



Brazilian BioEnergy Science and Technology Conference

Policies for a Bio-based Economy

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BBEST

Campos do Jordão, SP, BR

Centro de Gestão e Estudos Estratégicos
Ciência, Tecnologia e Inovação

14 – 18 August 2011



Biofuels in the World

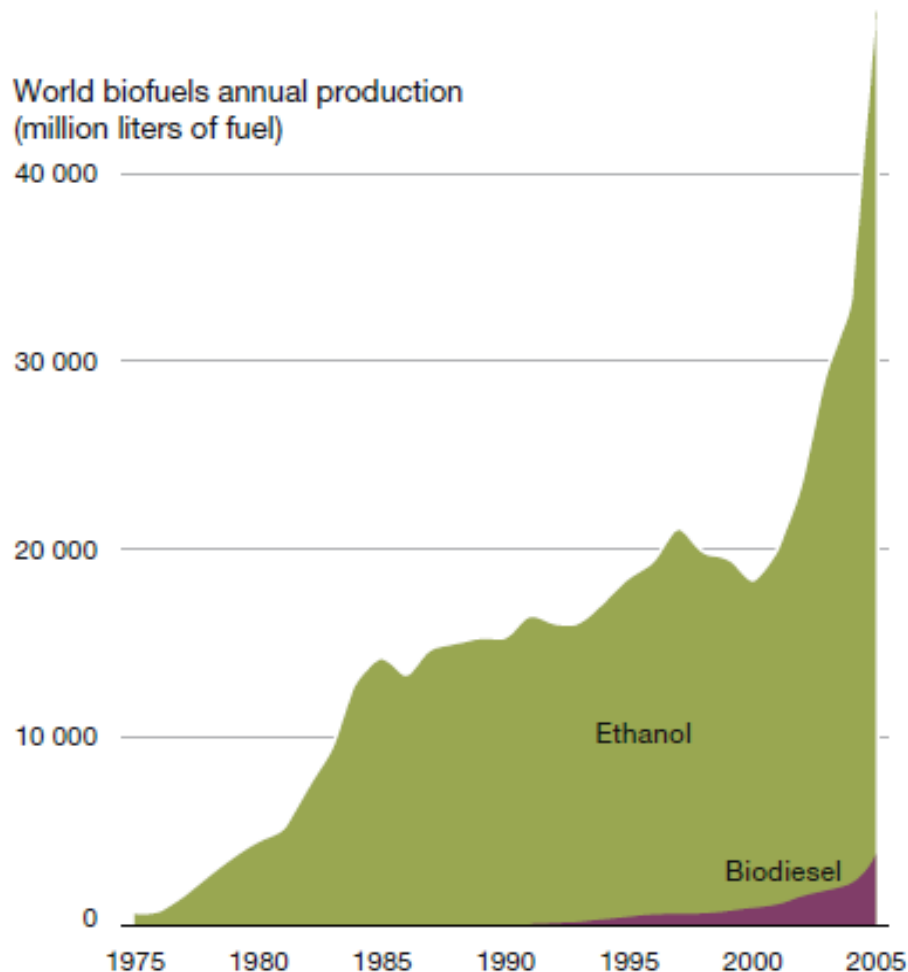


Figure 14: The production of biodiesel and ethanol has increased substantially in recent years. (Source: Earth Policy Institute, 2006).

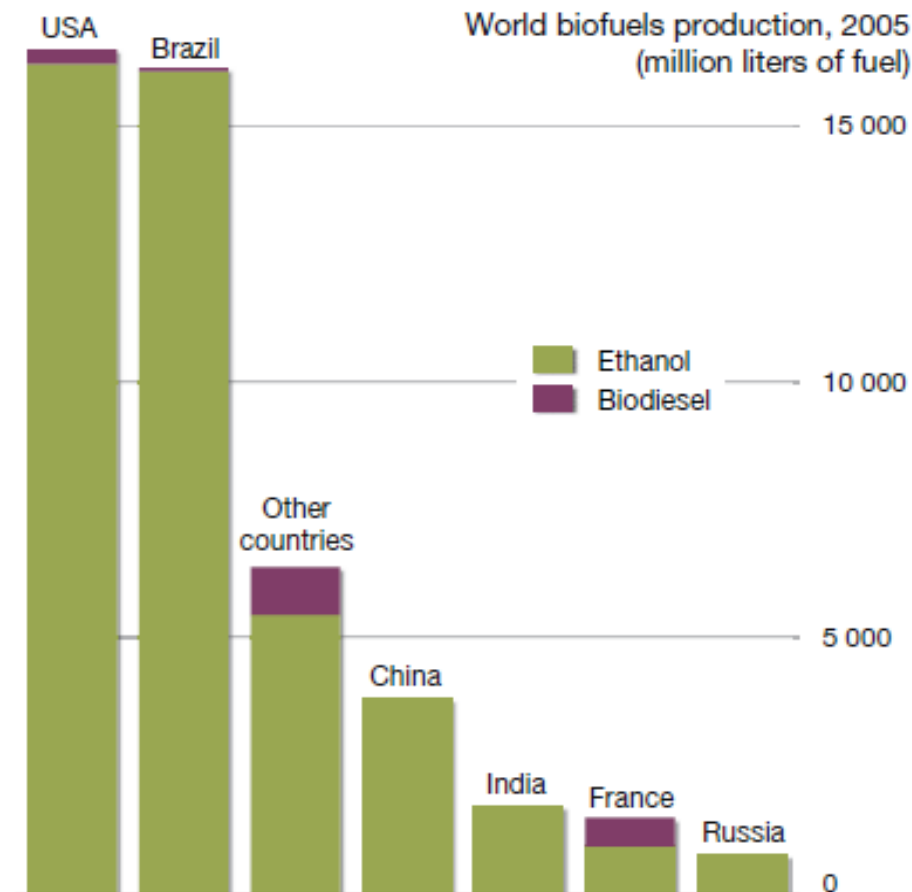


Figure 15: United States and Brazil are among the greatest producers of biofuels today. (Source: Earth Policy Institute, 2006).

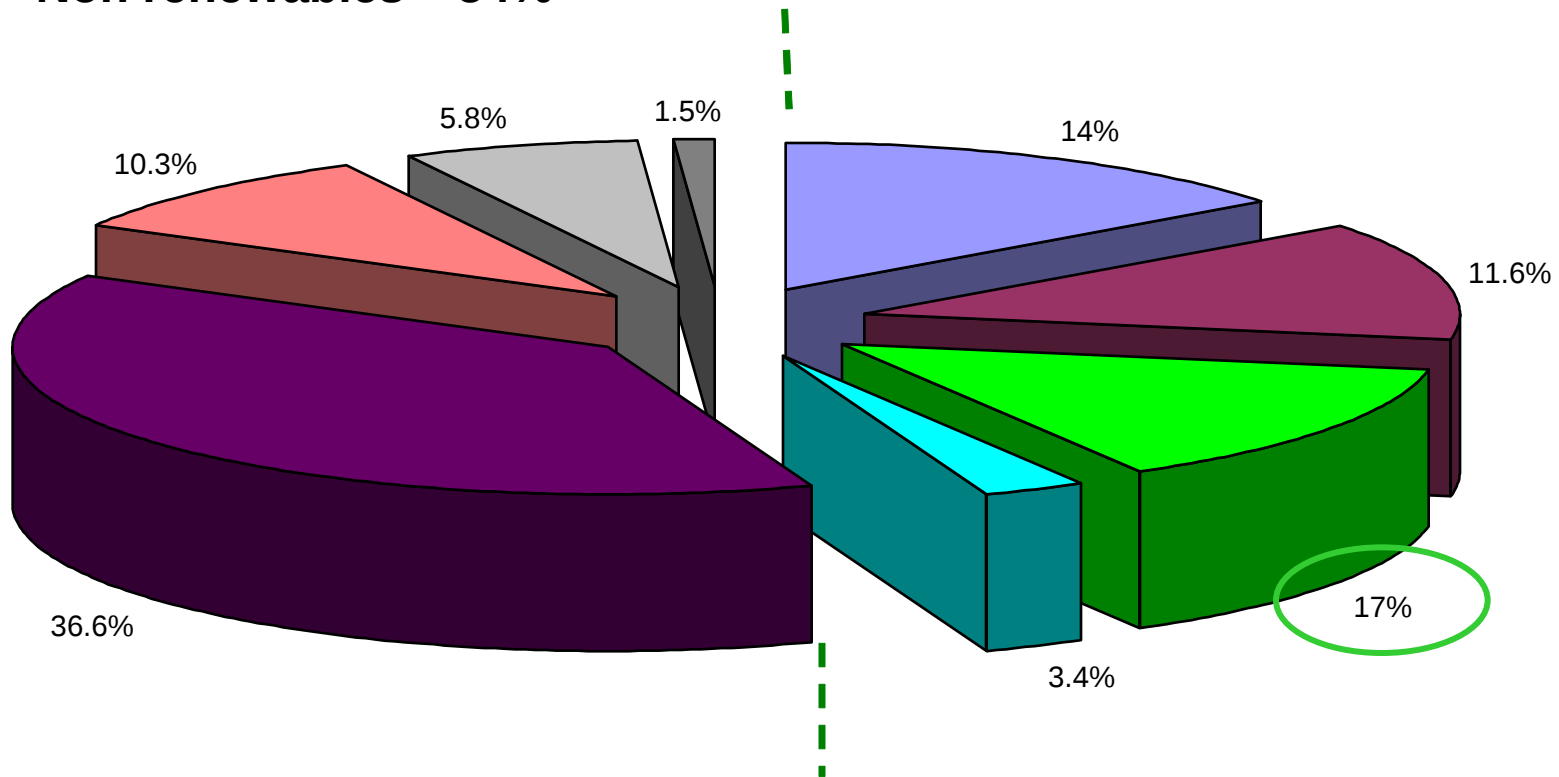


Brazilian energy supply



Non renewables – 54%

Renewables – 46%



■ Hydropower ■ Firewood ■ Sugar Cane ■ Other Renewable ■ Oil&Oil Products ■ Natural Gas ■ Coal ■ Uranium

