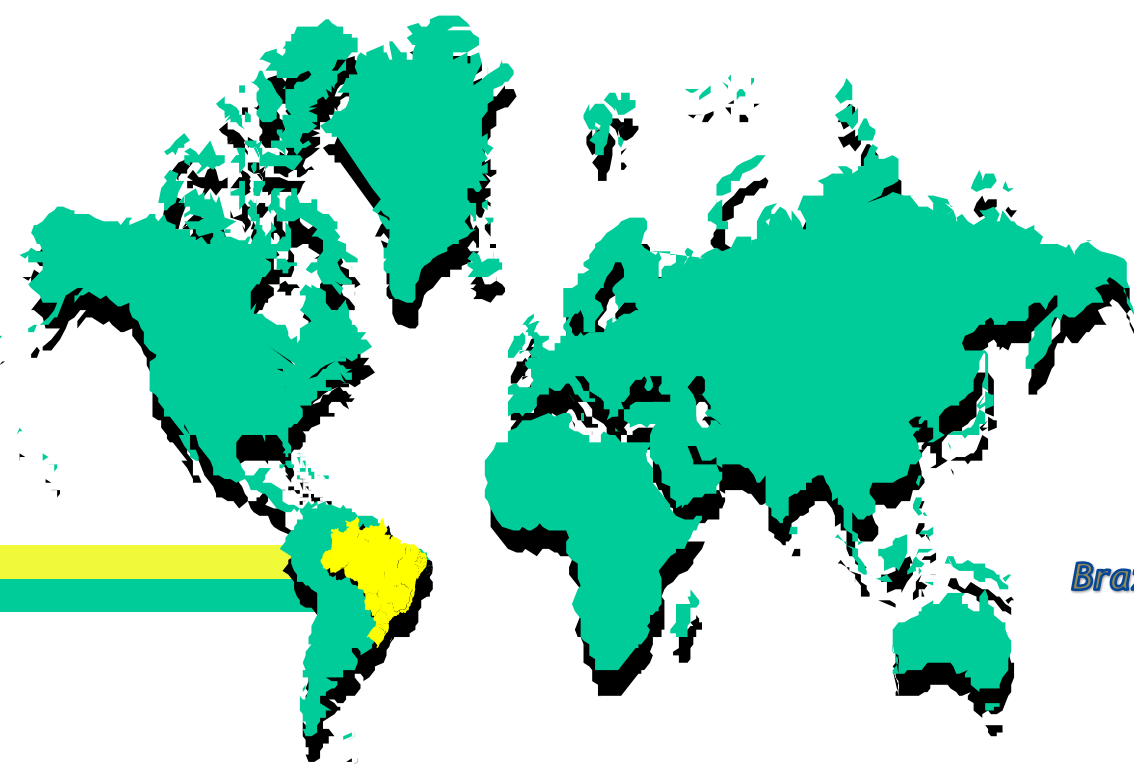


THE STATUS OF BIOENERGY IN BRASIL



Bioenergy Korea Conference (BEKOC
2012)

Gwangju, Republic of Korea

April 24 to 25th, 2012

Gilberto Silber Schmidt
Brazilian Agricultural Research Corporation
Embrapa Labex Korea



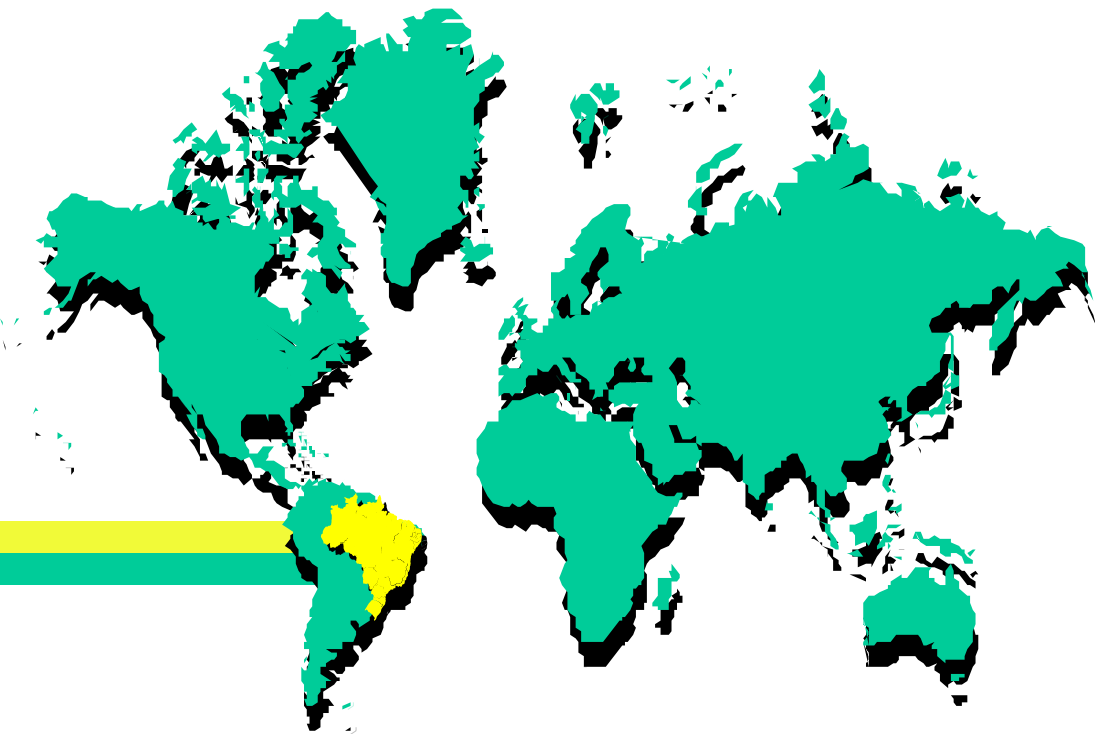
Labex Korea



Ministério da Agricultura,
Pecuária e Abastecimento



THE STATUS OF BIOENERGY IN BRASIL



- » Introduction
- » Brazilian Policies in Bioenergy
- » Bioenergy Technology Development in Brazil
- » Embrapa's Research and Development

There is a Brazil that most people know



Amazon forest



Carnival



Soccer



Rio de Janeiro

It keeps being successful,
but there is still more
to know

There is a Brazil that you must know

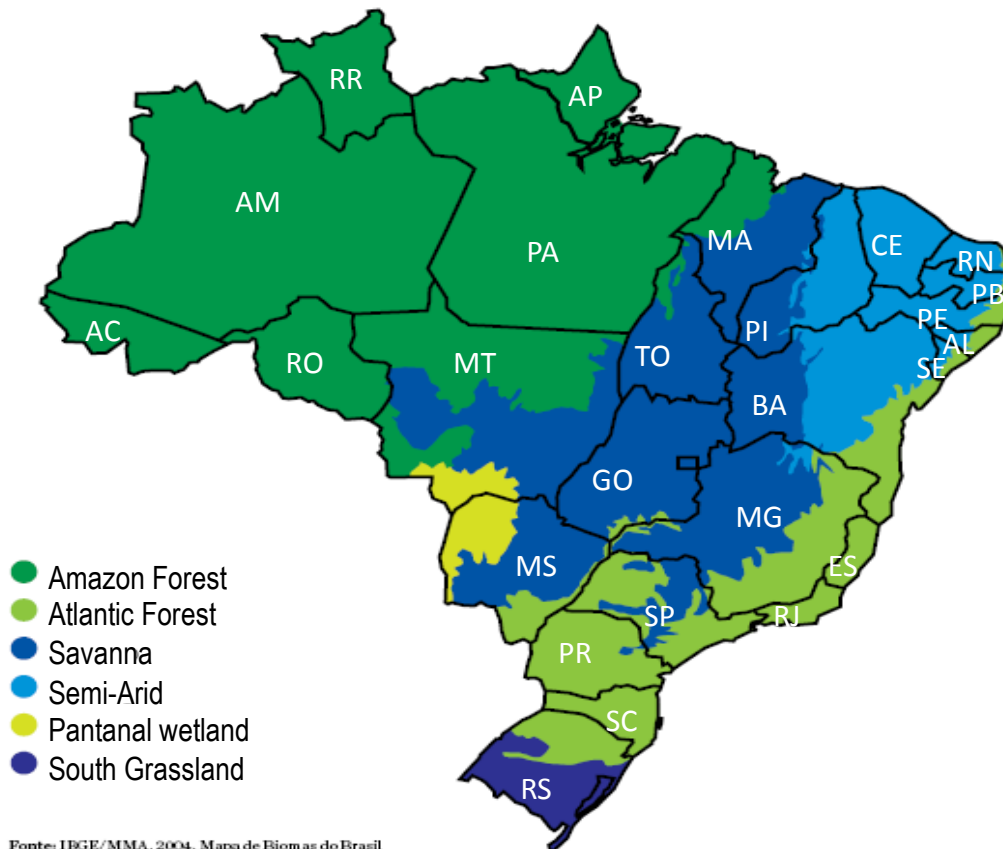


**Technology, Innovation,
Competitiveness**

**A strong academic base
10 thousand doctors trained every year
16 thousand scientific papers
Rank 13th in scientific publications
A growing intensity of industry R&D**

“Brazil: the natural knowledge economy”

Brazilian Biomes: a rich natural resource base



Fonte: IBGE/MMA, 2004. Mapa de Biomas do Brasil

- **Most of the Brazilian Territory is Located in the Tropical Belt.**
- **Total area: 850 million ha, most of it dedicated to conservation;**
- **388 million ha of highly productive arable land;**
- **90 million of which have yet to be farmed;**

