

Dr Les A Edye

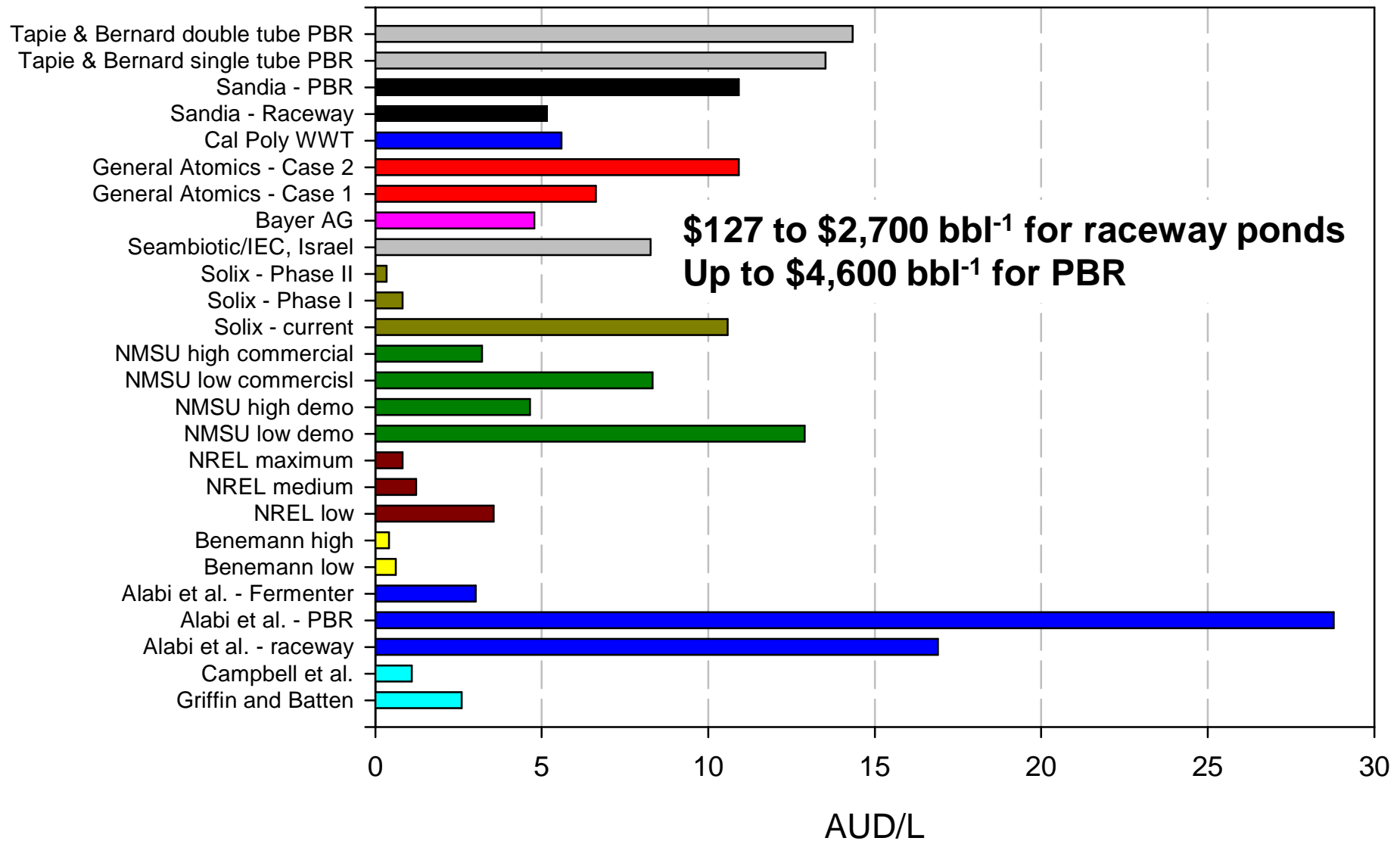
National Task Leader

Associate Professor, Queensland University of Technology

Director, BioIndustry Partners Pty Ltd



Cost estimates for algae to oil production



Griffin *et al.* (2010), adapted from the National Algal Biofuels Technology Roadmap
US Department of Energy Biomass Program (2009)