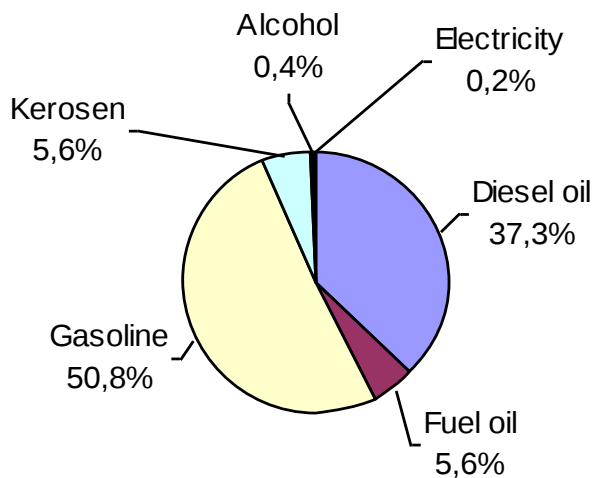
Source: Brazilian Energy Balance 2009



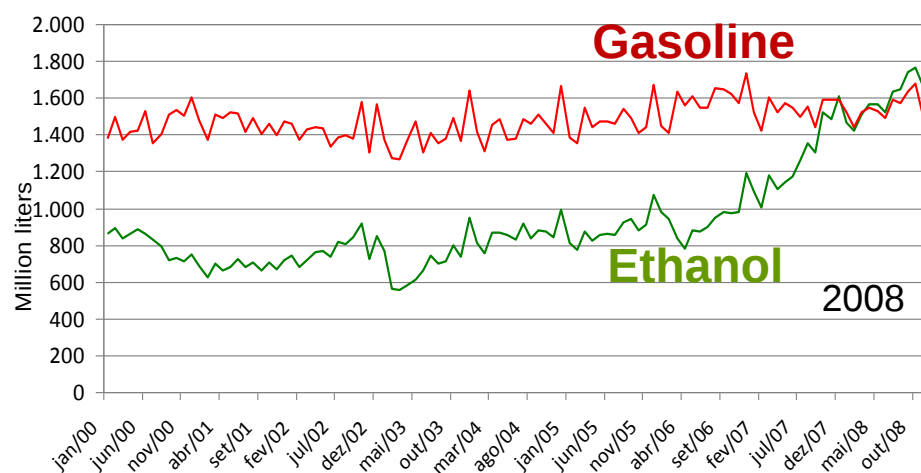
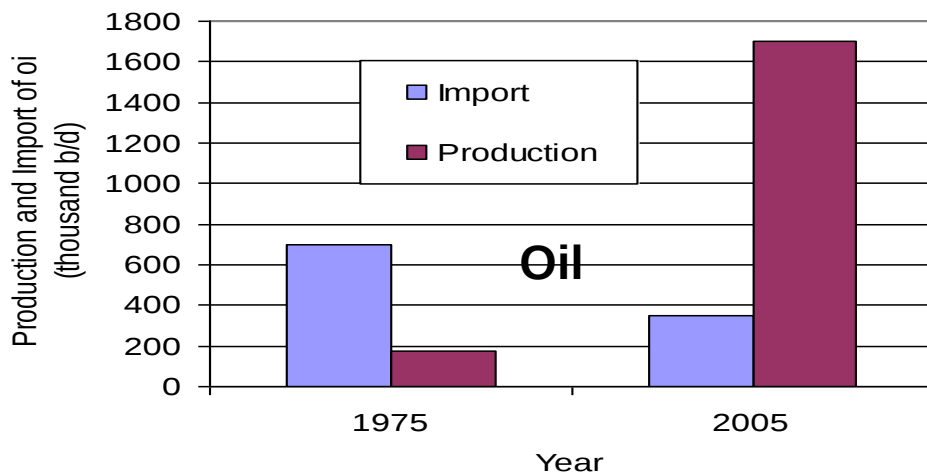
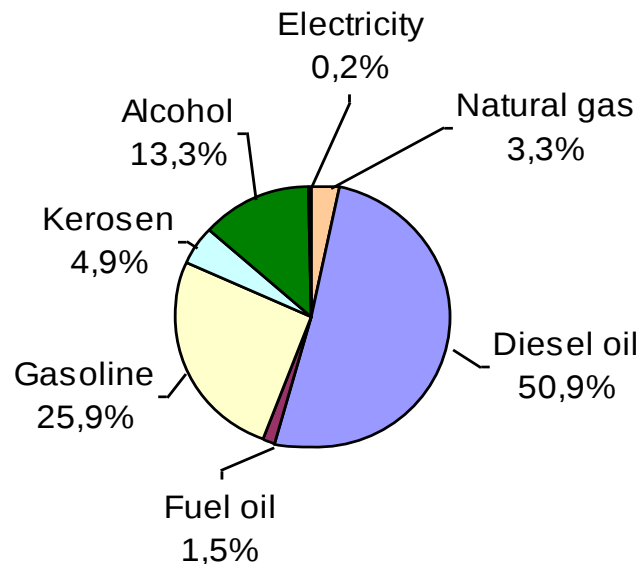
Energy pattern - transport sector



Energy Consumption Transport Sector (1975)



Energy Consumption Transport Sector (2005)





Biodiesel



Clean fuel programme

- Fuel diversification and green fuel promotion
- Job creation, land use and economic upswing in rural areas
- Reduction of diesel imports

Main steps

- Quality standards
- Price management
- Production chain: crop growing, transformation and trade



Meta de substituição do diesel

2005	2006	2007	2008	2009	2010
2.00%	2.75%	3.50%	4.25%	5.00%	5.00%

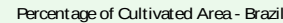
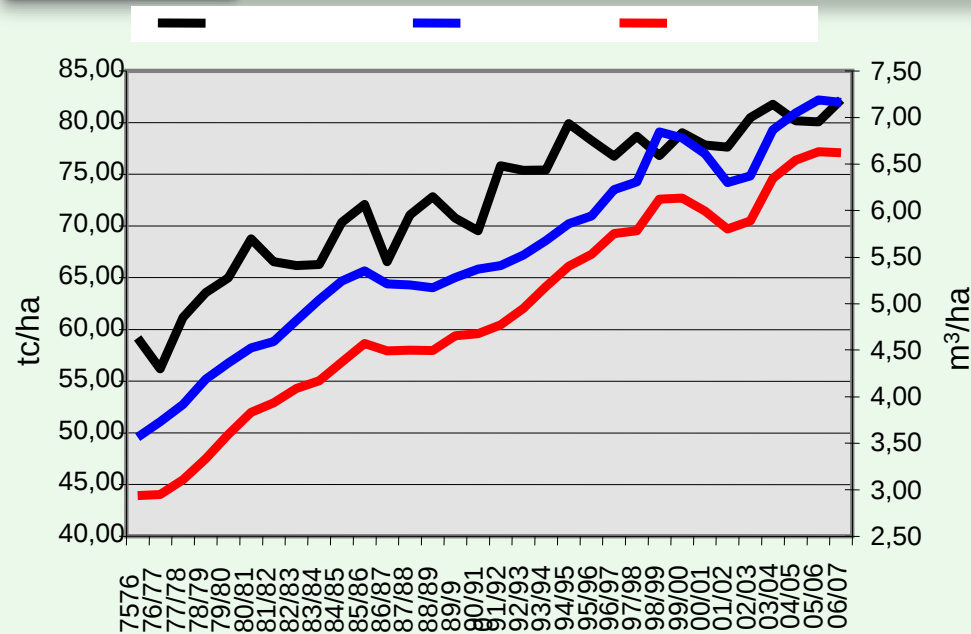


Bioethanol from sugarcane



- Close to 30 billion liters produced & 5 billion liters exported
- Energetic biomass cost = US\$ 1.4/GJ (industrial countries goal for 2020)
- 430 industrial units (100 new ones)
- >70,000 producers; ~1,000,000 jobs
- Knowledge frontier expansion :
genetics, biotechnologies, hydrolysis...







Genetics



New varieties adapted to local soils and climate and resistant against diseases



Biofactory: quick multiplication



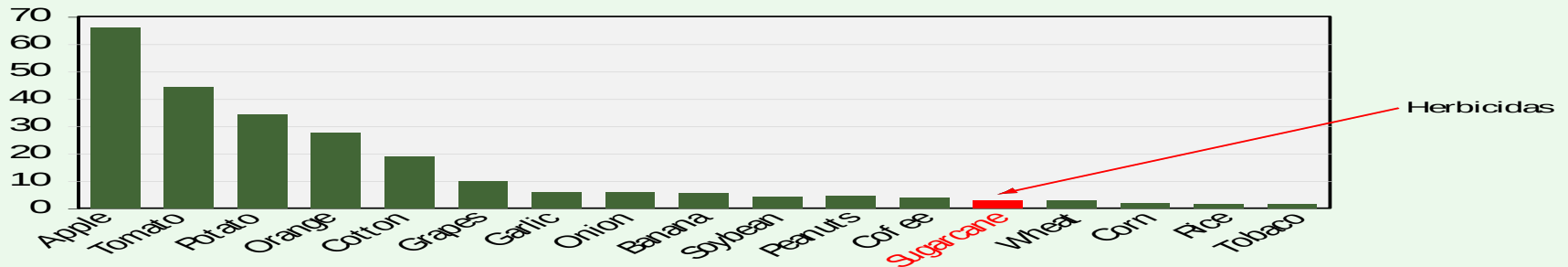
Sugarcane of high biomass: energy cane



Improving sugarcane agriculture



Agroquímicos— Principais Culturas
kg of active ingredient/ha (2006)



Nota: Defensivos: herbicida, fungicida, inseticida, acaricida, e outros (antibrotantes, reguladores de crescimento, óleo mineral e espalhante adesivo).

Fonte: Venda de defensivos obtida em Sindag (2007) e estimativa de área plantada obtida em IBGE (2007).

Source: Jank, MS Perspectivas do açúcar, do etanol e da bioeletricidade: a agenda da UNICA. SIMTEC 2007, Piracicaba, SP, 07/ 2007

