The Intersection of Energy and Agriculture: Implications of Biofuels and the Search for a Fuel of the Future

Biofuel in Brazil: Past and Present"

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Brazilian Reference Center on Biomass

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UC Berkeley

Berkeley, California"

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PRESENTATION ROAD MAP

- Alcohol in Brazil – Today
- Institutional Regulation
- Barriers to Production and Use of Ethanol
- Future Outlook
- Conclusions - World Development

The Brazilian Alcohol Program

- 1975 PROALCOOL:
  - sugarcane ethanol due to the oil shock
  - mandatory blend to gasoline (20 - 26% vol.)
  - high-octane fuel in vehicles, replacing lead and/or MTBE
- 2006:
  - fully competitive to gasoline: 3.1 bln liters exports)
  - 15.4 Mm3 consumed
  - saving 36.5 Mt CO_2 eq (~ 14% of national CO_2 emissions from fossil fuels)
  - increased mechanical harvesting and productivity high industrial (70 - 100 l/tc) and agricultural productivity (60 - 100 tc/ha).
  - 3.0 mln pure ethanol cars and 2.7 mln FFVs
- perspectives to 2010:
  - increased production to 26.6 million m3 of ethanol
  - avoiding 71.8 Mt CO_2 eq

PRESENT AUTOMOTIVE FUEL PORTFOLIO– BRAZIL - 2006

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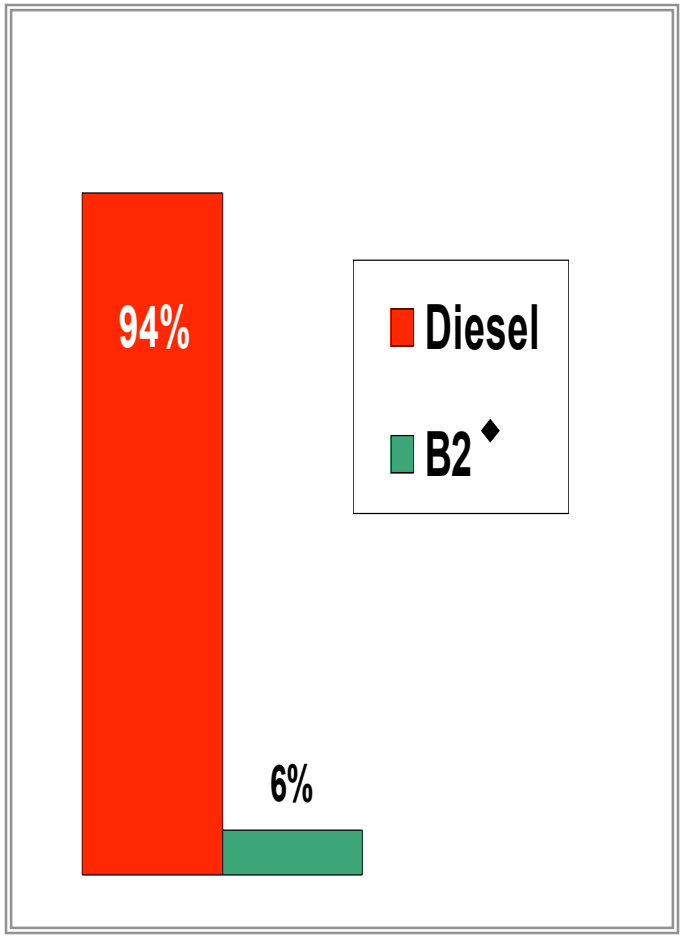
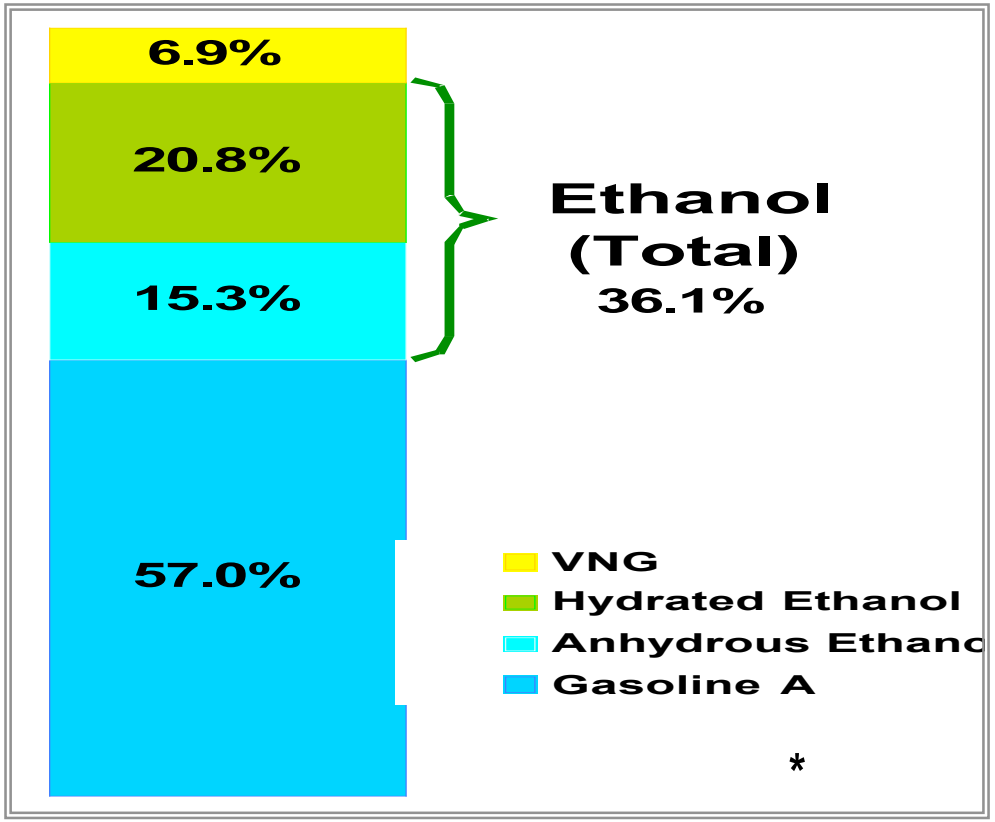
HEAVY VEHICLES



