

*ESPCA 2014 - São Paulo Advanced School on the Present and  
Future of BIOENERGY*



*Expanding Sugarcane Ethanol Production  
in Brazil and LACAf countries*



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# Structure of Presentation

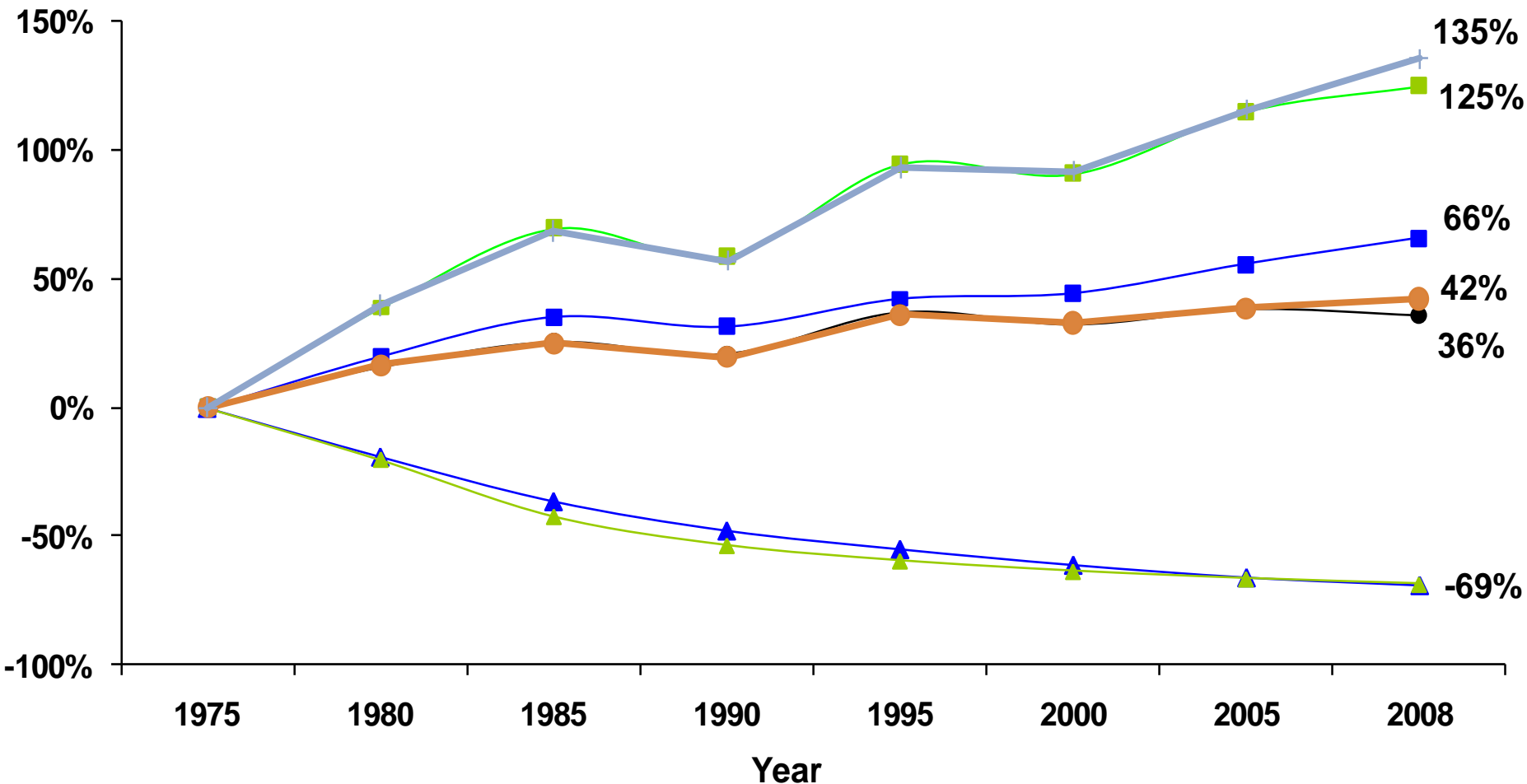
- Ethanol Production in Brazil
- Expanding sugarcane ethanol production in Brazil
- Expanding ethanol production in Mozambique, South Africa, Colombia and Guatemala (GSB/LACAf Project)

# ***Present Situation of Ethanol in Brazil***

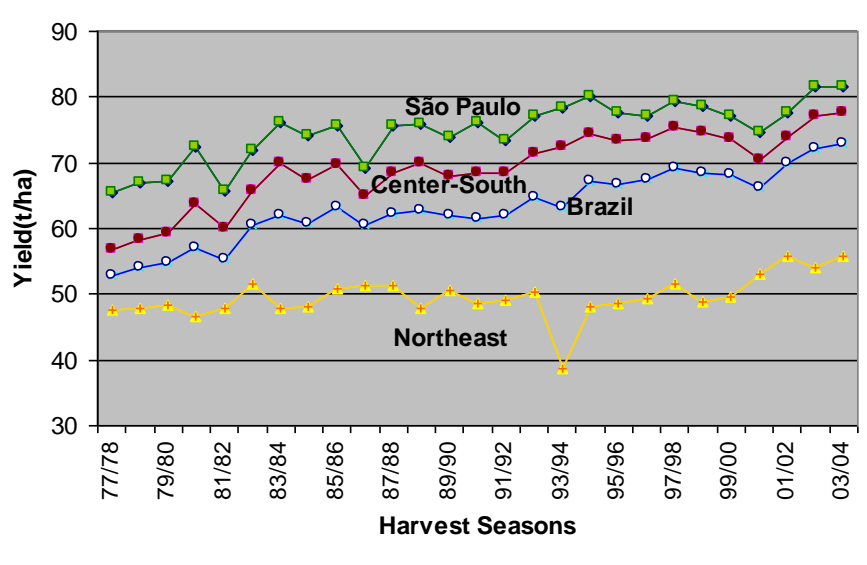
- Brazil produces sugar and ethanol at lowest cost in the world
- Sugarcane ethanol presents the best energy balance among biofuels (9:1)
- It also is the best alternative to mitigate GHG emissions
- ~35% of liquid fuels utilized in light vehicles fleet in Brazil
- Ethanol is sold all over Brazil
- Ethanol & bagasse represents 19% of Brazilian Energy Matrix (hydroelectricity 13% wood 15%)
- Generates nearly 750 thousand direct jobs in Brazil
- Important contribution to Brazilian GDP with positive socio-economic impacts, particularly in the country side

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

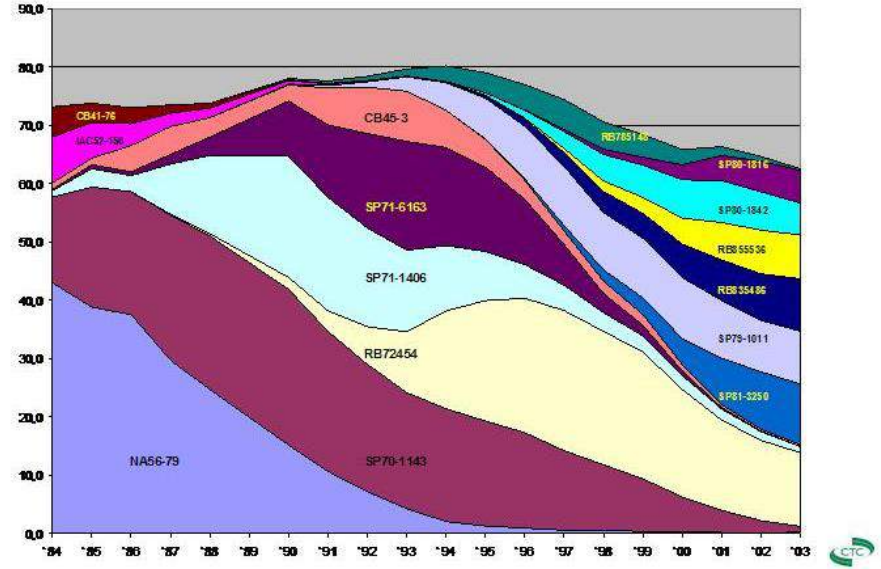
- Sugarcane yield (from 46.8 to 77.5 ton/ha)
- Ethanol yield (from 2,772 to 6,234 L/ha)
- ▲ Ethanol cost (from 1.20 to 0.38 US\$/L)
- Sugar yield (from 4.7 to 11.0 ton/ha)
- Ethanol yield (from 59.2 to 80.4 L/ton of sugarcane)
- ▲ Sugarcane cost (from 44.4 to 13.8 US\$/ton)
- Sugar yield (from 99.9 to 142.0 kg/ton of sugarcane)