Biological control of pests



Cotesia flavipes against *Diatraea saccharalis*

Entrants decrease



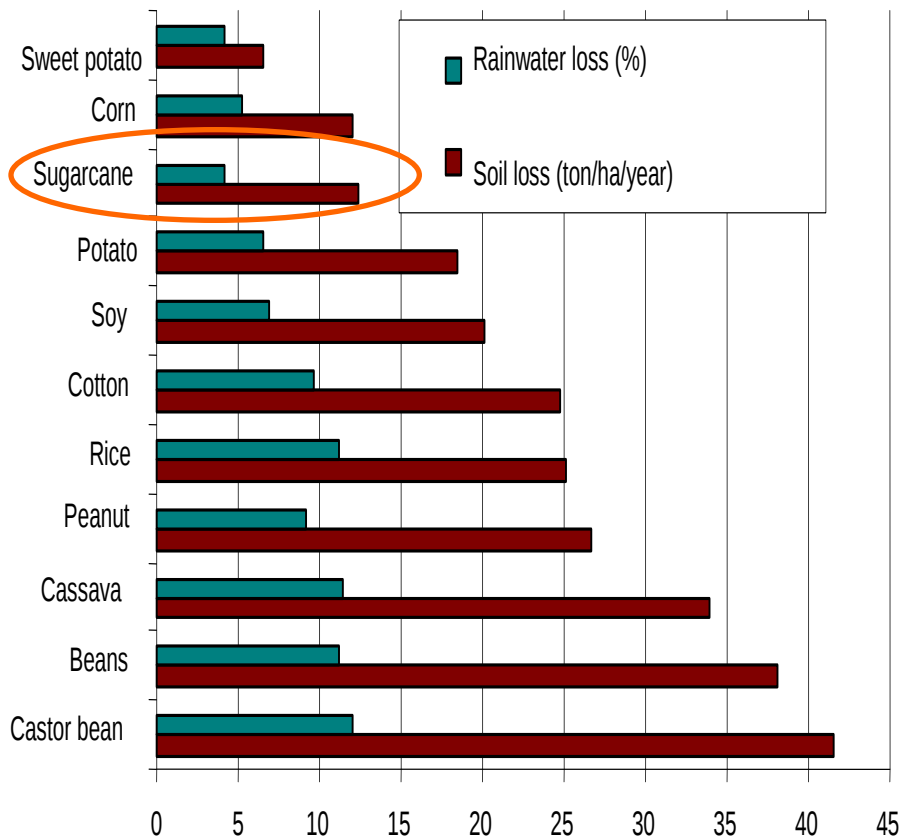
Effluent as fertilizer



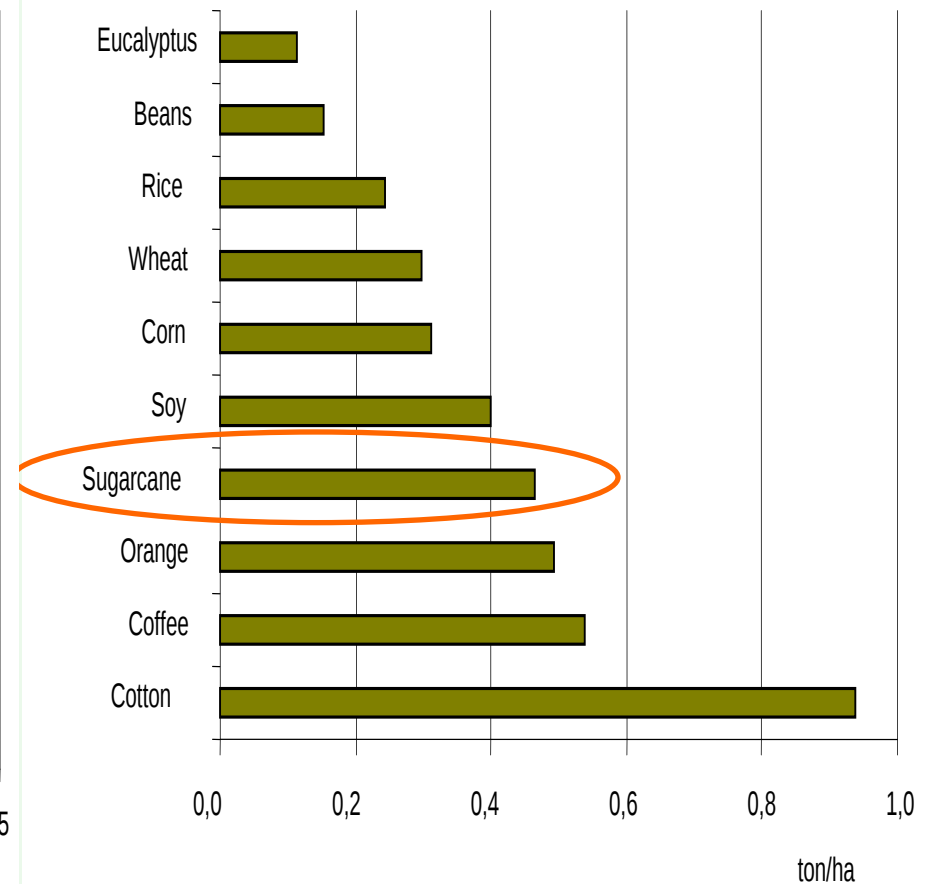
Agro-ecological indicators



Water and soil lost



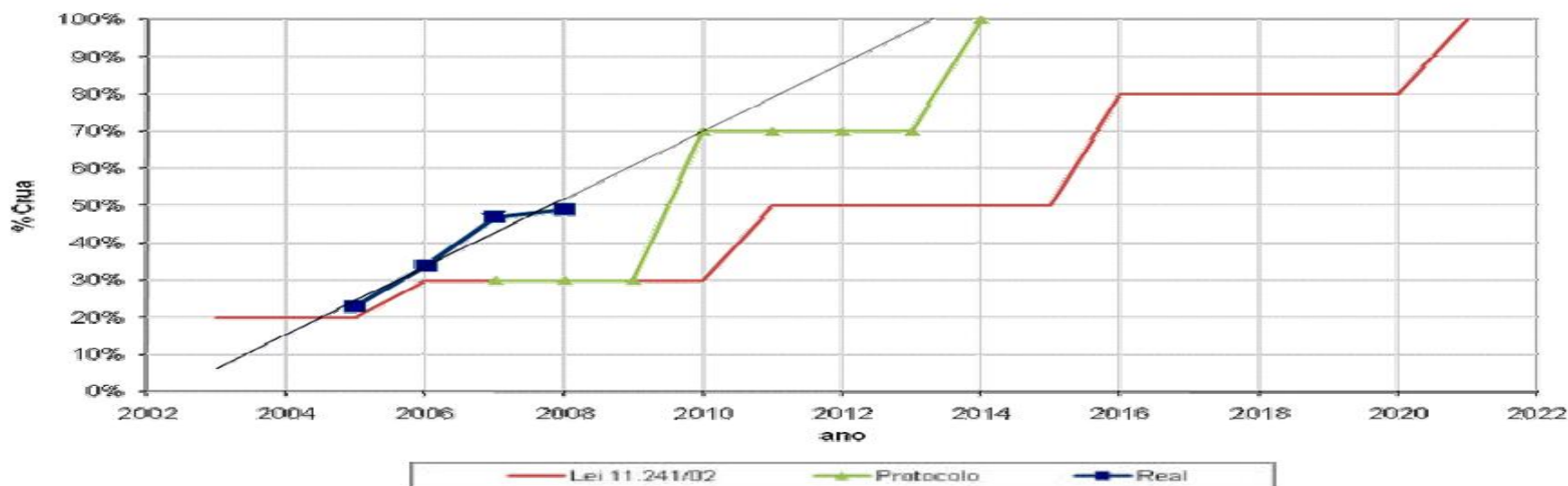
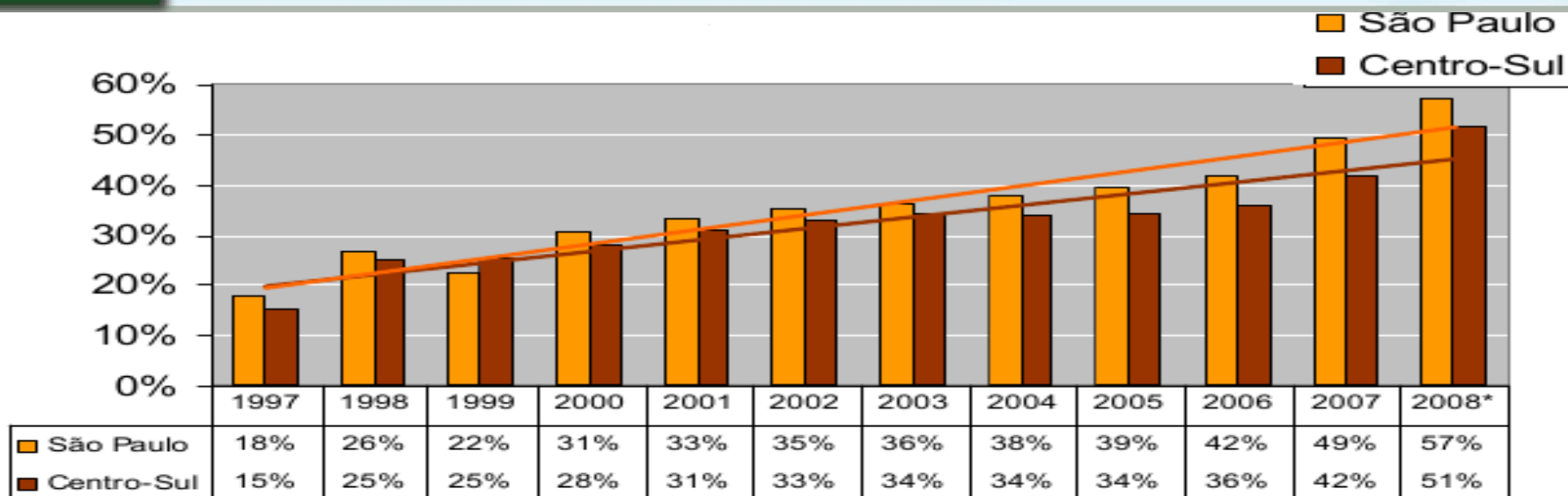
Fertilizer consumption



Source: Donzelli, 2005



Harvest mechanization without burning

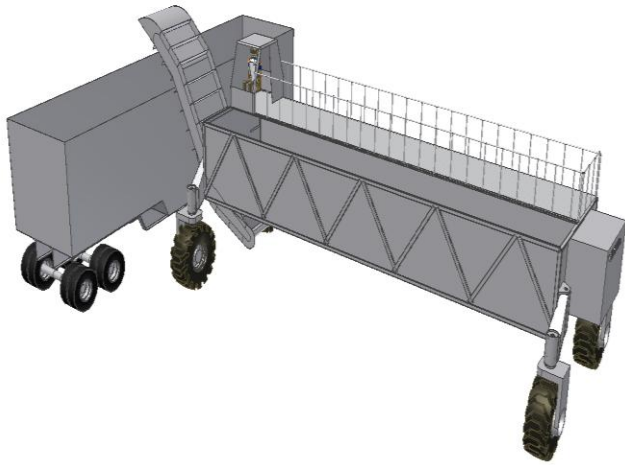




Next generation technologies



Low impact mechanization

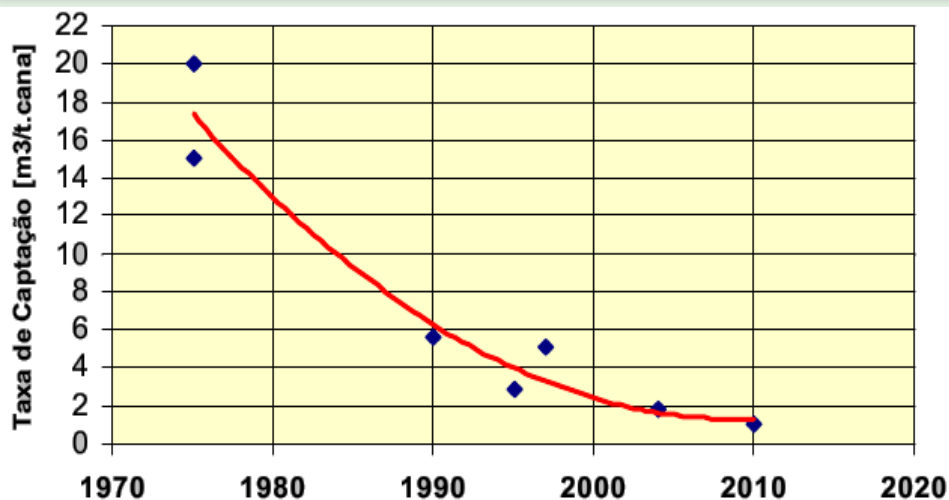


Recycle
Hydrolysis
Gasification
Pyrolysis
Biorefineries

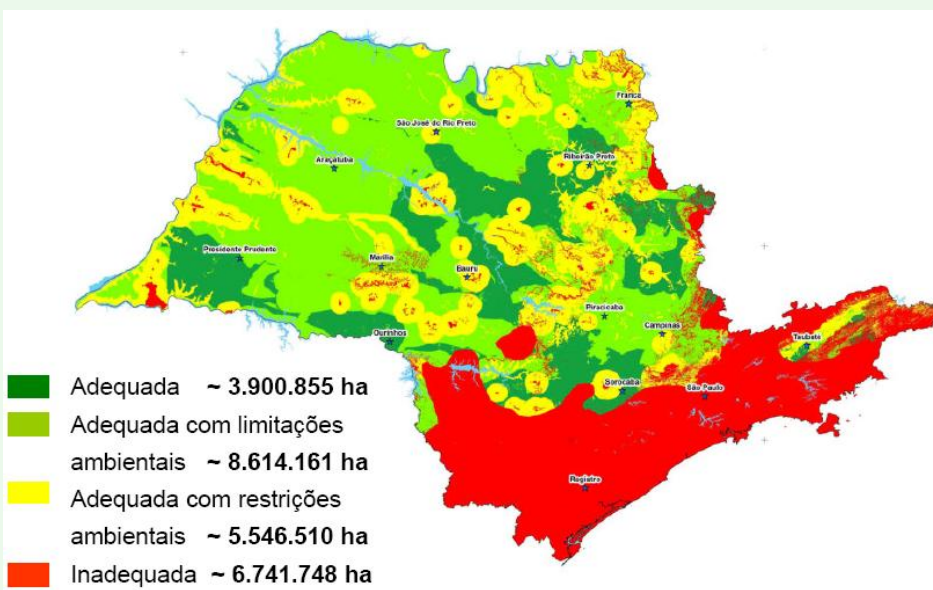
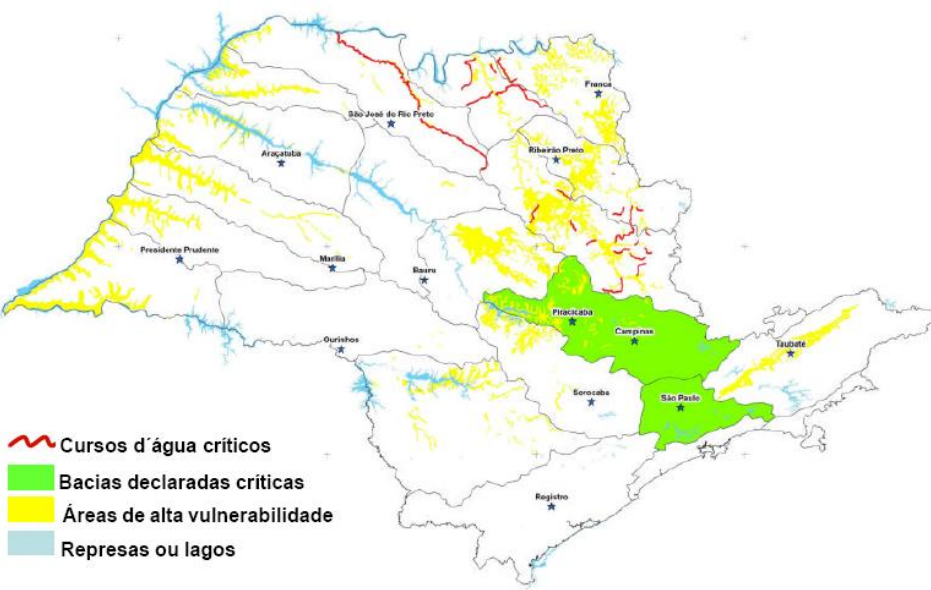




Industrial water withdraw evolution



	$\leq 1 \text{ m}^3/\text{tc}$
	$\leq 1 \text{ m}^3/\text{tc}$
	$\leq 0,7 \text{ m}^3/\text{tc}$
	Proibidas instalações