Agribusiness in Brazil is driven by innovation

Commercial partners

Around 79% of the Brazilian food production is consumed domestically and 21% is shipped to over 212 foreign markets

Exports

In 2010 Brazil exported more than 1500 types of agricultural products to foreign markets

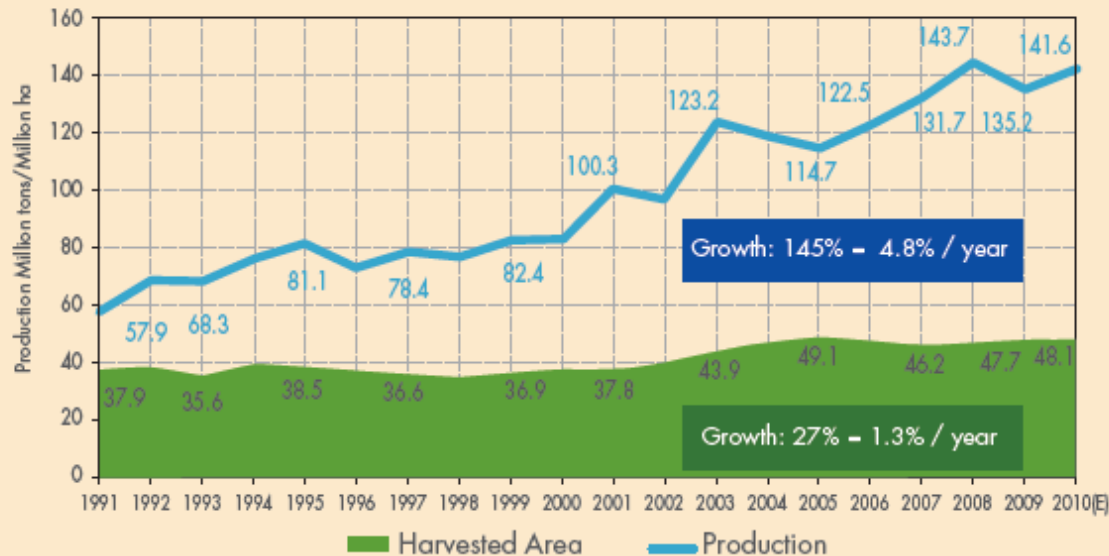
Product	Production	Exports
Sugar	1 st	1 st
Orange juice	1 st	1 st
Coffee	1 st	1 st
Beef	2 nd	1 st
Soybean	2 nd	1 st
Tobacco	3 rd	1 st
Broiler	3 rd	1 st
Corn	3 rd	4 th

Source: SPA/MAPA (Agricultura Brasileira em Números)



Evolution of Agricultural Systems in Brazil

Grain Production and Cultivated Area



Source: National Company of Food Supply

➤ Increase in grain production over the last 20 years has been a result of increased productivity;

➤ Grain volume has increased by 250% in the period, while the harvested area has grown less than 30%;

➤ Without advances in crop productivity and increased agricultural system's efficiency, additional 58 million ha would have been necessary to reach today's production.



Brazilian Policies in Bioenergy

Brazilian Policies in Bioenergy

Objectives

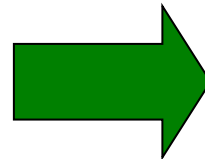
1. Secure to Brazil the international leadership in this new economic sector: BIOENERGY.

2. To structure the production chains of Bioenergy

- Security of long term energy supply
- Cheaper prices for energy sources
- Keeping the local energy competitiveness
- Dealing with climate change and environment

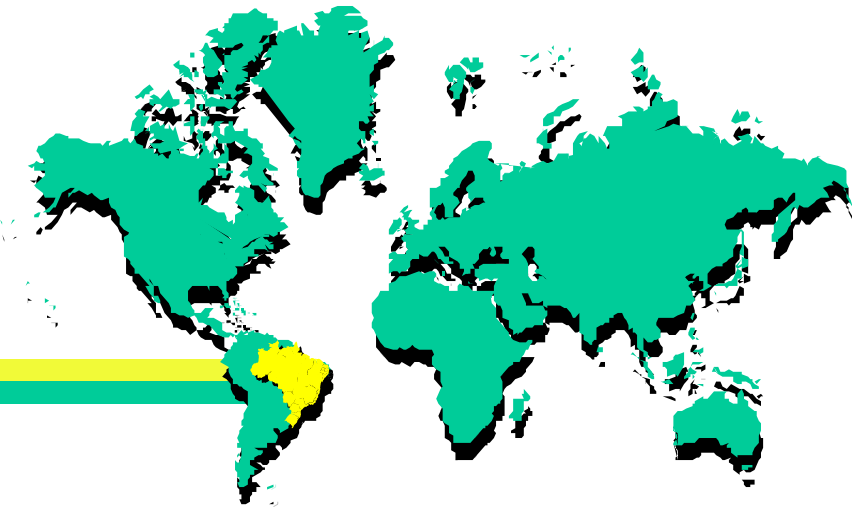
Challenges of Brazilian Energy Policy

(Law No. 9.478/97)



BIOFUELS

Why Biofuels ?



Environmental gains

- Carbon sequestration
- Lower level of emissions



Social aspects

- Generation of new jobs
- Better income distribution

Economical aspects

- A new global energy demand
- Strong impacts on commerce & trade

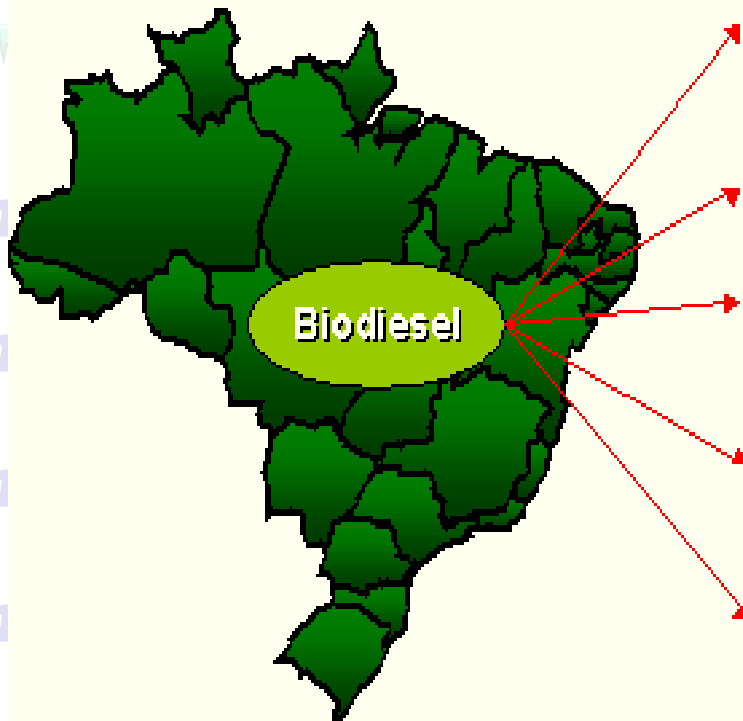
Sustainability - Renewable

- Short production cycle
- Whole process controlled by man



Biofuel Production Perspectives in Brazil

Brazil presents all the conditions for the development of a large and sustainable national program for biofuel production



High diversity of raw materials (plant species) - regionalization

Ample potential for agricultural expansion

Capable human resources to carry out a national biofuel program

Major vegetable oil and alcohol industries already installed

Knowledge, previous experience and world leadership in biofuels - Proalcohol



Bioenergy Technology Development in Brazil



Ministério da Agricultura,
Pecuária e Abastecimento



The 10 biggest global challenges (Next 50 years)

