

**Presentation to  
The California Energy Commission**

**July 31, 2013**

**DATAGRO** 

PLANTING DATA HARVESTING SOLUTIONS



# BRAZIL'S SUGARCANE ETHANOL EXPORT POTENTIAL

**Dr. Plinio Nastari**  
president, DATAGRO

**Presentation to**  
**The California Energy Commission (CEC)**

Hearing  
July 31, 2013

# ABOUT DATAGRO

DATAGRO is the world's largest ethanol and sugar consulting company. It produces innovative and differentiated analysis, providing tools for a better understanding, adding value to its Clients' commercial and strategic positioning. DATAGRO Clients are located in 41 countries, of the 5 continents.

It has over 80 co-workers spread in its Head office in Alphaville, and other 5 locations – São Paulo, New York (US), Recife, Santos and Ribeirão Preto.

DATAGRO consists of 11 Business Units, and most of its work is based on independent research and expertise. It has also helped Governments in Trade Negotiations and Trade Disputes (USITC, WTO) , and Arbitrations (ICC, and FGV).

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# ABOUT DATAGRO

## Business Units:

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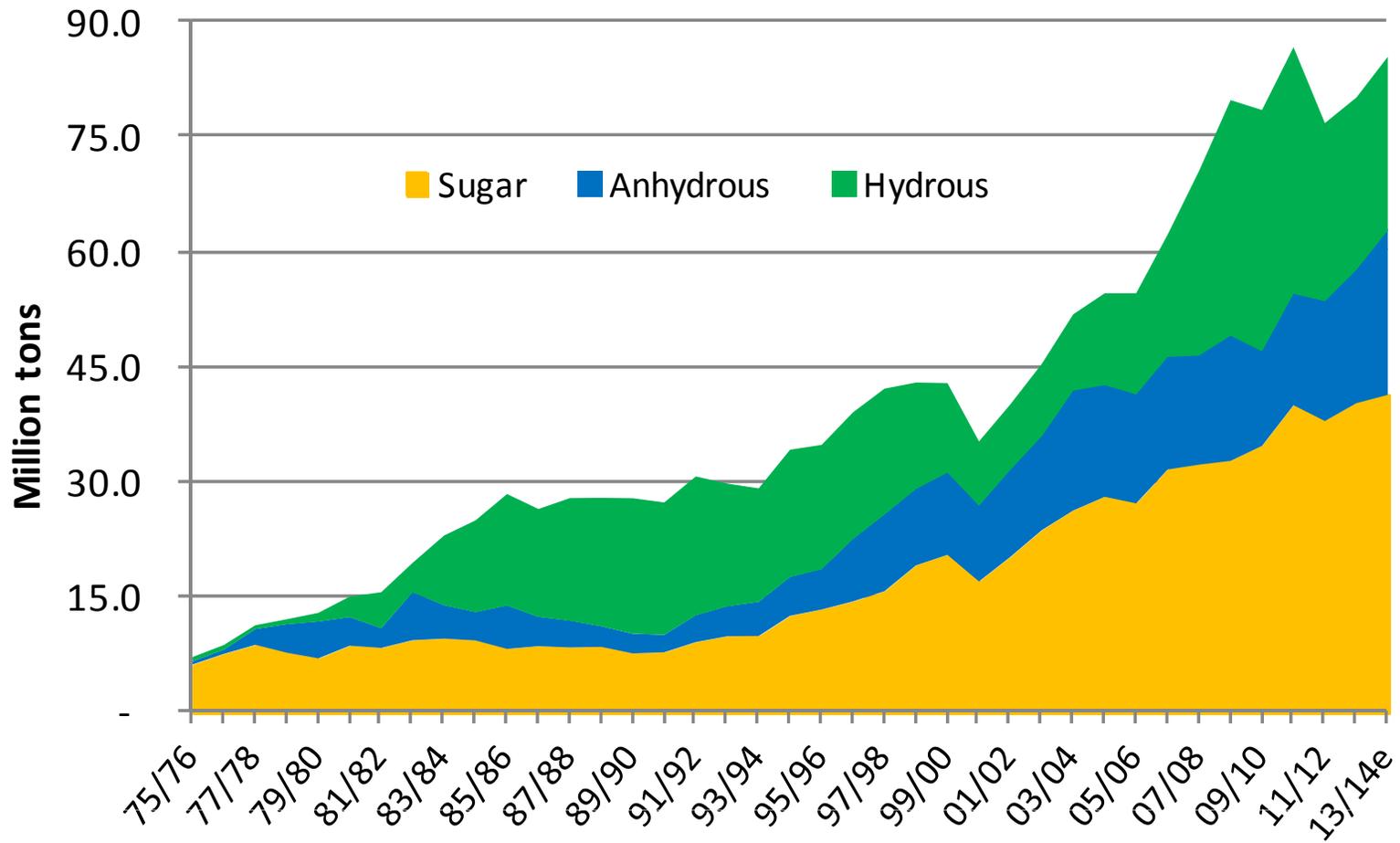
# Brazil in the world context of Sugar & Ethanol

- Brazil is positioned in the world as (2012):
  - No. 1: sugarcane producer (34.6% of world's 1.794 billion tons of cane)
  - No. 1: sugar producer (23% of world)
  - No. 2: ethanol producer (28% of world)
  - No. 1: sugar exporter (49% of world)
  - No. 1: ethanol exporter (55% of world)
- It is remarkable that it has achieved this market share with only:
  - 36.1% of its cane converted to export sugar;
  - 6.8% of its cane converted to export ethanol.
- This explains why Brazil is such an important fundament to the world sugar & ethanol markets.

# Energy derived from Sugarcane in Brazil

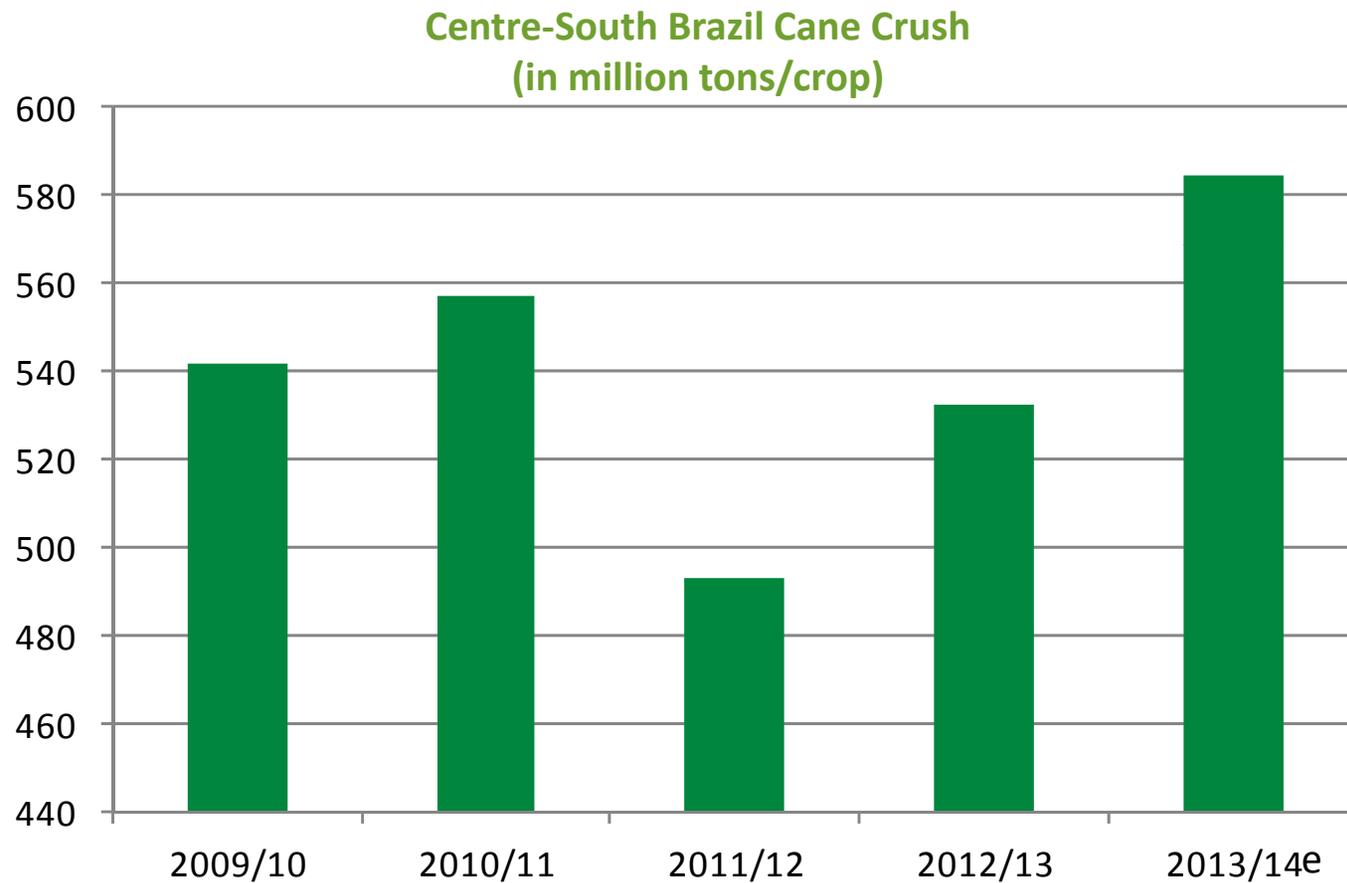
- Sugarcane is the 2<sup>nd</sup> largest source of primary energy in Brazil (17%), after oil (36%), and above hydropower (15%).
- Sugarcane production has grown after the intensification of diversification of production towards ethanol, started in mid-70s.
- Another diversification process is under way from the economic use of bagasse and leaves , for power, 2<sup>nd</sup> gen ethanol, and biogas.
- 2008 financial crisis + adverse climate, reduced ag yields in recent years.
- Feedstock gap of 130 million tons of cane was eliminated in 2013. Brazil is positioned to continue expanding production.
- DATAGRO estimates cane crush in Brazil can grow to 1.06 billion tons in 2023 (10 years).