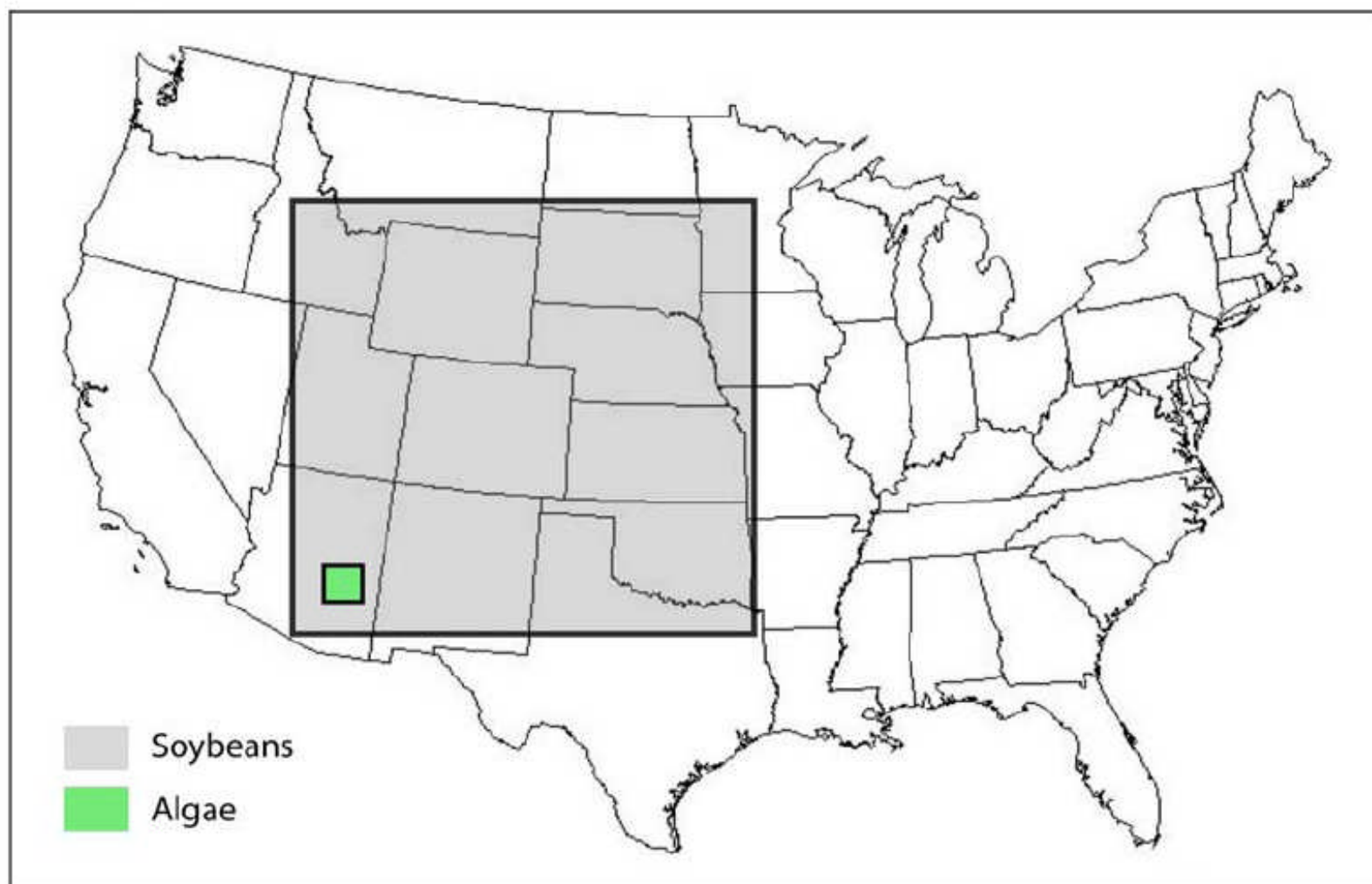


Figure 1-6 Land Requirement

The amount of land required to replace 50% of the current petroleum distillate usage using soybean (gray) and algae (green).

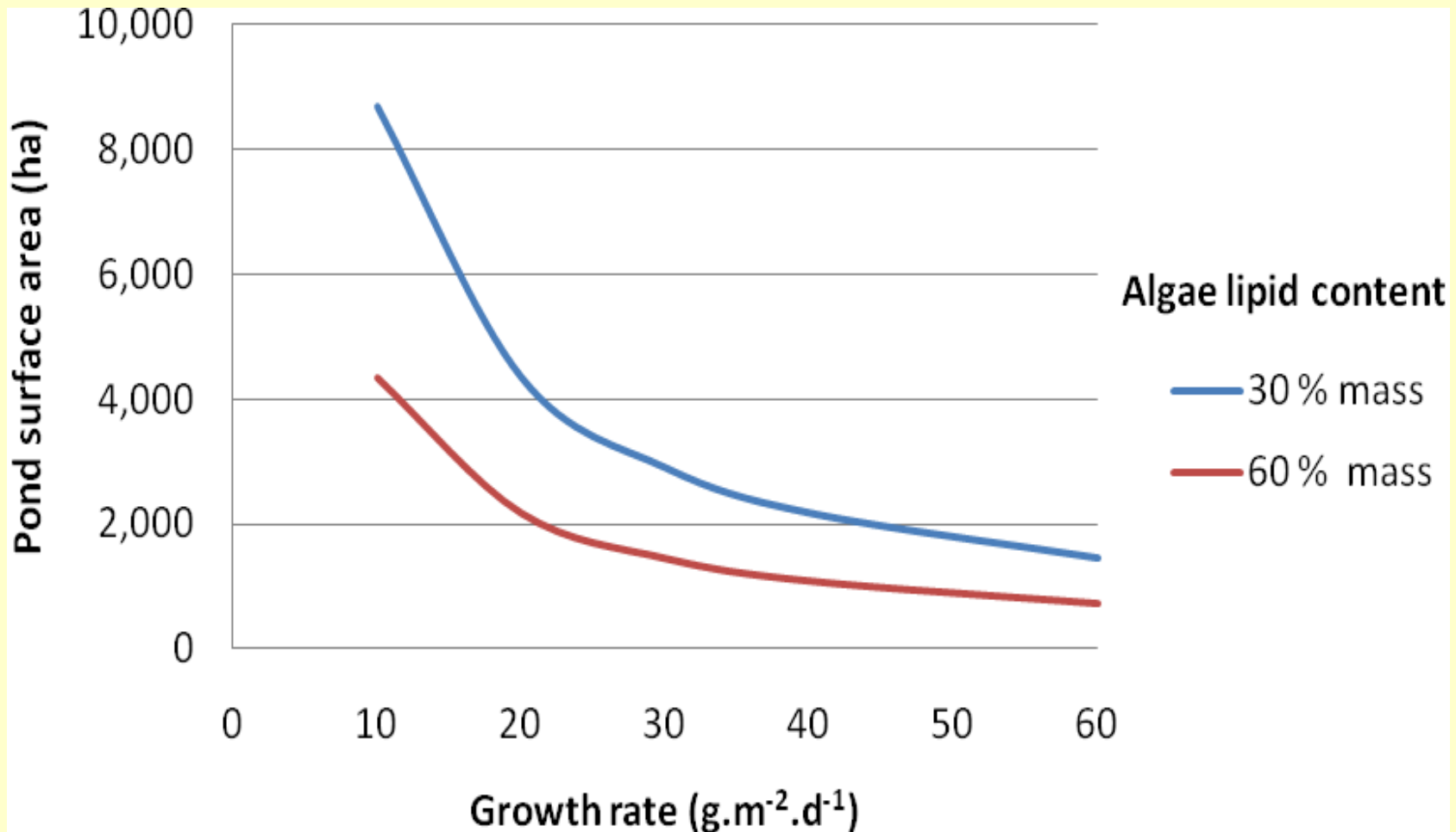
Keeping productivity real

- Productivity – 20 g/m²/day (even this is objectively optimistic - in current operations - 15 to 18 g/m²/day)
- Biomass lipid content – 30%
- 340 days of operation