# Cane Productivity (t/ha)

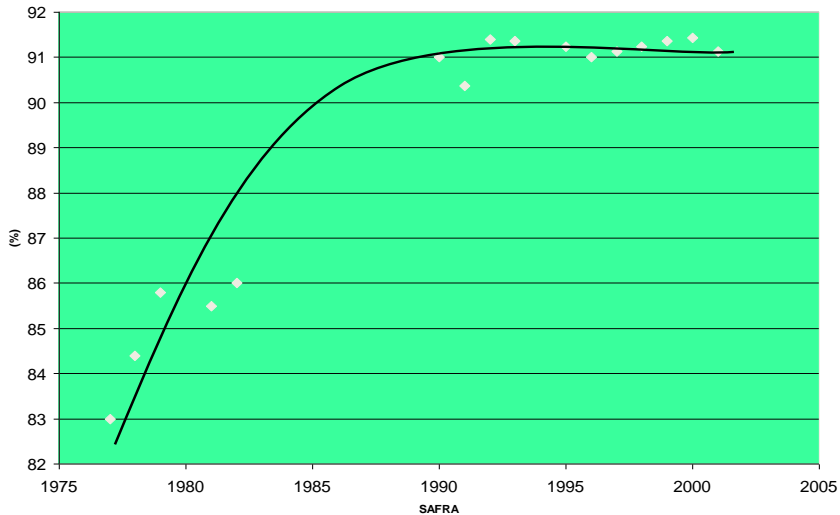


# New Cane Varieties

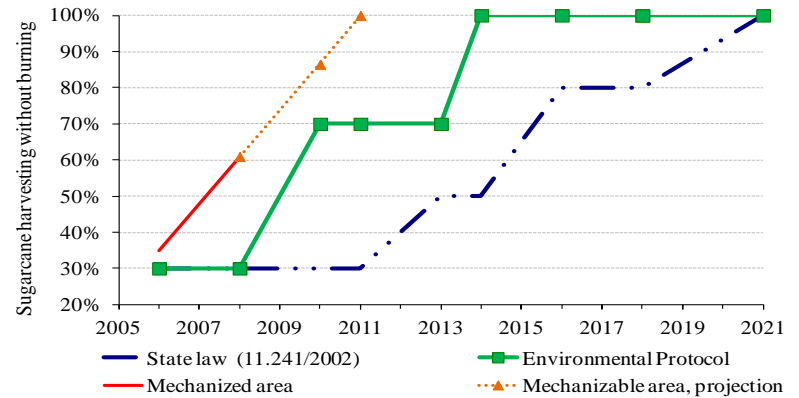


# Fermentation Yield (%)

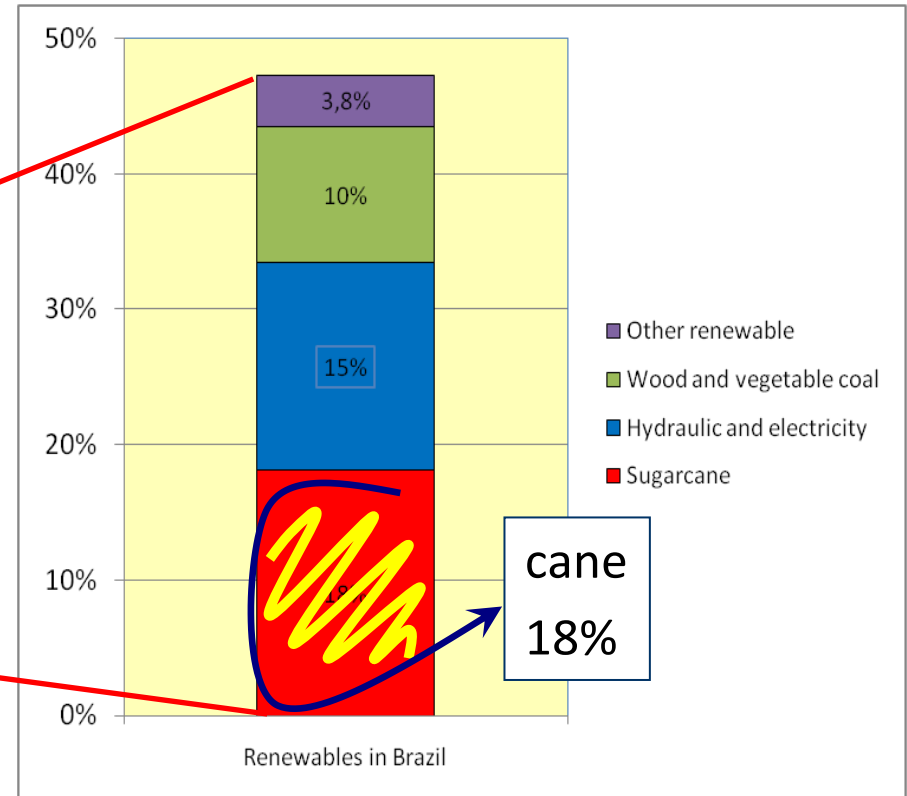
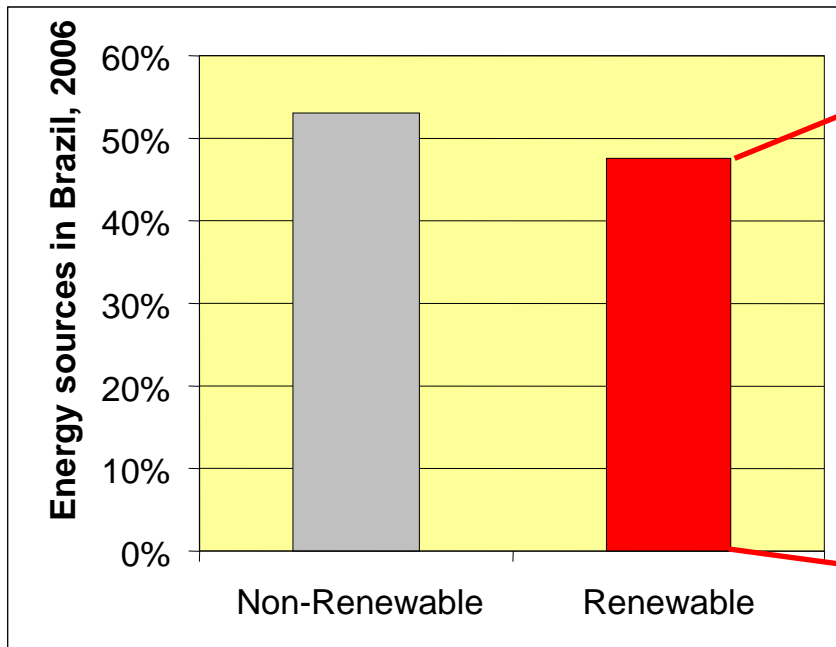
RENDIMENTO FERMENTATIVO(%)