➤ *Water*



➤ *Energy*



➤ *Food*



➤ *Environment*



➤ *Poverty*



➤ *Education*



➤ *Democracy*



➤ *Population*



➤ *Diseases*

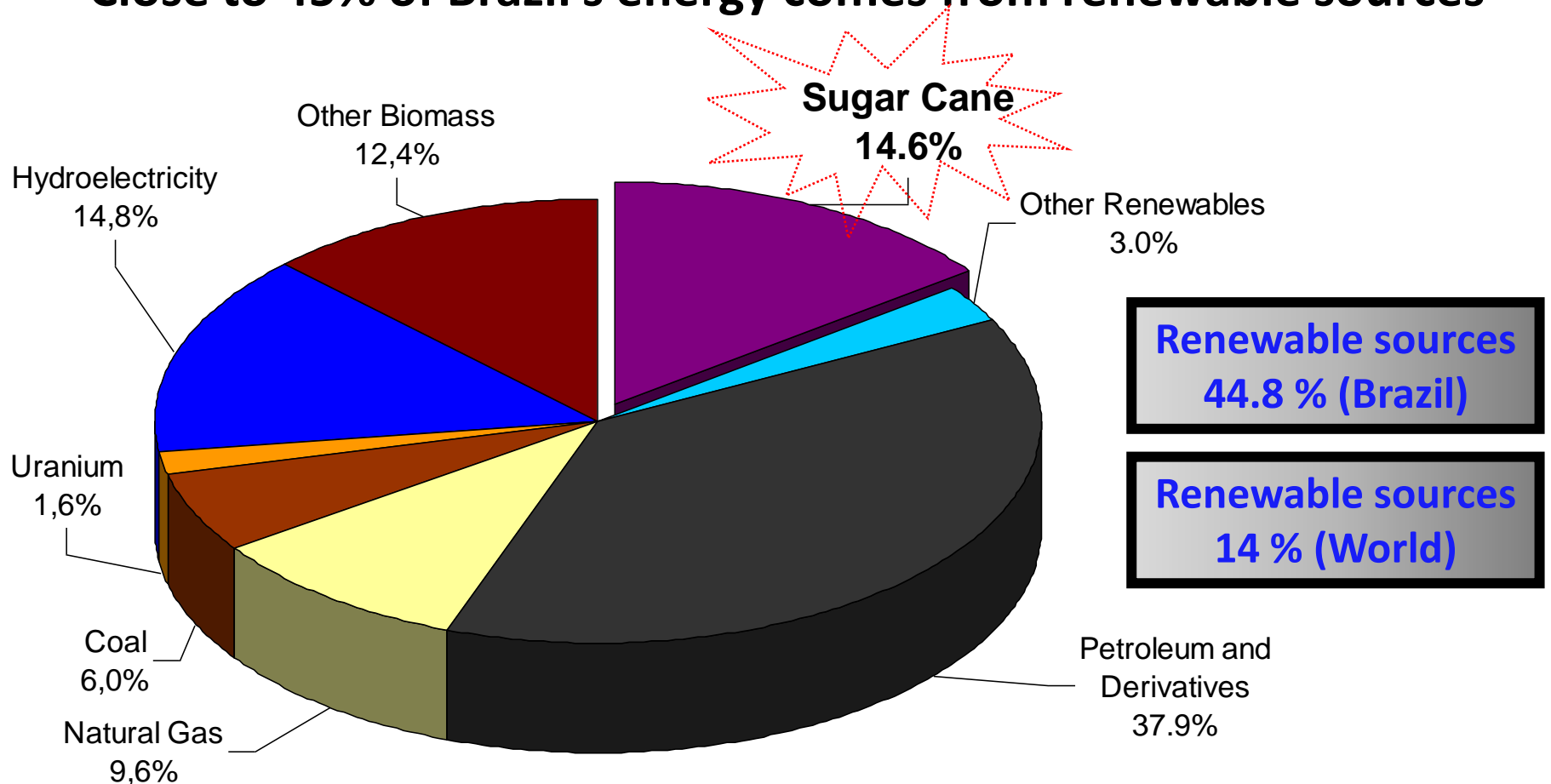


➤ *Terrorism & Wars*

m.pablo

Renewable Energy in Brazil

Close to 45% of Brazil's energy comes from renewable sources



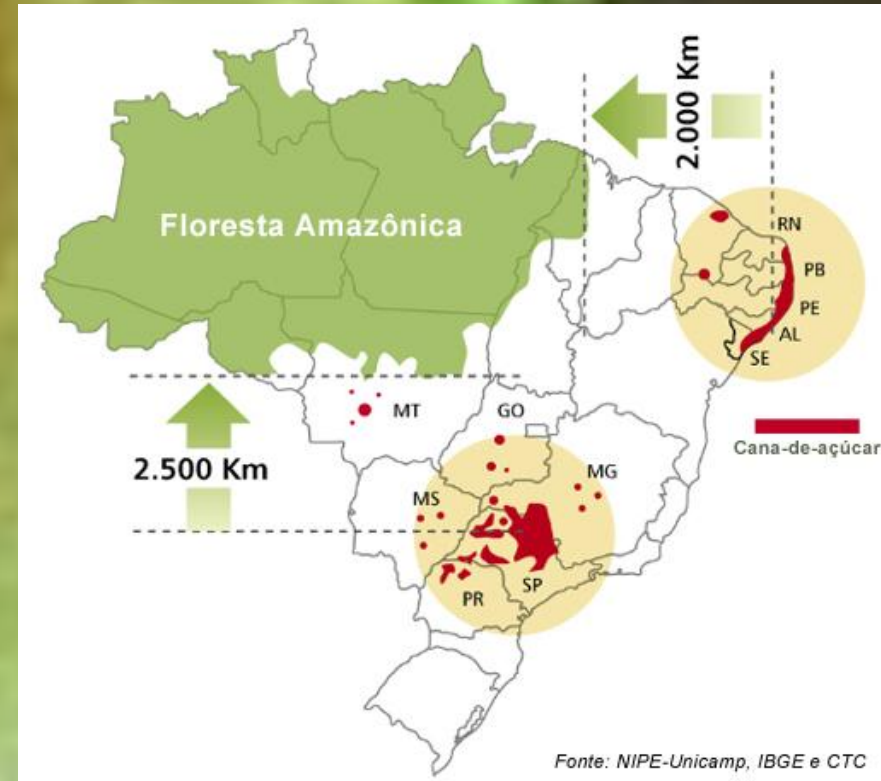
AGROENERGY - ETHANOL

Before (2008/2009):

Sugarcane: 622 million ton
Planted area: 7.8 million ha
Sugar: 31.6 million ton
Ethanol: 26.7 billion liters
“Sugarcane brandy”: 1.5 billion liters
Employees – direct: 1.0 million
 indirect: 2.6 million

Estimate (2012):

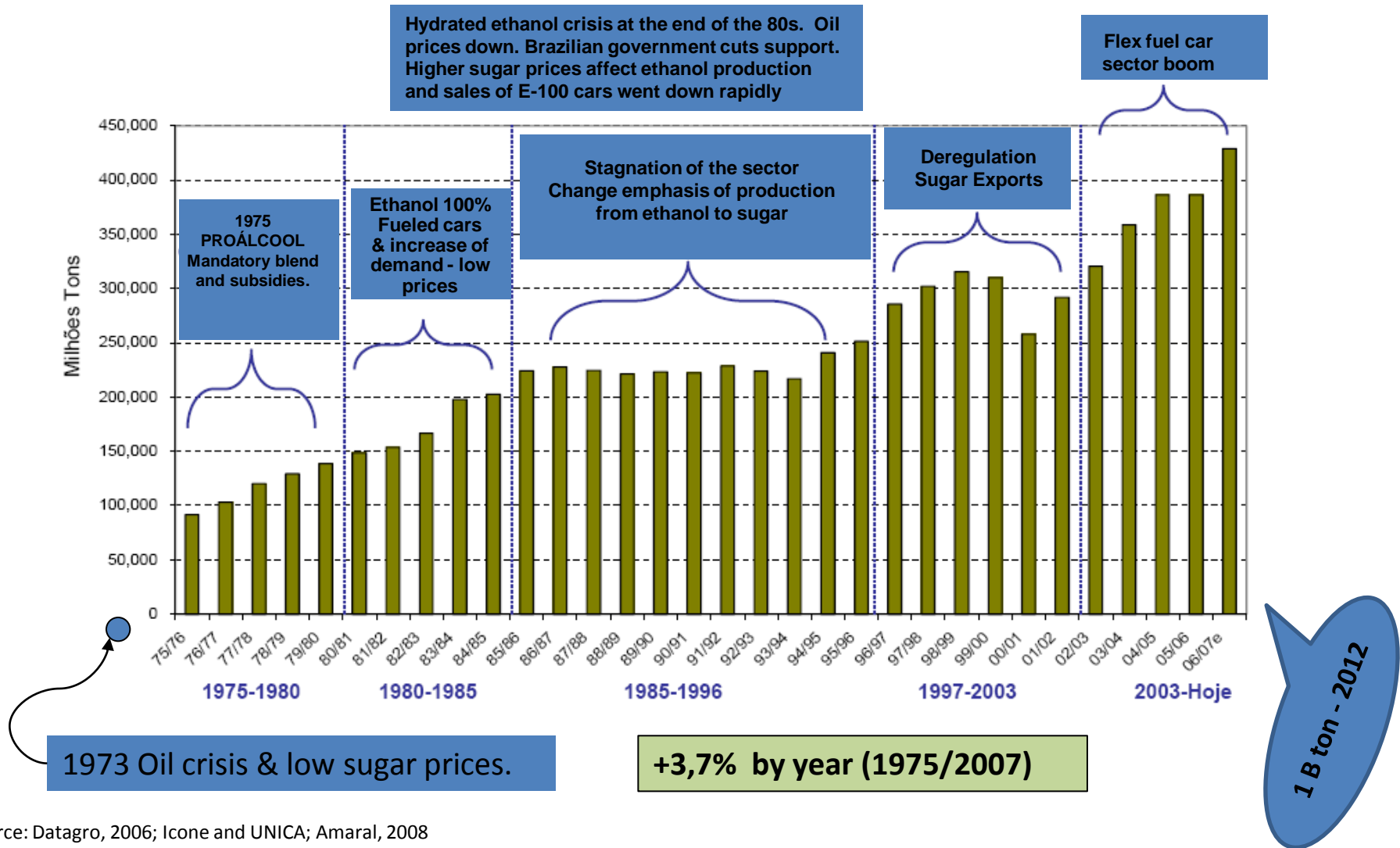
Sugarcane: 1 billion ton
Planted area: 10-12 million ha
Ethanol: 48 billion liters