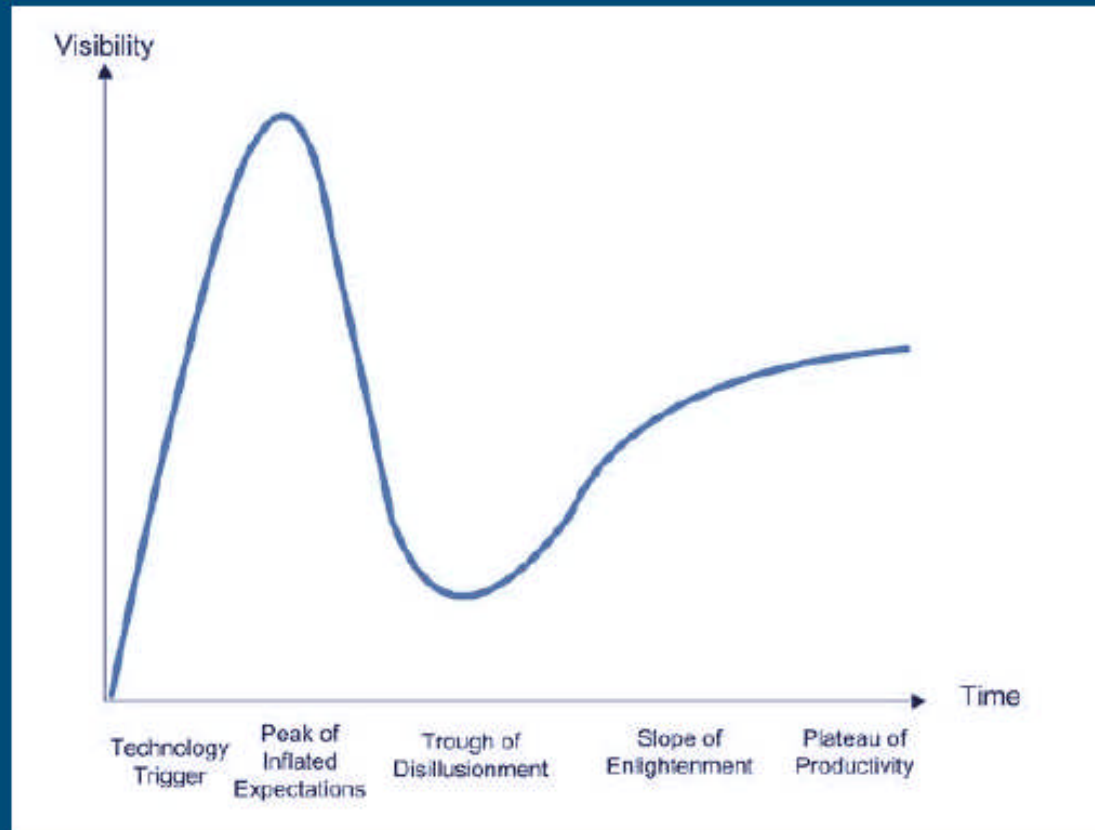
Productivity (l.ha ⁻¹ .yr ⁻¹)	
Corn; Soybean	172; 450
Jatropha	2000
Algae @ 15 g/m ² /day	3650
Algae @ 20 g/m ² /day	4870
Palm oil	6000

IEA - 3,800 l.ha⁻¹.yr⁻¹ (Roswell) to 50,800 l.ha⁻¹.yr⁻¹ (NREL 50 g.m⁻¹.d⁻¹ at 40% lipid)
Yusuf Christi (2007) Biotechnol. Adv. 25, 294–306 up to 136,900 l.ha⁻¹.yr⁻¹

Pond surface area for 100 ML production



Hype cycle of biofuels?



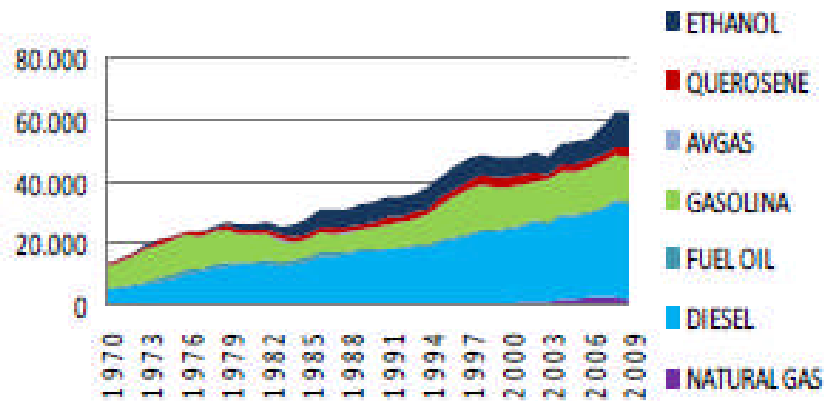
Task Meeting at Petrobras

Guest Presentations

- [Agricultural Ministry](#) - Jose Vieira
- [IEA Bioenergy Task 38](#) - Manoel Regis Leal
- [Petrobras: Biofuels](#) - Juliana Vaz Bevilaqua
- [Petrobras: Agronomy](#) - Jose Junior and Pedro Fernandes
- [COPPE](#) - Luiz Rosa
- [Federal University of Rio](#) - Elba Bon
- [National Institute of Technology](#) - Viridiana Ferreira-Leitao
- [UNICA](#) - Luiz Fernando do Amaral
- [Petrobras: Technologies](#) - Francesco Palombo
- [National Institute for Space Research](#) - Bernando Rudorff
- [CTBE](#)