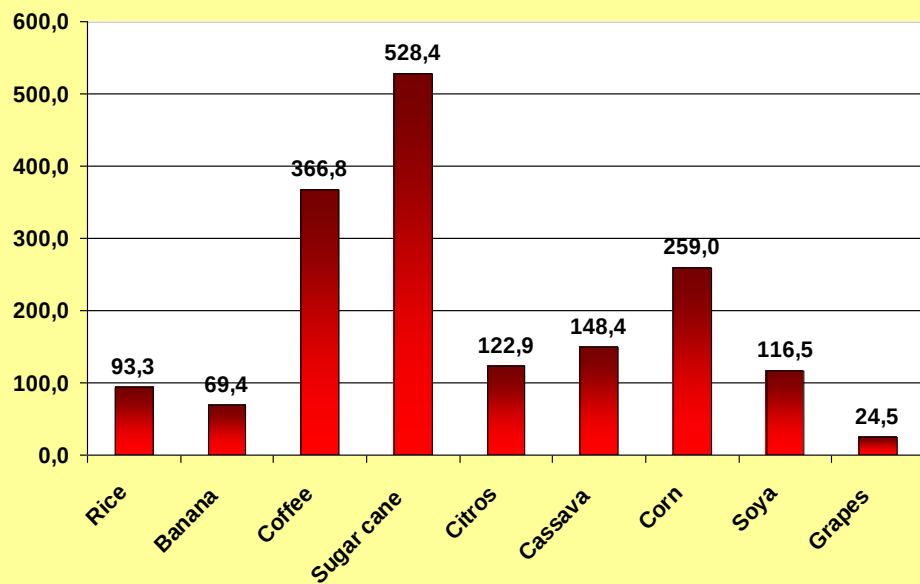


Social indicators

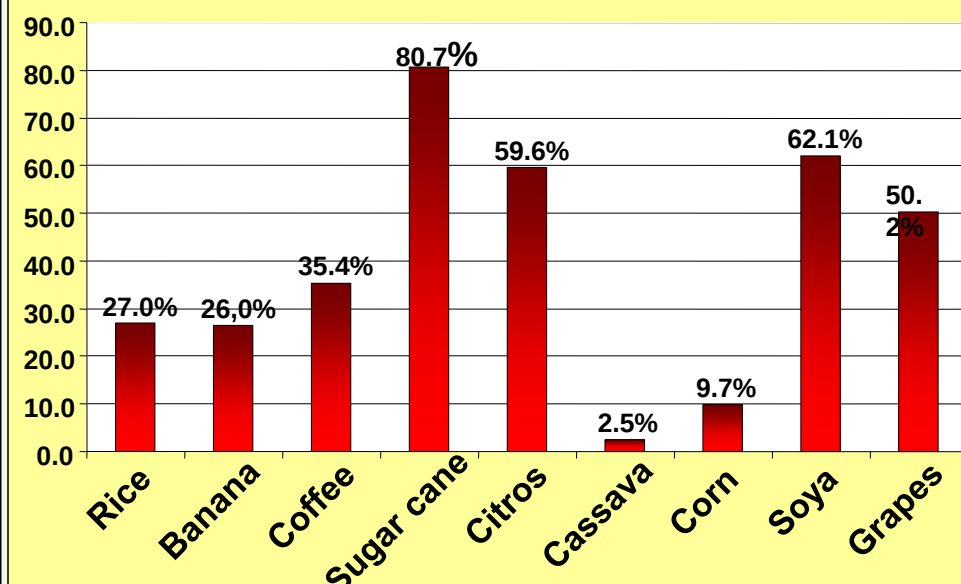


861 thou
employees
224 mi ton

528 thou
employees
493 mi ton



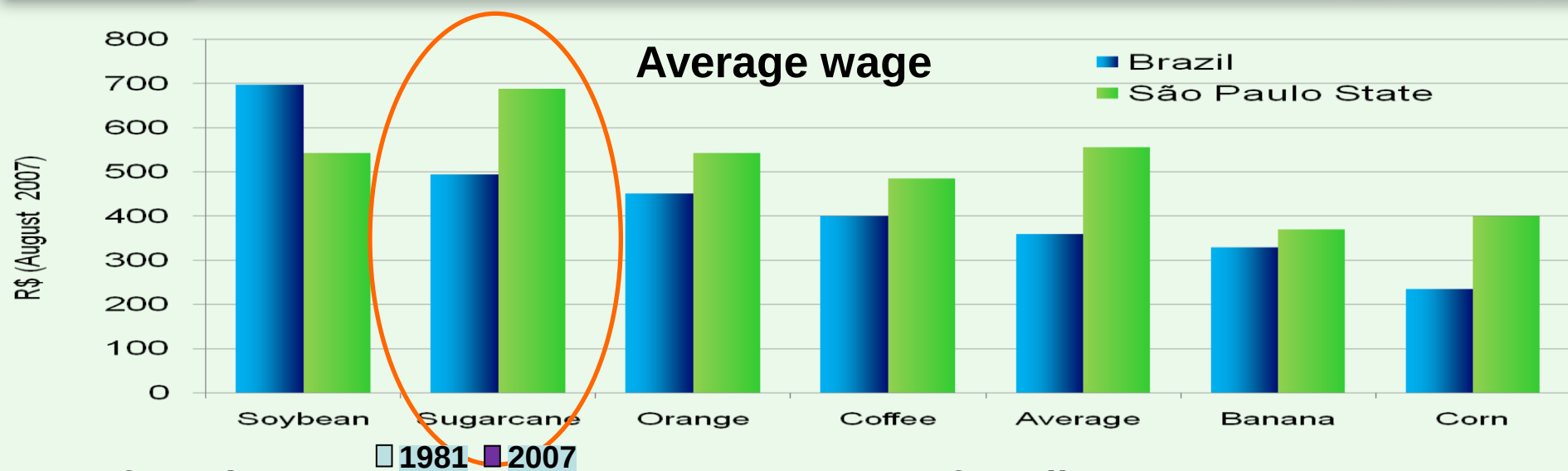
Number of employees (x 10³)



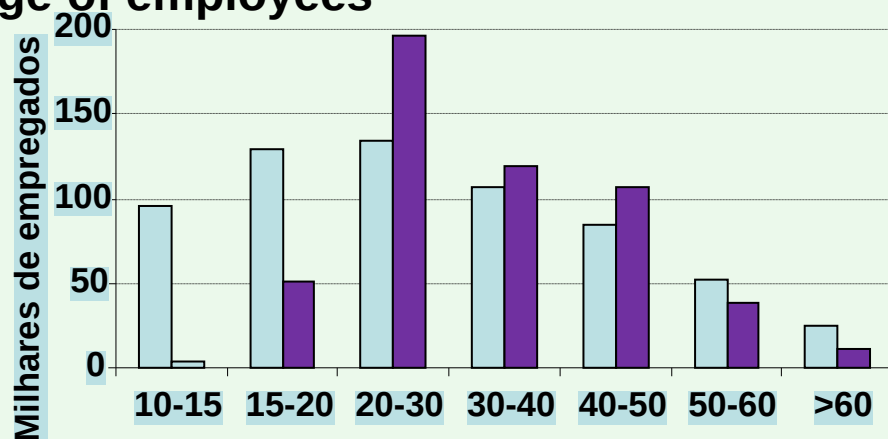
Formal workers



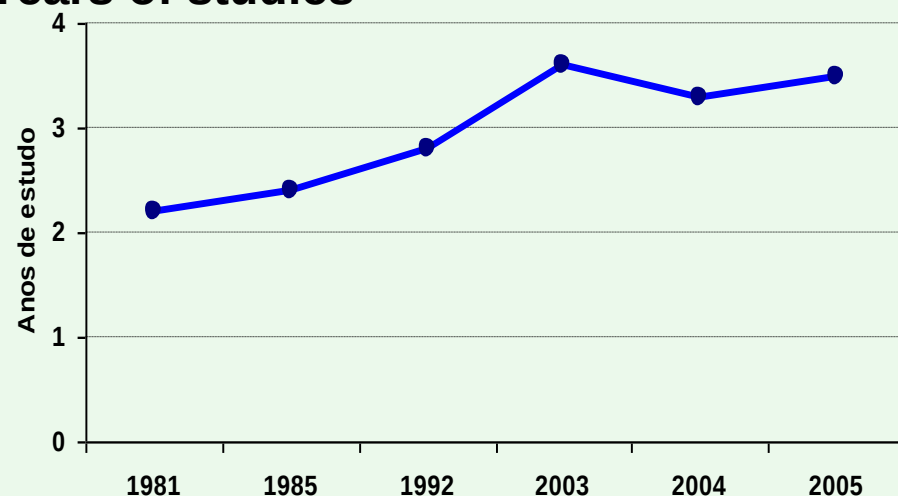
Social indicators



Age of employees



Years of studies



Source: Adapted from Moraes (2007)

based on PNAD (many years)

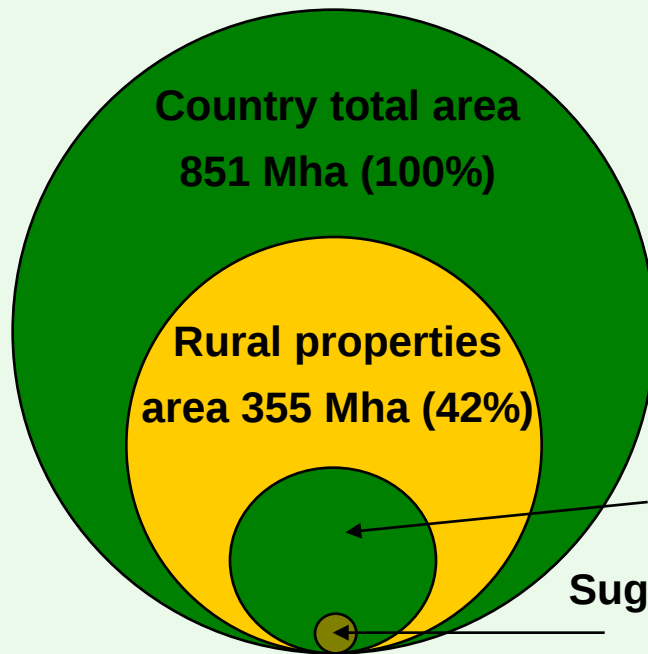


Land use

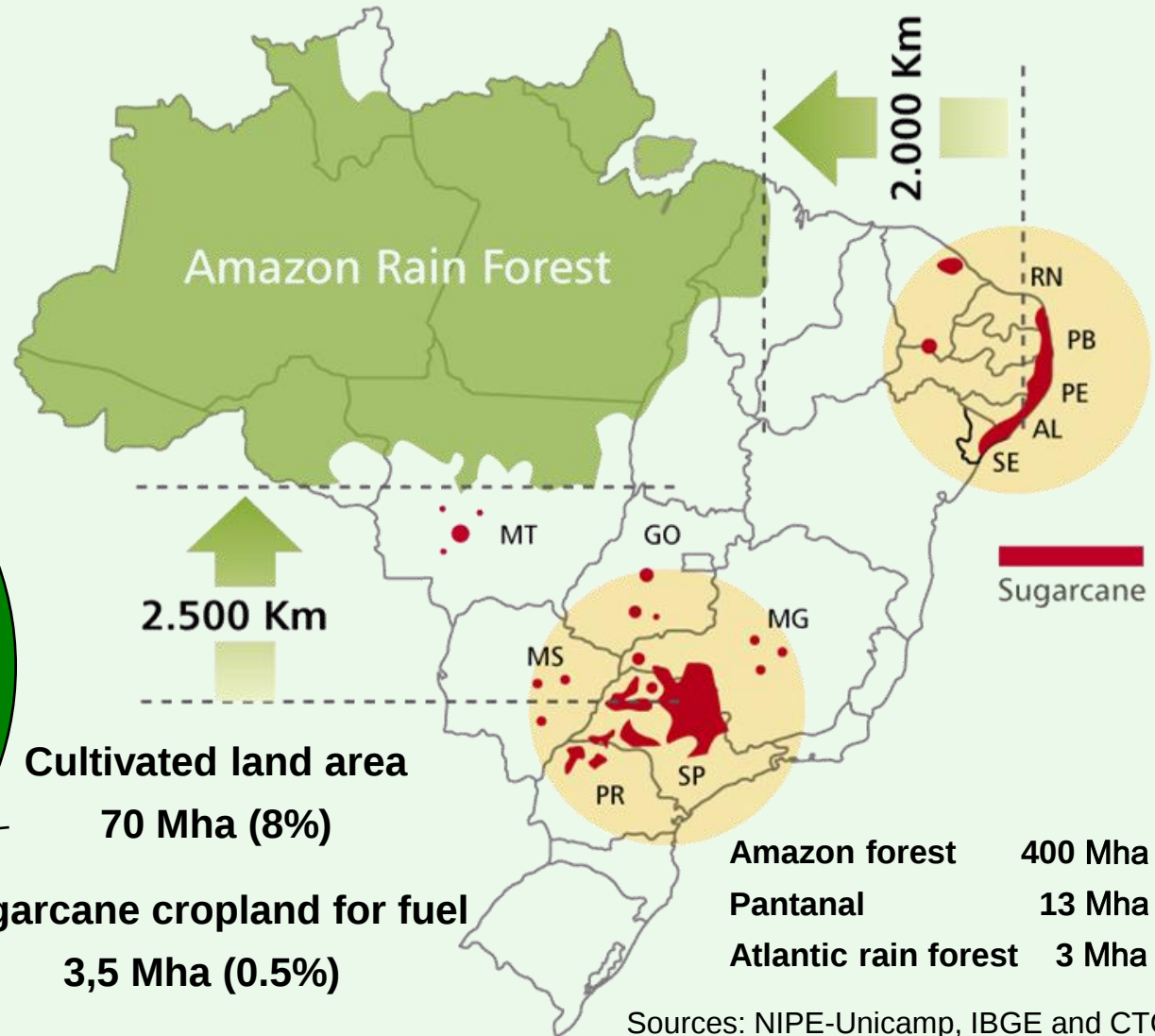


Farming (2007)