♦ Diesel misturado com 2% de Biodiesel

LIGHT VEHICLES



* Gasolina pura – Antes da mistura com etanol

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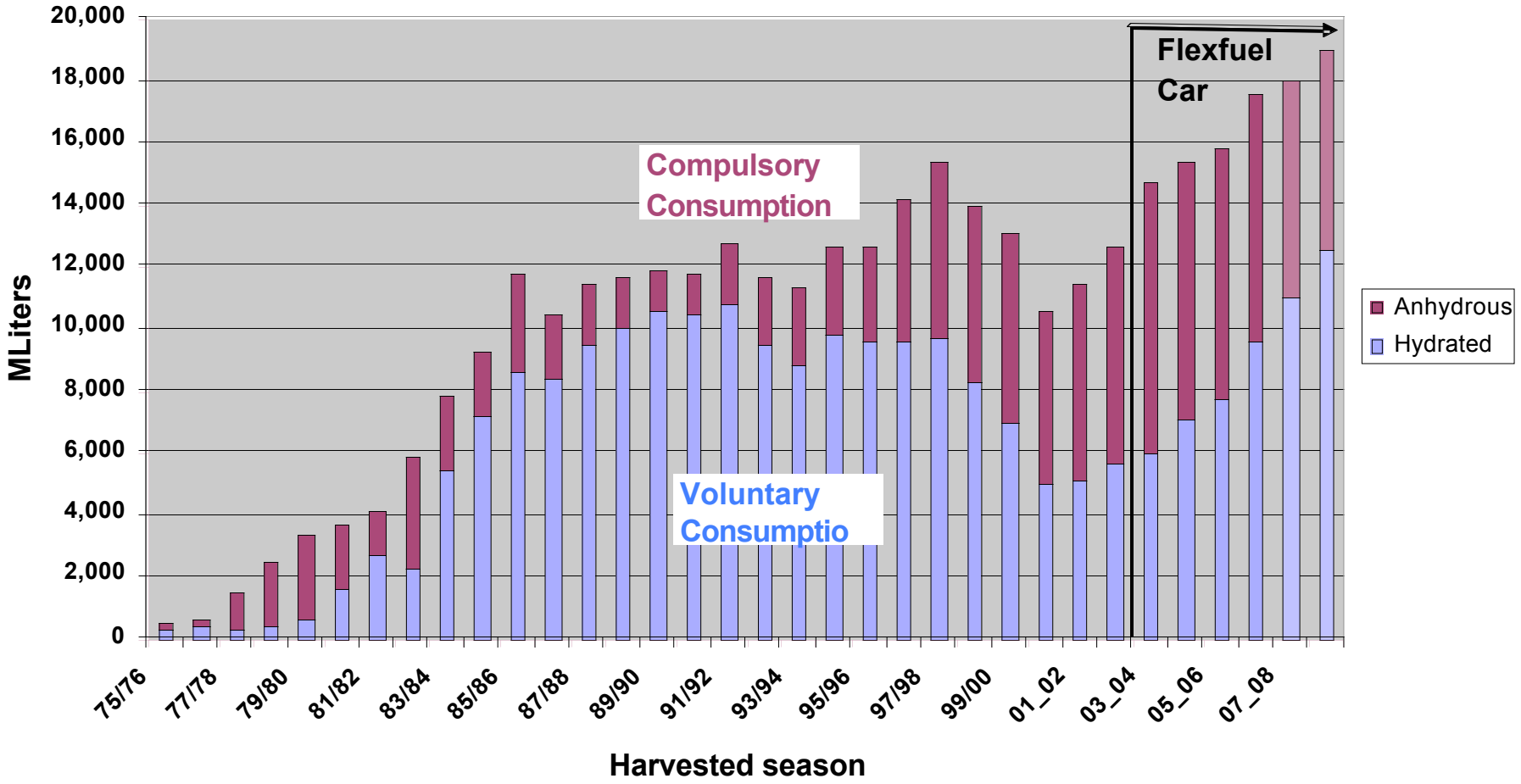
Total ethanol production - Brazil 1975/2008



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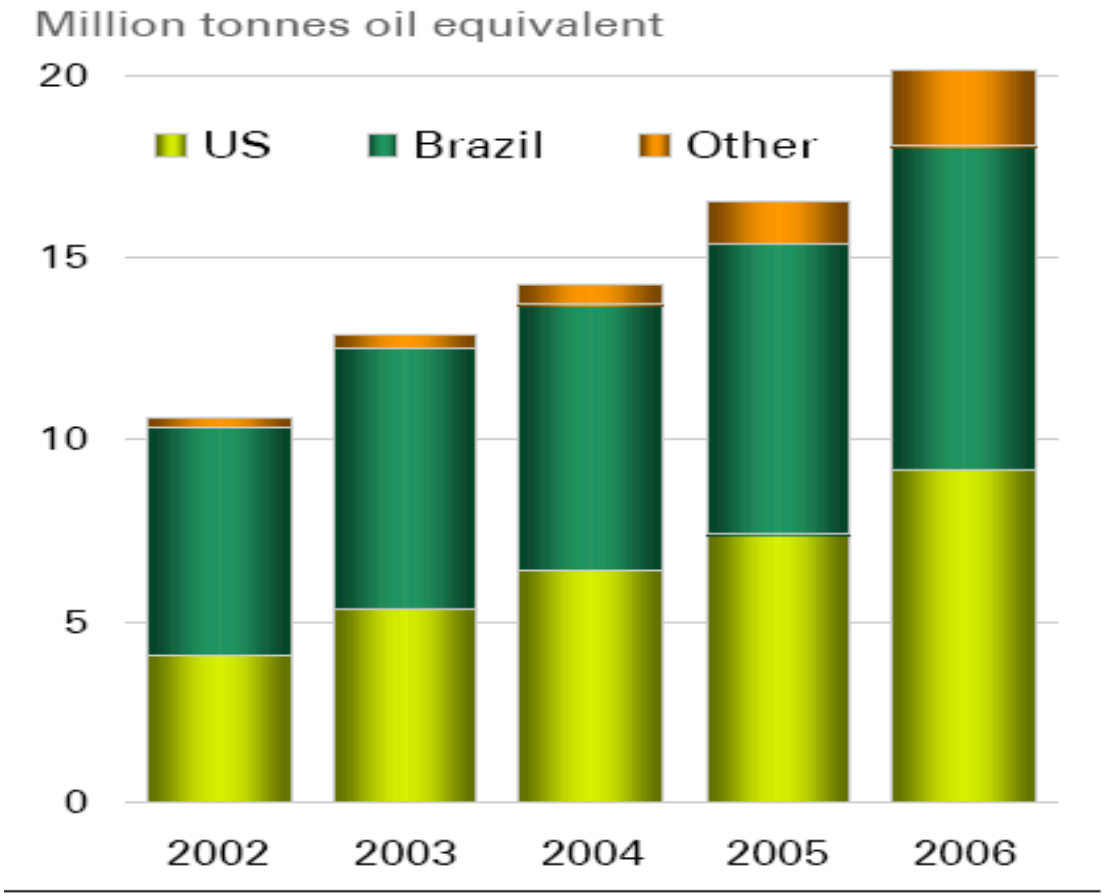
Ethanol Production – World – 2002 to 2006



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Government Intervention from 1975 to end of 80s

Ethanol:

- Level of guaranteed purchase, at controlled prices
- "Fixed" ratio of ethanol/gasoline selling prices:
- 0.59(1975) 0.75(1989)
- Low interest rate in loans for investment (1980-1985)

Sugar:

- Government issued "production quotas"
- Exports: by the Government
- From 1990-1999, production/commercialization were entirely de-regulated (both for ethanol and sugar)

Source: Macedo 2002

DEREGULATION OF OIL DERIVATIVES AND ALCOHOL MARKET - BRAZIL

1995	Monopoly flexibilization of national oil market
1996	End-users price liberalization – Alcohol & Gasoline
1997	Producers price liberalization – Anhydrous alcohol
	Oil Law – define transitions to free market
1998	
1999	Producers price liberatization – Hydrated alcohol
	End of hydrated alcohol subsidy
2000	
2001	Law creating new fossil fuel tax-CIDE
2002	End of price control on all fuels

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Brazil still employs a series of policies that secure ethanol's place in the country's energy matrix