# No Burning/Mechanization

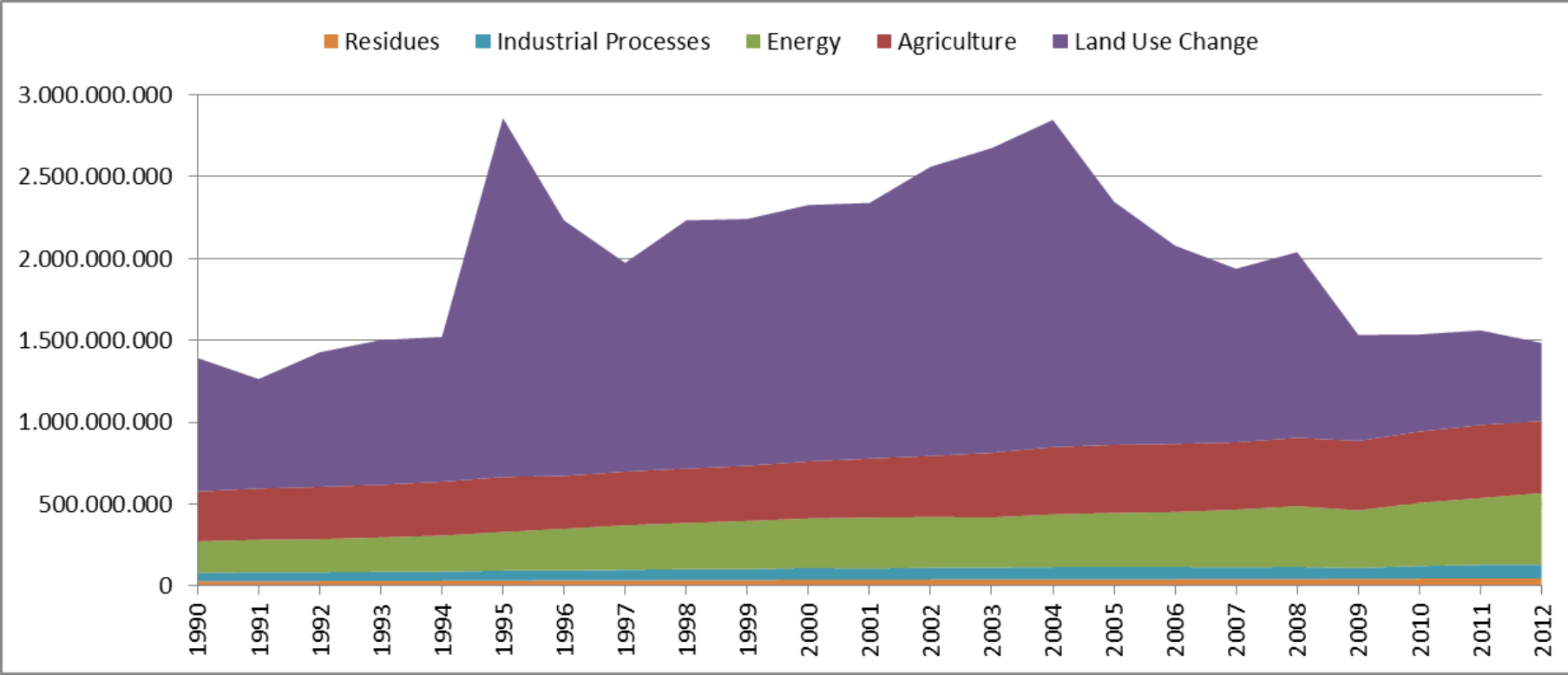


# 47% of Brazil's energy comes from renewable sources (2009)



Renewables in Brazil: 47%; World: 13%; OECD: 7,2%

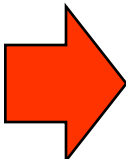
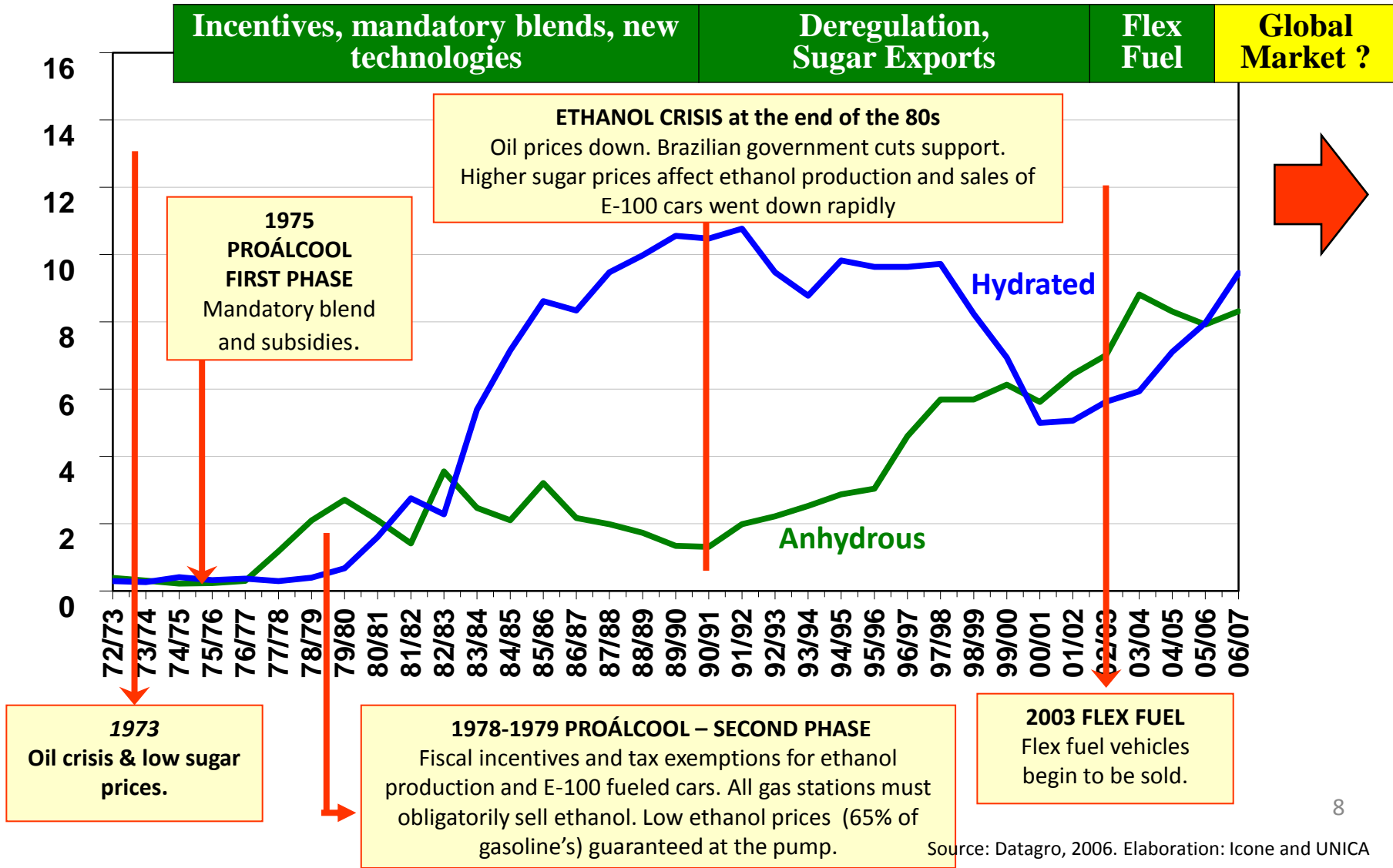
# Evolution GHG Emissions in Brazil (tons of CO<sub>2</sub>)