	Area (Mha)
Soya	23
Corn	12
Sugar cane	7
Agriculture	70
Cattle	180



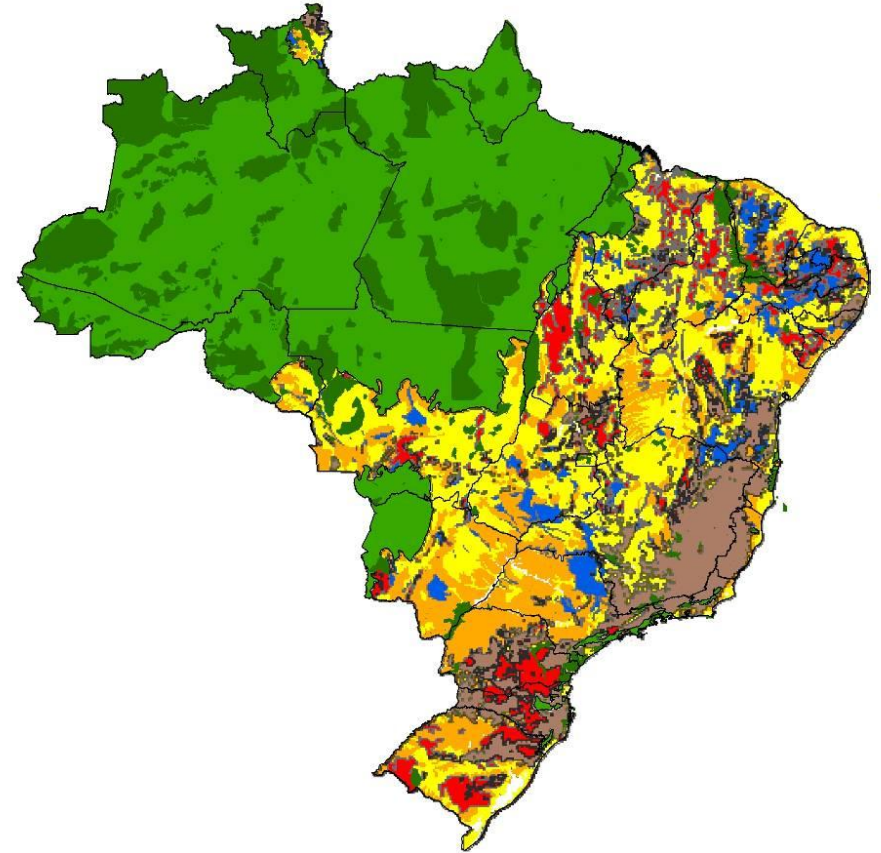
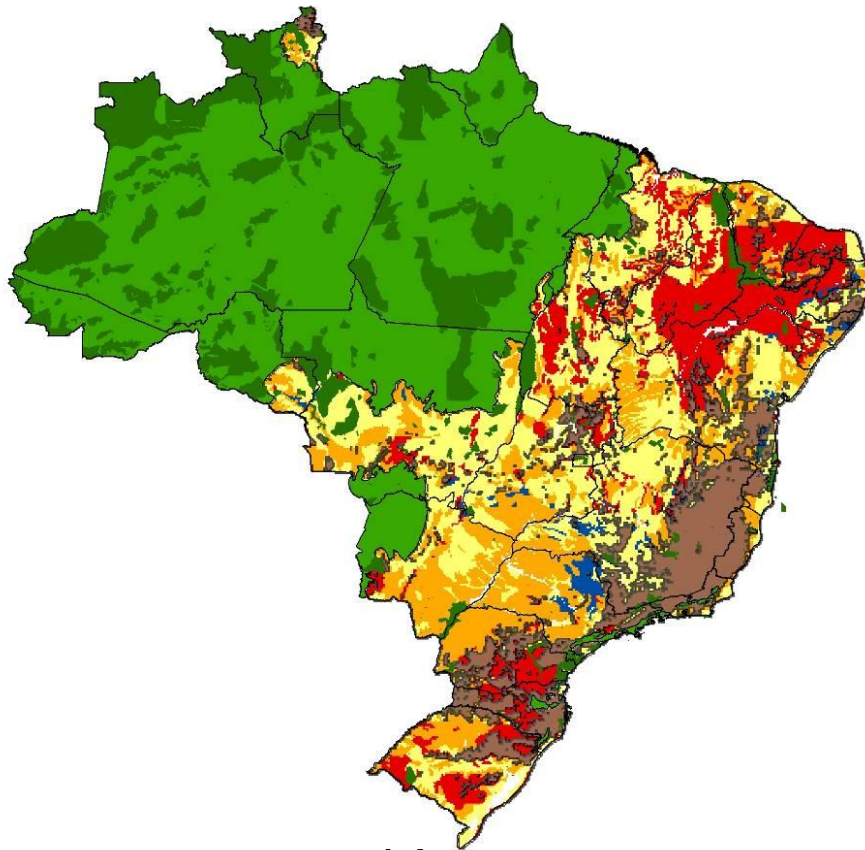
Source: IBGE, 2008



Sources: NIPE-Unicamp, IBGE and CTC



Soil & climate potential for sugarcane agriculture



Amazon Rainforest



Pantanal



Other important
preservation areas



Above 12% slope
area (75 Mha)

Atlantic Forest

High
(> 80 t/ha)

Good
(> 70 t/ha)

Medium
(> 60 t/ha)

Inadequate

Source: CGEE – NIPE/Unicamp - CTC



Bioethanol for vehicle



- Large experience using bioethanol as mixed fuel for vehicle (1925) ~ 5%
- Proálcool (1975):
 - up to 25% of bioethanol blended in the gasoline (E 25)
 - 5 million pure bioethanol powered cars manufactured
- Flex-fuel motors using the E 25 blend, bioethanol, or a mix of both (2003)
 - 10 million flex-fuel cars manufactured; 90% of the 2008 new car market
- Only E 25 & bioethanol delivered by all the 35,000 Country's fuel station

1925



1975



2003



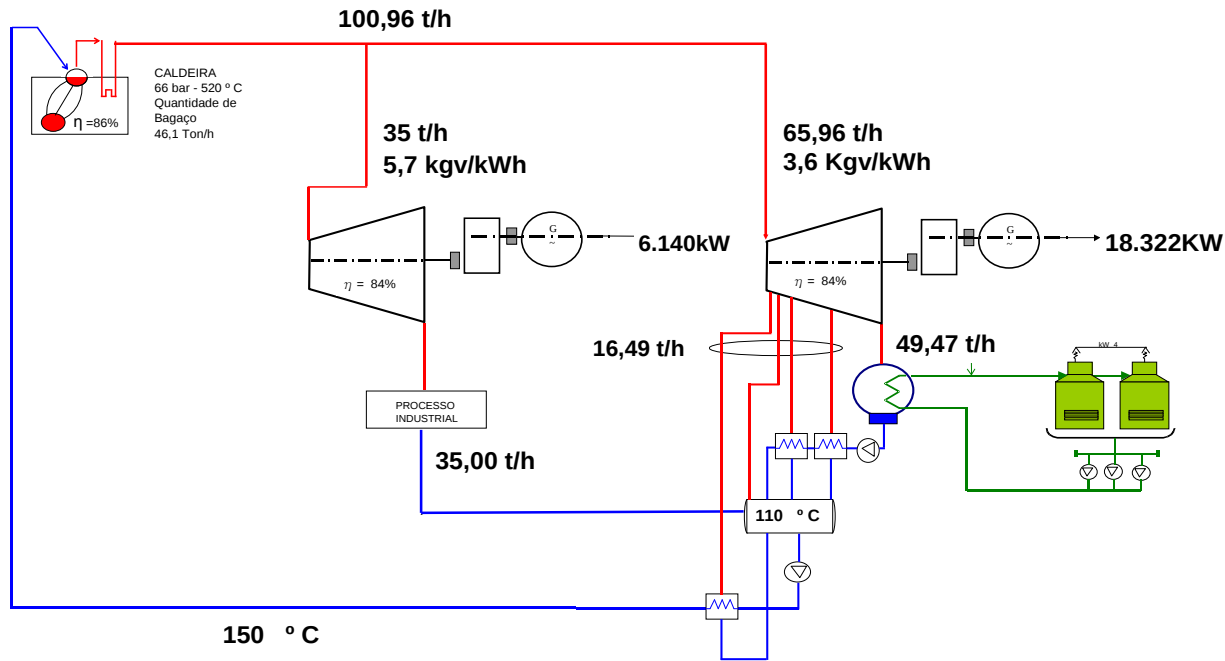


Diversifying bioethanol use





Switch of sugarcane agroindustry to energy business



Biopower in Country's electricity generation

2007 3%

2012 6%

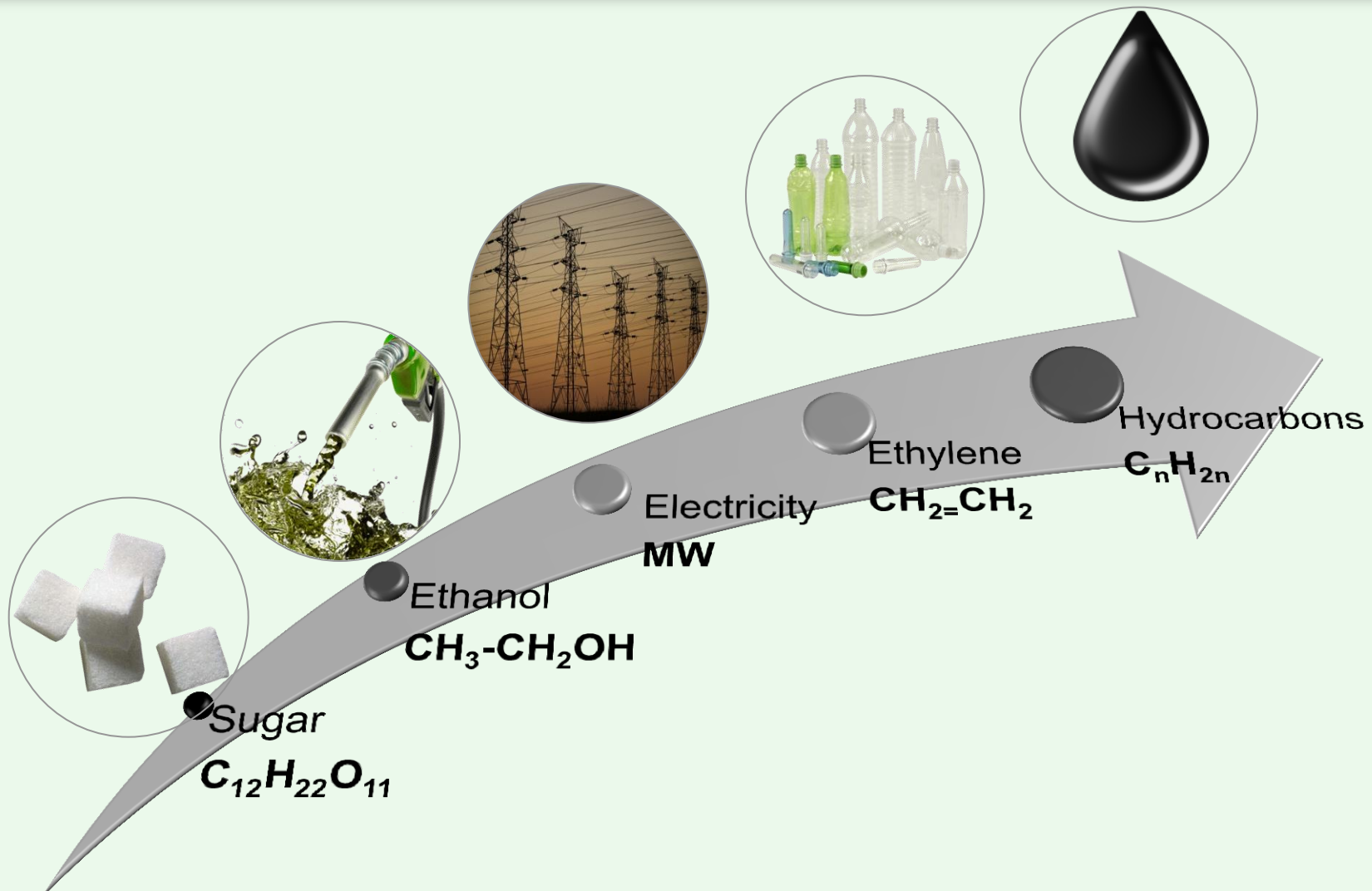
2020* 15%

Business income	2005	2015
bioethanol	39%	54%
bioelectricity	1%	16%
energy	40%	70%

* COGEN 2008



Sugarcane agroindustry business diversification



Source: Unica 2009



Biofuel and agriculture research studies at CGEE



NAE Journals: Biofuels

Study commissioned by the Strategic Issues Unit of the Presidency of the Brazilian Republic

Authorship: Isaías Macedo & Luiz A. Horta Nogueira



Book on the role of State Agricultural Research Organizations (OEPAs)