Area harvested: 41% and Ethanol: 80%

The Evolution of the Brazilian Ethanol Industry

Processed sugarcane since the 1970's - M tons



Diversity of raw materials for bioethanol production

Sucrose



Sugar cane

Sorghum

Starch



Corn

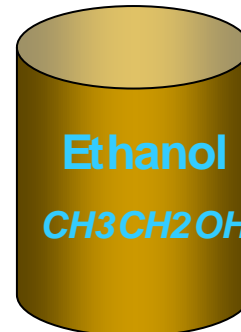
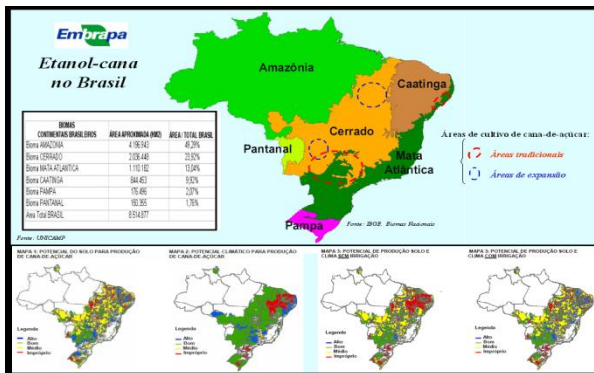
Manioc

Sweet Potatoes

Potatoes

Fermentation Process

1st Generation



Chemical / Enzymatic Hydrolysis

Lignocellulosic Materials

2nd Generation

Renewable Energy in Brazil

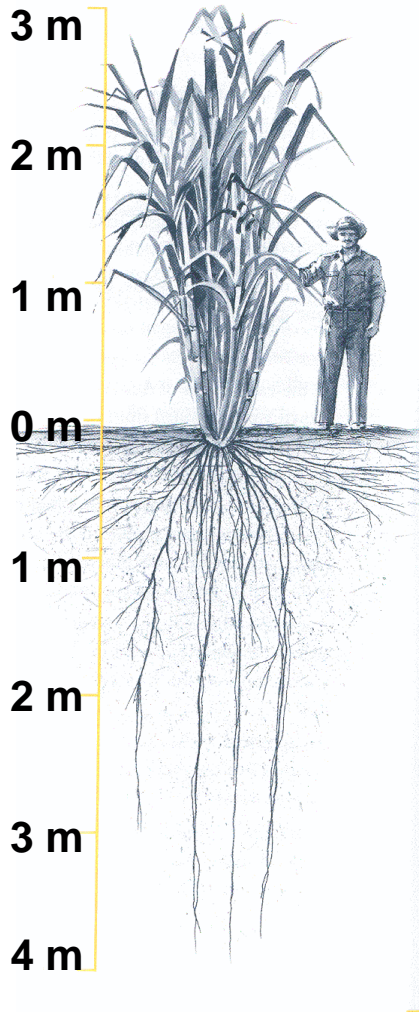
A few recurrent questions...

- **Is ethanol production from sugarcane sustainable?**
- Which other sources can complement ethanol?
- What are the challenges and opportunities for the future?



Sustainability of Sugarcane Ethanol

Sugarcane is one of the most sustainable energy factories in the world



Productivity

Favorable energy balance

Significant carbon emission reduction

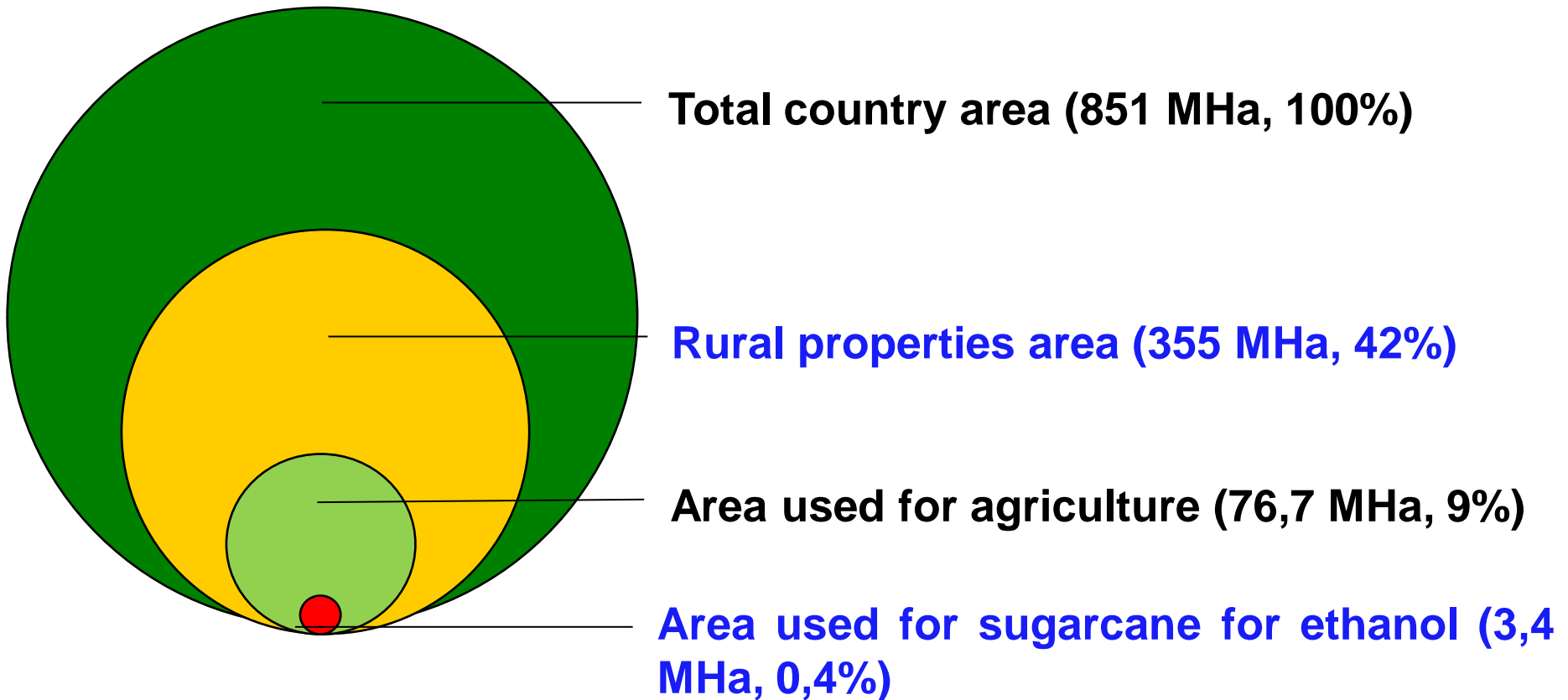
Competitive fuel for consumers

Clear contribution to energy security



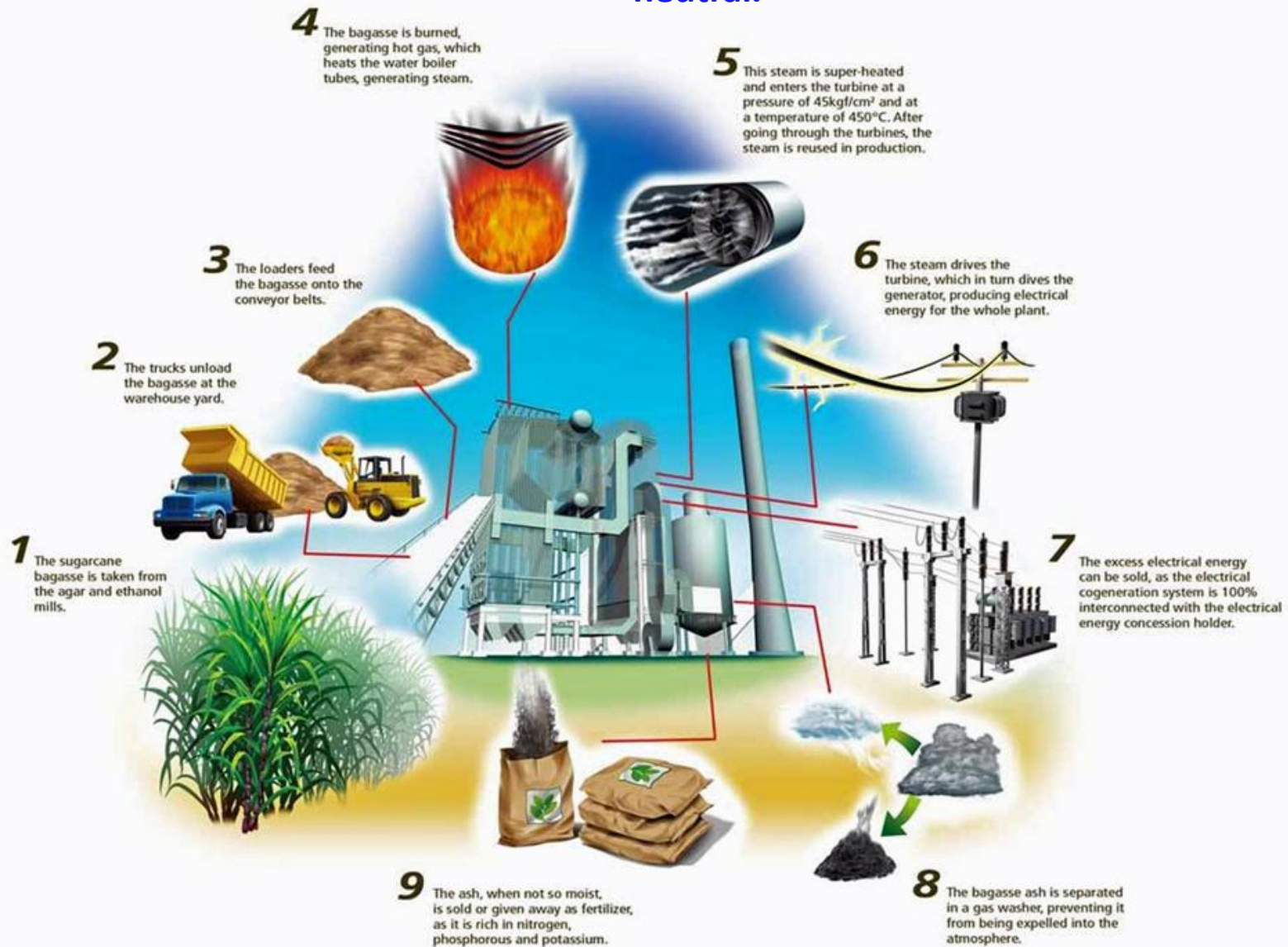
Sustainability of Sugarcane Production in Brazil

Sugarcane for ethanol uses less than 1,0% of the total area in Brazil



Energy efficiency of Sugarcane

Innovative cogeneration plants generate energy from sugar cane waste - completely carbon-neutral.