- A mandate requiring that all gasoline be blended with a minimum of 20–25 percent ethanol (flexible with respect to changing sugar and ethanol prices on the world market);
- An import tariff on gasoline that is one of the highest in the world;
- A ban on diesel-powered personal vehicles to boost the demand for ethanol-powered vehicles;
- A requirement that all government entities purchase 100-percent hydrated alcohol-fueled vehicles; and
- Low interest loans for financing producer-owned stocks

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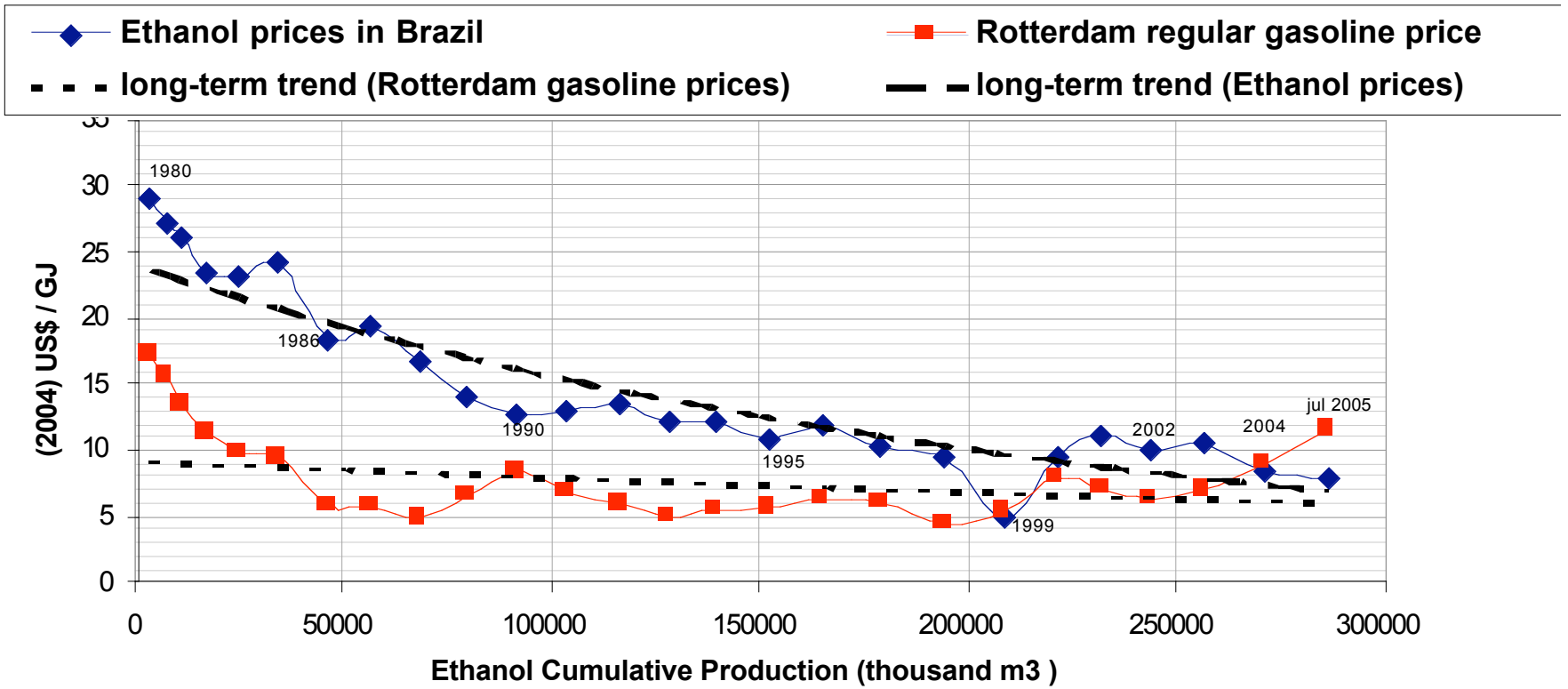
Alternative energy sources require long-term effort Commercial Feasibility - Ethanol



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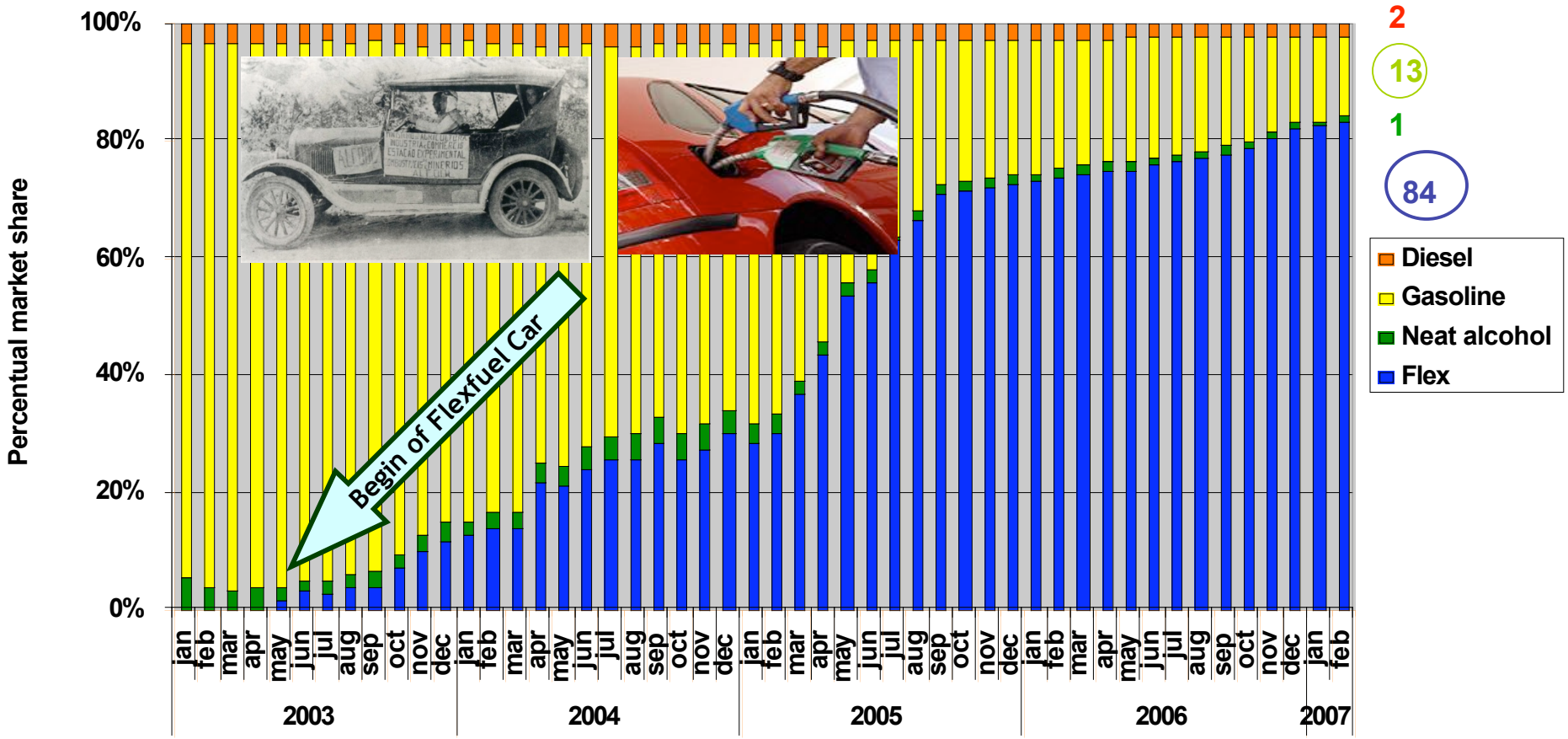
Present Scenario: Brazilian automotive market - liquid fuel consumption

Sales of Light Vehicles in the Internal Market



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Inventory of Barriers

- ***Economic barriers***

One of the principal barriers for the use of biomass energy in general is the competition with fossil fuel on a direct production cost basis (i.e. excluding externalities)

- ***Technical barriers***

A general problem of some biomass types is its variety in physical properties (e.g. low density and bulky nature) and chemical properties, such as high ash and moisture content, nitrogen, sulphur or chlorine content.