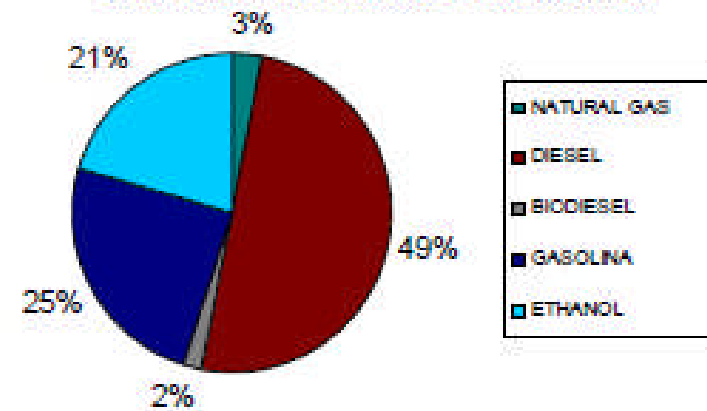
The Brazilian fuel consumption in the transport segment

Evolution of fuel consumption in the transport segment in Brazil (10^3 tep)

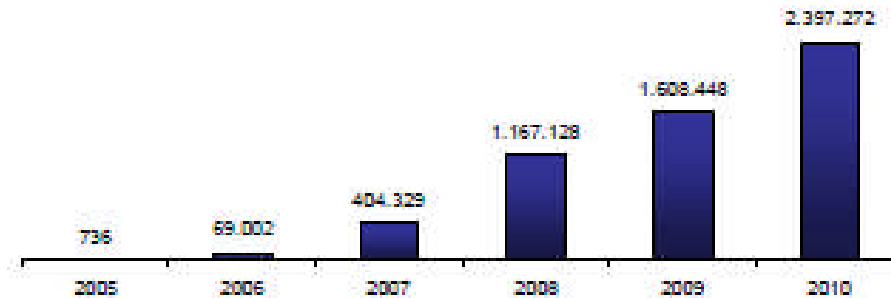


Source: Balanço Energético Nacional 2010, EPE, regarding 2009 data

Brazilian Vehicular Fuel Matrix



Evolution of Brazil biodiesel production (m³)



Source: ANP, 2011

The Mandate for biodiesel in Brazil had a gradual growth:

B2- 2008

B3- Jul/2008

B4- Jul/2009

B5- Jan/2010

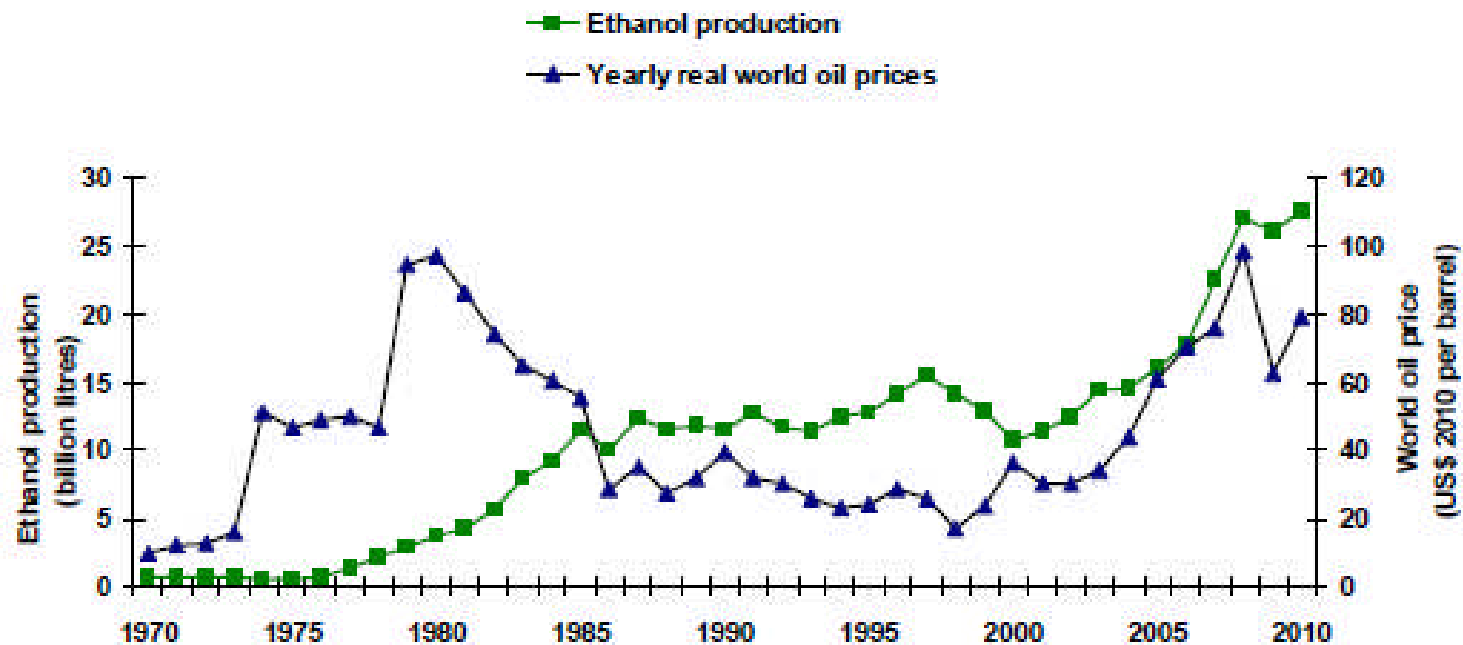
PETROBRAS

BIOCOMBUSTÍVEL



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Brazilian ethanol production and world oil prices (1970 to 2010)



Source: Oil prices: BP

Brazilian ethanol production: EPE and MAPA

LAND USE IN BRAZIL

USE	Area	
	Million ha	%
Amazon Forest	357	42,0%
Pasture	172	20.2%
Yearly crops	55	6.5%
Perennial crops, except sugar cane	9	1.1%
Sugar cane	9	1,05%
Cultivated forests	6	0,7%
Non exploited	113	13.5%
Cities	21	2,5%
Protect areas	71	8.3%
Others	38	4,5%
Total	851	100%



Current area under sugar cane cultivation: ~ 9 million hectares, only 11% of the preserved areas.