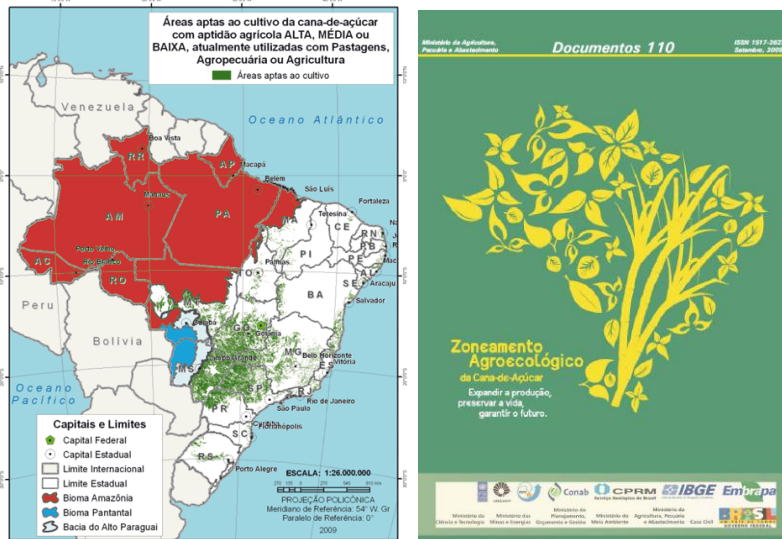


Brazil is Managing Sugarcane Expansion



Brazil increases environmental preservation measures with sugarcane zoning proposal

Coupled with the areas not suitable for sugarcane farming, the zoning will effectively make 92.5% of Brazil's national territory off-limits for sugarcane farming and processing.



New bill based on a zoning plan developed by Embrapa establishes that areas for cultivation of sugarcane may reach a maximum of 64 million hectares.

Renewable Energy in Brazil

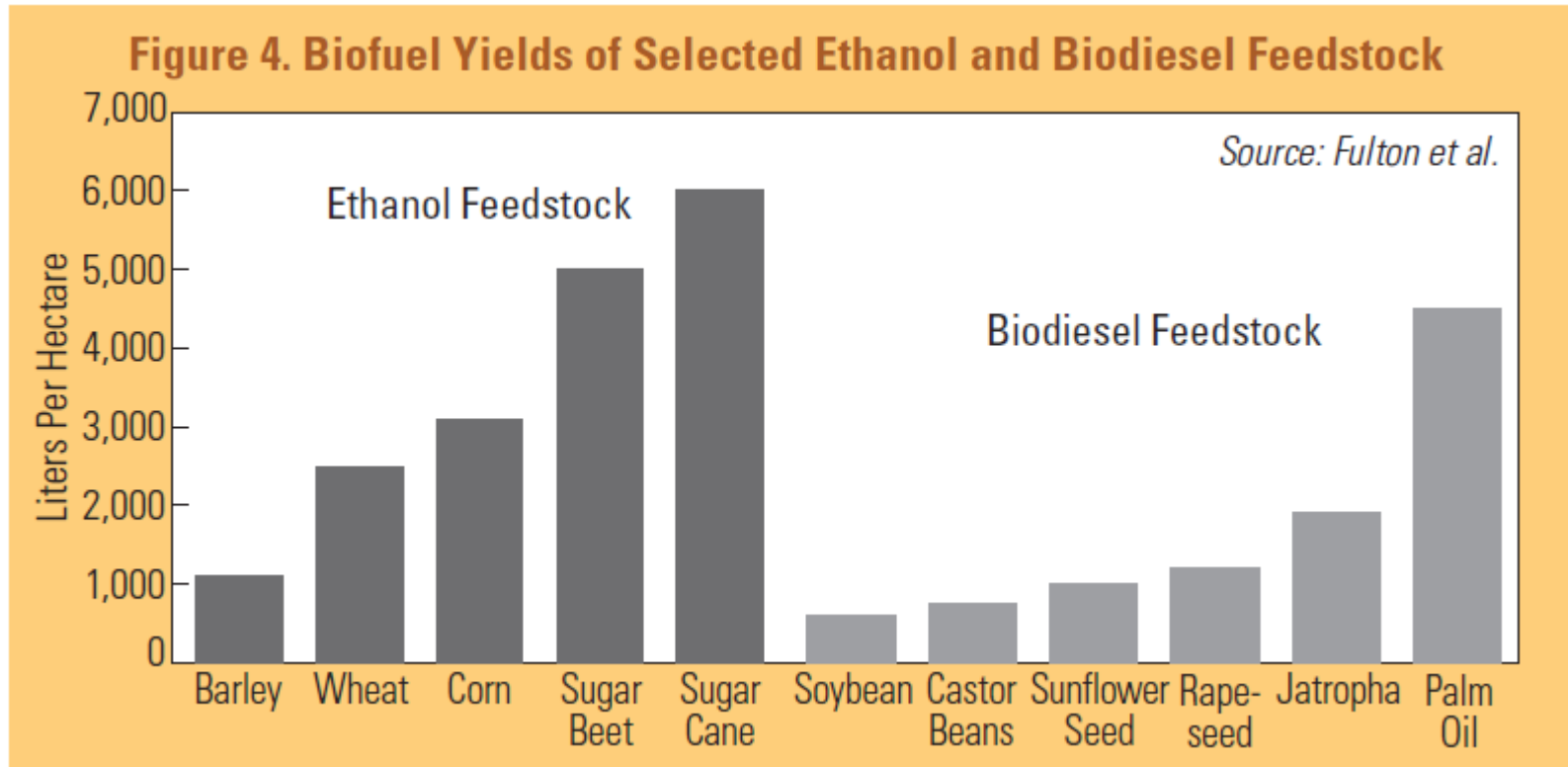


A few recurrent questions...

- Is ethanol production from sugarcane sustainable?
- **Which other sources can complement ethanol?**
- What are the challenges and opportunities for the future?

Other Alternative Biofuels in Brazil

- Biodiesel -



Brazil has around 100 potential oil plants in the Cerrado and Amazonia Biomes that can be developed as oil crops for biodiesel production

Other Alternative Biofuels in Brazil - Biodiesel -



Jatropha

Castor

Sunflower

Soybeans

Oil Palm

Cotton

Average Agricultural Productivity (kg/ha)

5.000*

1.500

1.500

3.000

20.000

3.000

Oil Content (%)

25

47

42

18

20

15

Productivity of Vegetable Oil (kg/ha)

1250

705

630

540

4.000

450

Source: Biofuels for Transportation - Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century
World Watch 2006, http://www.worldwatch.org/system/files/EBF008_1.pdf



Biodiesel Programs in Brazil

Species under investigation for biodiesel production in Brazil

<i>Acrocomia aculeata</i> (macauba palm)	<i>Licania rigida</i> (oiticica)
<i>Astrocaryum murumuru</i> (murumuru)	<i>Mauritia flexuosa</i> (buriti palm)
<i>Astrocaryum vulgare</i> (tucumã)	<i>Maximiliana maripa</i> (inaja palm)
<i>Attalea geraensis</i> (indaiá-rateiro)	<i>Oenocarpus bacaba</i> (bacaba-do-azeite)
<i>Attalea humillis</i> (pindoba)	<i>Oenocarpus bataua</i> (patauá)
<i>Attalea oleifera</i> (andaiá)	<i>Oenocarpus distichus</i> (bacaba-de-leque)
<i>Attalea phalerata</i> (uricuri)	<i>Paraqueiba paraensis</i> (mari)
<i>Caryocar brasiliense</i> (pequi)	<i>Sesamum indicum</i> (benneseed)
<i>Cucumis melo</i> (melon)	<i>Theobroma grandiflorum</i> (cupuassu)
<i>Jatropha curcas</i> (pinhão-manso)	<i>Trithrinax brasiliensis</i> (carandaí)
<i>Joannesia princeps</i> (cutieira)	<i>Zea mays</i> (corn)