Study under the Management Contract signed between MCT and CGEE



Sugarcane bioethanol prospective assessment



Book on sugarcane bioethanol as an opportunity for the Brazilian development

Editors: Luís Cortez, Regis Leal, Marcelo Cunha and Marcelo Poppe



Sugarcane bioethanol development review



Book in four languages
launched during the
International Conference on
Biofuels, held in São Paulo
(November 2008)

www.bioetanoldecana.org

www.bioetanoldecanadeazucar.org

www.sugarcanebioethanol.org

www.bioetanoldecanne.org



Partnership: BNDES, CGEE, ECLAC and FAO
Authorship : Luiz A. Horta Nogueira



Sugarcane bioethanol sustainability studies



Studies commissioned to Nipe/Unicamp in partnership with CTBE

Coordination: Luís Augusto Barbosa Cortez

Studies under the Management Contract signed between MCT and CGEE



Aviation biofuels



Technical Document on aviation biofuels
Authorship: Luiz Augusto Horta Nogueira



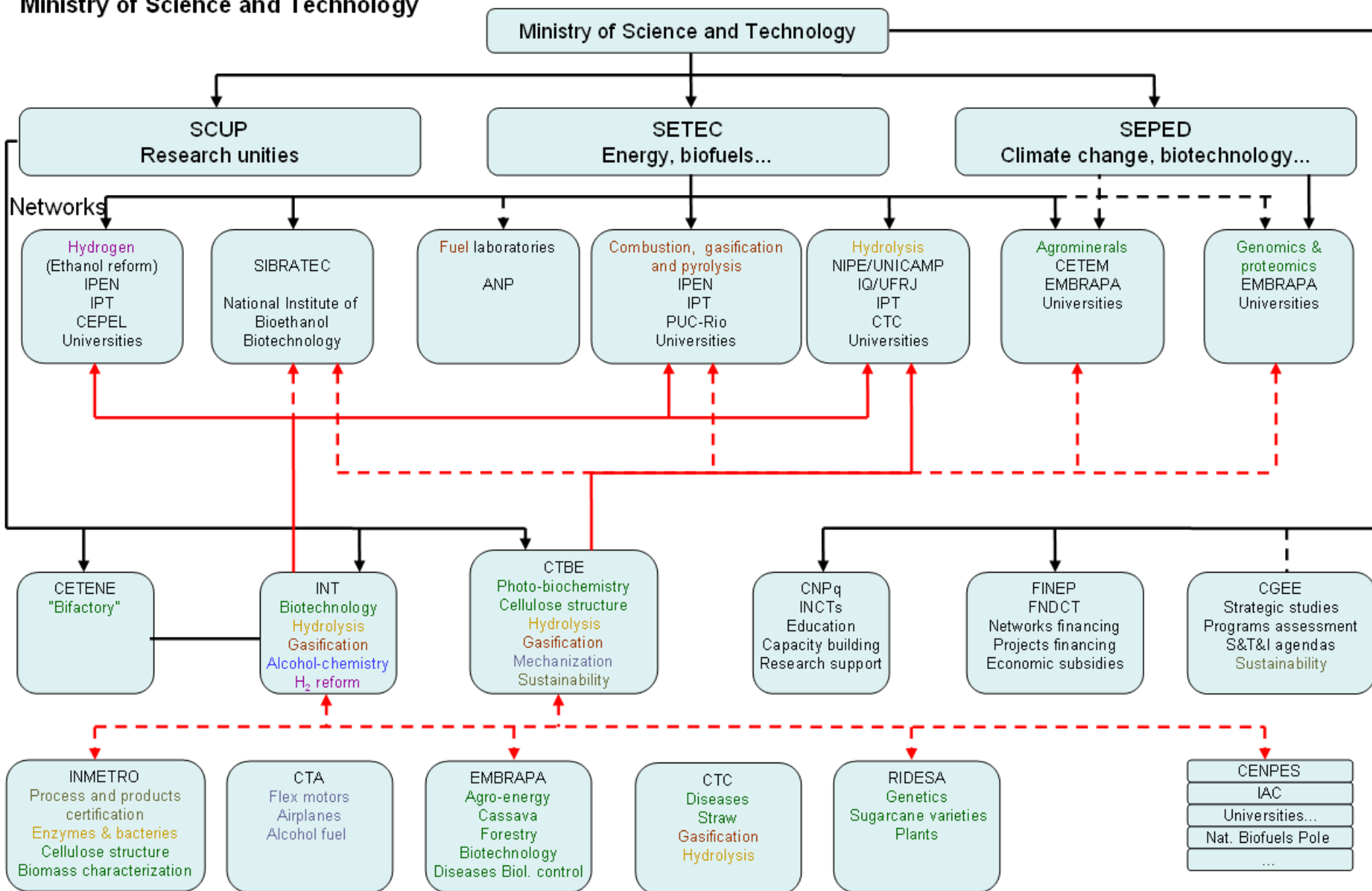
Green chemistry



Book on green chemistry in Brazil

Study under the Management Contract signed between MCT and CGEE

Sugarcane Bioethanol S&T&I initiatives related to the Brazilian Ministry of Science and Technology