Land Use in Brazil (2010)

Sugarcane uses **3.4%** of available agricultural land in Brazil!
Brazil has nearly **40 million hectares** of degraded pastures.

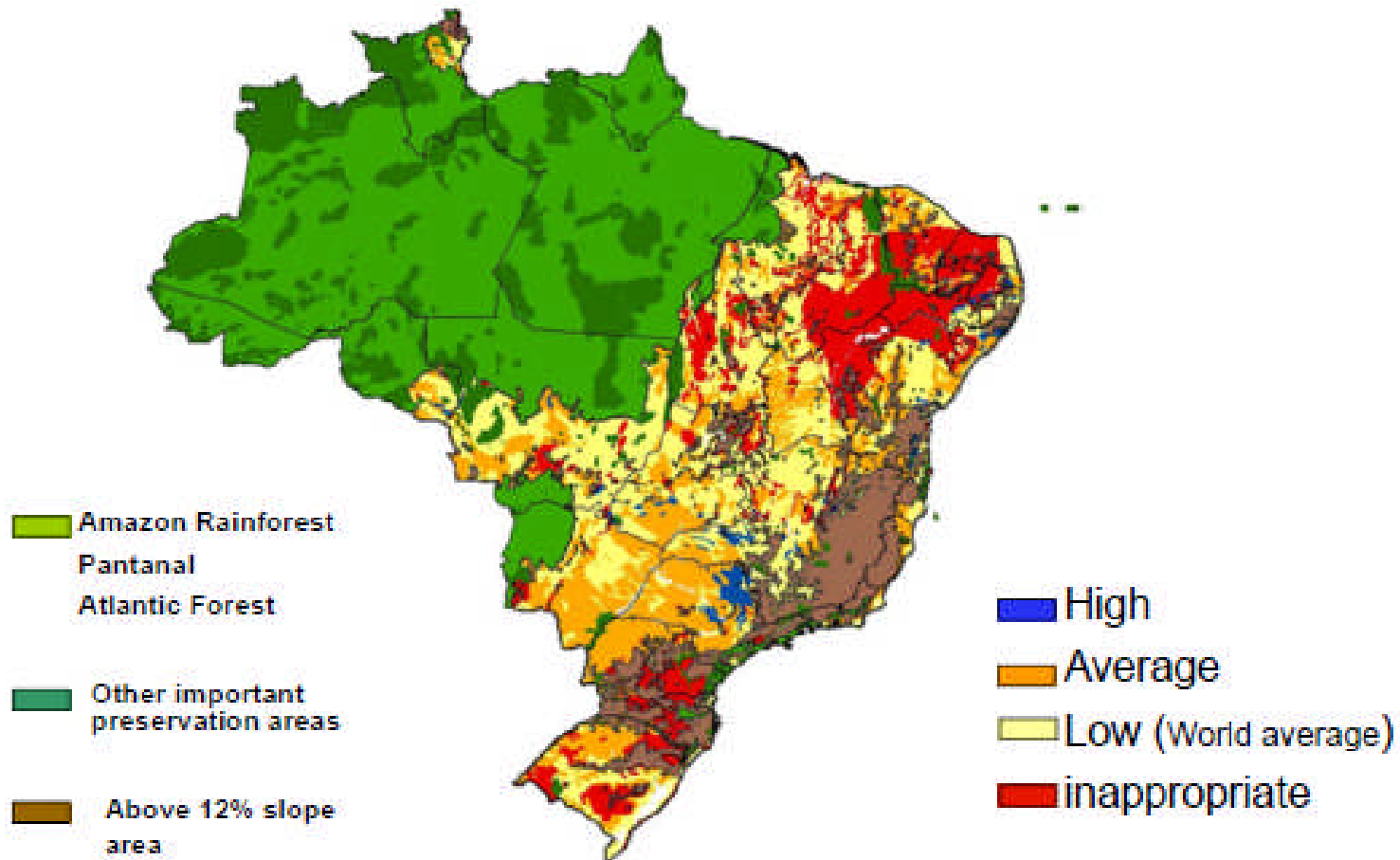
Crop	Area (Mha)	Area/Total	Production (Mt)
Soybean	23.3	36.6%	68.5
Maize	12.8	20.1%	56.1
Sugarcane	9.1	14.3%	719.2
Beans	3.5	5.4%	3.2
Rice	2.7	4.3%	11.3
Wheat	2.2	3.4%	6.0
Coffee	2.2	3.4%	2.9
Cassava	1.8	2.8%	24.4
Cotton	0.8	1.3%	2.9
Sorghum	0.6	1.0%	1.5
Other	4.8	7.5%	
Total	63.7	100.0%	