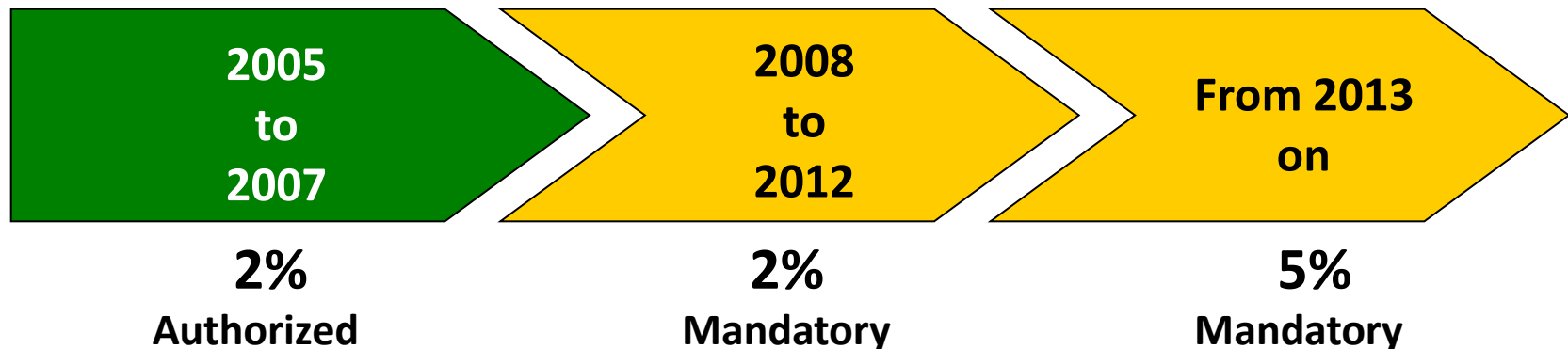
Biodiesel Programs in Brazil



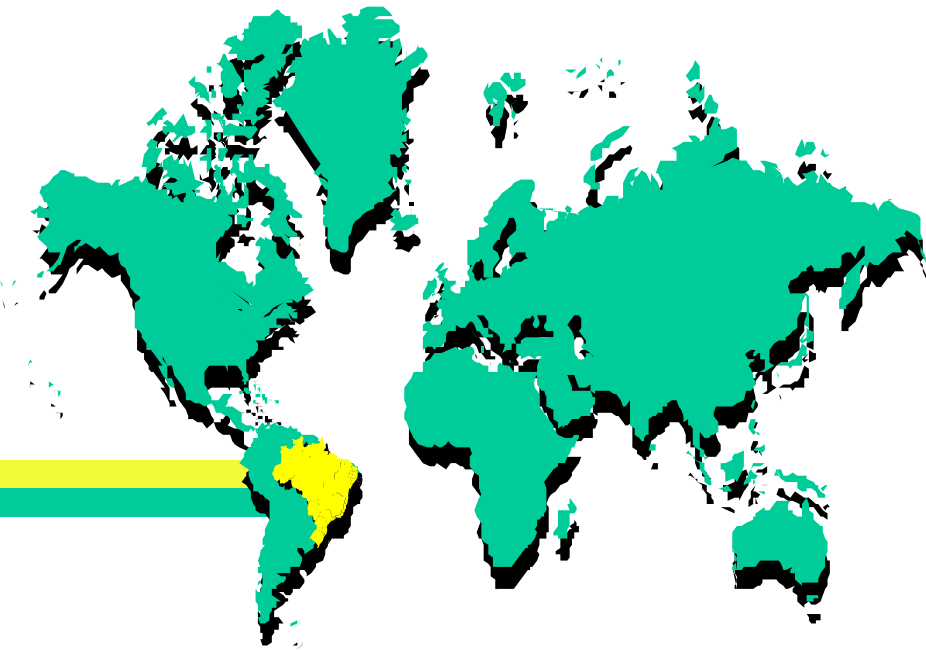
Public Policies to support development and use

- 2002** Ministry of Science and Technology initiated ProBiodiesel
- 2004** National Program of Biodiesel Production and Use (PNPB)
- 2005** First biodiesel processing plant was established in Minas Gerais State

➤ **Law 11.097/2005**: Establishes minimum percentages to mix biodiesel to diesel, defines criteria to monitor the introduction of this new fuel into the market.



Renewable Energy in Brazil



A few recurrent questions...

- Is ethanol production from sugarcane sustainable?
- Which other sources can complement ethanol?
- **What are the challenges and opportunities for the future?**

Renewable Energy in Brazil



Challenges and opportunities

ETHANOL

- ✓ Improve Agricultural and industrial processes (burning, harvesting, waste...)
- ✓ Biotechnology to introduce new traits to sugarcane (resistance, drought, etc)
- ✓ Implement the agroecological zoning to open new areas in a sustainable way
- ✓ Develop technologies to promote symbiotic N fixation and alternative P
- ✓ New products and processes based on alcohol chemistry and improved use of sugarcane biomass

BIODIESEL

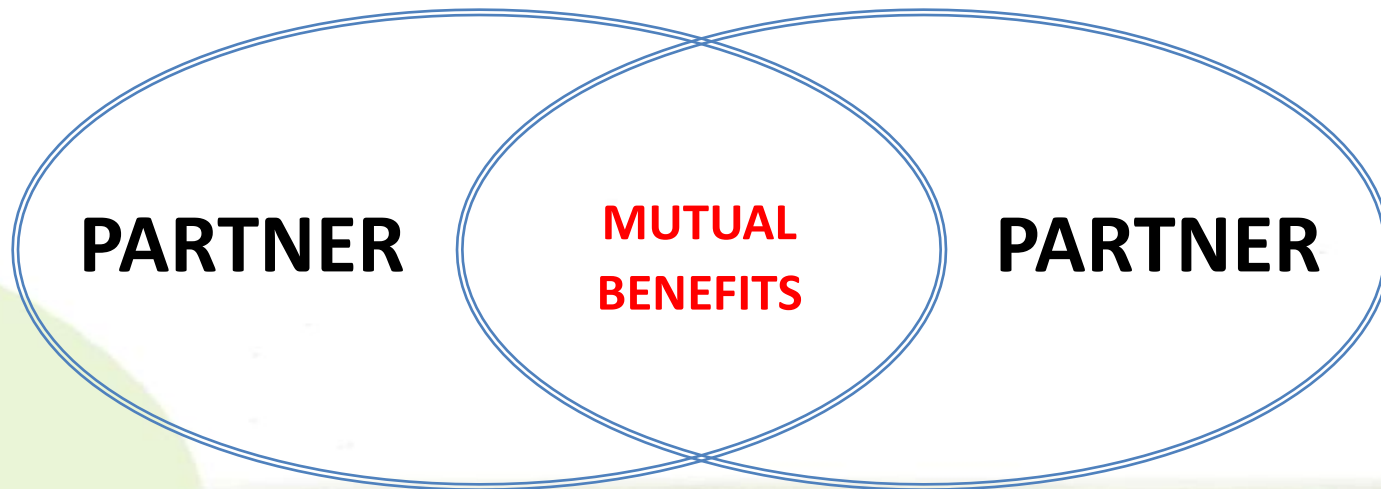
- ✓ Evaluation of additional oil plant species
- ✓ Development of new varieties
- ✓ Development of new cropping systems
- ✓ Agroecological zoning of conventional and potential species
- ✓ Harvesting and processing systems for improved oil extraction and coproducts use
- ✓ Biotechnology to introduce new traits and to speed up the breeding process



Renewable Energy in Brazil

International Cooperation is a Priority

Brazil counts on many other countries producing ethanol and biodiesel from various sources. Great interest in technology transfer and cooperative R&D





EMBRAPA's Research and Development

Research & Development Programs

Embrapa's Strategic Objectives



S01:
Competitiveness &
Sustainability of
Brazilian Agribusiness

S02:
Technological
competitiveness in
Agroenergy and
Biofuels

S03:
Sustainable Use of
Biomes and
Productive
Integration of
Brazilian Regions

S04:
Biodiversity
Prospecting for the
Development of
Differentiated and
Value-added
Products

S05:
Advances in the
Knowledge Frontier
and Emergent
Technologies

R&D - Agroenergy and Biofuels

Development of new technologies for energy production (ethanol from cellulose, products of bio-refinery, hydrogen)



Development of technologies for economical use of by-products and residues



Enzymatic pathway for ethanol from lignocellulosic materials

Enzymes, fungi, bacteria and catalysts with impact in energy production

R&D focusing the concept of bio-refinery

Economical use of meals, glycerin & by-products of biodiesel production

Economical use of by-products from the charcoal industry for the production of biofertilizers and biopesticides

Economical use of residues and by-products from the 1st and 2nd generation ethanol production processes