Junginger et al., 2006. Opportunities and barriers for sustainable international bioenergy trade and strategies to overcome them, IEA Task Force 40,

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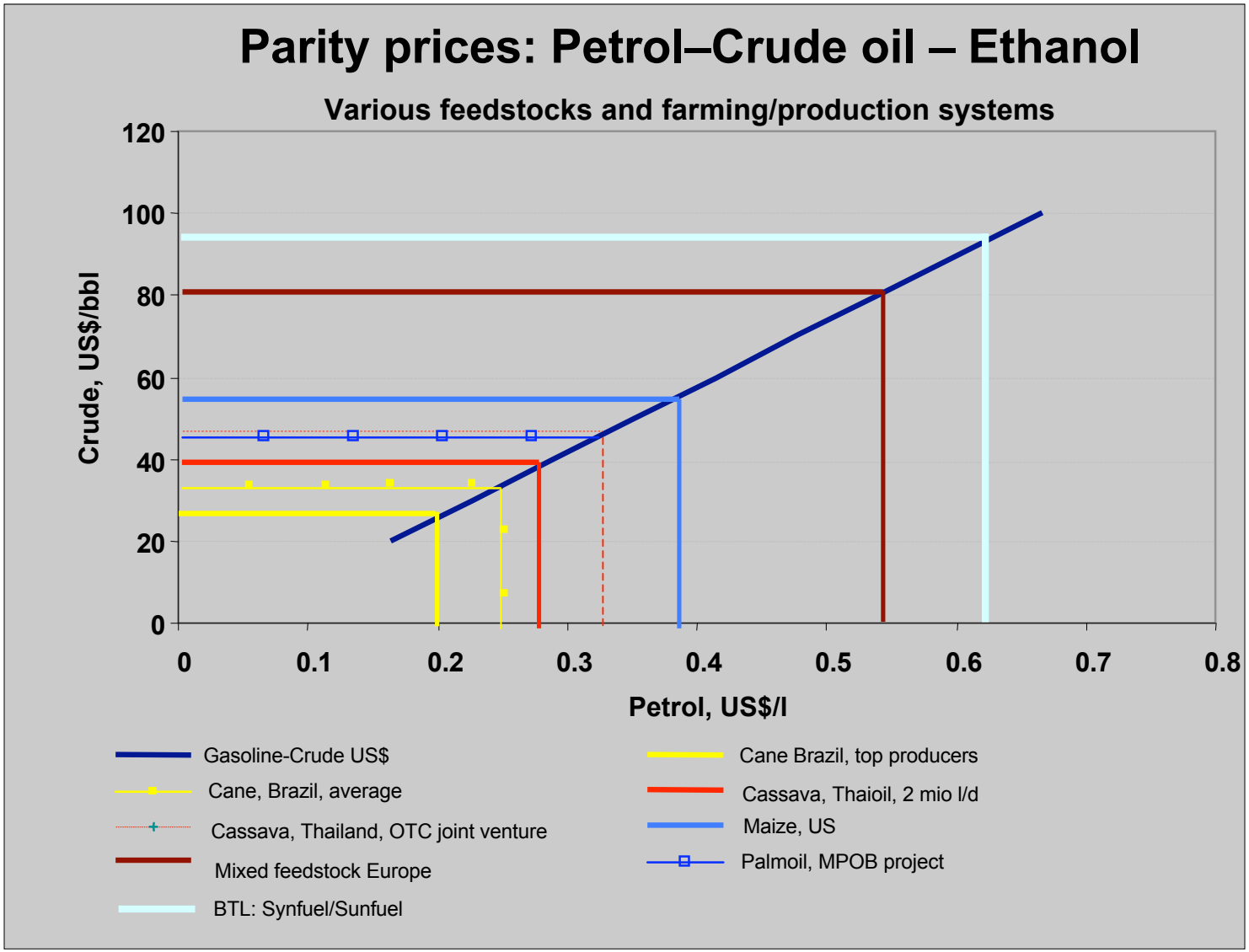
Economic barriers



Josef Schmidhuber (2005)

August 2007


ALCOOL COMUM
1,099
GASOLINA COMUM
2,399
V-Power
Colecione cards e concorra.
A 1,099
G 2,399
G 2,599

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Technical barriers

Setting up technical biomass standards on bioenergy trade

- For biomass to become a large-scale commodity, which can be traded on an exchange, technical standards are needed. **It is recommended that the various standards that are applied today are developed into internationally accepted quality standards for specific biomass streams (e.g. CEN biofuel standards).**

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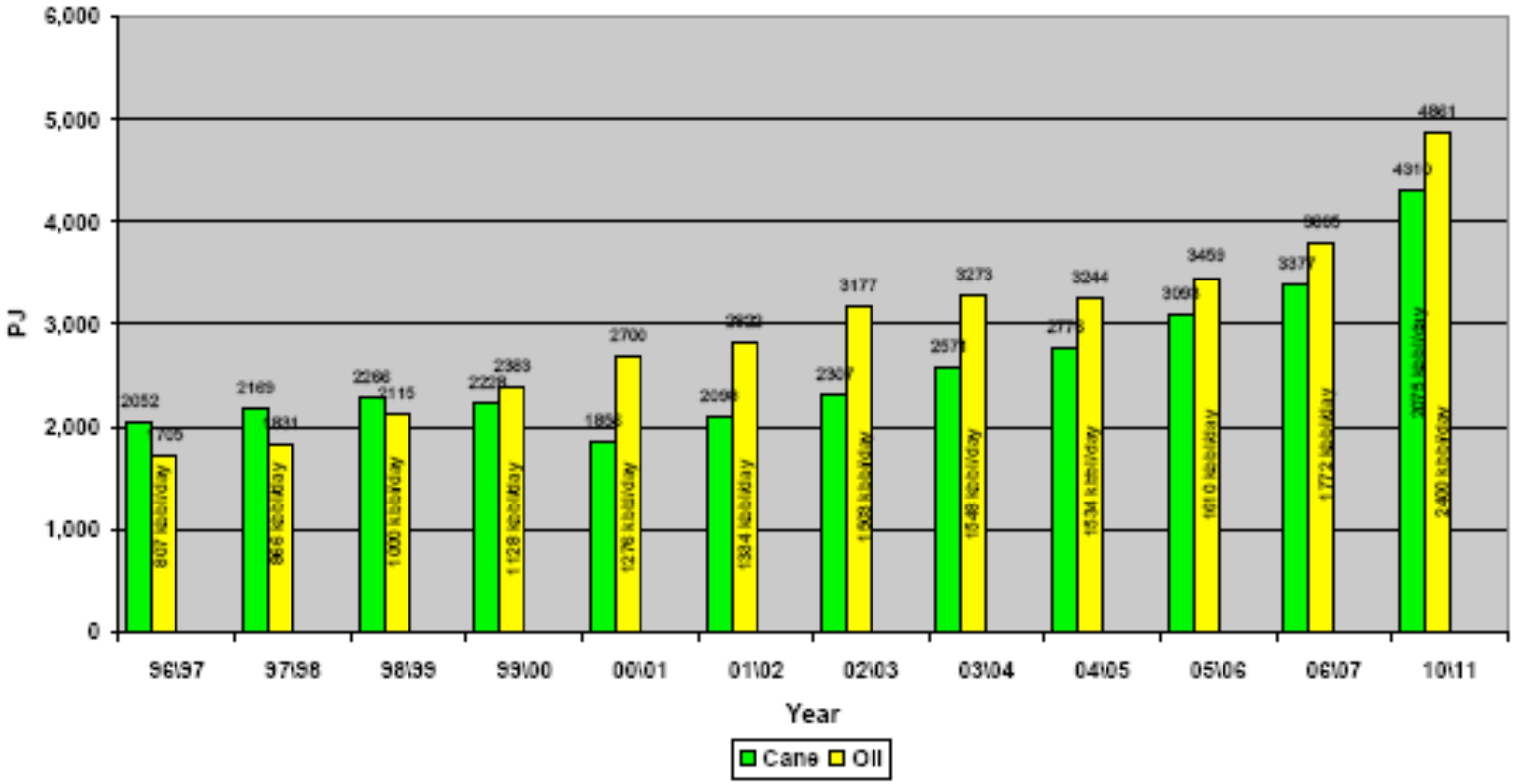
FOOD VERSUS FUEL