Source: IBGE, 2011



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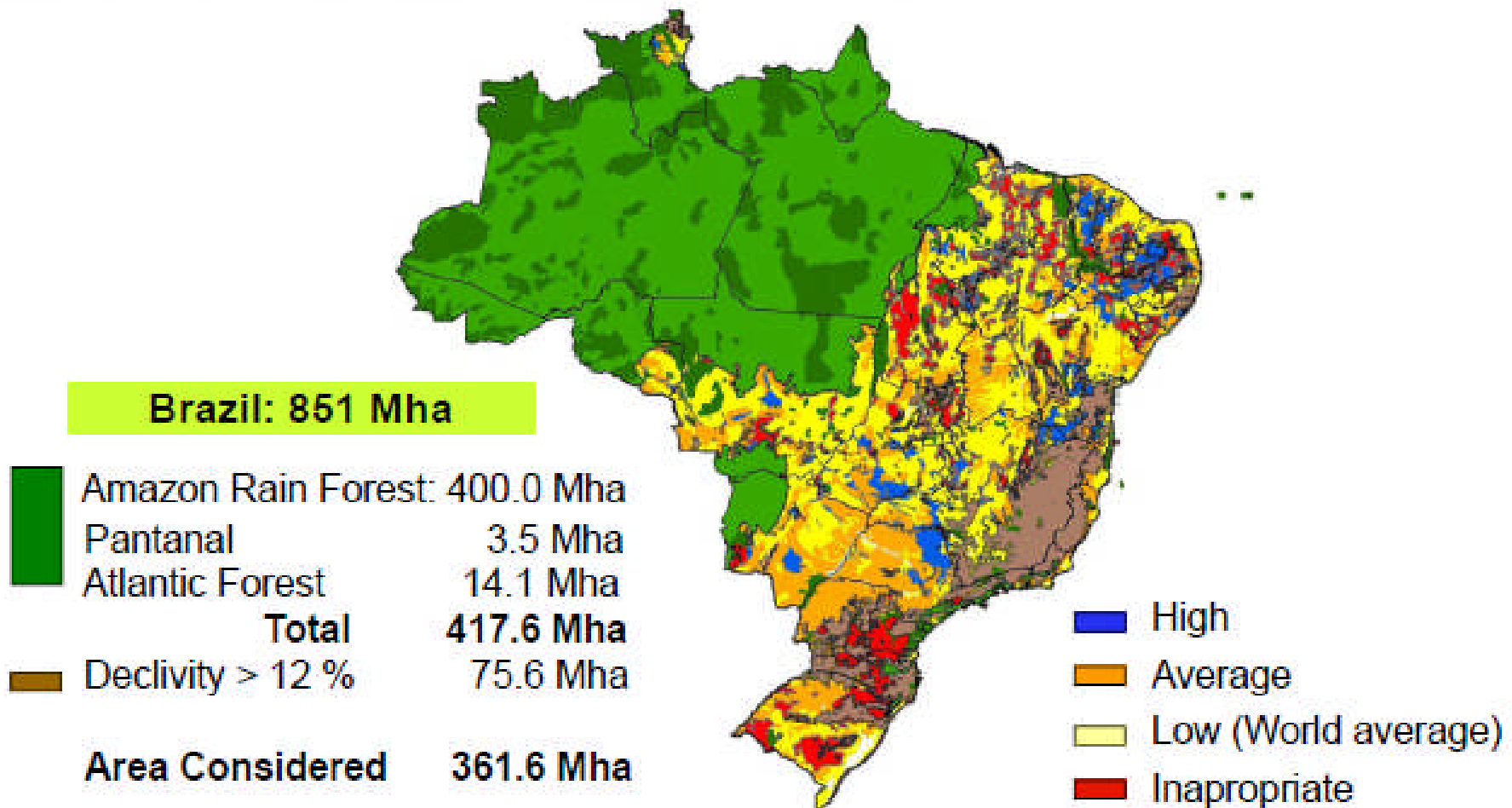
Potential areas for sugarcane production Soil and climate – without irrigation





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Potential Areas for Sugarcane Production Soil and Climate – with Irrigation



Sugarcane Zoning results

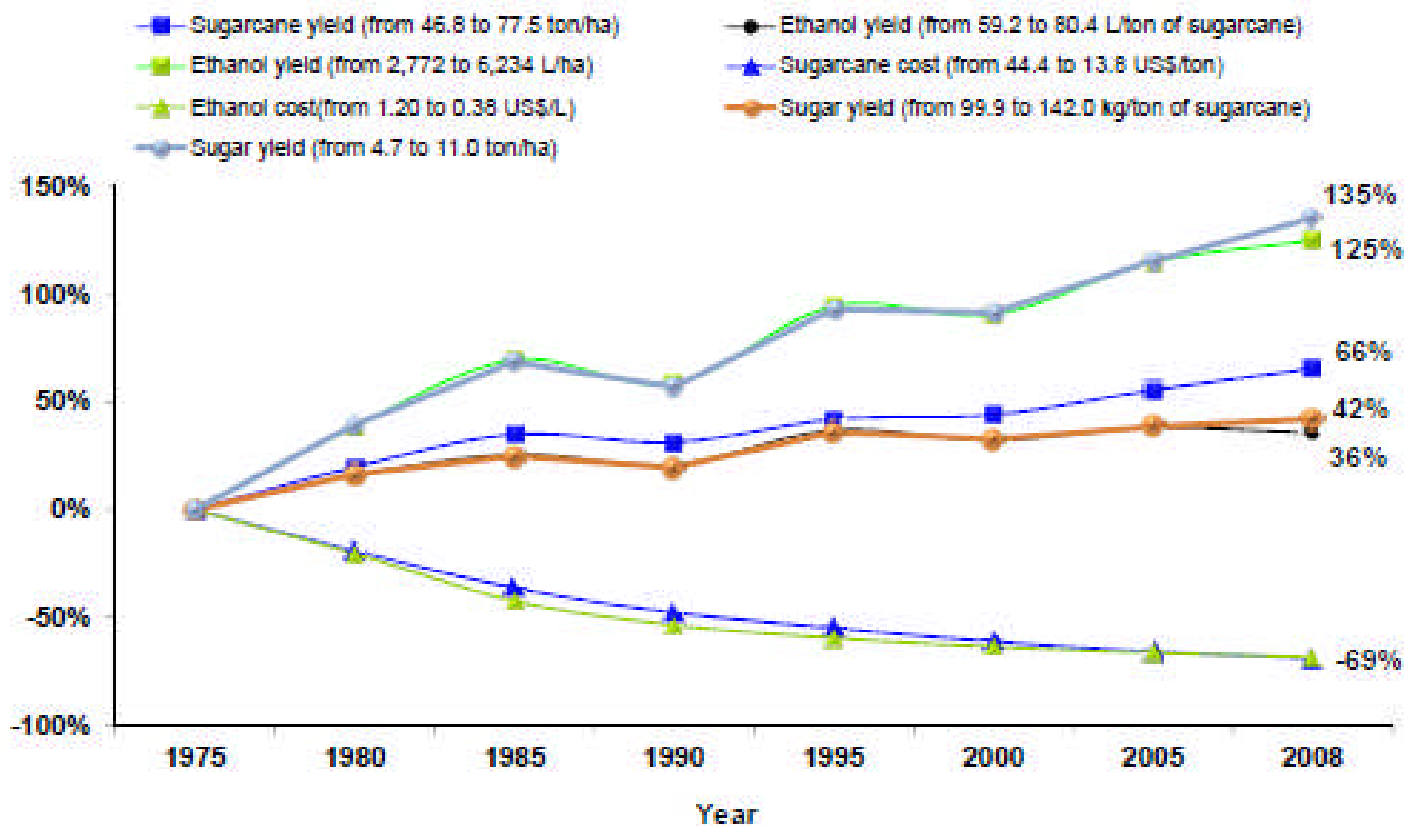
Potential areas in Brazil by level of aptitude and land use (ha)				
Potential	Potential by land use (ha)			Total
	Ap	Ag	Ac	
High (H)	10.251.027	585.989	7.191.388	18.028.403
Medium (M)	22.818.770	2.015.247	16.340.890	41.174.906
Low (L)	3.062.029	490.027	733.152	4.285.208
H+M	33.069.796	2.601.235	23.532.277	59.203.309
Total	36.131.825	3.091.263	24.265.429	63.488.517