# Brazil's Supply of Total Reducing Sugars (TRS) has grown from 7.1 to 85.7 mmt since 1975



Source: DATAGRO.

# Centre-South Brazil: cane deficits in 2011 & 2012, disappeared in 2013



Source: DATAGRO.

# World Biofuels Production

- In the past decade, world biofuels production rose from 30 to ~130 billion liters => can no longer be considered exotic fuels.
- Biodiesel rose more rapidly than bioethanol, but ethanol accounts for 83.8% of all biofuel supply.
- Brazil pioneered large scale production and use of ethanol as a gasoline substitute, and achieved a high rate of substitution.
- Industry in Brazil is going thru a phase of transformation, in which new levels of sustainability are being achieved.

# Ethanol accounts for 83.8% of all biofuels production...

<b>World Production of Biofuels (Bioethanol and Biodiesel)</b>					
<b>Year</b>	<b>Total Biofuels</b>	<b>Bioethanol</b>		<b>Biodiesel</b>	
		<b>million liters</b>	<b>% share</b>	<b>million liters</b>	<b>% share</b>
2000	30,386	29,565	97.3%	821	2.7%
2001	32,392	31,368	96.8%	1,024	3.2%
2002	33,763	32,277	95.6%	1,486	4.4%
2003	39,549	37,573	95.0%	1,976	5.0%
2004	42,655	40,278	94.4%	2,377	5.6%
2005	48,468	44,480	91.8%	3,988	8.2%
2006	60,802	53,928	88.7%	6,874	11.3%
2007	76,678	65,856	85.9%	10,822	14.1%
2008	98,359	82,387	83.8%	15,972	16.2%
2009	106,024	88,119	83.1%	17,905	16.9%
2010	120,490	101,273	84.1%	19,217	15.9%
2011e	129,413	108,422	83.8%	20,991	16.2%

Source: DATAGRO

# 88.1% of all ethanol is used as fuel...

Bioethanol Uses in the world					
Year	Total Production	Used as Fuel		Other Uses	
		million liters	% share	million liters	% share
2000	29,565	18,952	64.1%	10,613	35.9%
2001	31,368	19,928	63.5%	11,440	36.5%
2002	32,277	23,698	73.4%	8,579	26.6%
2003	37,573	28,395	75.6%	9,178	24.4%
2004	40,278	34,821	86.5%	5,457	13.5%
2005	44,480	36,414	81.9%	8,066	18.1%
2006	53,928	41,386	76.7%	12,542	23.3%
2007	65,856	53,014	80.5%	12,842	19.5%
2008	82,387	70,155	85.2%	12,232	14.8%
2009	88,119	75,056	85.2%	13,063	14.8%
2010	101,273	88,374	87.3%	12,899	12.7%
2011e	108,422	95,468	88.1%	12,954	11.9%

Source: DATAGRO

Brazil has achieved a  
remarkable achievement  
in gasoline substitution

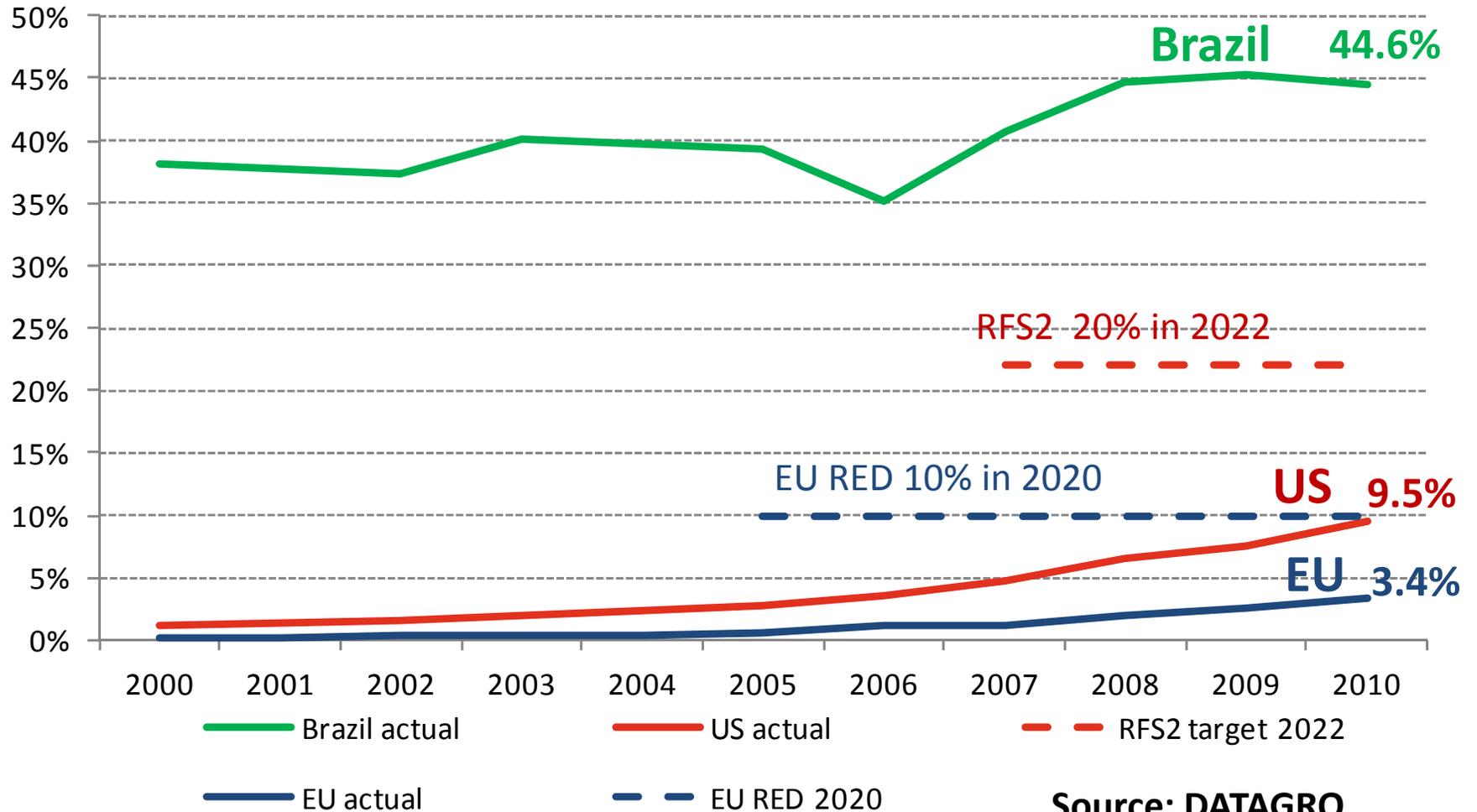
# Production Growth in Brazil

- Since 1975, when the diversification towards ethanol started cane production rose 8.3 times, the supply of total sugars 11.0 x, sugar production 5.2x, and production of ethanol 49.5 x.
- Since 2003, when flex car sales started , cane crushing rose from 358 to 634 million tons, sugar production rose 63% and production of ethanol rose 88%.

Crop Brazil	1975/76	2003/04	2010/11	2012/13	2013/14e	Var. %	
	A	B	C	D	E	E/A	E/B
Cane (million tons)	68.3	358.6	620.0	587.9	633.5	827%	77%
Supply of TRS (million tons)	7.1	52.5	86.9	79.7	85.7	1102%	63%
Sugar (million tons)	5.9	24.9	38.0	38.2	36.5	519%	46%
Ethanol (billion litres)	0.6	14.7	27.4	23.2	27.8	4947%	88%
% cane to ethanol	13.4%	50.3%	54.2%	49.7%	55.3%		
% cane to export sugar	16.8%	28.6%	30.8%	36.6%	33.4%		
% cane to export ethanol	0.0%	3.6%	3.9%	7.7%	8.3%		

Source: Datagro.

# Ethanol as % of Otto-cycle fuel demand in Brazil, US & EU – 2000 to 2010 – in gasoline equivalent



# Since 1975, ethanol has substituted in Brazil 2.3 billion barrels of gasoline

Proven reserves of oil and condensates (2012, incl. Pre-Salt):  
**15.3 billion barrels**



Between 1975 & Dec/2012, volume of substituted  
**gasoline** is:

**2.3 billion barrels**

At current pace, every year new 120 million barrels  
are substituted without additional investment,  
**because Sugarcane Ethanol is Renewable.**

Source: Datagro

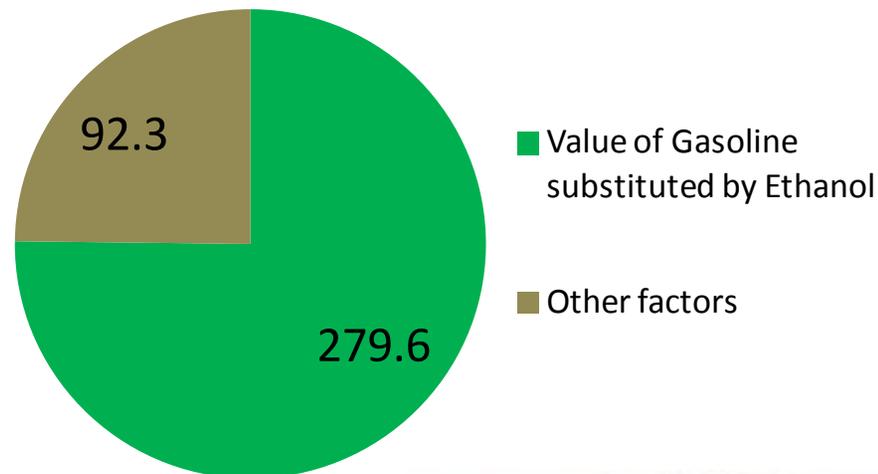
# Savings in Imports

- Between 1975 & Dec/2012, the value of substituted gasoline, at world market prices, plus the avoided service on foregone debt evaluated at Prime+200pts, in constant US dollars of Dec/2012, brought economy of

**US\$ 279.6 billion.**

Source: Datagro

## Brazil's Foreign Reserves (June/2013): US\$ 371.90 billion



# Issues affecting Brazil's cane sector in the past 4 years

- Change in production systems, from manual to mechanical planting and harvesting => higher losses, greater investments, higher costs in the short term due to climate problems.
- Current effort to recover lost productivity: large cane planting effort underway.
- Production was impacted by unusual climate, but also new mode of production has made it more sensitive to climatic events.

