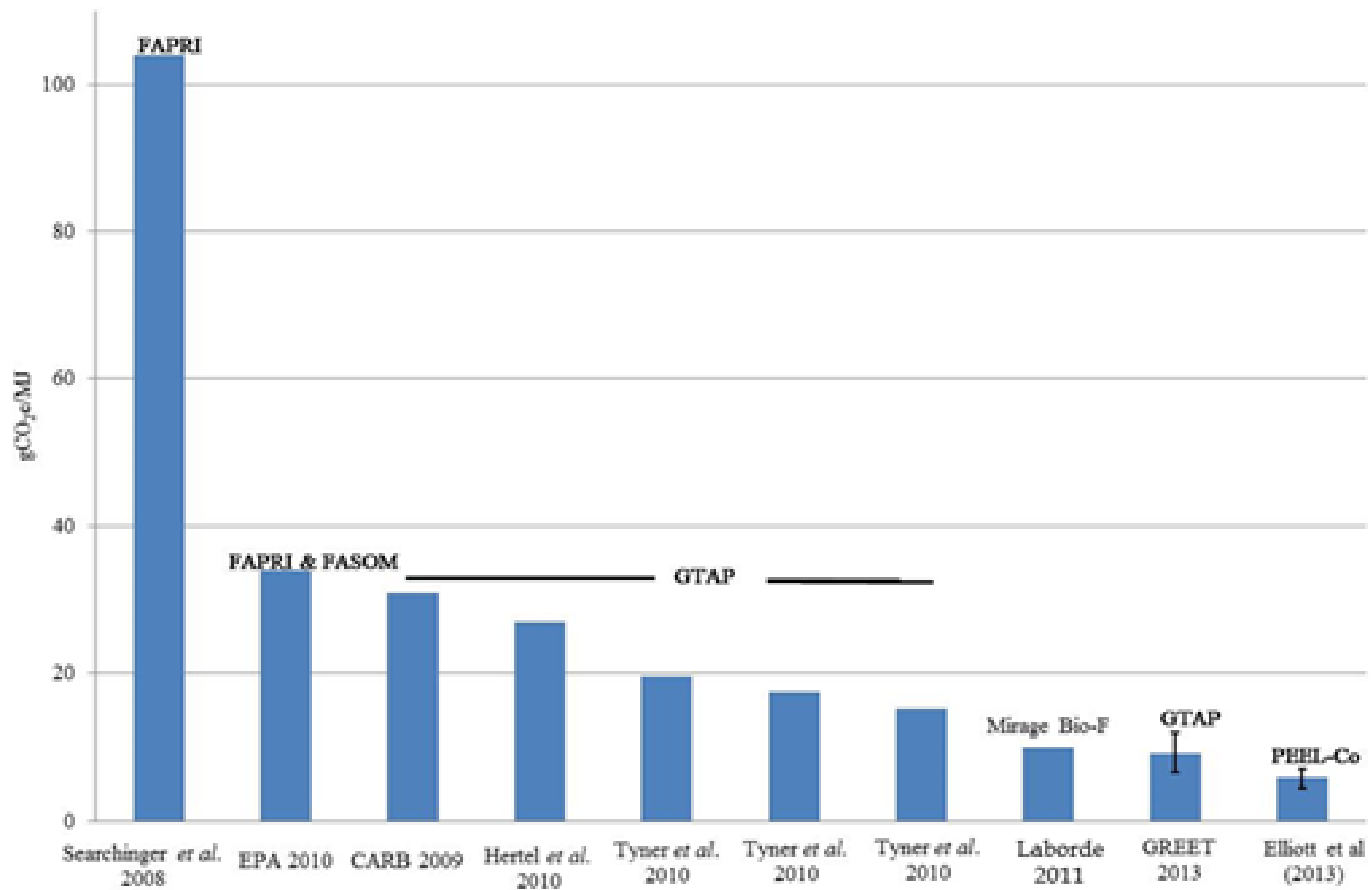
Productivity of cereal production in regions of the world



Source: Hazel & Wood 2008 (adapted from FAOSTAT 2006)

Deforestation in the Amazonia and ethanol production 1988-2014





iLUC Factors for biofuels (Macedo, I.C. and Nassar, A., in press)

Celulosic Ethanol Plants

Plant	Location	Nameplate Capacity (mLpa/gpa)	Technology	Enzymes and Yeast	Feedstock	Shareholders	Start up
Dupont	Iowa	113.6 (30.00)	Dupont (enzymatic hydrolysis)	Enzymes: Accellerase (Dupont) Ethanol produced by bacteria (not yeast)	Corn stover (leaves and stalks) and corn cobs	Dupont Danisco	2014
Abengoa	Hugoton/Kansas	87.1 (23.00)	Abengoa (enzymatic hydrolysis)	Enzymes: Abengoa (with a microorganism licensed from Dyadic)	Corn stover, wheat straw and cotton residue	Abengoa Bioenergy Inc	2014
Bioflex/GranBio	São Miguel dos Campos	82 (21.66)	Proesa (enzymatic hydrolysis)	Enzymes: Novozymes Yeast: DSM	Sugarcane straw	GranBio Investimentos	2014 September
Poet DSM	Emmetsburg/Iowa	75.7 (20.00) 94.6 (25.00)	Poet DSM (enzymatic hydrolysis)	Enzymes: Novozymes (to be replaced by DSM)	Kemels and corn cobs	Poet and Royal DSM	September 3, 2014
Chemtex	Crescentino/Italy	50.7 (13.4)	Proesa (enzymatic hydrolysis)	Enzymes: Novozymes Yeast: Leaf	Kemels and corn cobs	Syngenta and Cellulosic Ethanol Tech (Quad County)	3Q, 2013
Raizen	Piracicaba/Brazil	40.00 (10.57)	logen (enzymatic hydrolysis)	Enzymes: Novozymes Yeast: TBC	Sugarcane straw and bagasse	Raizen and logen	
Enerkem Inc.	Edmonton/Canada	37.78 (10.00)	Gasification	N/A	Municipal solid waste - MSW	RHO Ventures, Valero, Braemar Venture and others	June 2014
INEOS Bio	Vero Beach/Florida	30.28 (8.00)	Gasification	N/A (INEOS uses a proprietary bacteria)	Wood waste, agri residues, etc	INEOS	August, 2013 (Test) Returned to production on sep/14.
Quad County	Galva/Iowa	7.57 (2.00)	Cellerate	Enzymes: Enogen (Syngenta) Yeast: TBC	Kemels and corn cobs	Syngenta and Cellulosic Ethanol Tech (Quad County)	July, 2014
Anhui Guozhen CO	Fuyang City/China	~200 (52.80)	Proesa (enzymatic hydrolysis)	Enzymes: Novozymes Yeast: TBC	Rice straw	M&G (70%) and Anhui Guozhen CO (30%)	TBC
Energo chemica	Strazske, Slovak Republic	70.0 (18.4)	Proesa (enzymatic hydrolysis)	Enzymes: Novozymes Yeast: Leaf	Non-food biomass	Energochemica	First-half 2017

 Bigger Plants (more than 50 million liters per year)

 Middle size plants

 Announced or Under Construction



Energy Cane:

- More Robust
- Drought Resistant
- More Productive
- Low Soil Requirements
- More resistant to plagues