Ap = areas with pastures; Ag = areas with agriculture; Ac = areas with agriculture and livestock.

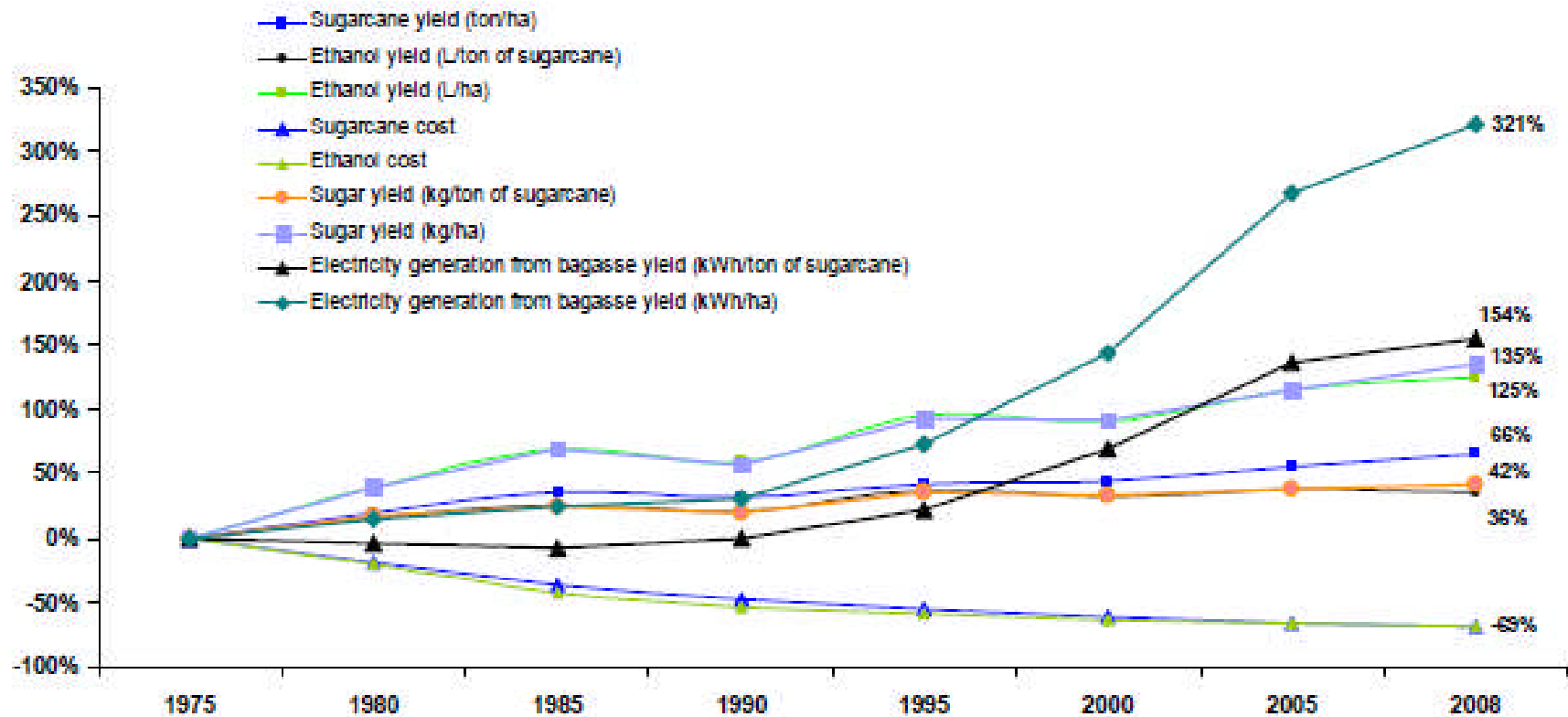
Only 7.5% of Brazil were named as areas suitable for expansion of sugarcane and only 10% of this potential area is supposed to be occupied in the next 10 years .