Primary energy from sugar cane and from oil production - Brazil



BRAZIL 329 SUGAR MILLS IN OPERATION 400

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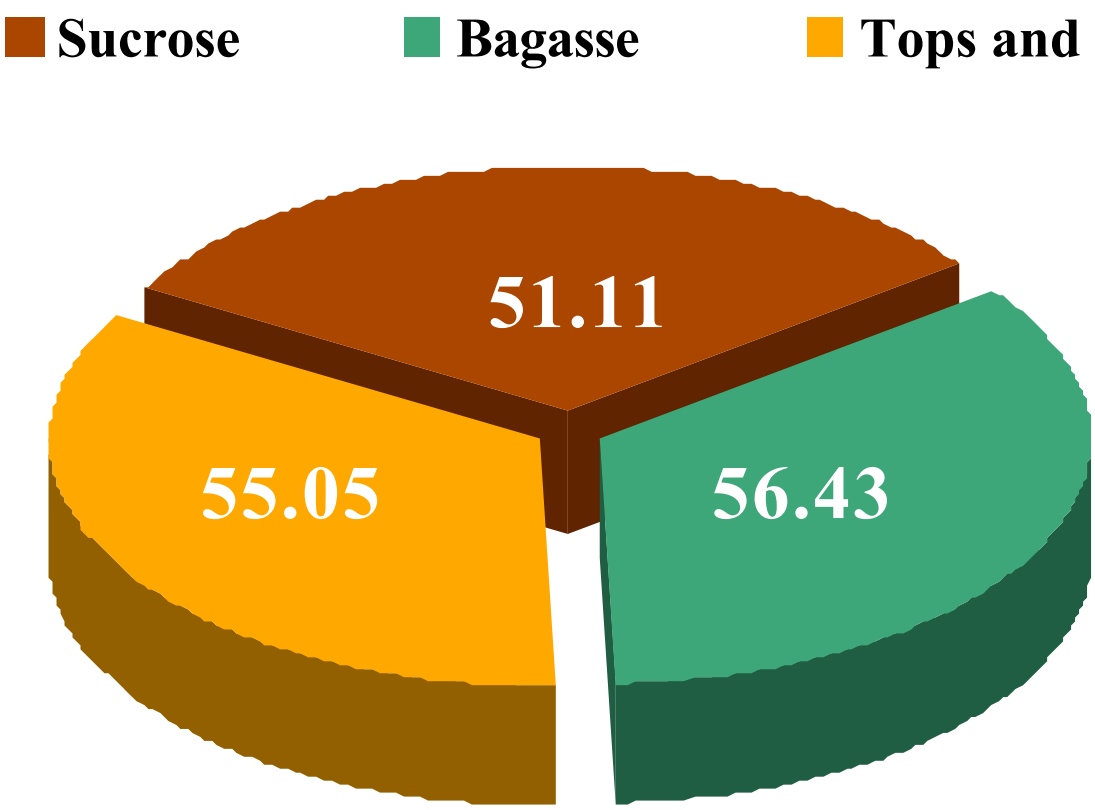
Energy Contained in 1,000 tonnes of cane (in toe)



Source: Nastari, Lisbon, 2000

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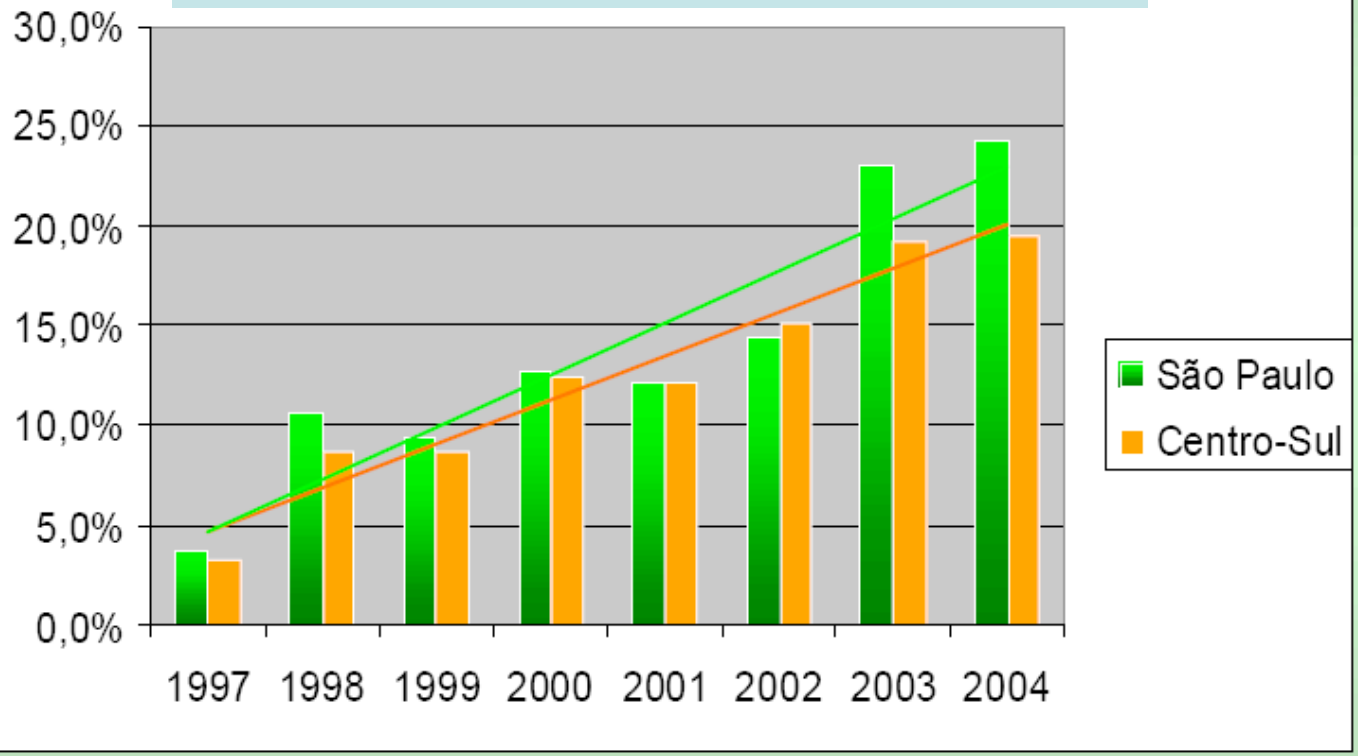
Evolution of Green Sugar Cane Harvest