# Manual Planting & Harvesting Operations



# Mechanical Planting & Harvesting Operations



DATAGRO Crop Survey Project



## US EPA & EU RED

- 180 plants in Brazil are accredited by the US EPA as suppliers of Advanced Bioethanol (July/13, out of 441).
- 28 installations in Brazil are certified by Bonsucro to supply ethanol and sugar to the EU (July/13 – there are only 2 other plants in Australia, certified by Bonsucro).

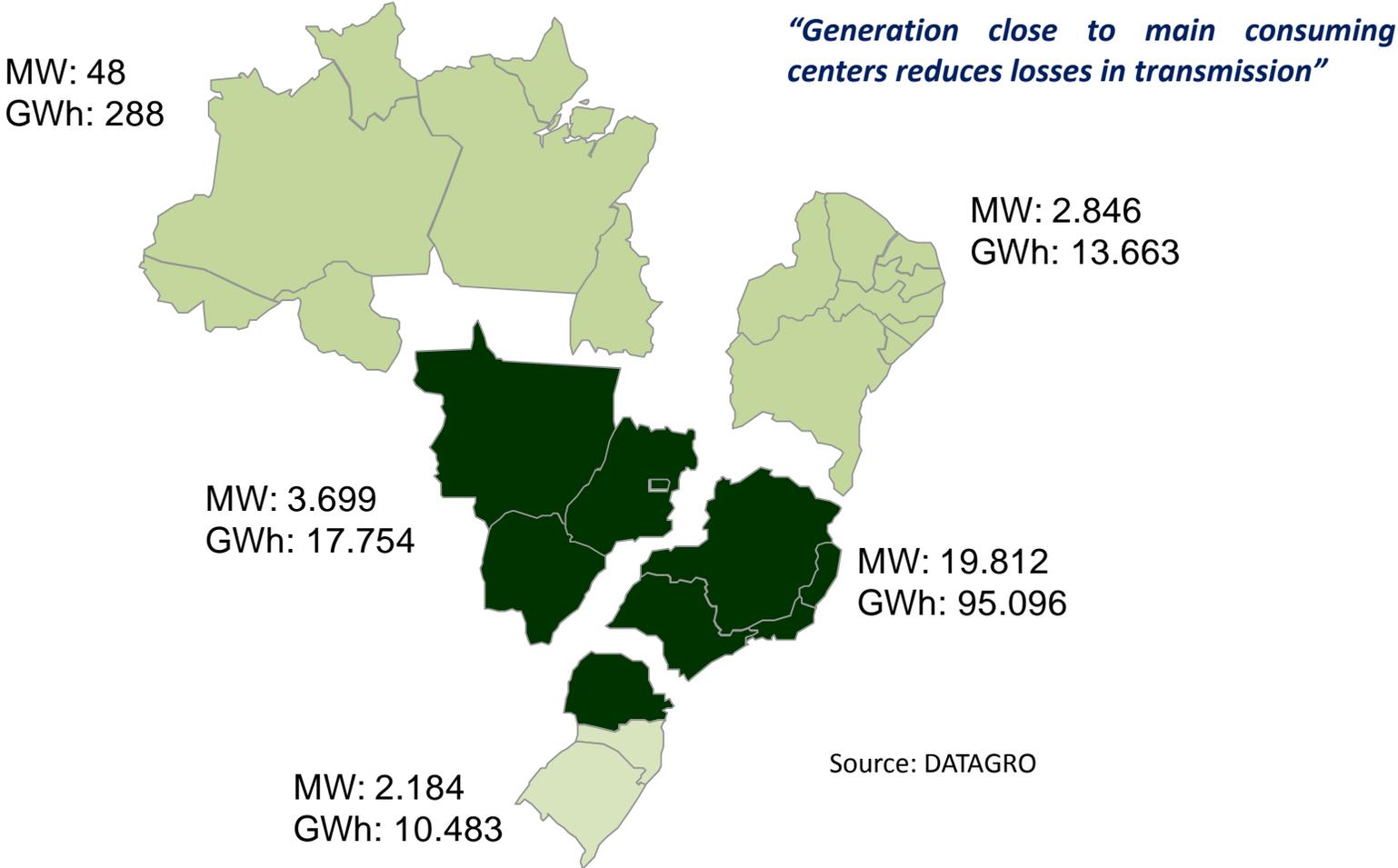
# Cane ethanol: closed circuit of soil nutrients

- This is one of the most interesting and differentiated characteristics of cane ethanol compared with other sources of biofuels and agroindustries.
- Cane mills only “export” carbohydrates, sugar & ethanol, molecules with atoms of Carbon and Hydrogen.
- All other chemical elements, such as Nitrogen (N), Phosphorus (P), Potash (K), Calcium (Ca), Magnesium (Mg), Sulfur (S), and other micronutrients are recycled thru the byproducts (vinasse, ash, filter cake) which are returned to the soil.
- This is why cane “builds-up” soil overtime.

Economic use of tops and  
leaves will enlarge  
production and income  
from same production  
base

# Cogen Potential with Cane Bagasse in 2012

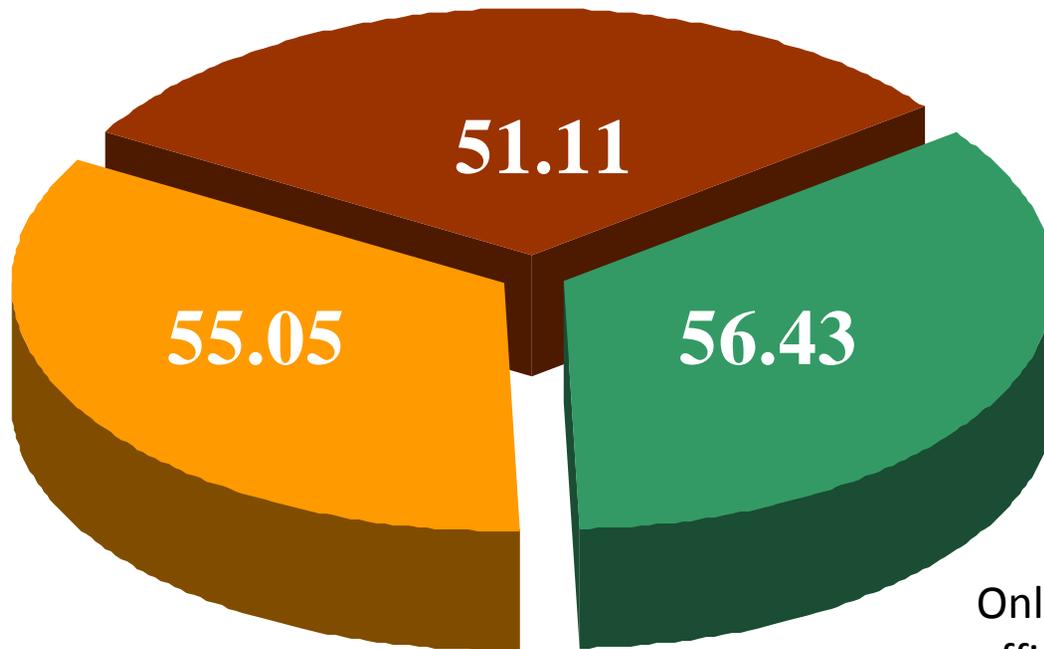
During the crop (200 days, dry season)



# Energy Contained in 1,000 tons of Sugar Cane

(in tons of oil equivalent)