Learning curve

Rise of yields and reduction on production costs for Brazilian sugarcane, ethanol and sugar - 1975 to 2008



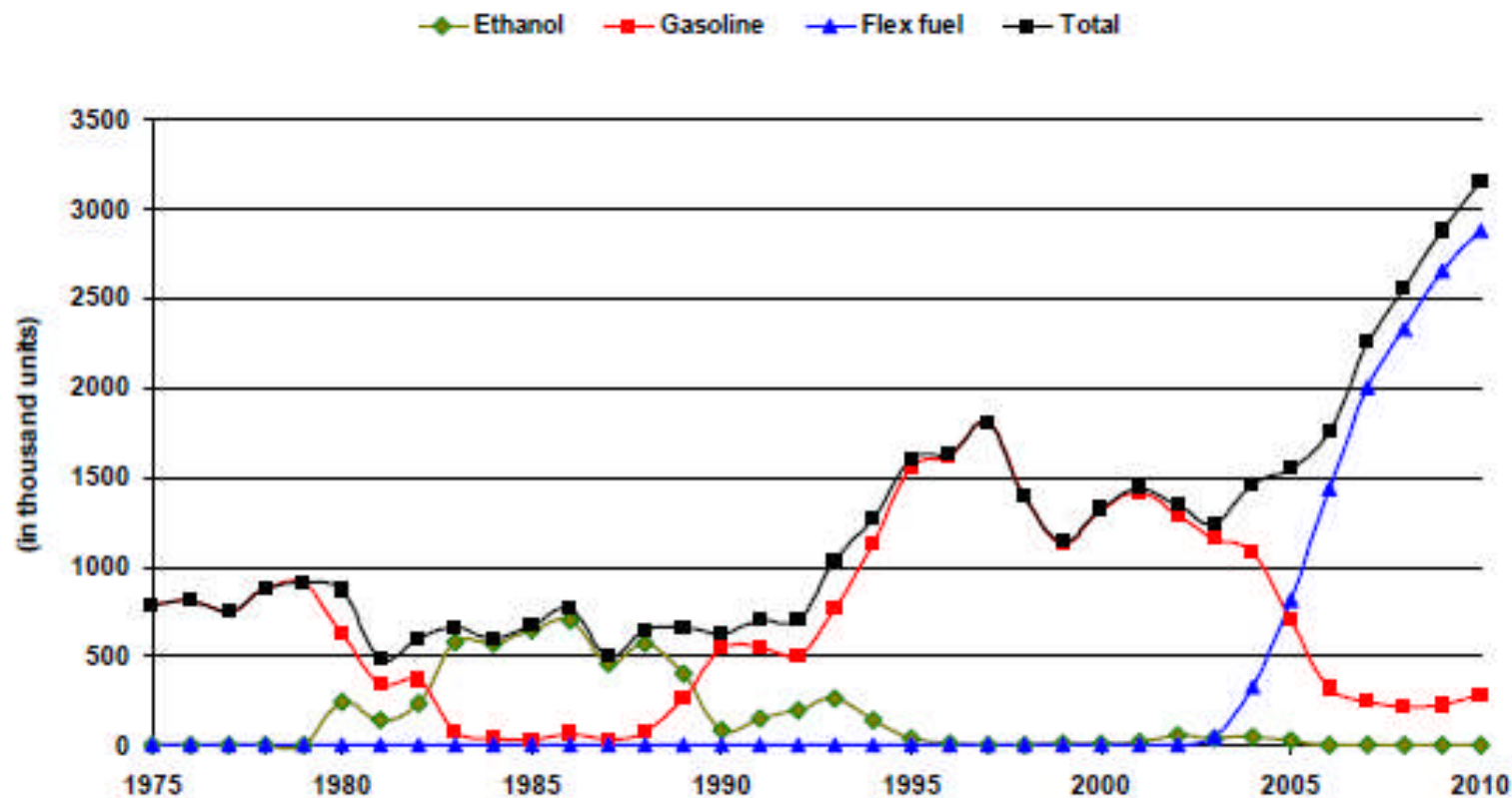
Rise of yields and reduction on production costs for Brazilian sugarcane, ethanol, sugar and bioelectricity - 1975 to 2008





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Brazil – Registration of new vehicles by fuel type (1975 to 2010)

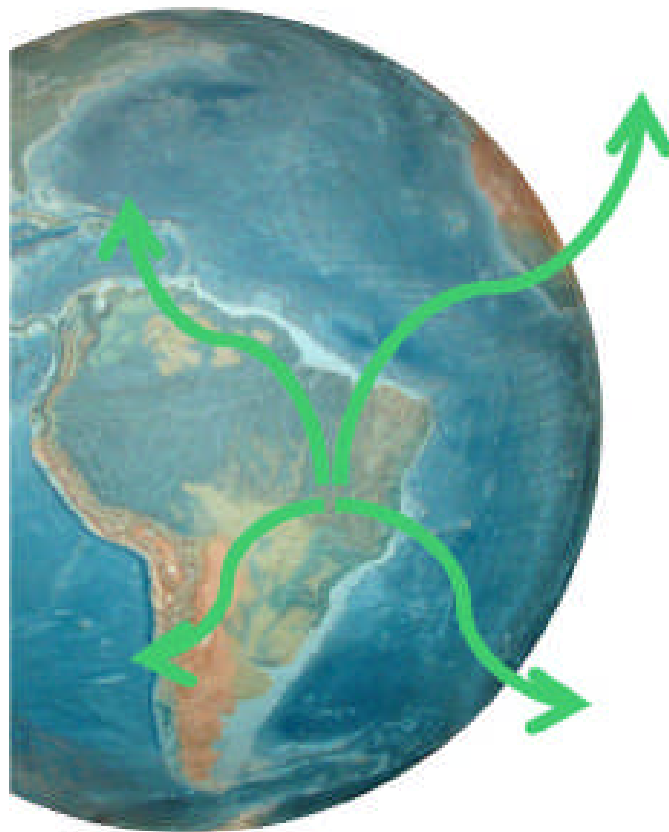


Source: Brazilian automotive industry yearbook 2011



Brazilian Bioethanol Science
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Replacing 10% of the world demand for gasoline by Brazilian ethanol in 2025



Ethanol Project (NIPE/Unicamp-CGEE/MCT)

A production of 250 billion liters of ethanol could
generate in Brazil:

- Over **9 million new jobs** (direct, indirect and induced).
- **A raise of 13% in the GDP.**
- **1000 new distilleries.**

Strategy: To create a National Laboratory that can produce scientific knowledge on the bioethanol production cycle, and able to face technological bottlenecks.

Ethanol Logistic - Logum



- Next Task meeting is in Copenhagen in February 2012

Acknowledgements



Contacts

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