Source: SEEG, 2013

# Phases in Brazilian Ethanol

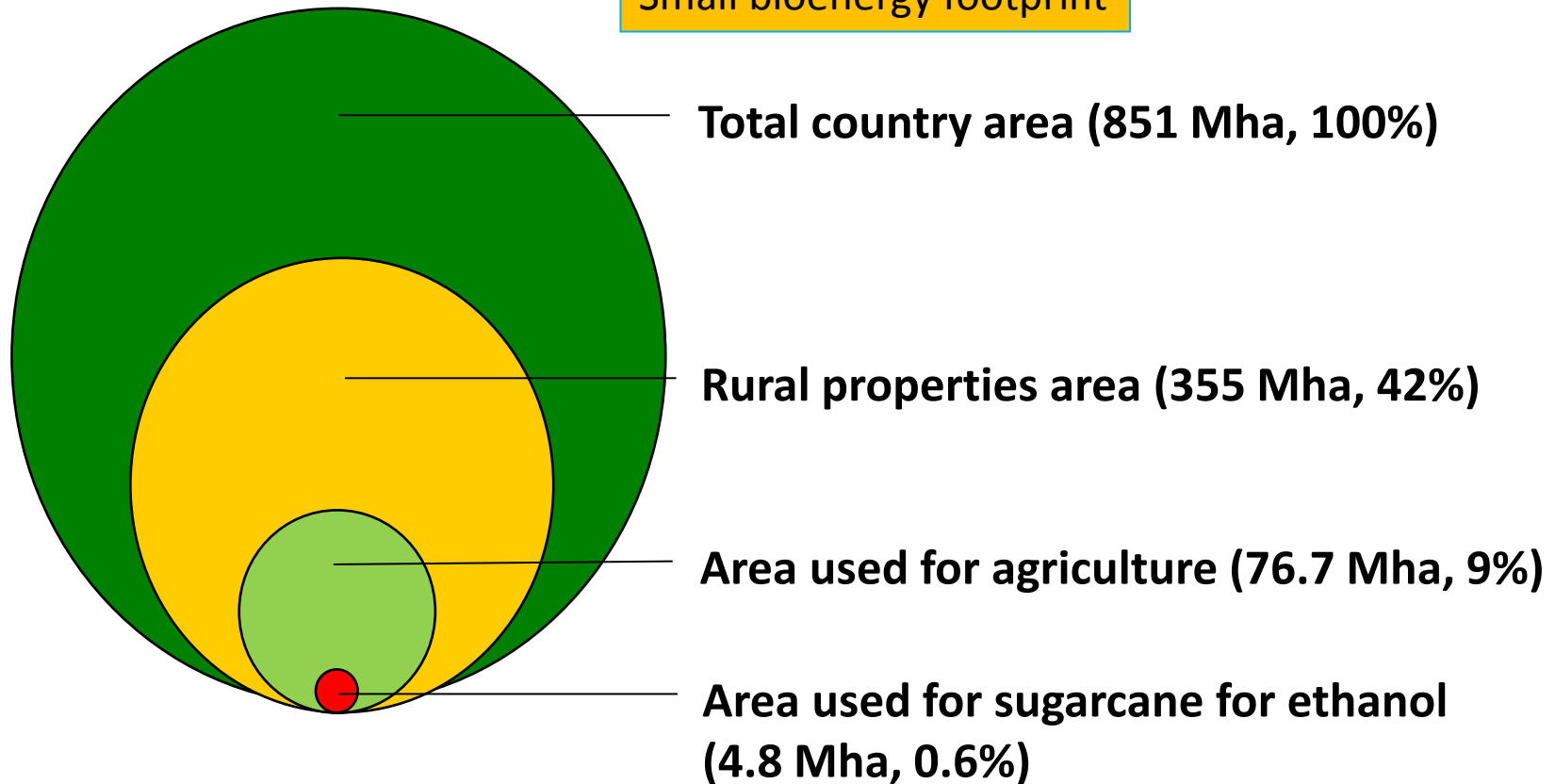
Ethanol production (billion liters)





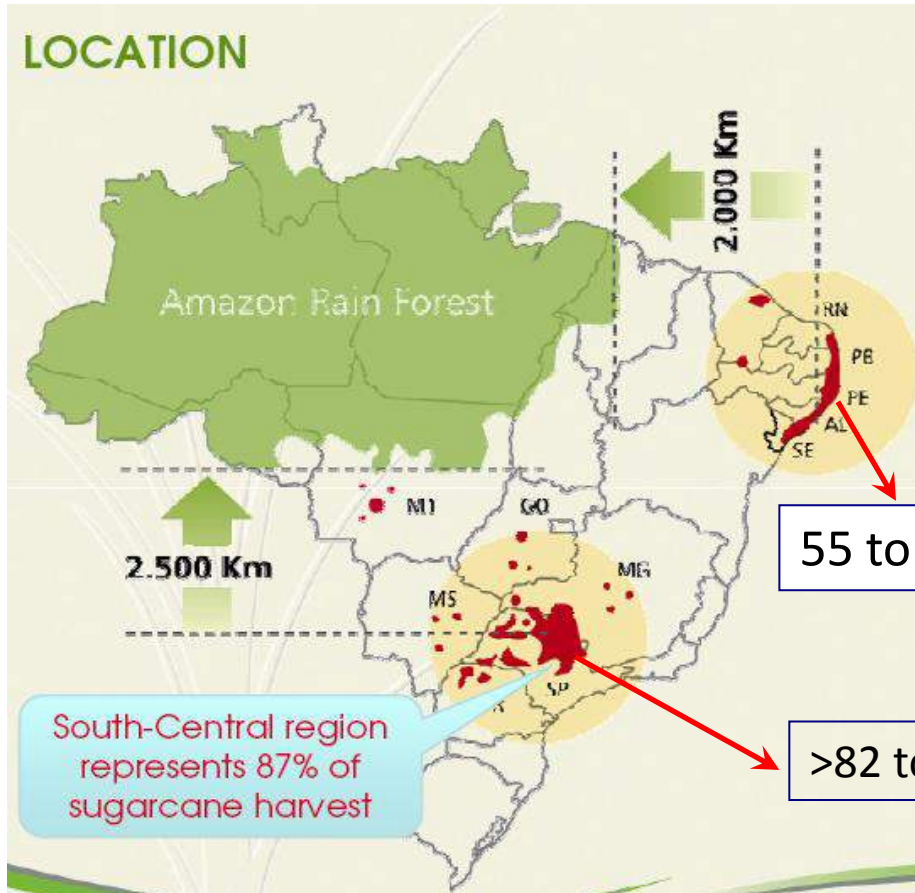
# Sugarcane for ethanol uses 0.6% of total area

Small bioenergy footprint



Source: Horta Nogueira and Seabra (2008)  
modified for 2008 data

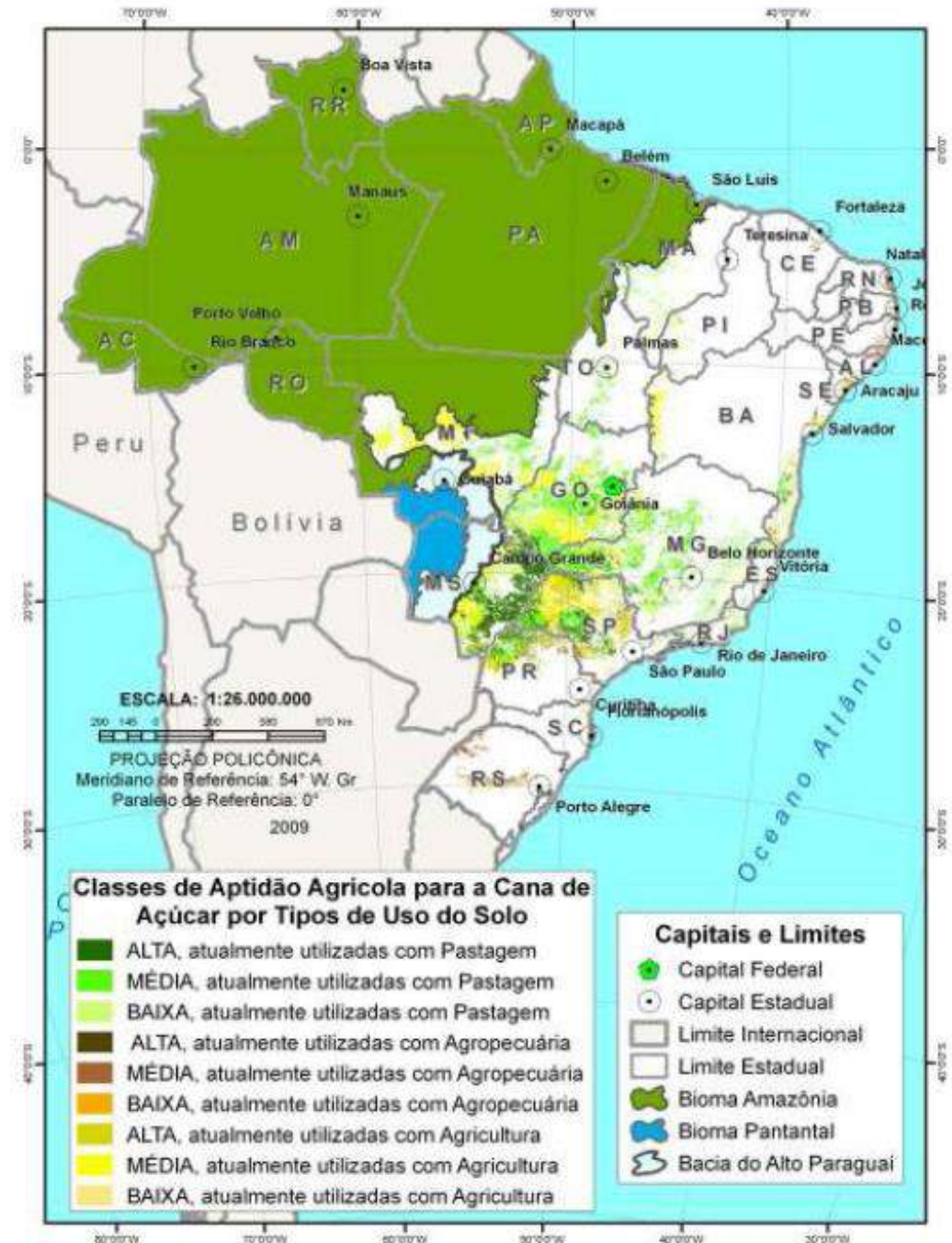
# Where does Brazil plant Sugarcane?