Fonte: IDEA (1997 to 2002)
CTC (2003 to 2004)

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Inventory of Barriers (2)

- *International trade barriers*

As with other traded goods, several forms of biomass can face technical trade barriers. As some biomass streams have only recently been traded, so far no technical specifications for biomass and no specific biomass import regulations exist.

- *Ecological barriers*

Large-scale biomass dedicated energy plantations may in principle pose various ecological and environmental issues that cannot be ignored, e.g. monocultures and associated (potential) loss of biodiversity, soil erosion, fresh water use, nutrient leaching and pollution from chemicals

Social barriers

Also linked to the potential large scale energy plantations are the social implications, e.g. the effect on the quality of employment (which may increase, or decrease, depending on the level on mechanization, local conditions, etc.), potential use of child labour, education and access to health care

Junginger et al., 2006. Opportunities and barriers for sustainable international bioenergy trade and strategies to overcome them, IEA Task Force 40,

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International trade barriers

Solving sustainability issues: International classification and certification of biomass

- Certification of biomass may be one way to prevent negative environmental and social side-effects. Setting up minimum social and ecological standards, and tracing biomass from production to end-use can ensure the sustainability of biomass. In an exploratory study has been shown that certification schemes for social and environmental standards do not necessarily result in high additional costs

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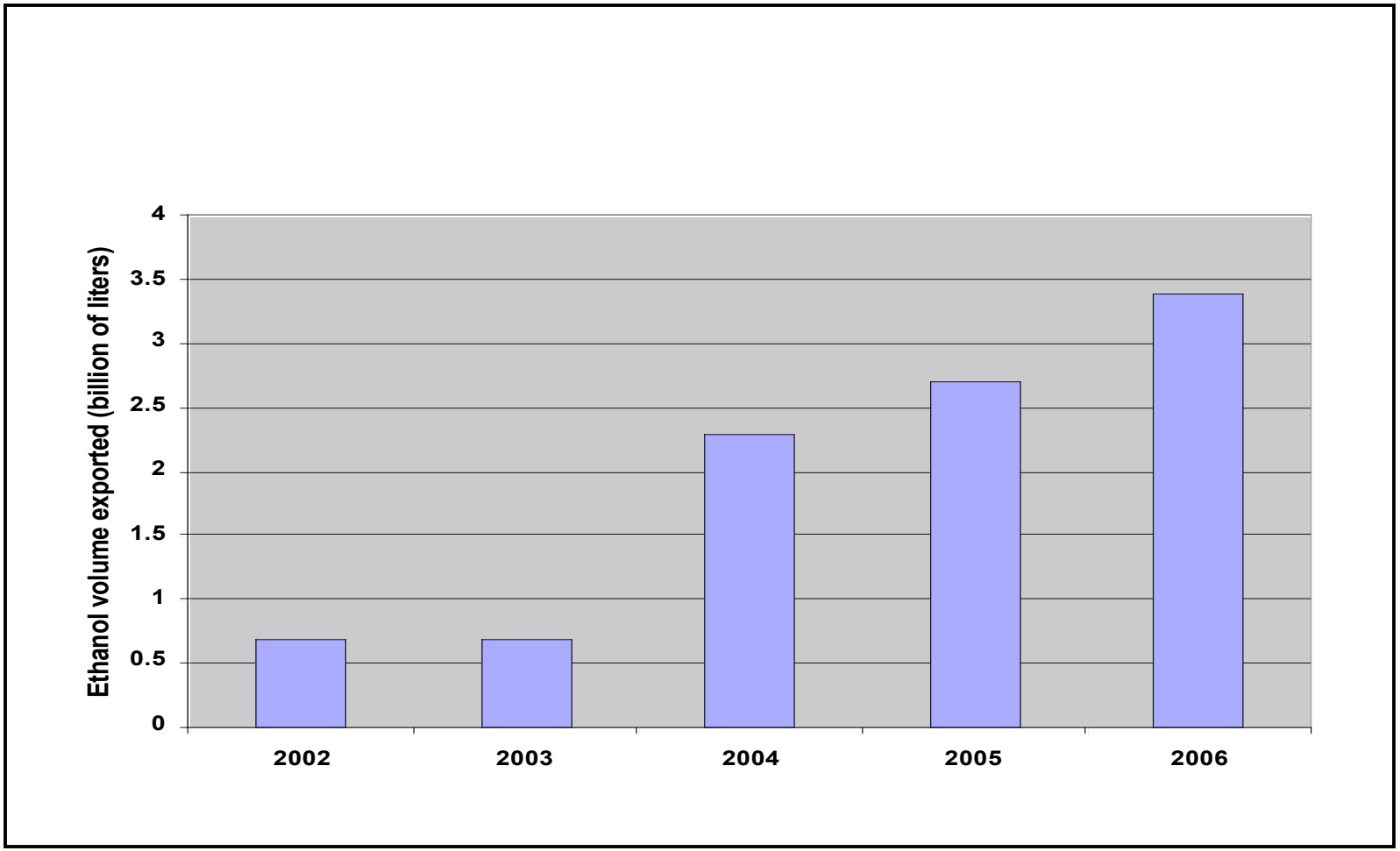
Brazilian Ethanol Exports 2002-2006



Source: SECEX, MDIC

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Ecological barriers

1) Life cycle analysis, labelling and "certification of origin" of biofuels should be applied in the global energy market to ensure that "sustainable bioenergy" production is not affecting biodiversity and food security.