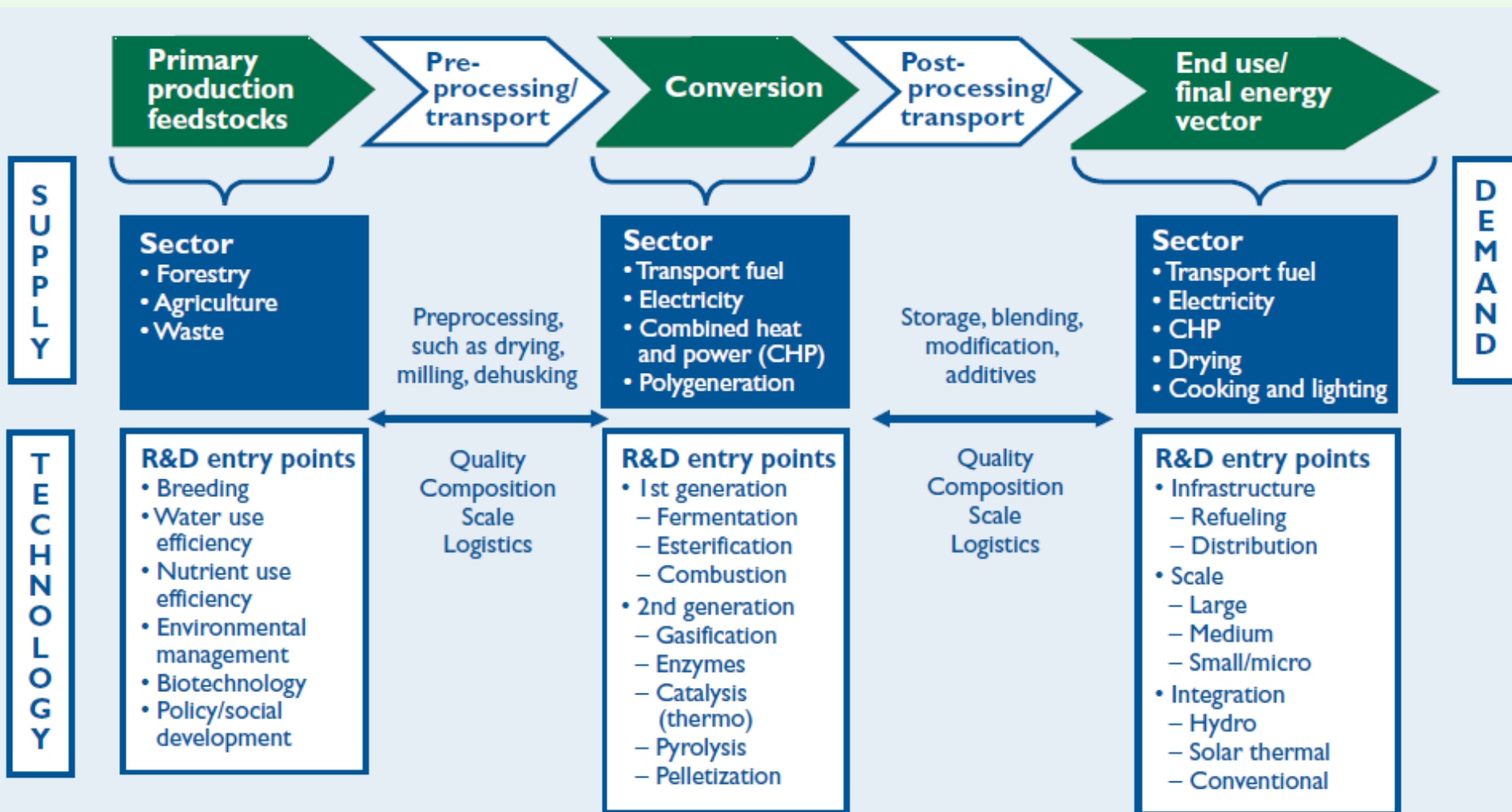


Black lines – managing relations

Red lines – S&T&I thematic relations



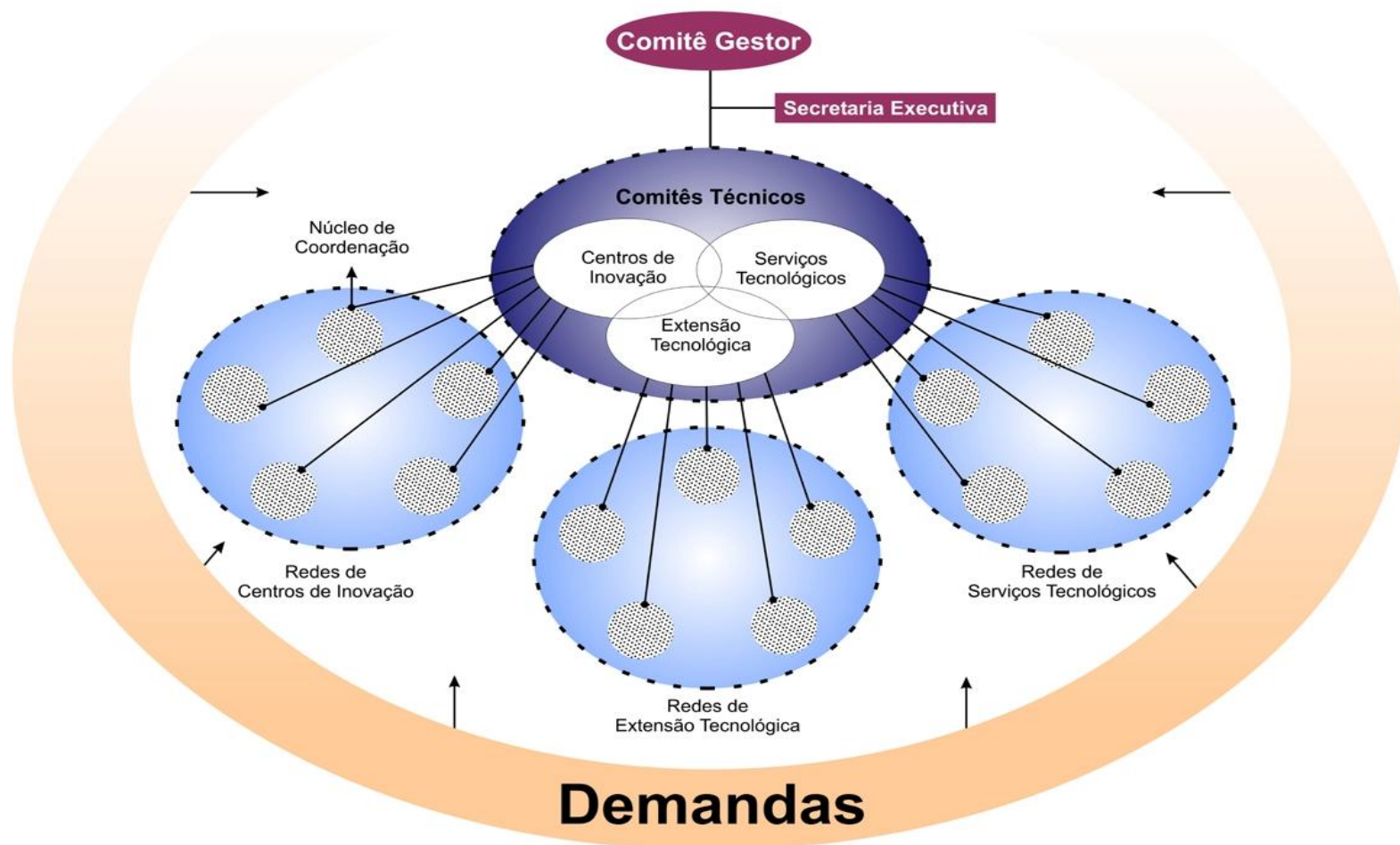
Bioenergy technology road map



Source: <http://www.ifpri.org/2020/focus/focus14/focus14.pdf>

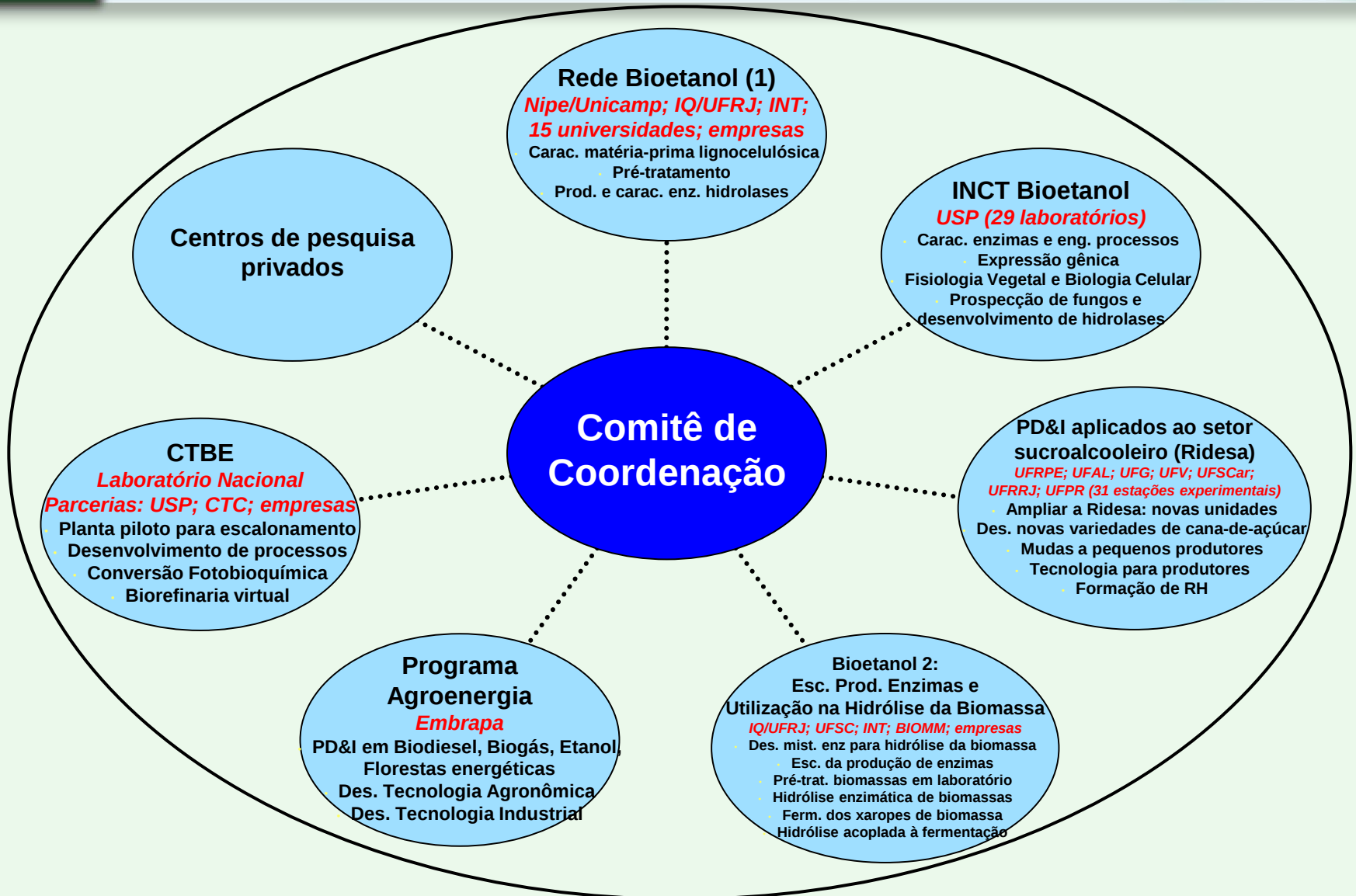


Brazilian technology system - SIBRATEC





Network of innovation actors

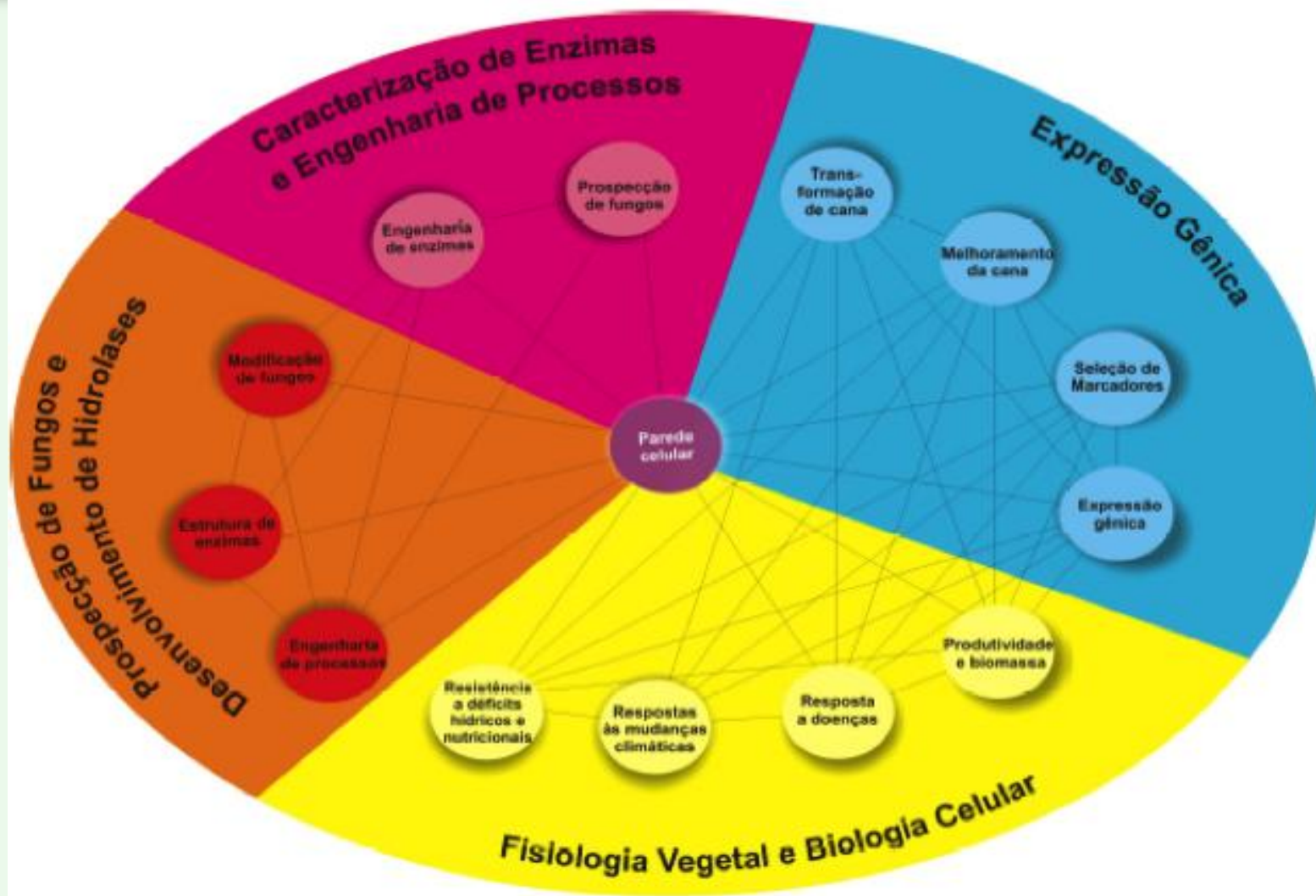


REDE/PROJETO	ENTIDADES PARTICIPANTES	COMPETÊNCIAS
Rede Bioetanol (1) [Produção de Etanol por hidrólise enzimática da biomassa da cana-de-açúcar] (EM CONCLUSÃO)	Nipe/Unicamp; IQ/UFRJ; INT; 15 universidades; empresas	- Caracterização da matéria-prima lignocelulósica - Pré-tratamento - Produção de enzimas e caracterização de enzimas hidrolases
INCT Bioetanol	USP (29 laboratórios em seis estados); empresas	- Caracterização de enzimas e engenharia de processos - Expressão gênica - Fisiologia Vegetal e Biologia Celular - Prospecção de fungos e desenvolvimento de hidrolases
Pesquisa, desenvolvimento e inovação aplicados ao setor sucroalcooleiro (Ridesa)	UFRPE; UFAL; UFG; UFV; UFSCar; UFRRJ; UFPR (31 estações experimentais); empresas	- Ampliar a Ridesa, com incorporação de três novos núcleos de pesquisas (Universidades Federais), com criação/reforço de infra-estruturas de P&D em estados/regiões (MT, MS, PI) com grande potencial de desenvolvimento da indústria sucroalcooleira - Desenvolver novas variedades de cana-de-açúcar, por meio de melhoramento genético clássico e também com adoção de ferramentas avançadas da biotecnologia - Produzir e fornecer mudas geneticamente melhoradas a pequenos produtores - Fomentar programa de difusão de tecnologia para produtores - Promover formação de RH na fase agrícola do setor sucroalcooleiro
Bioetanol 2 – Escalonamento da Produção de Enzimas Celulolíticas e Acessórias e sua Utilização na Hidrólise da Biomassa da Cana e Outras Biomassas Pré-tratadas	IQ/UFRJ; UFSC; INT; BIOMM; empresas	- Desenvolvimento de misturas enzimáticas efetivas e econômicas para hidrólise da biomassa - Escalonamento da produção de enzimas - Pré-tratamento das biomassas em nível de laboratório e semi-piloto - Hidrólise enzimática de biomassas pré-tratadas - Fermentação alcoólica dos xaropes de biomassa e de suas misturas com caldo de cana e melaço - Hidrólise acoplada à fermentação
Programa Agroenergia	Embrapa; empresas	- Programa de PD&I da Embrapa Agroenergia está baseado nos seguintes temas: Biodiesel, Biogás, Etanol, Florestas energéticas - Desenvolvimento de Tecnologia Agronômica (sistemas de produção sustentáveis) - Desenvolvimento de Tecnologia Industrial (processos de conversão eficientes) - Estudos sociológicos, econômicos, mercado, gestão, e políticas públicas
Laboratório Nacional - CTBE	CTBE (em consolidação) Parcerias: USP; CTC; empresas	- Planta piloto para escalonamento - Desenvolvimento de processos - Conversão Fotobioquímica - Biorefinaria virtual



Bioethanol National Institut for Science, Technology and Innovation - INCT Bioethanol

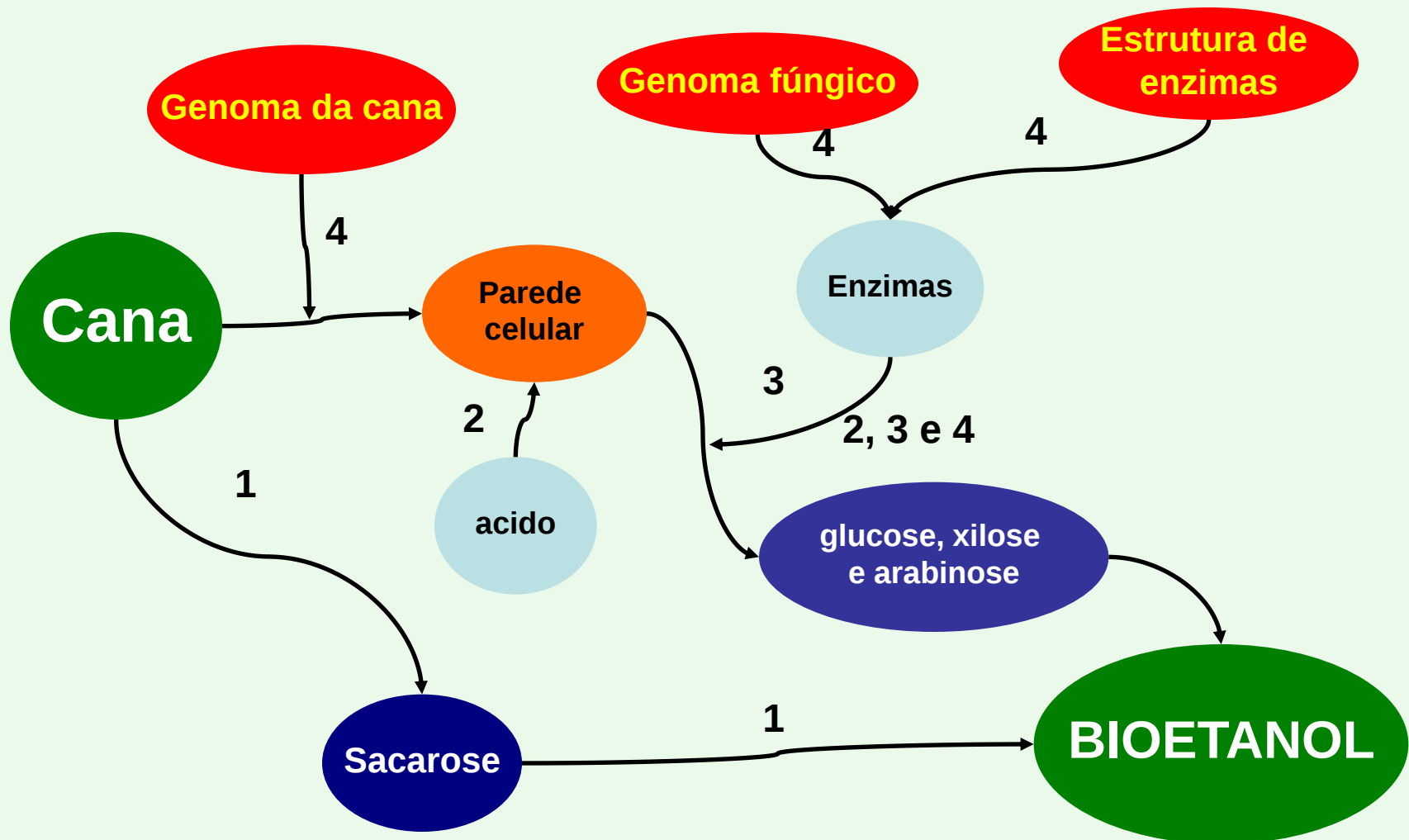
5 centres with 29 laboratories in 6 states