- Not in the Amazon
- Best land for cane:
  - Northeast coast
    - Oldest (XVI century)
  - Southeast
    - highest productivity
  - Centralwest
    - main expansion area

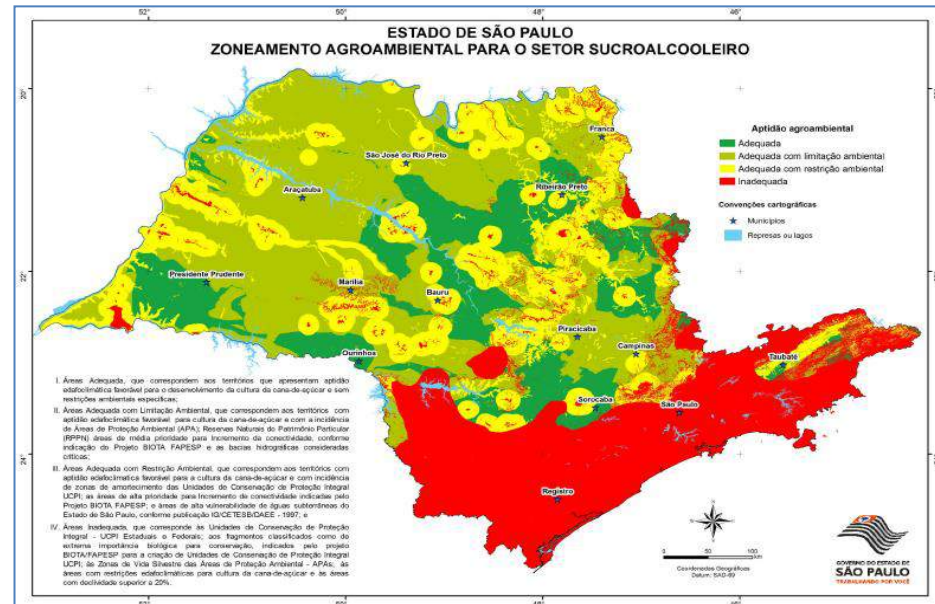
# Agricultural Zoning for Sugarcane in Brazil EMBRAPA-MAPA (2009)

65 Mha adequate for  
sugarcane production in  
Brazil (8% of territory)



# Sao Paulo State Environment Ethanol Issues

- Law to regulate waste disposal (vinasse)
- Law to regulate end of sugarcane burning (“Goldemberg Law”) burning phase out 2014
- Sugarcane Agroecological Zoning in São Paulo



# *Expanding Ethanol Production in Brazil*

- But the present questions are:
- **How much sustainable ethanol can Brazil produce?**
- What are the limits without touching the Amazon and other eco sanctuaries and preserving food and feed production?
- What could be the sugarcane ethanol contribution to **decrease GHG emissions?**
- What **research** can we do to reduce cost and improve sustainability indicators?





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Energy

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## Can Brazil replace 5% of the 2025 gasoline world demand with ethanol?

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### ARTICLE INFO

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Brazilian potential

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Sugarcane

### ABSTRACT

Increasing use of petroleum, coupled with concern for global warming, demands the development and institution of CO<sub>2</sub> reducing, non-fossil fuel-based alternative energy-generating strategies. Ethanol is a potential alternative, particularly when produced in a sustainable way as is envisioned for sugarcane in Brazil. We consider the expansion of sugarcane-derived ethanol to displace 5% of projected gasoline use worldwide in 2025. With existing technology, 21 million hectares of land will be required to produce the necessary ethanol. This is less than 7% of current Brazilian agricultural land and equivalent to current soybean land use. New production lands come from pasture made available through improving pasture management in the cattle industry. With the continued introduction of new cane varieties (annual yield increases of about 1.6%) and new ethanol production technologies, namely the hydrolysis of bagasse to sugars for ethanol production and sugarcane trash collection providing renewable process energy production, this could reduce these modest land requirements by 29–38%.

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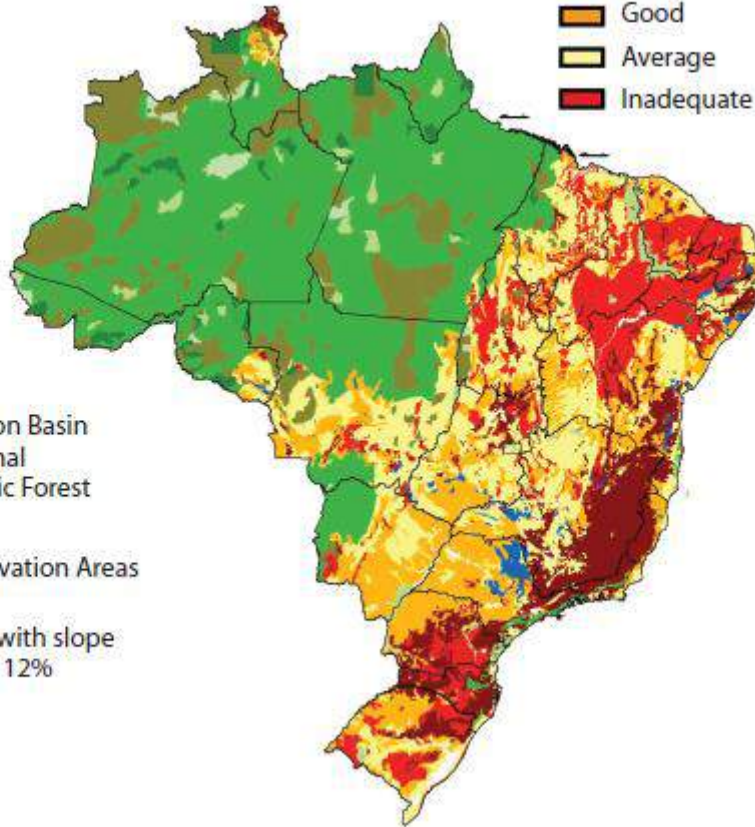
Source: Leite et al. 2009  
Energy 34(2009) 655-661

09242013; FAPESP BIOEN Programme

Source: Leite et al. 2009

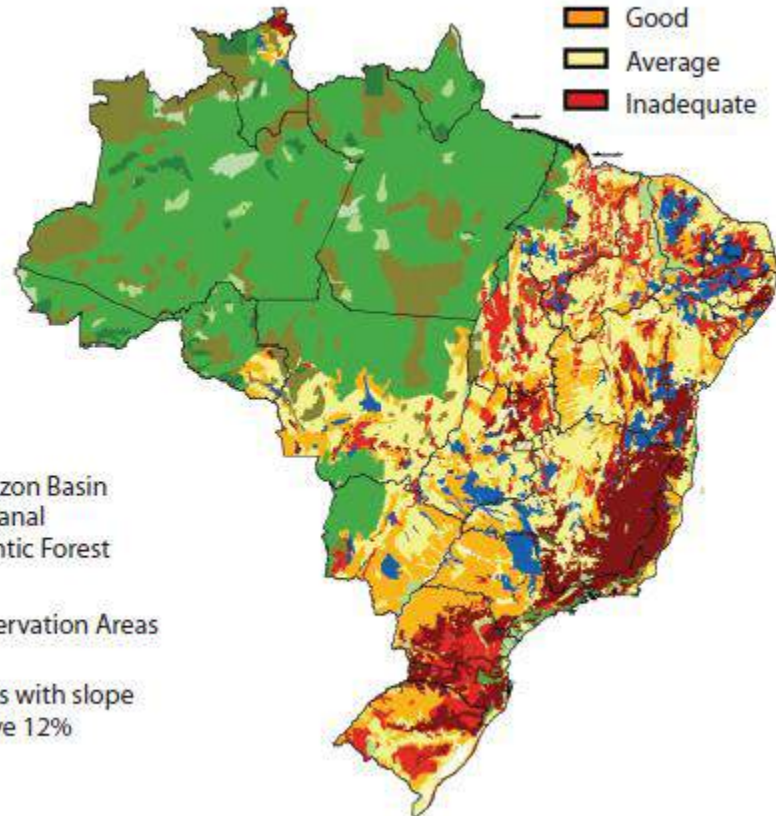
Without irrigation

- High
- Good
- Average
- Inadequate



- Amazon Basin  
Pantanal  
Atlantic Forest
- Preservation Areas
- Areas with slope  
above 12%