R&D - Agroenergy and Biofuels

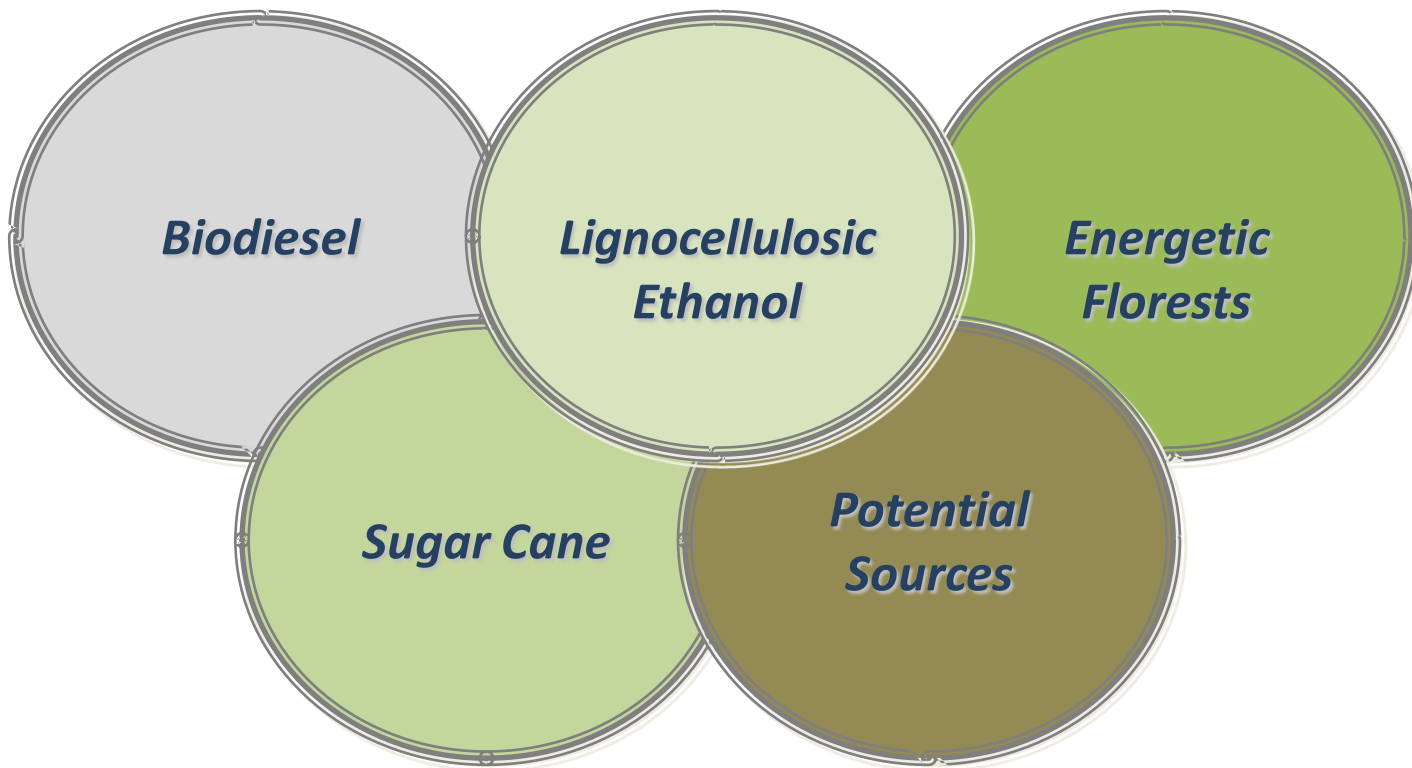
Longer-term objectives

Development of novel production systems and raw materials with superior characteristics for the production of energy.

Zoning and evaluation of environmental, economic and social impacts of agroenergy sources for the identification of areas for competitive and sustainable production.

Development of technologies and production systems aiming at using degraded areas for the production of Bioenergy.

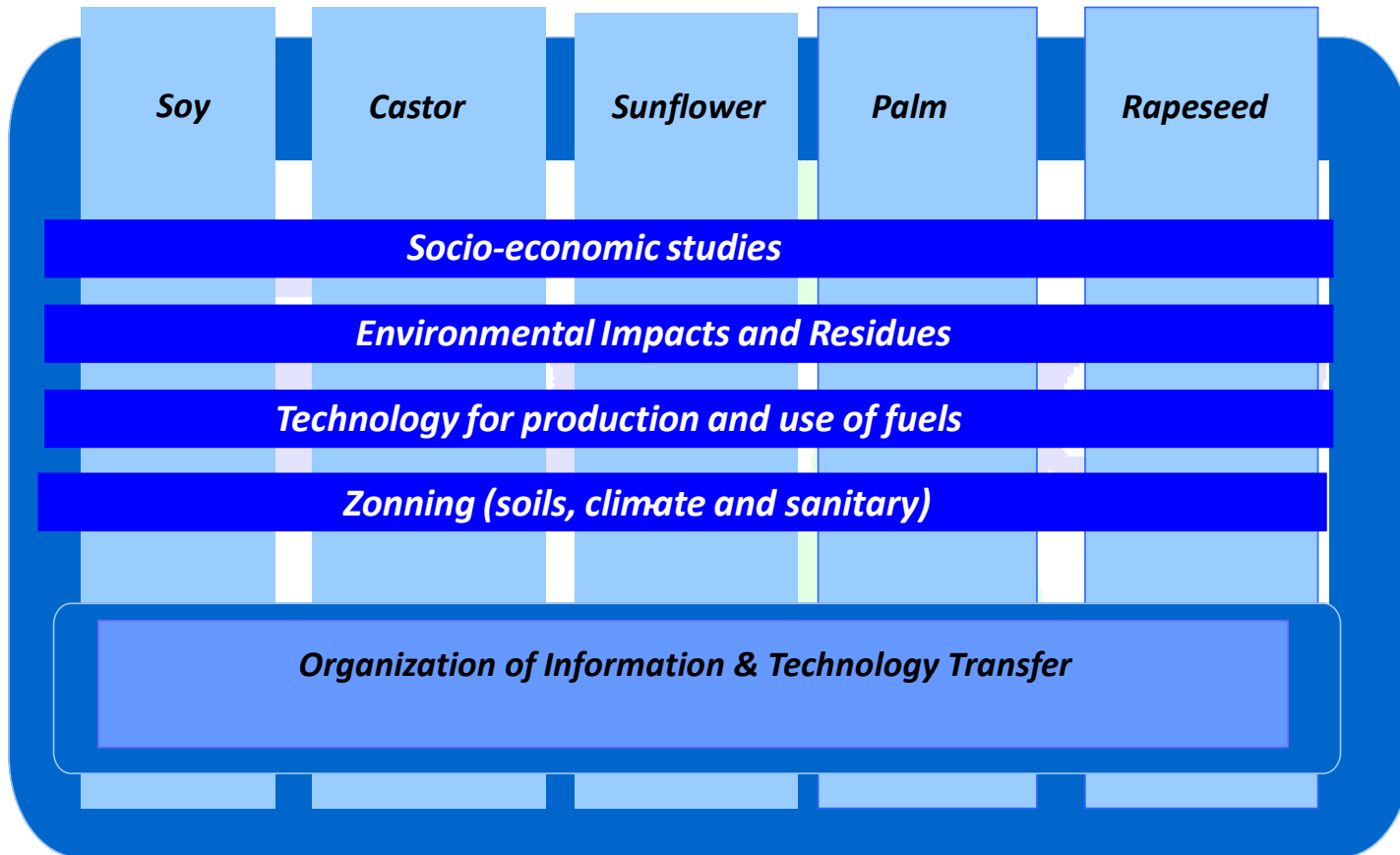
Embrapa's R&D Platforms in Agroenergy



R & D - Agroenergy and Biofuels

Biodiesel Platform

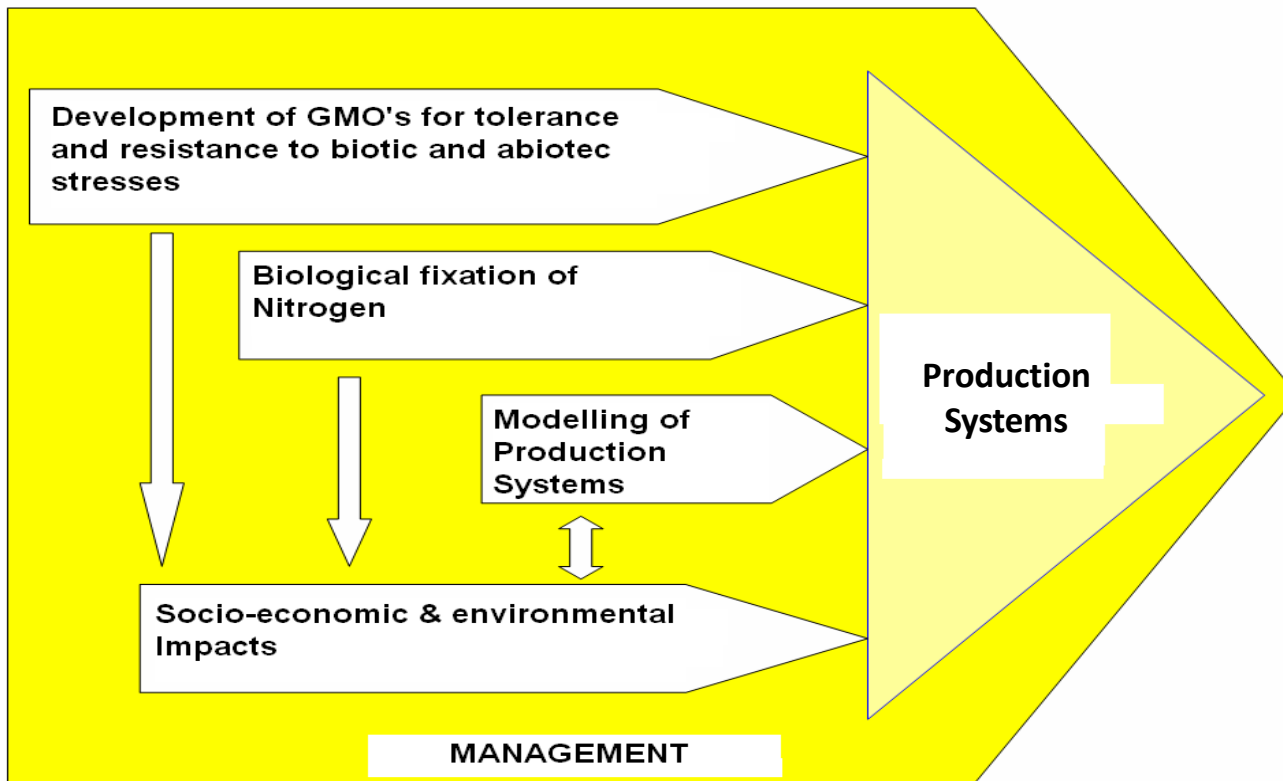
NETWORK: 160 scientists (15 Embrapa R&D Centers, 9 Universities, 5 R&D Institutes, ...)