■ **Sucrose**      ■ **Bagasse**      ■ **Tops and Leaves**

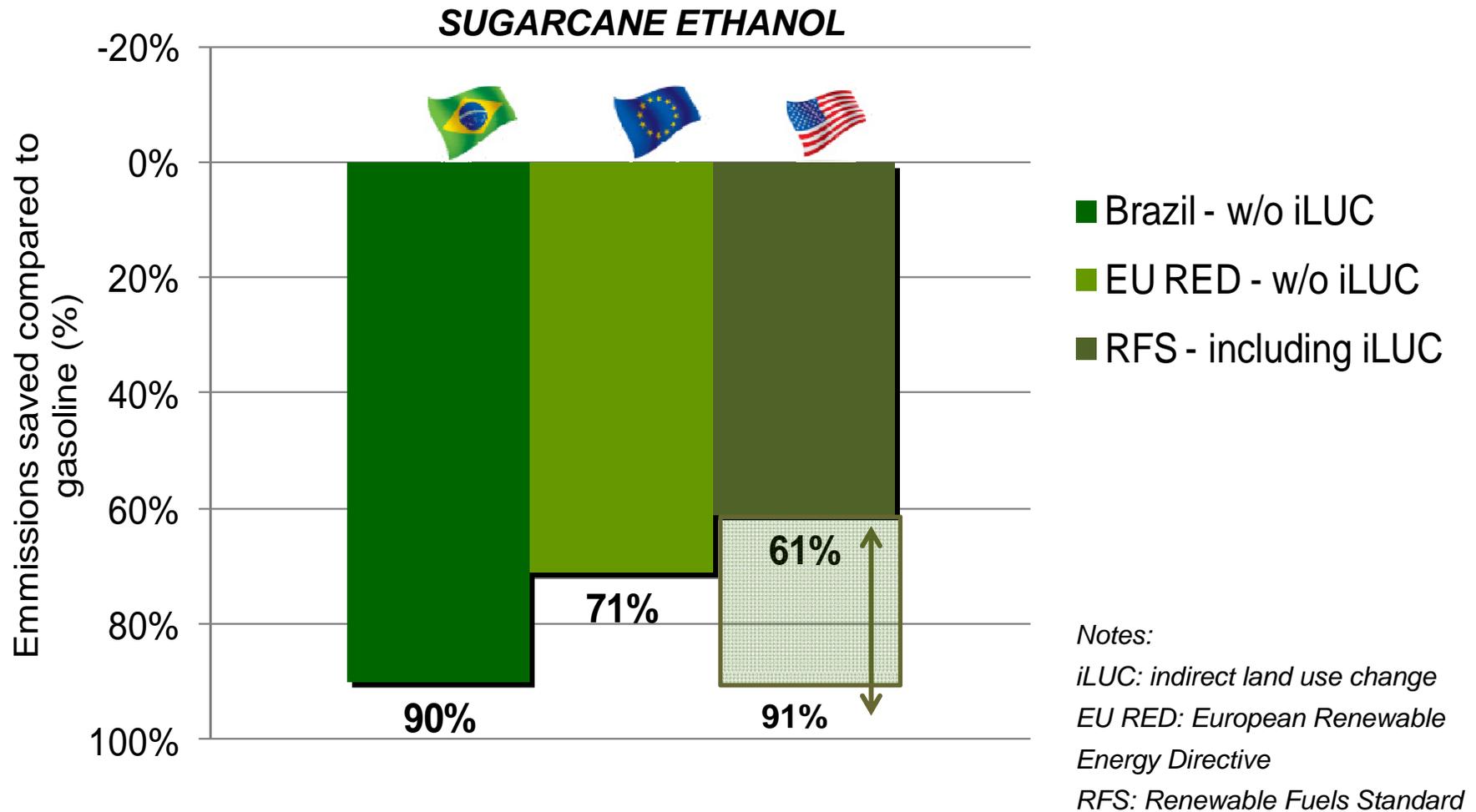


Source: Nastari, Lisbon, 2000

Only sucrose part is used efficiently today. Bagasse is used inefficiently and leaves until recently were wasted.

# SUGARCANE ETHANOL: HIGH GHG REDUCTIONS

(SEVERAL METHODOLOGIES, COMPARED TO GASOLINE)



Sources: Isaias Macedo e Joaquim Seabra (2008); Meira & Macedo (2010); RFS; CARB and European Directive

# Projected demand for cane until 2023

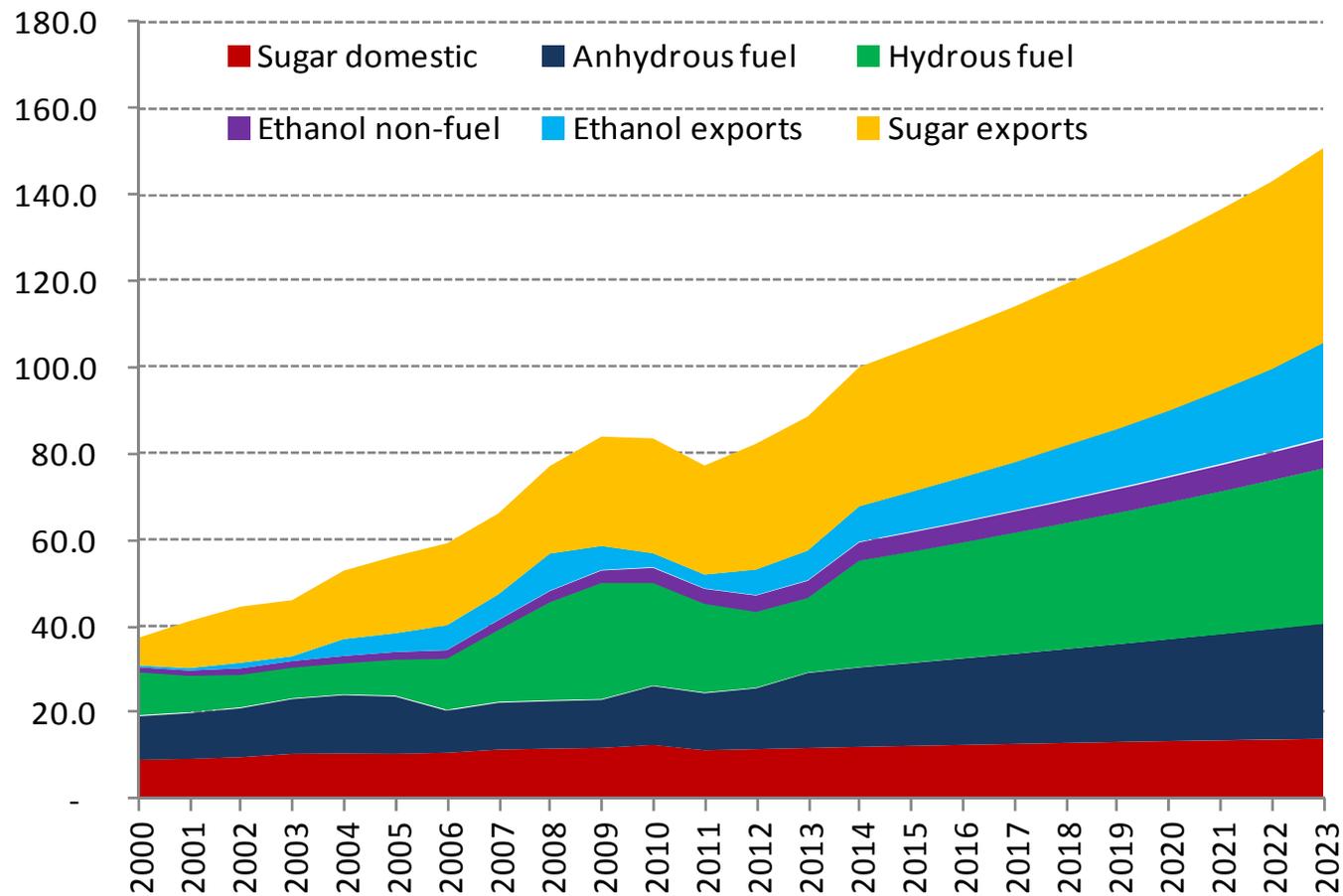
- With conservative assumptions on the potential expansion of sugar and ethanol demand, the projected demand for cane indicates that the domestic and export markets will continue asking for more sugar and ethanol from cane.

# Projected demand for cane until 2023

- Estimated demand for cane until 2023, indicates for a conservative scenario of:
  - 20% usage of hydrous ethanol in flex fleet;
  - Stable Brazil's market share in sugar exports,
- 1.06 billion tons of cane in 2023.

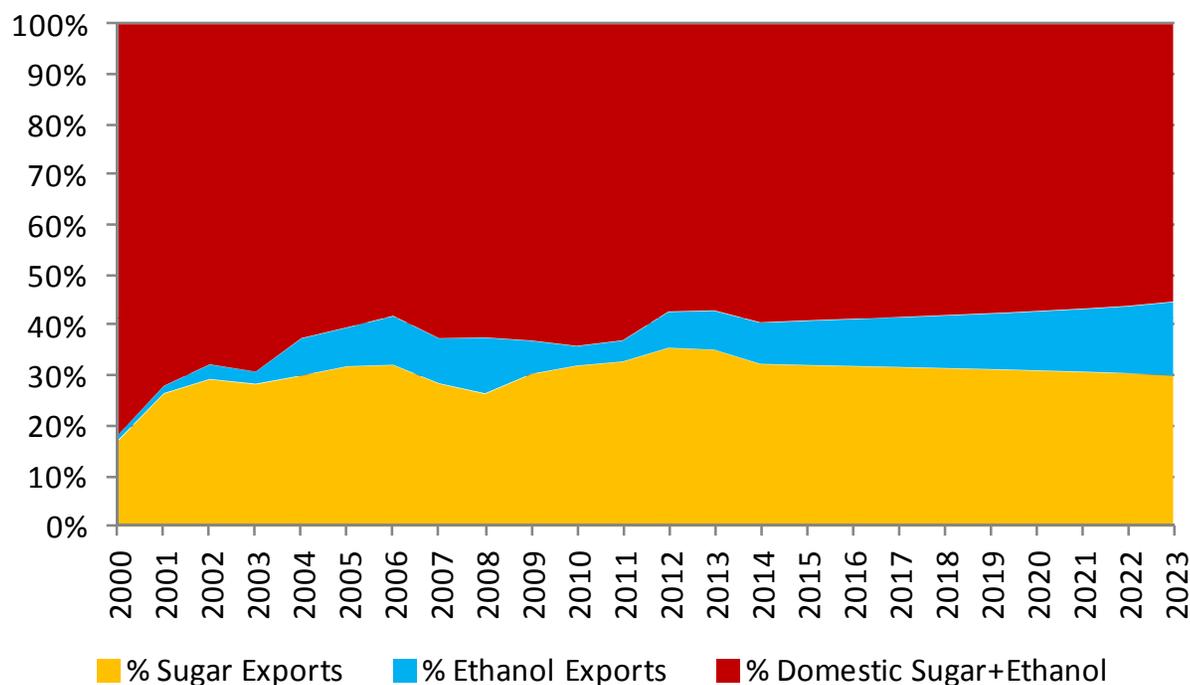
# Forecast of Brazil's Sugar+Ethanol Demand (Datagro, 2013)