- High
- Good
- Average
- Inadequate

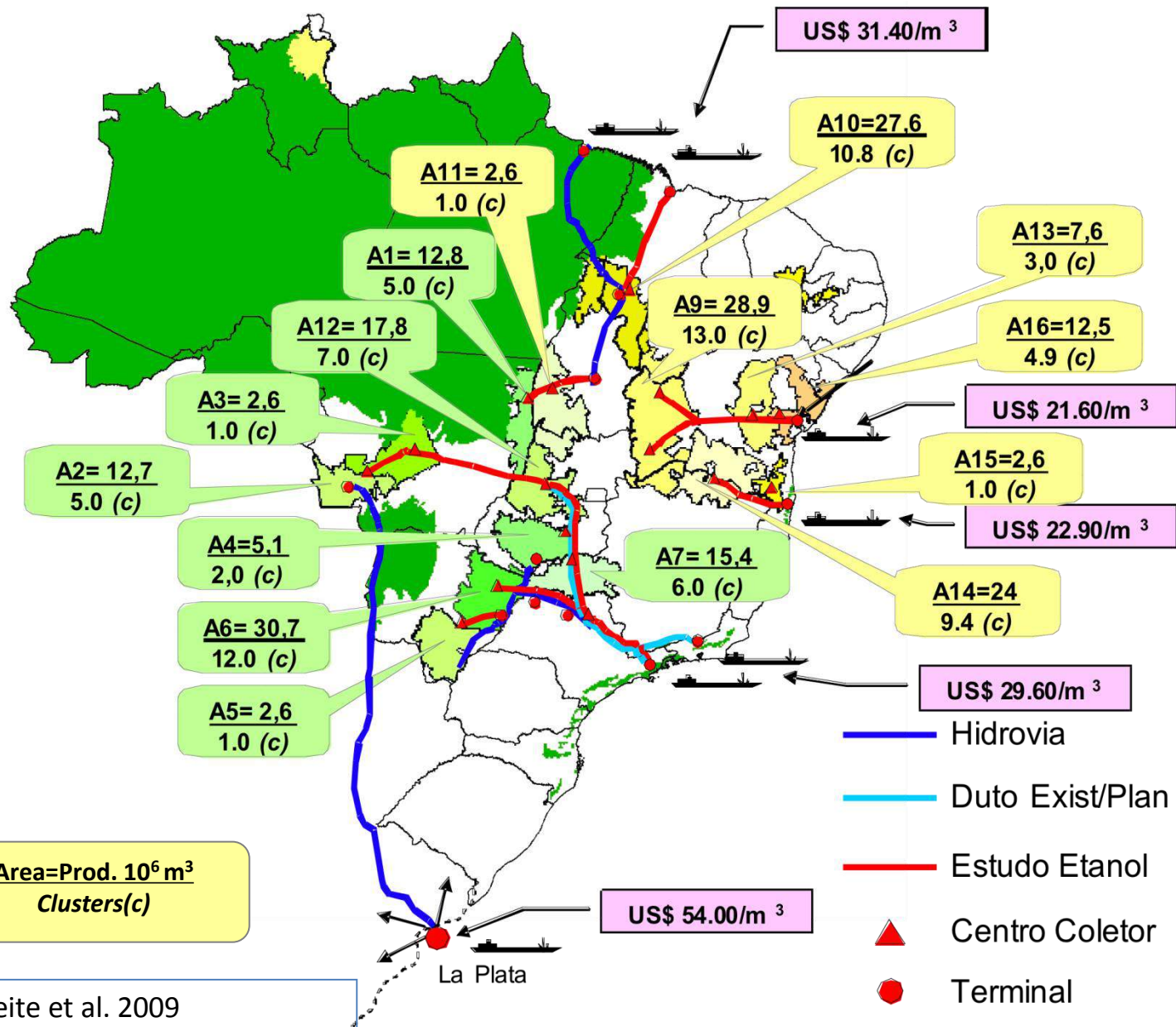


- Amazon Basin  
Pantanal  
Atlantic Forest
- Preservation Areas
- Areas with slope  
above 12%