<http://bioethanolbrazil.wordpress.com>

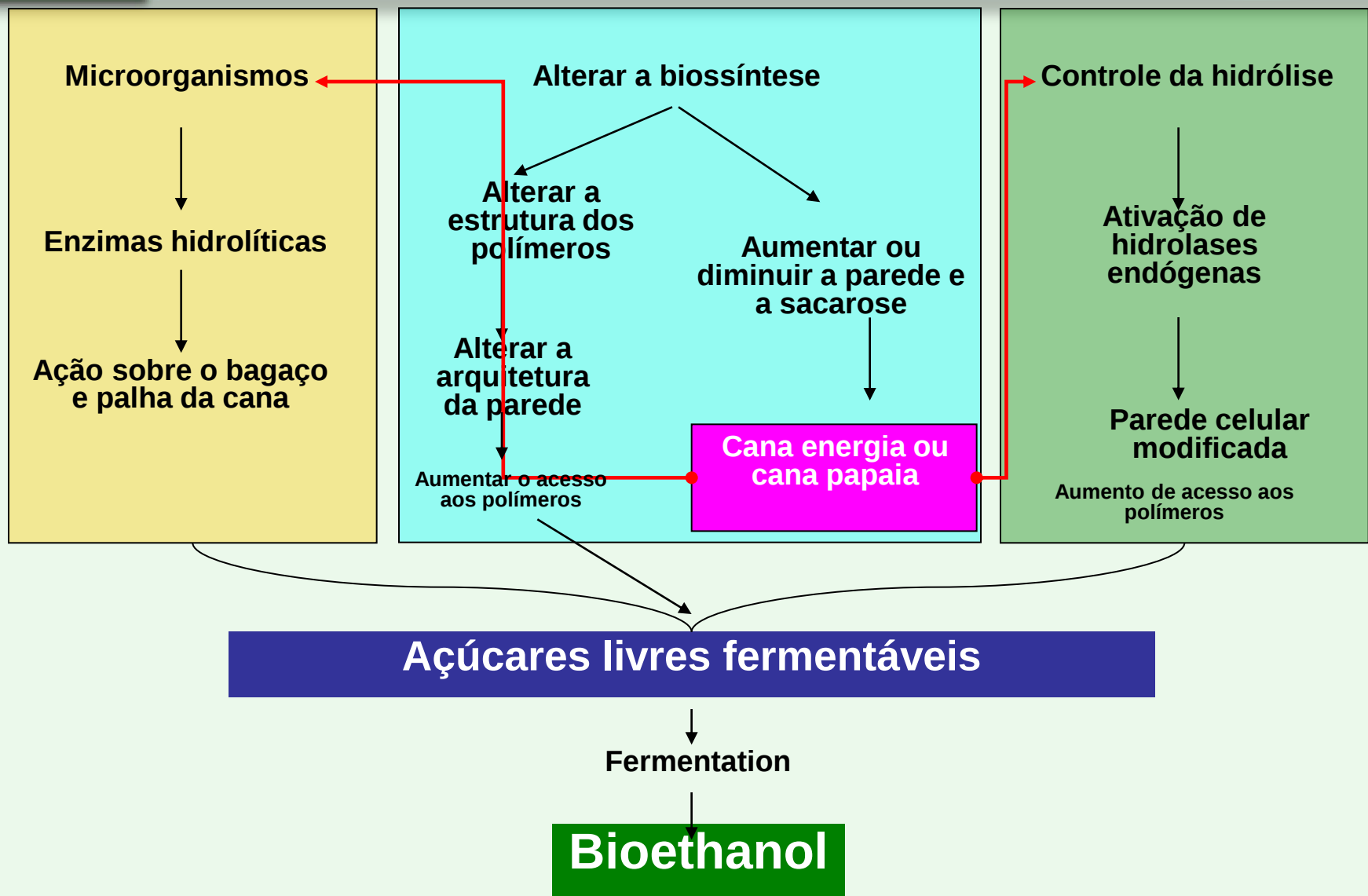


Four steps strategy to reach cellulosic bioethanol



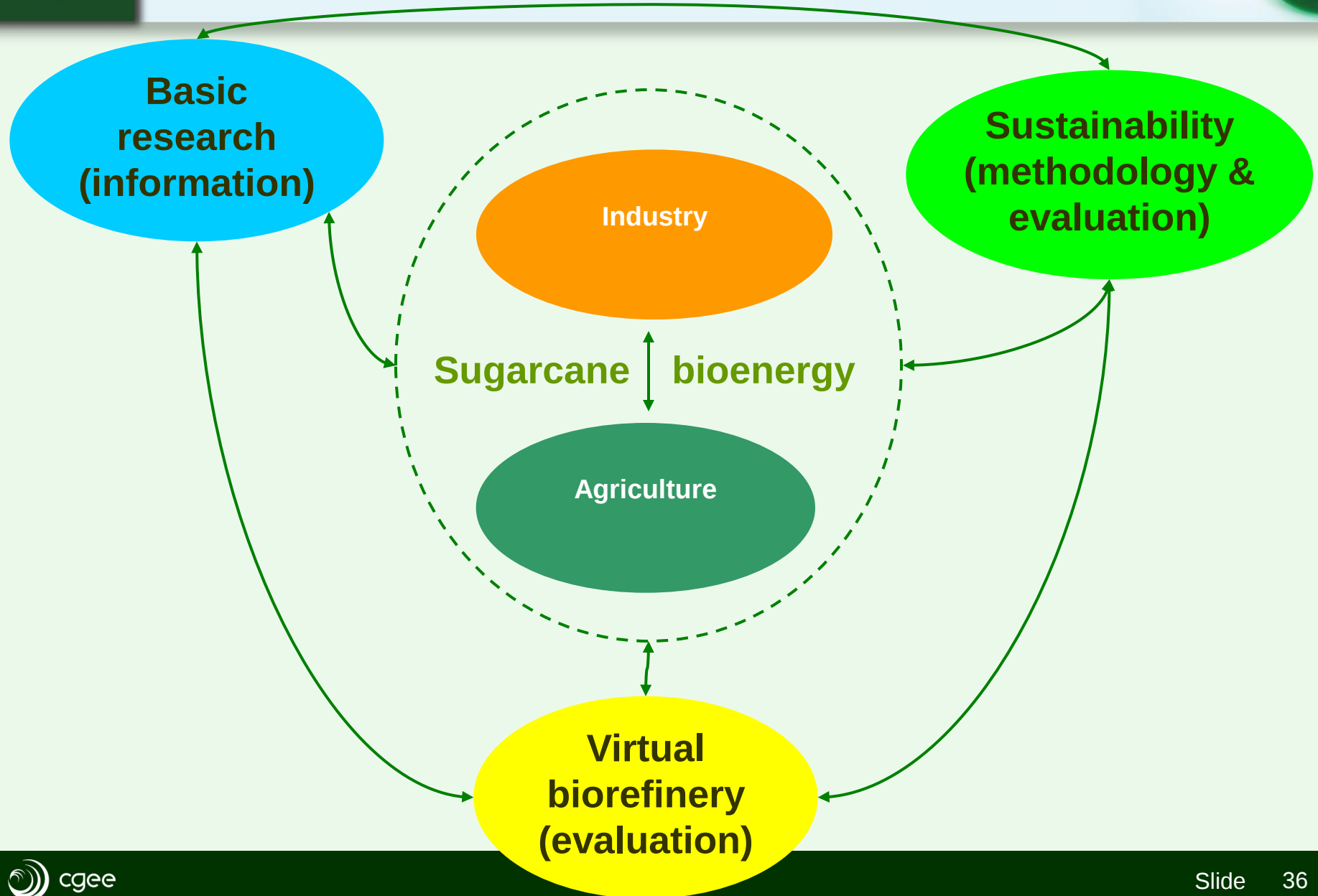


Strategies to modify organisms in order to obtain more energy from cell walls





National Laboratory on Science, Technology and Innovation related to sugarcane bioenergy - CTBE





Bioethanol energy and GHG balances

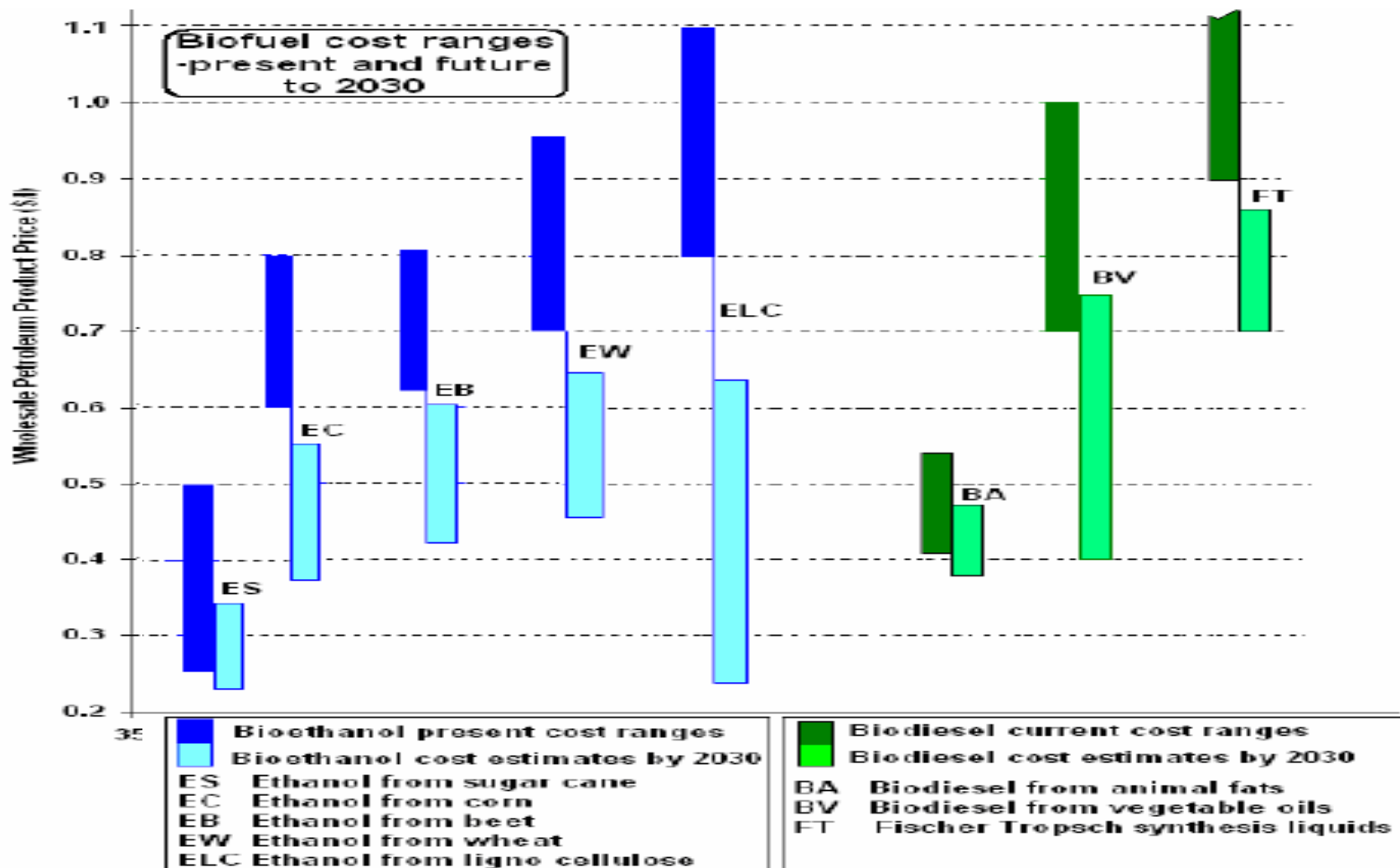


Raw material	Energy ratio (production/consumption)	Avoided emissions
Sugarcane	9,3	91%
Corn	0,6 – 2,0	30% a 38%
Wheat	0,97 – 1,11	19% a 47%
Beet	1,2 – 1,8	35% a 56%
Cassava	1,6 – 1,7	63%
Ligno-cellulosic residues	8,3 – 8,4	66% a 73%

Based in Dai et al., 2006, EBAMM, 2005, IEA, 2004, Macedo et al., 2007 e Nguyen et al., 2007



New biofuel technologies – cost perceptions



Fonte: IEA, 2006



Visionary perception



“I foresee the time when industry shall no longer denude the forests which require generations to mature, nor use up the mines which were ages in the making, but shall draw its raw material largely from the annual products of the fields”

Henry Ford, Modern Mechanics (1934)

Ford Model A (1896) fueled by pure ethanol [Fuel Testers (2008)]





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