(in million tons of total reducing sugars)



Source: DATAGRO

# Proportion of Exports of Sugar & Ethanol in Total Production (as % of TRS)



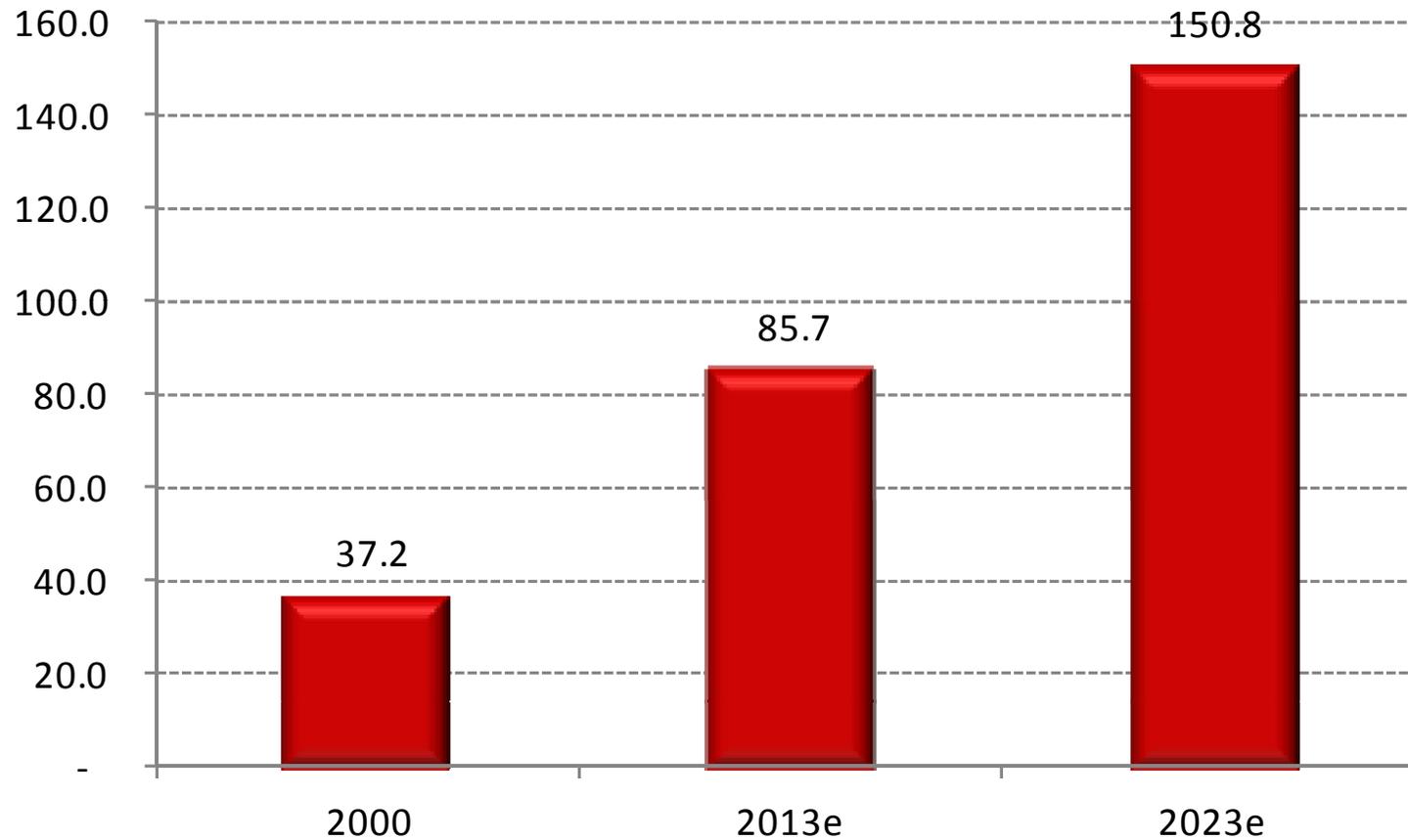
Source: DATAGRO

**Ethanol exports as a percentage of total production rose from 1% in 2000, to 11.1% in 2008, is 7.8% in 2013, and is projected at 14.7% in 2023.**

**Exports of Sugar+Ethanol accounted for 18% of production in 2000, 42.9% in 2013, and are projected at 44.6% in 2023.**

# Total Reducing Sugars

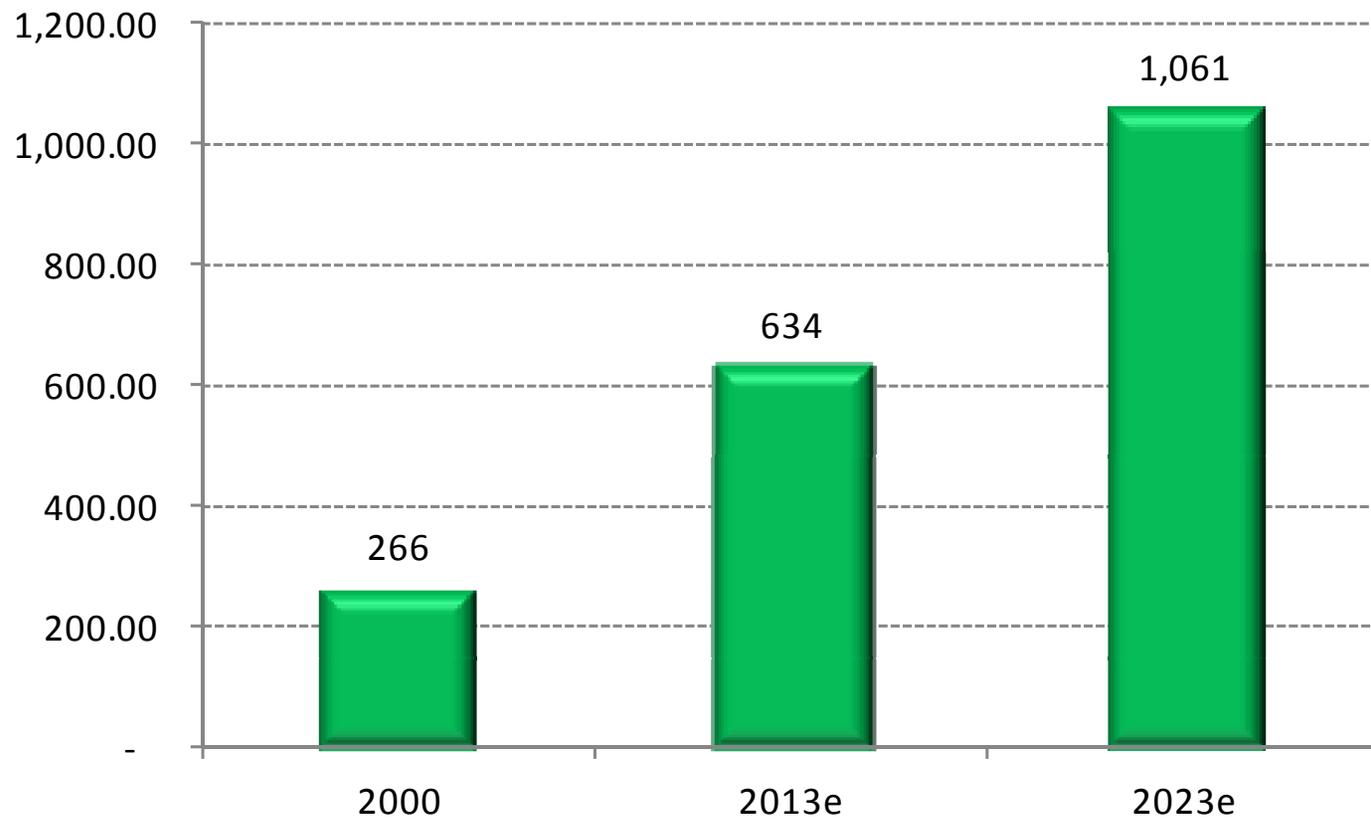
(in million tons)