2) Classification of "sustainable bioenergy" should be introduced in the WTO rules in order to reduce or, as appropriate, eliminate tariff and non tariff barriers according to the Doha Development Agenda, paragraph 31 (iii)

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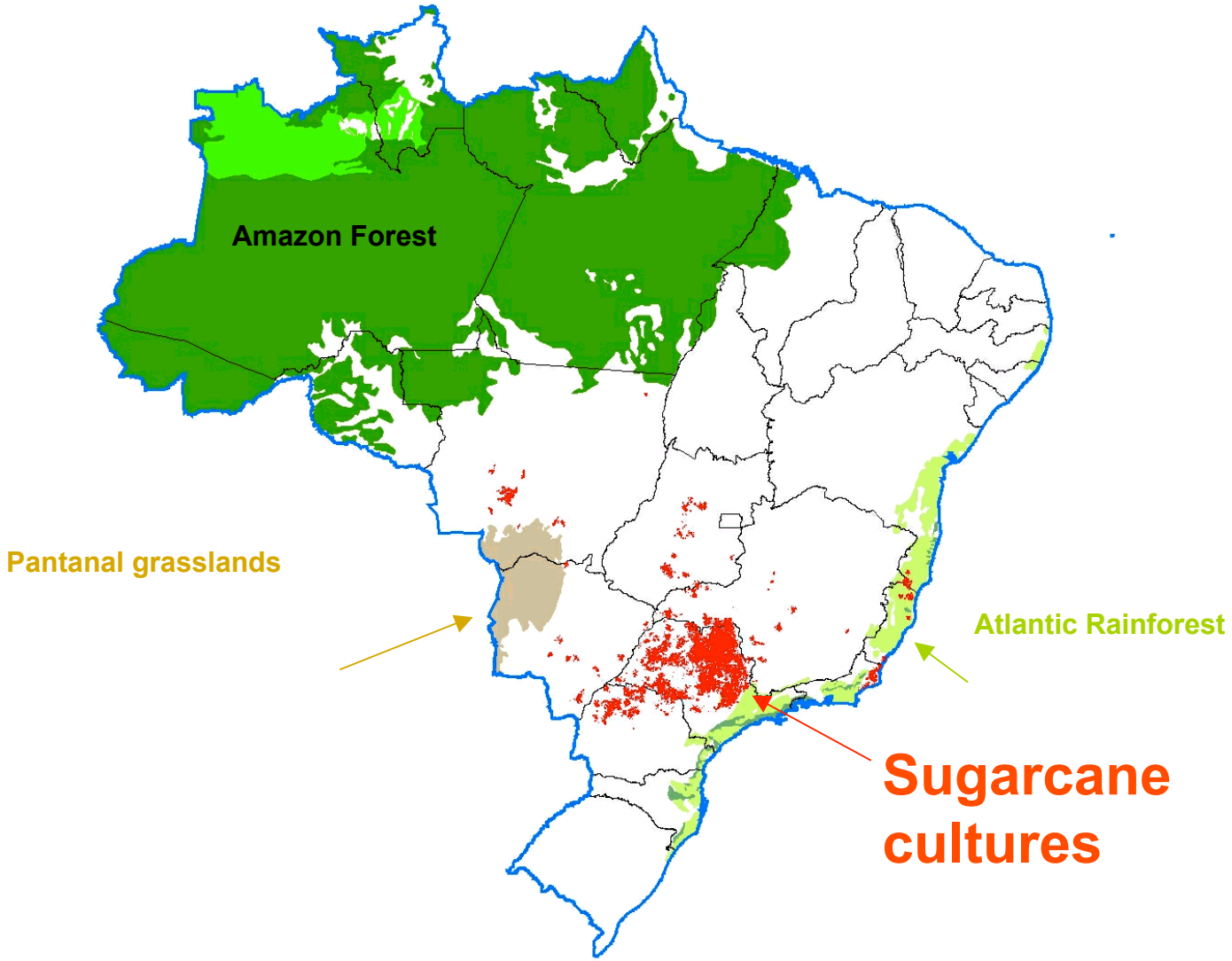
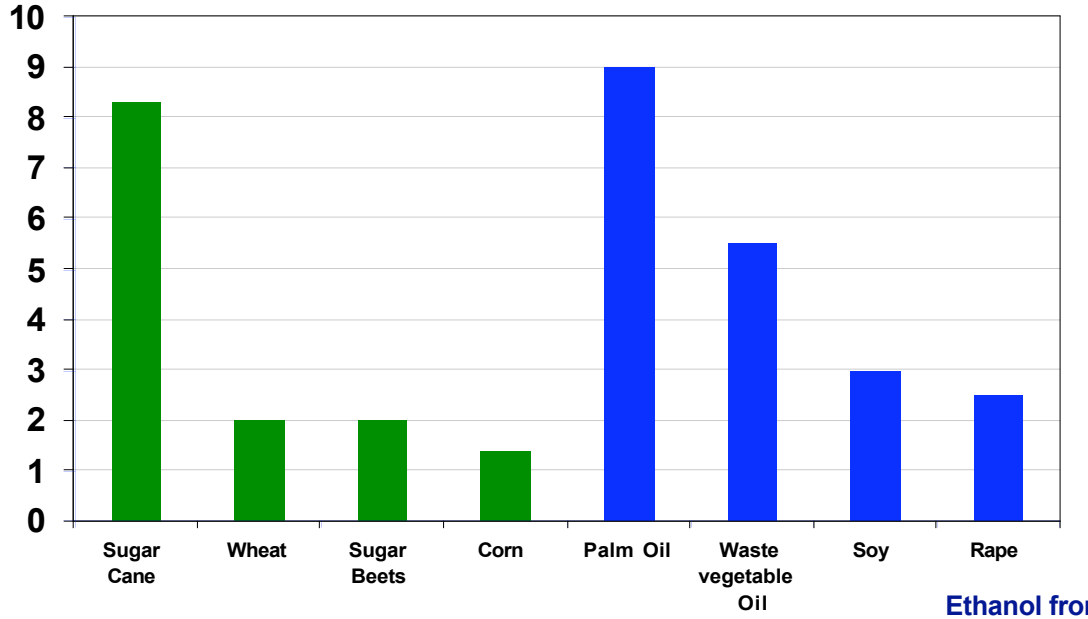
SUGARCANE ISN'T PLANTED IN AMAZONIA



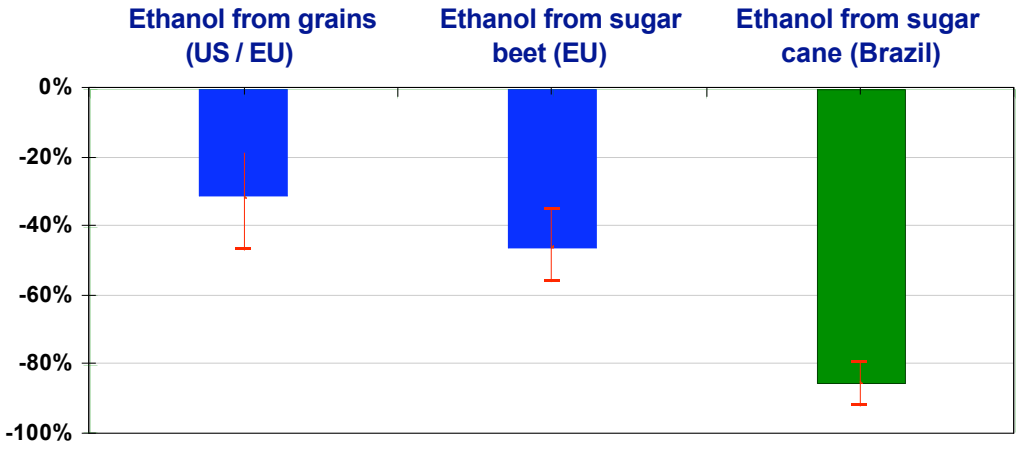
FOSSIL ENERGY AND GHGs BALANCE

Data represent the amount of energy contained in the listed fuel per unit of fossil fuel input



Source: Various, compiled by World Watch Institute.