R & D - Agroenergy and Biofuels

Sugar Cane Platform

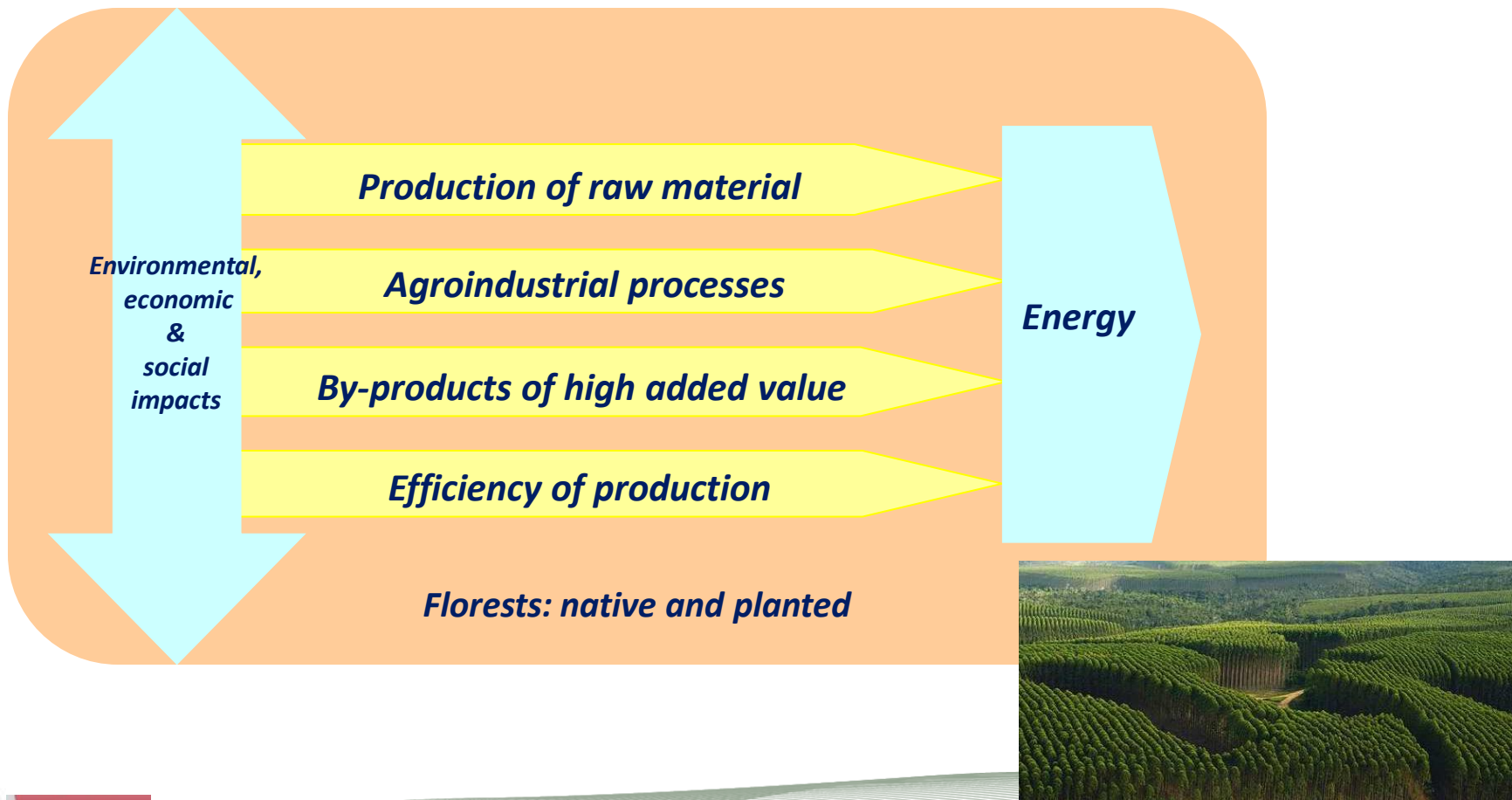
NETWORK: 100 scientists (8 Embrapa R&D Centers, 2 Universities, 1 R&D Institute, ...)



R & D - Agroenergy and Biofuels

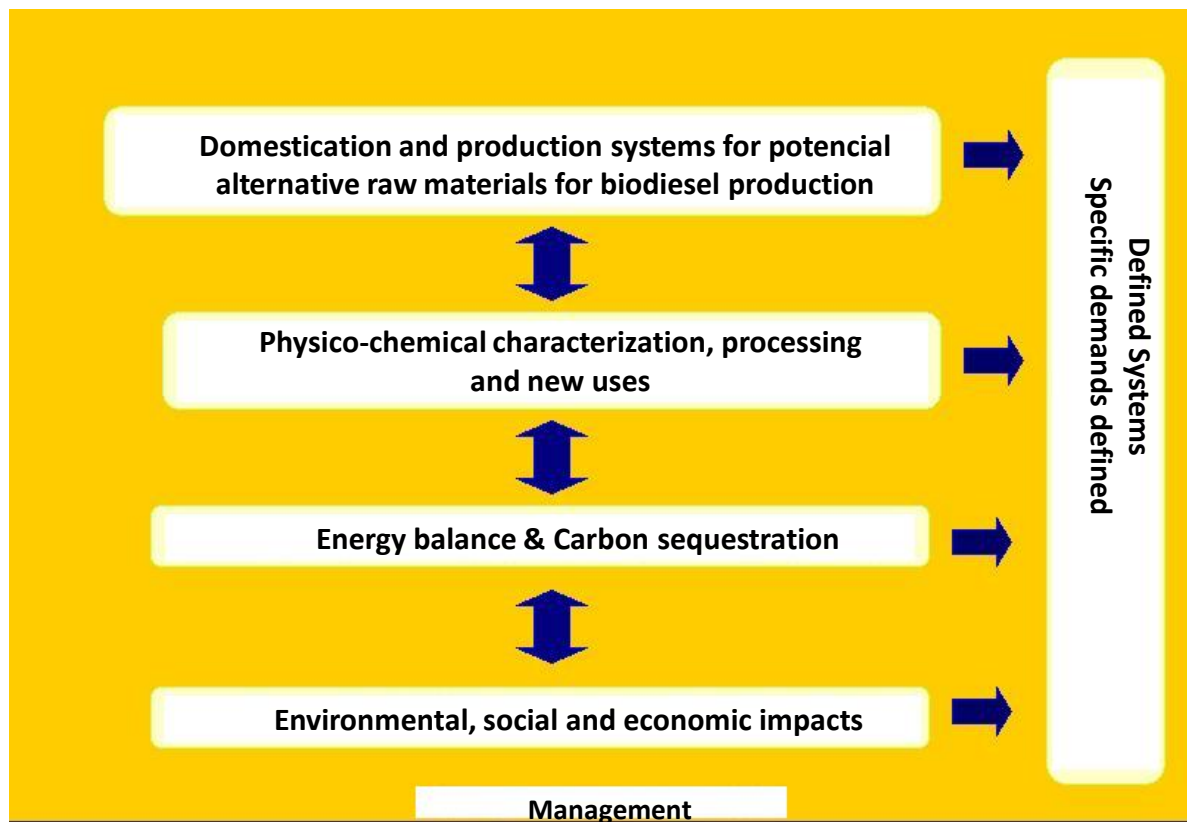
Energetic Forests Platform

NETWORK: ±130 scientists (17 Embrapa R&D Centers, 15 Universities, 14 R&D Institutes, ...)



Potential agroenergy sources

NETWORK: ±170 scientists (20 Embrapa R&D Centers, 9 Universities, 1 R&D Institute, ...)



R&D - Agroenergy and Biofuels

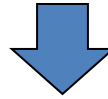
Ethanol from lignocellulosic materials

Characterization & selection of lignocellulosic biomass

Prospection & selection of microorganisms

Molecular genetics of gramineae & microorganisms

Conversion Processes



Alternative sources of biomass & technological routes for the sustainable production of ethanol from lignocellulosic materials



NETWORK: ±75 scientists (14 Embrapa R&D Centers, 7 Universities, 1 R&D Institute, ...)



Labex Korea



Embrapa uses microorganisms to produce biofuels

Production process of biodiesel by supercritical route



Co-products and biomass waste are raw materials for chemicals products

Agroenergy in Spotlight

HTL: From waste to algae to fuel

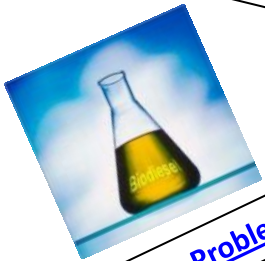


On the route of biofuels for airplanes

Sustainable charcoal – New system produces raw material cleanly



Giant rice for silage and ethanol production



Biomass Waste: Problems or solutions?

Sun, sewage and algae: a recipe for success?

<http://labexkorea.wordpress.com/>





Embrapa Agroenergy

Obrigado
Thanks
감사합니다.



Labex Korea



Ministério da Agricultura,
Pecuária e Abastecimento