Source: DATAGRO

# Sugarcane for Sugar+Ethanol

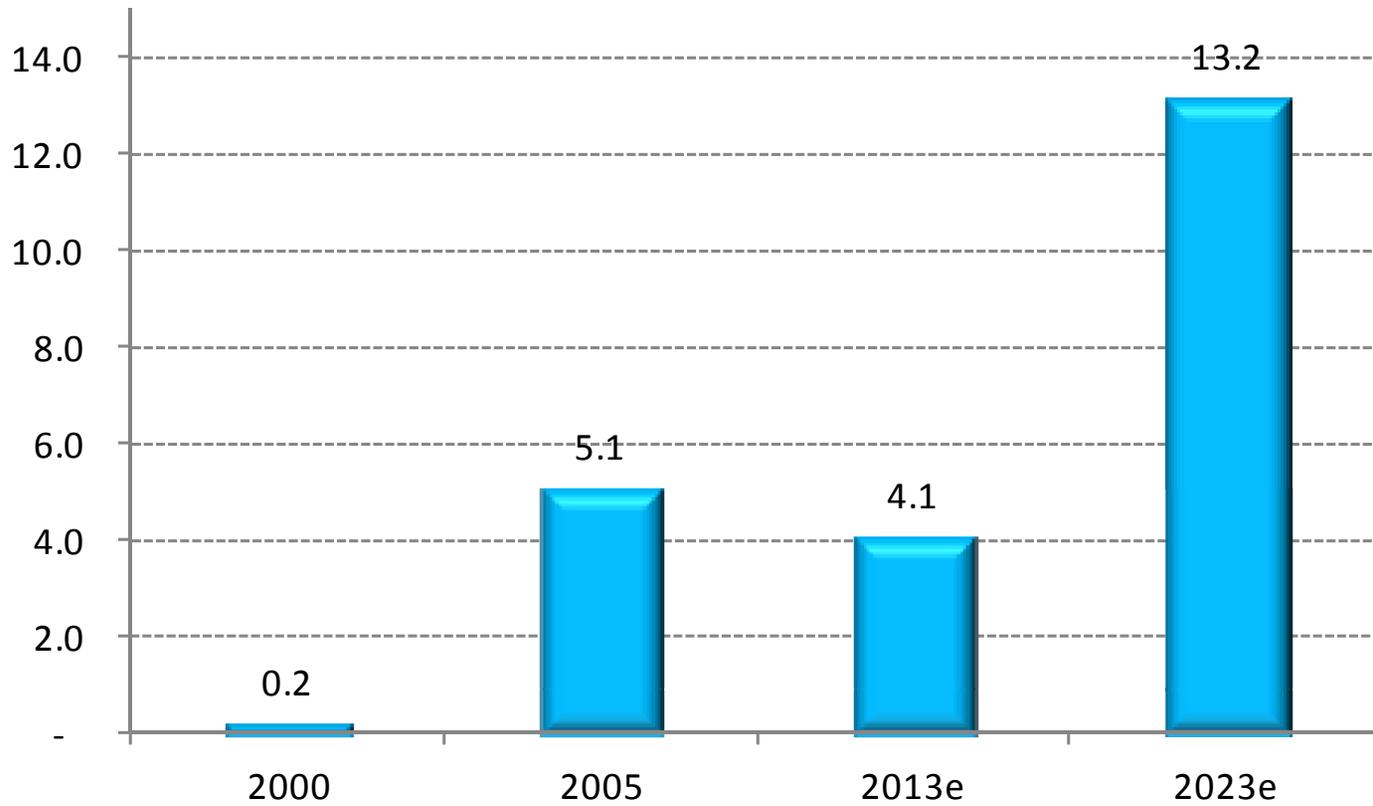
(in million tons)



Source: DATAGRO

# Ethanol Exports

(in million cubic meters)



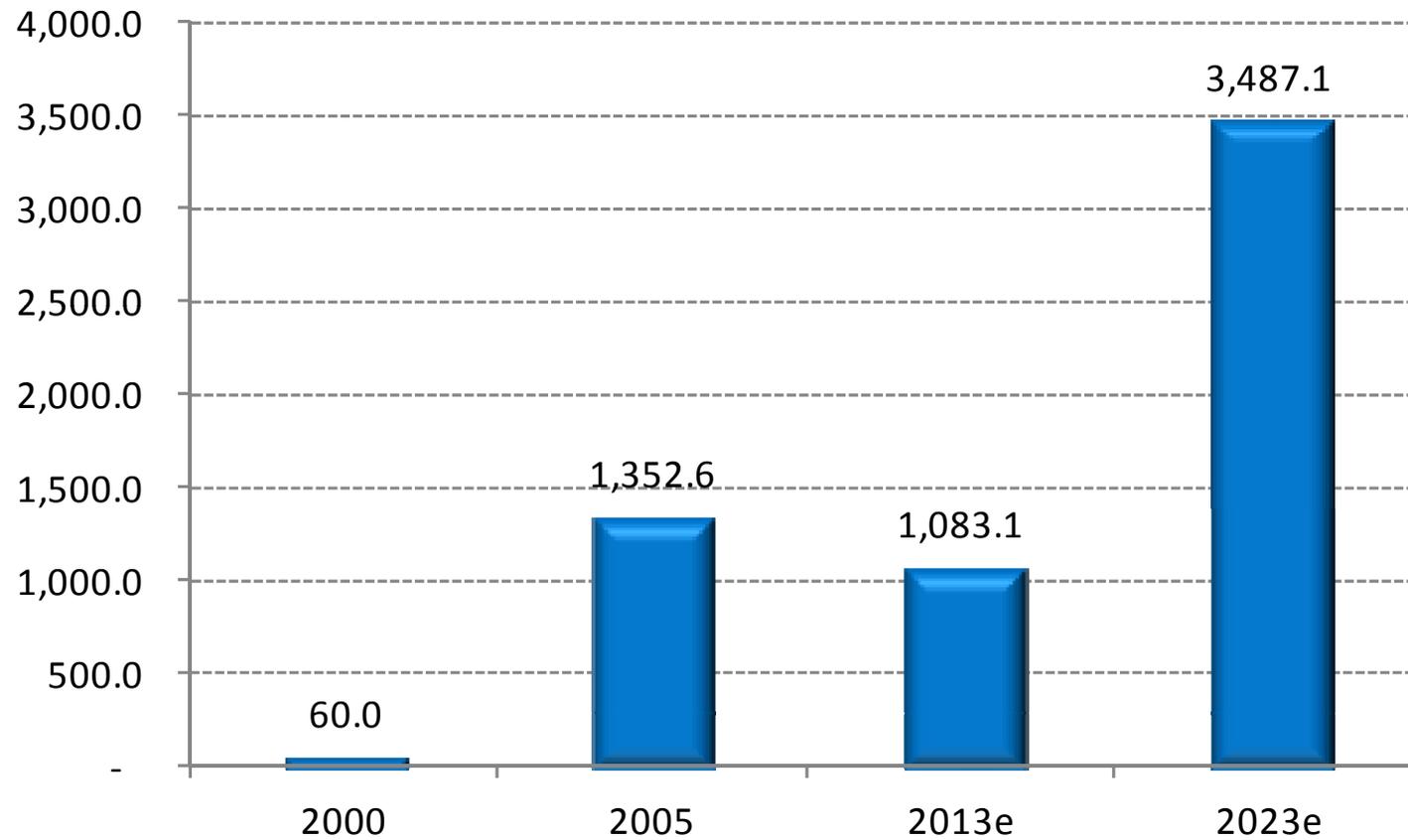
Source: DATAGRO

# Volumetric Conversion Factors

- 1 Cubic Meter (cbm) = 1,000 liters
- 1 US Gallon = 3.78541 liters
- 1 Cubic Meter (cbm) = 264.17218 US Gallons

# Ethanol Exports

(in million gallons)

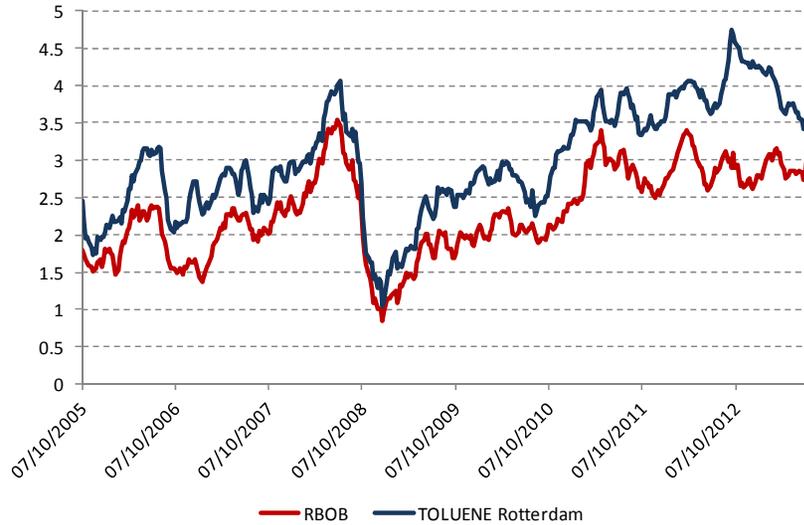


Source: DATAGRO

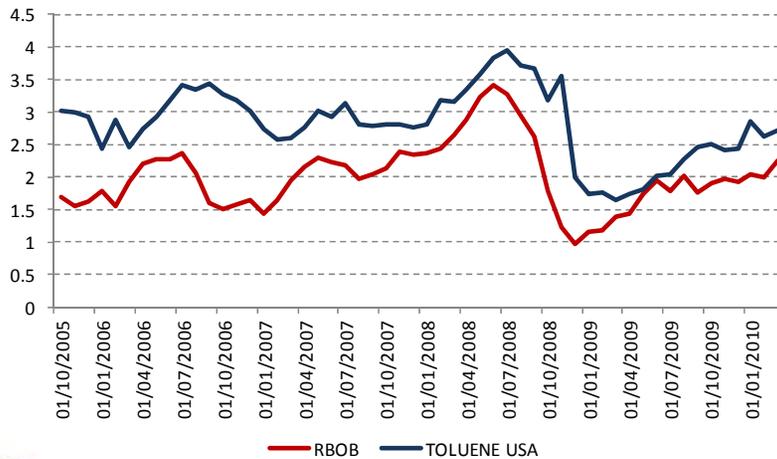
# Bioethanol's opportunity price is the price of Toluene, not Gasoline

- Ethanol's superior characteristics as fuel, and fuel additive, show that its value should be referenced to the price of Toluene, not Gasoline.
- Toluene has a market value which is 30%-45% higher than the price of gasoline (depending on market, and time series length).
- Regulation that recognizes the environmental benefit of ethanol only internalizes in market prices the inherent value of ethanol as fuel.
- Share of total exportable surplus (sugar+ethanol) dedicated to ethanol will depend on how effective is this recognition.