Emissions avoided with ethanol replacing gasoline



Note: Reductions in well-to-wheel CO_2-equivalent GHG emissions per km, from bioethanol comparared to gasoline, calculated on a life-cycle basis.
Source: IEA – International Energy Agency (May, 2004), based on a review of recent articles.

Social barriers

Evolution of numbers workers by producing region and sector

RAIS – Formal Jobs

	Region	2000	2005	Δ	Results
Sugarcane	NNE	81,191	100,494	23.8%	↑
	CS	275,795	314,174	13.9%	↑
	Grand Total Brazil	**356,986**	**414,668**	**16.2%**	↑
Sugar	NNE	143,303	232,120	62%	↑
	CS	74,421	207,453	178.8%	↑
	Grand Total Brazil	**217,724**	**439,573**	**101.9%**	↑
Ethanol	NNE	25,730	31,829	23.7%	↑
	CS	42,408	96,534	127.6 %	↑
	Grand Total Brazil	**68,138**	**128,363**	**88.4%**	↑
Grand Total for Brazil - 3 sectors		**642,848**	**982,604**	**52.9 %**	↑

de Moraes, M. A. F., 2007. Labor market indicators of the Sugar Cane-AgroSystem in Brazil, Ethanol Summit, Sao Paulo – Jun 2007

Alcohol: Number of employees, Wages and Schooling (2005)

	Total	Years of Schooling	Monthly Average Wage (US$)	National Minimum Wage (US$)	Wage/ National Wage
Brazil	79,905	8.3	401.8	131.26	206%
NNE	2,939	3.2	135.3	131.26	3%
CS	76,966	8.5	412	131.26	213.9%
SP	44,912	9.3	508.7	131.26	287.6%

Source: Prepared based on data provided by PNAD – in US$ dec 2005

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FUTURE EXPECTATIONS

- Biomass gasification
- Convertion of cellulose to ethanol
- CO2 capture and storage from sugar fermentation
- CO2 capture and storage from sugar/ethanol mills boilers – Negative CO2 emissions

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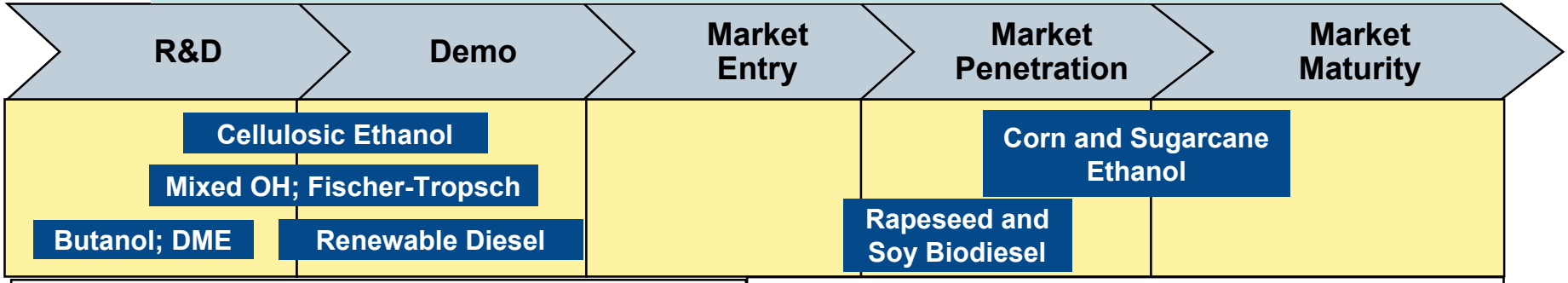
"First generation" biofuels are commercially developed technologies. "Second generation" are not yet commercially available



2nd Generation Biofuels

- **R&D efforts are focused on**:
  - Increasing the range of feedstock from which to produce biofuels
  - Reducing biomass-to-liquid conversion costs
- **Two main technology platforms in development:**
  - *Biochemical pathway*: conversion of the cellulose to sugars and fermentation to alcohol fuels
  - *Thermochemical pathway*: gasification of biomass to syngas and synthesis to fuels
- **Commercial renewable diesel plants are under construction (e.g., Neste oil "NexBTL")**

1st Generation Biofuels

- ***Ethanol*** is a clean burning, high-octane alcohol fuel used as a replacement and extender for gasoline
  - Has been commercially produced since the 70s in the US and Brazil, still the market leaders
  - Corn ethanol is cost competitive (with no subsidies) with gasoline when crude oil is above $50/barrel ($30/brl from sugar cane)
- ***Biodiesel*** is a high-cetane, sulfur-free alternative to (or extender of) diesel fuel and heating oil
  - Commercialized in Europe in the 90's
  - Worst economics (and smaller market) than ethanol

Source: Navigant

Second generation" technologies aim to preserve oil companies interest

SUGAR CANE, ETHANOL AND THE GHG EFFECT

121 CO_2

88 CO_2

77 CO_2 from boiler

88 CO_2

Net CO2 balance from air

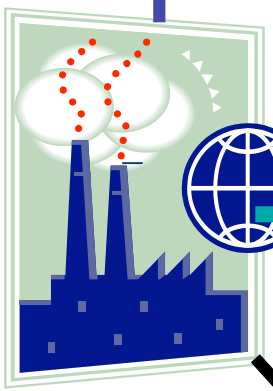
In 121g

Out 8+77=85g

Per 46g ETH.

photosynthesis

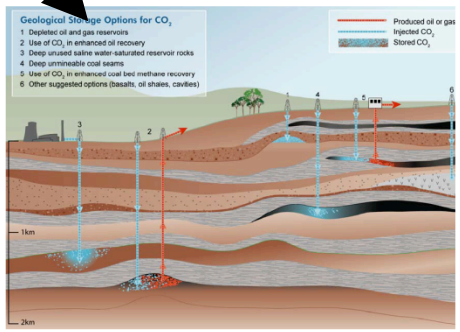
Sugar cane 209 CO_2



Alcohol 88 CO_2

44 CO_2 from fermentation

8 CO_2 from fuel



Removal 618g CO2/liter ethanol

Source; Moreira, 2003, IPCC, 2005

CONCLUSION - Create a *stable demand-side*

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- Institutional Regulation is a must for implementation of renewable energy markets
- On the longer-term, market support policies in the various countries, etc. should be designed to promote and stimulate international trade when and where trade would be the logical option. Some task member advocate a harmonization of e.g. EU policies but recognize that this will be hard to achieve.
- Policy incentives could also include requirements for energy and/or CO2 balances.
- In order to create long-term incentives, policy makers in countries with biomass targets are advised to formulate sound long-term biomass policies, including new targets with a time horizon of at least 10 years or longer in order to create clarity and security for the industry for long-term investments.

Source: **Opportunities and barriers for sustainable international bioenergy trade and strategies to overcome them, IEA Task 40**

CONCLUSION - stimulate a *stable supply side*

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- Improved logistical infrastructure on the supply-side is needed, such as low-cost long-range shipping.
- Further technology development of pretreatment technologies should be stimulated
- Projects by e.g. the World Bank or FAO should recognize and increasingly stimulate the use of residues as important (by-) products and actively promote energy crops as bioenergy source.
- Stimulate and support capacity building on bioenergy trade related issues.

Source: **Opportunities and barriers for sustainable international bioenergy trade and strategies to overcome them, IEA Task 40**

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THANK YOU VERY MUCH

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