With survival  
irrigation



# Ethanol Exports by 2025: 205.5 million of m<sup>3</sup>

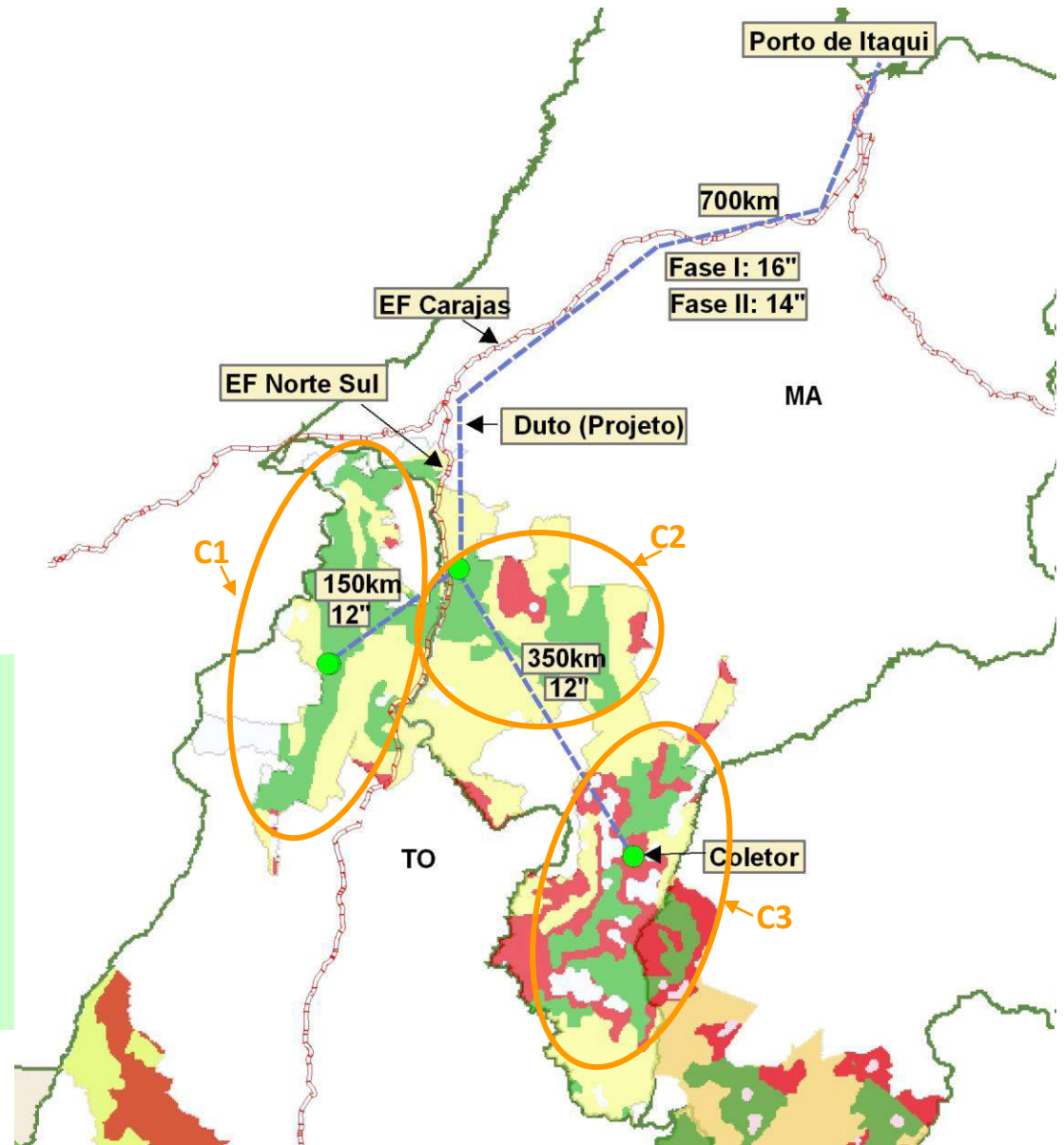


Source: Leite et al. 2009

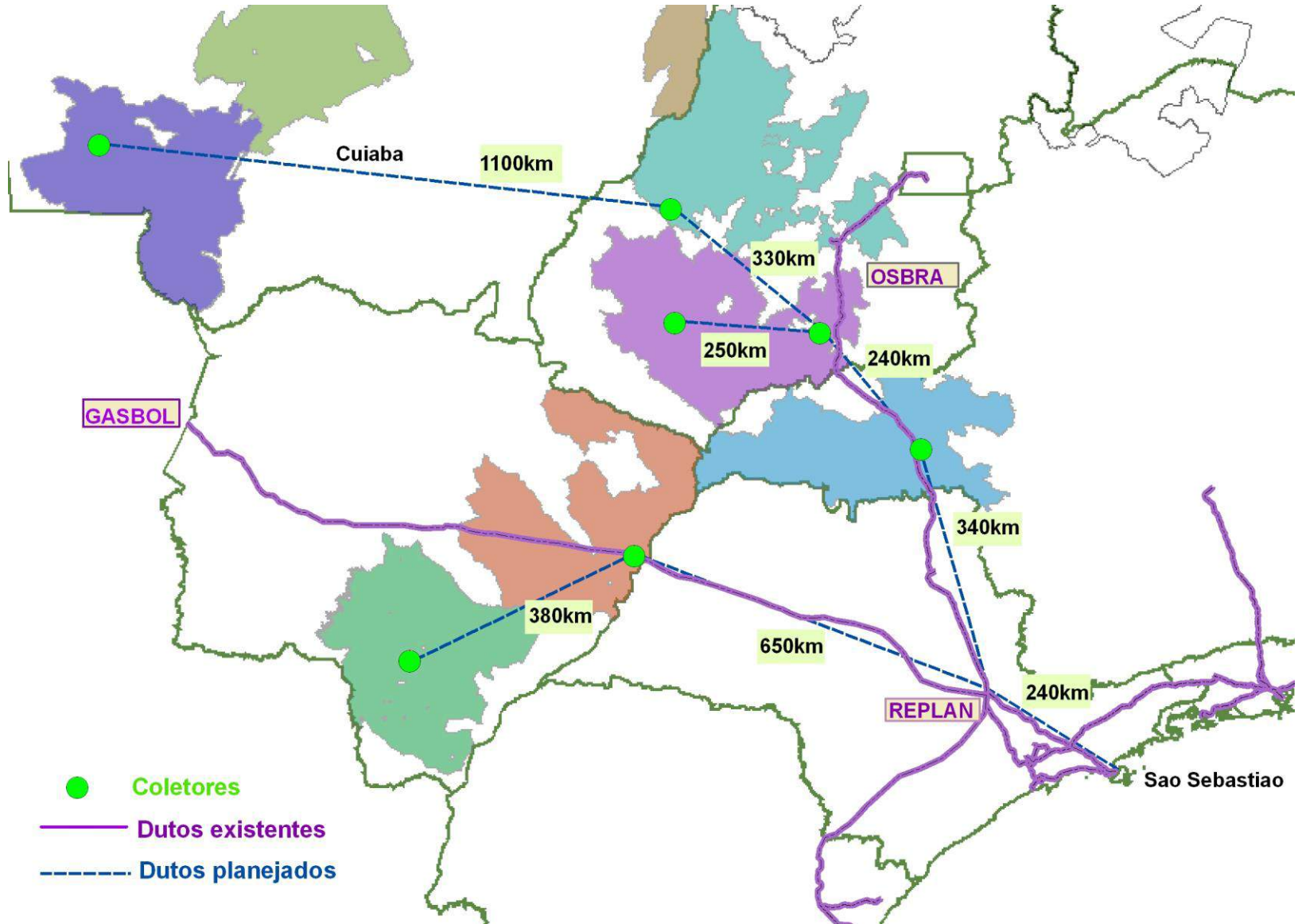


**Estudo preliminar:  
Logística para  
Escoamento de Álcool  
Área 10**

- ✓ 11 bilhões de litros
- ✓ 2,3 milhões de ha
- ✓ 3 clusters (C1;C2;C3)
- ✓ Total: 64 usinas
- ✓ 1.900 km de dutos



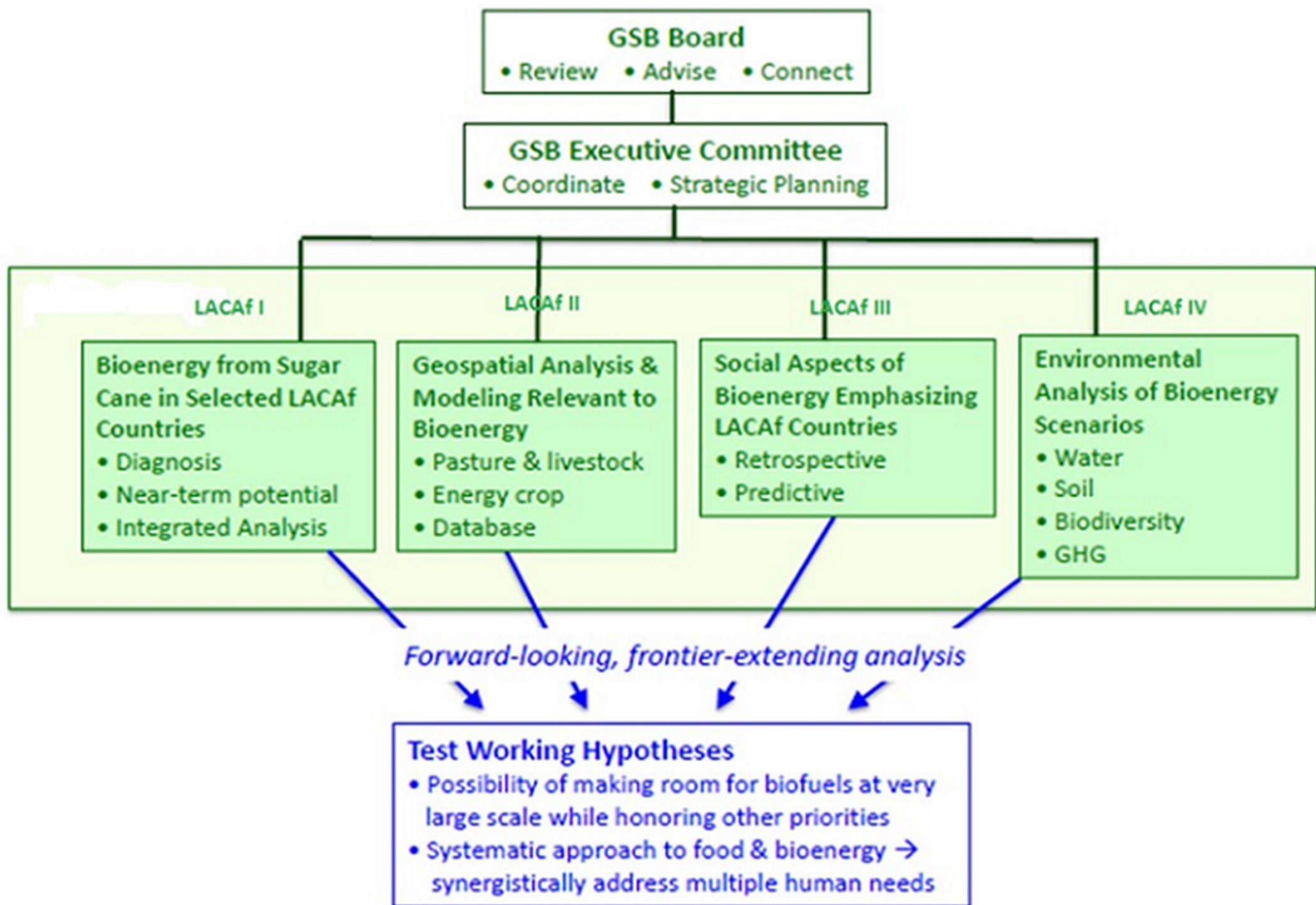
# Preliminary ethanol pipelines in South-Central Brazil