# Bioethanol's opportunity price is the price of Toluene, not Gasoline



In Rotterdam (2005-2013), Toluene has an average 30% premium over gasoline.



In the US (2005-2010), Toluene has an average 45% premium over gasoline.

Source: Bloomberg

# Brazil is the Major Exporter of Ethanol to the US

<b>Ethanol Exports (in cubic meters)</b>			
<b>Year</b>	<b>Brazil to US</b>	<b>All origins to US</b>	<b>All origins to CA</b>
2003	46,349	709,681	158,153
2004	425,523	920,013	243,313
2005	277,076	820,634	311,447
2006	1,718,886	2,733,203	400,180
2007	864,018	1,961,774	85,706
2008	942,078	2,208,855	137,435
2009	253,554	1,101,882	40,949
2010	299,271	497,471	3,193
2011	659,225	1,152,017	135,024
2012	2,053,368	2,535,991	378,138
2013 (Jan-May)	569,266	816,367	196,748

Source: US-ITC, compiled and analyzed by DATAGRO

# Brazil is the Major Exporter of Ethanol to CA

(Direct and Indirect, thru CBI)

<b>Ethanol Exports (in cubic meters)</b>				
<b>Year</b>	<b>Brazil to CA</b>	<b>CBI to CA</b>	<b>Brazil+CBI to CA</b>	<b>All origins to CA</b>
2003	-	158,153	158,153	158,153
2004	97,184	146,090	243,274	243,313
2005	66,778	243,562	310,340	311,447
2006	110,109	164,806	274,915	400,180
2007	15,857	63,840	79,697	85,706
2008	18,105	118,319	136,424	137,435
2009	-	40,516	40,516	40,949
2010	-	-	-	3,193
2011	85,094	46,488	131,583	135,024
2012	247,980	126,186	374,166	378,138
2013 (Jan-May)	137,289	57,949	195,238	196,748

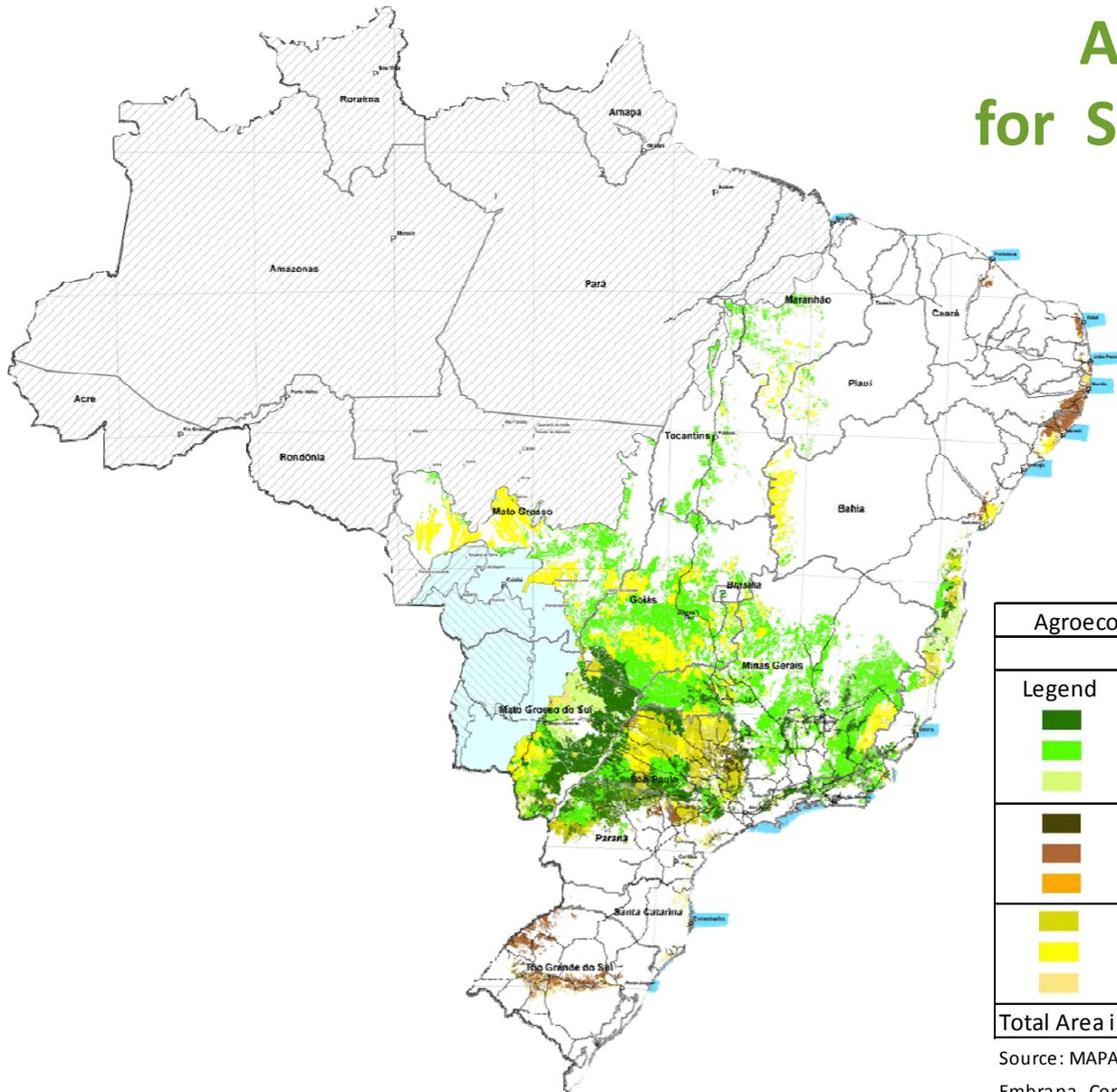
Source: US-ITC, compiled and analyzed by DATAGRO

# **ETHANOL PRODUCTION CAN EXPAND IN A SUSTAINED WAY BASED ON CANE.**

**FOR THE BRAZILIAN CASE,  
SUGARCANE (FOR SUGAR & ETHANOL)  
OCCUPIES (IN 2012) 9.8 MILLION HA OUT  
OF 65.0 MILLION HA POSSIBLE FOR CANE,  
ACCORDING TO THE AGROECOLOGICAL ZONING.**

**SUGARCANE FOR ETHANOL OCCUPIES ONLY  
5.1 MILLION HA, OR 1.6% OF TOTAL  
ARABLE LAND.**

# Agroecological Zoning for Sugar Cane Growth in Brazil



Agroecological Zoning for Sugar Cane Growth in Brazil - 2009			
Areas Considered Suitable for Sugar Cane			
Legend	Suitability	Current occupation	Area (million ha)
	High	Pasture	11,302,343
	Medium	Pasture	22,863,866
	Low	Pasture	3,041,122
	High	Cattle	600,767
	Medium	Cattle	2,126,395
	Low	Cattle	483,326
	High	Agriculture	7,360,310
	Medium	Agriculture	16,496,736
	Low	Agriculture	731,077
Total Area in Brazil (H+M+L)			65,005,941

Source: MAPA, MCT, MME, MPOG, MMA, Casa Civil, Embrapa, Conab, IBGE, CPRM, INPE, UNICAMP, PNUD.

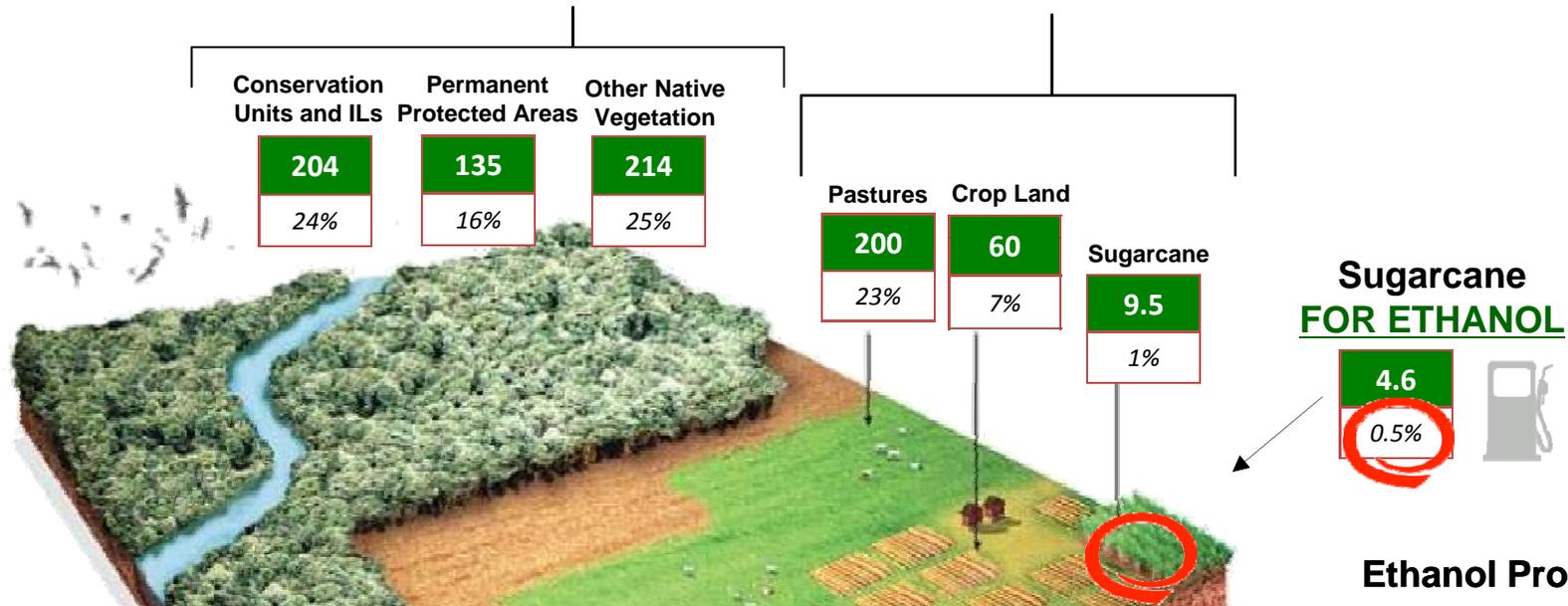
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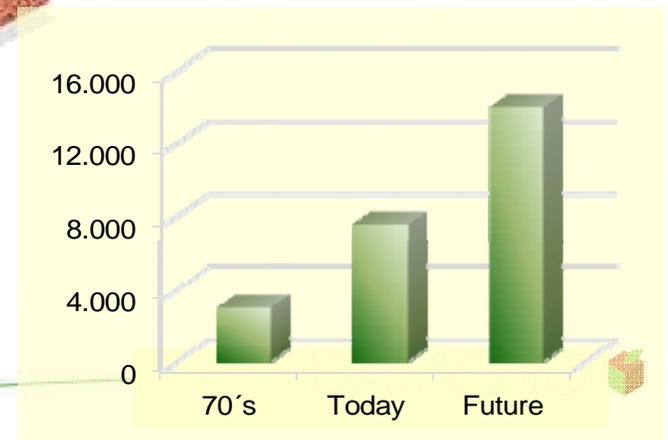
# LAND USE IN BRAZIL