***The FAPESP/GSB Project: ESTIMATING THE LATIN  
AMERICA AND AFRICAN BIOENERGY  
POTENTIAL (LACAf Project)***

# LACAf-I FAPESP Project: milestones

Diagnosis (Horta)	Methodology Indicators dignosis	Database Food & energy security	Integrated analysis		Full analysis	Papers
Survey CTC (Beauclair)	Evaluations of areas and obtain data Basic maps	Field trips	Creation of production near-term potential maps	Final Report		
Survey Agrolcone (Beauclair)	Methodology	Land Use Basic Maps	Land Use Maps			
Determining Land Use and Physical Near- Term Potential (Beauclair)	Identify the potential area to plant sugarcane based on climate and soil conditions	To establish the constrains - preservation areas	To development yield model to estimate the potential biomass production			Papers
Productive Model (Regis)	ossible models will be visualized based on variations of the preliminarily assumed as the optimum model	Information on agricultural production model, field trips, visits and discussions with the government, private sector, agricultural workers and NGO's.	Analysis of the alternatives and suggestion of the models to be presented to the stakeholders in each country	Final analysis and recommendations based of the results of the workshops	papers	
Meeting November 14-16th 2013 Atibaia, SP, Brazil		Meeting March/April 2014 Durban and Mozambique	Meeting August 26-29 <sup>th</sup> 2014 Piracicaba		Meeting 1st semester 2015 Colombia and Guatemala	



# Considerations of the LACAf Project

- There are excellent opportunities for bioenergy in Latin America and Africa
- Available land around 250 Mha for bioenergy production
- LA created a large and successful experiment on planting biofuels in Brazil (bioethanol) and Argentina and Colombia (biodiesel)
- Need to understand specific situation for selected countries: contribution to GSB project, verifying its potential and constraints

<http://bioenfapesp.org/gsb/lacaf/>

# Conclusions

- LACAf countries can look at Brazil as an example. Biofuels can reconcile energy, food, and biodiversity
- Brazil has enough land to expand significantly its ethanol production, also for exports, without endangering food and biodiversity security
- Brazil needs to follow another model
- We need to create innovative high competitive ways to use land

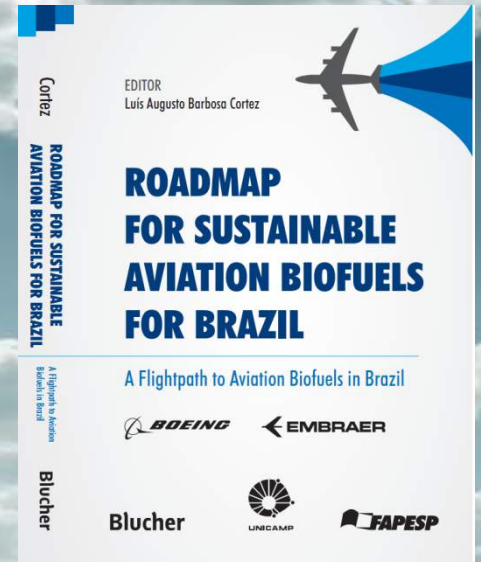


# ROADMAP FOR SUSTAINABLE AVIATION BIOFUELS FOR BRAZIL



**FLIGHTPATH TO AVIATION BIOFUELS IN BRAZIL**

**BBEST, Campos do Jordão, Brazil, October 21<sup>st</sup>, 2014**







# FLIGHTPATH TO AVIATION BIOFUELS IN BRAZIL: ACTION PLAN

## *Sustainable Aviation Biofuels for Brazil*

<http://www.fapesp.br/publicacoes/flightpath-to-aviation-biofuels-in-brazil-action-plan.pdf>

São Paulo, Brazil July 10<sup>th</sup> 2013





## CANA

DIRETRIZES DE POLÍTICAS PÚBLICAS  
PARA A AGROINDÚSTRIA CANAVIEIRA  
DO ESTADO DE SÃO PAULO



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### > Novidades e eventos

**26/09/2007**  
CONFERÊNCIA NACIONAL DE BIOENERGIA - USP - UNIVERSIDADE DE SÃO PAULO OBJETIVOS DA BIOCONFERÊNCIA ...  
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**25/09/2007**  
SIMPÓSIO DE AGROENERGIA E BIOCOMBUSTÍVEL: "Oportunidades para Um Novo Modelo Energético" Período: ...  
[> saiba mais](#)

**20/09/2007**  
XX SEMANA DA AGRONOMIA - CANA-DE-AÇÚCAR O Centro Acadêmico da Agronomia e a UNESP Iha Solteira p...  
[> saiba mais](#)



### Bem vindo ao nosso Web Site

Este projeto tem por objetivo propor diretrizes, estratégias e políticas para o desenvolvimento do setor sucroalcooleiro no Estado de São Paulo. Para tal está sendo realizado um projeto de pesquisa integrado, a partir da cooperação de uma equipe interdisciplinar de pesquisadores com vasta experiência acadêmica e profissionais do setor.

[> saiba mais](#)

### > Workshops

- [VII Workshop - Pragas da Cana-de-Açúcar](#)
- [VI Workshop - Produção Vegetal e Modelagem Agrícola](#)
- [V Workshop - Melhoramento Genético e Biotecnologia](#)

### > Parceiros

Apoio Financeiro



Parceiros



### > Newsletter

### OUTROS ARQUIVOS

- Cronograma 2007 
- Metodologia Workshop 
- Projeto PPP 



# Sugarcane Bioethanol: R&D for Productivity and Sustainability

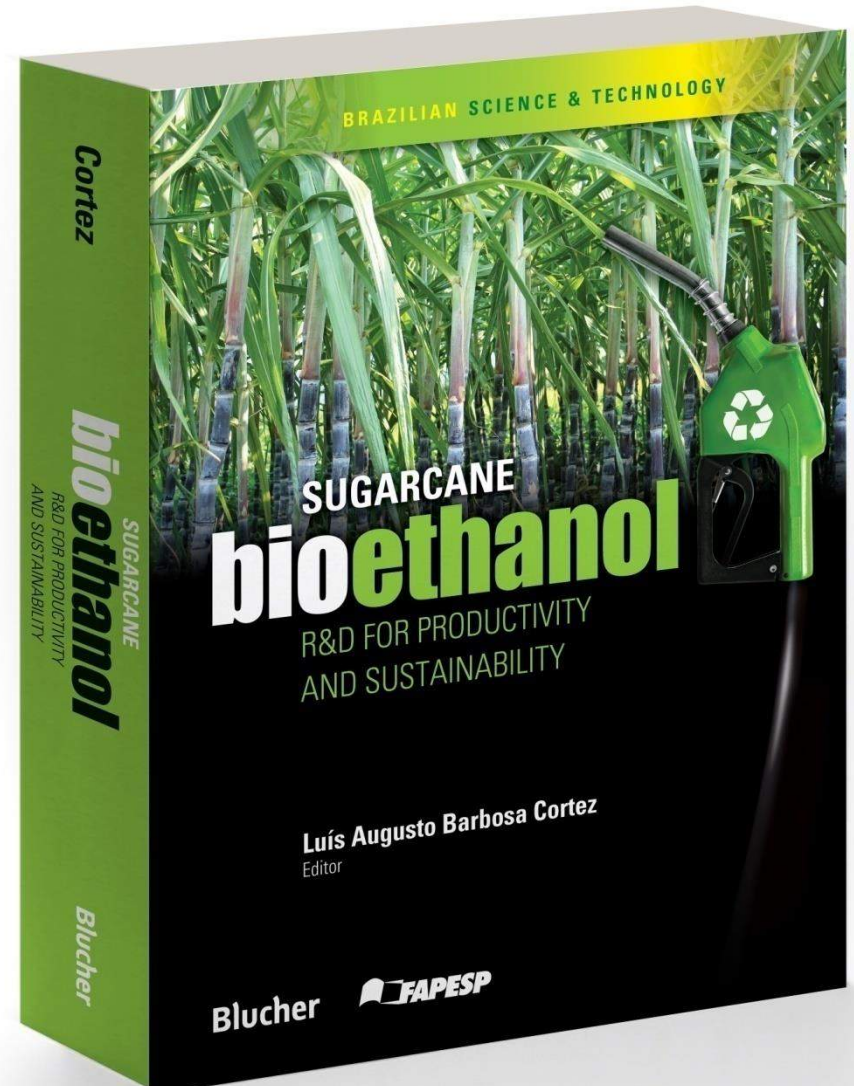
- Launched Sept 2010
- 992 pages
- 76 chapters
- 139 authors
- Publisher: **Blucher**
- Ethanol PP Project:



*Sales by Amazon*

open access:

<http://blucheropenaccess.com.br/issues/details/1>





**SBE**

The Bioenergy Society

# The Bioenergy Society

Launching Ceremony  
Campos do Jordão, Brazil  
October 21<sup>st</sup>, 2014

<http://bioenfapesp.org/sbe>