Million Ha\*

Total Area	Native Vegetation	Land in Actual Use	Other Uses
851	554	260	38
100%	65%	30%	5%



## Ethanol Productivity

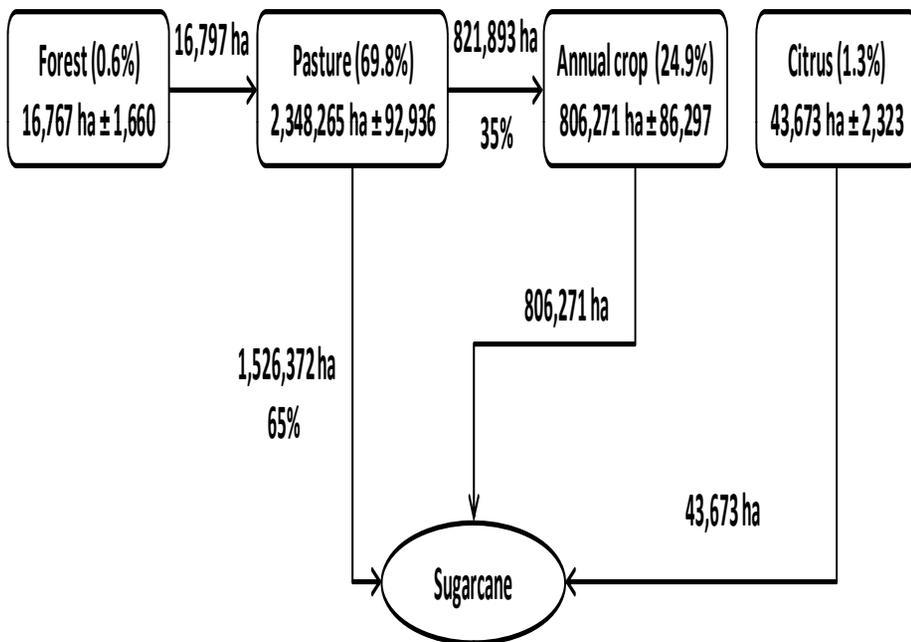


Sources: ICONE, Gerd Sparovek, IBGE, MMA, INPE/TerraClass, Embrapa, PAM2010.  
 Note: ILs = Indigenous Lands. Other Native Vegetation include Legal Reserves (RLs)

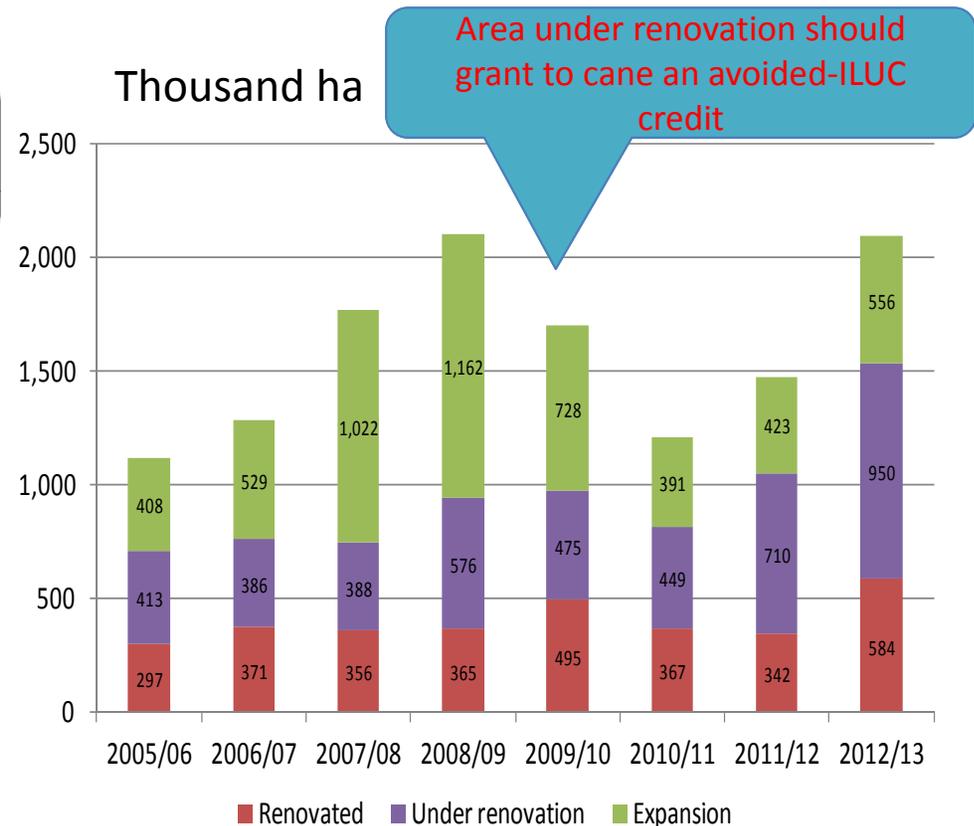
# DYNAMICS OF SUGARCANE EXPANSION AND INTERCROPPING

- Regardless the land availability, sugarcane expansion dynamic has been pasture-based

- Each hectare of cane can bring together 1/6 hectare of food production (intercropping)



Expansion (2005-09): 3.2 million ha

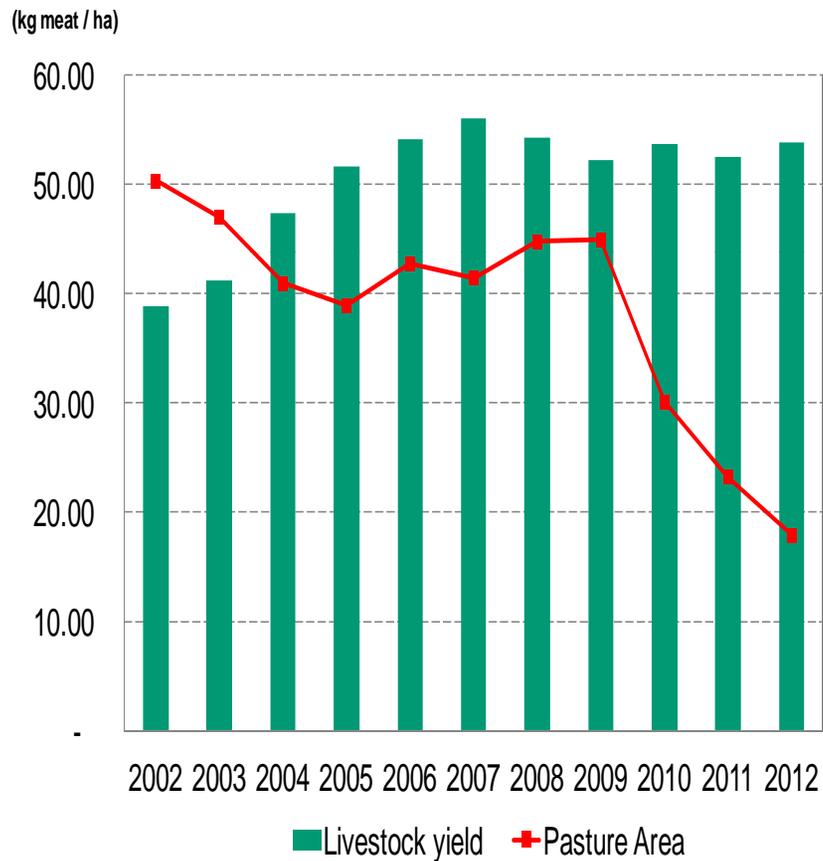


Source: Canasata/INPE

Sources: Adami, M.; Rudorff, B. F. T.; Freitas, R. M.; Aguiar, D. A.; Sugawara, L. M.; Mello, M. P. (2012). Remote Sensing Time Series to Evaluate Direct Land Use Change of Recent Expanded Sugarcane Crop in Brazil. Sustainability 2012, 4, 574-585 (doi:10.3390/su4040574). Elaborated by ICONE

Study available at: <http://www.iconebrasil.org.br/projetos/detalhes/41>

# YIELD IMPROVEMENT – CATTLE INTENSIFICATION



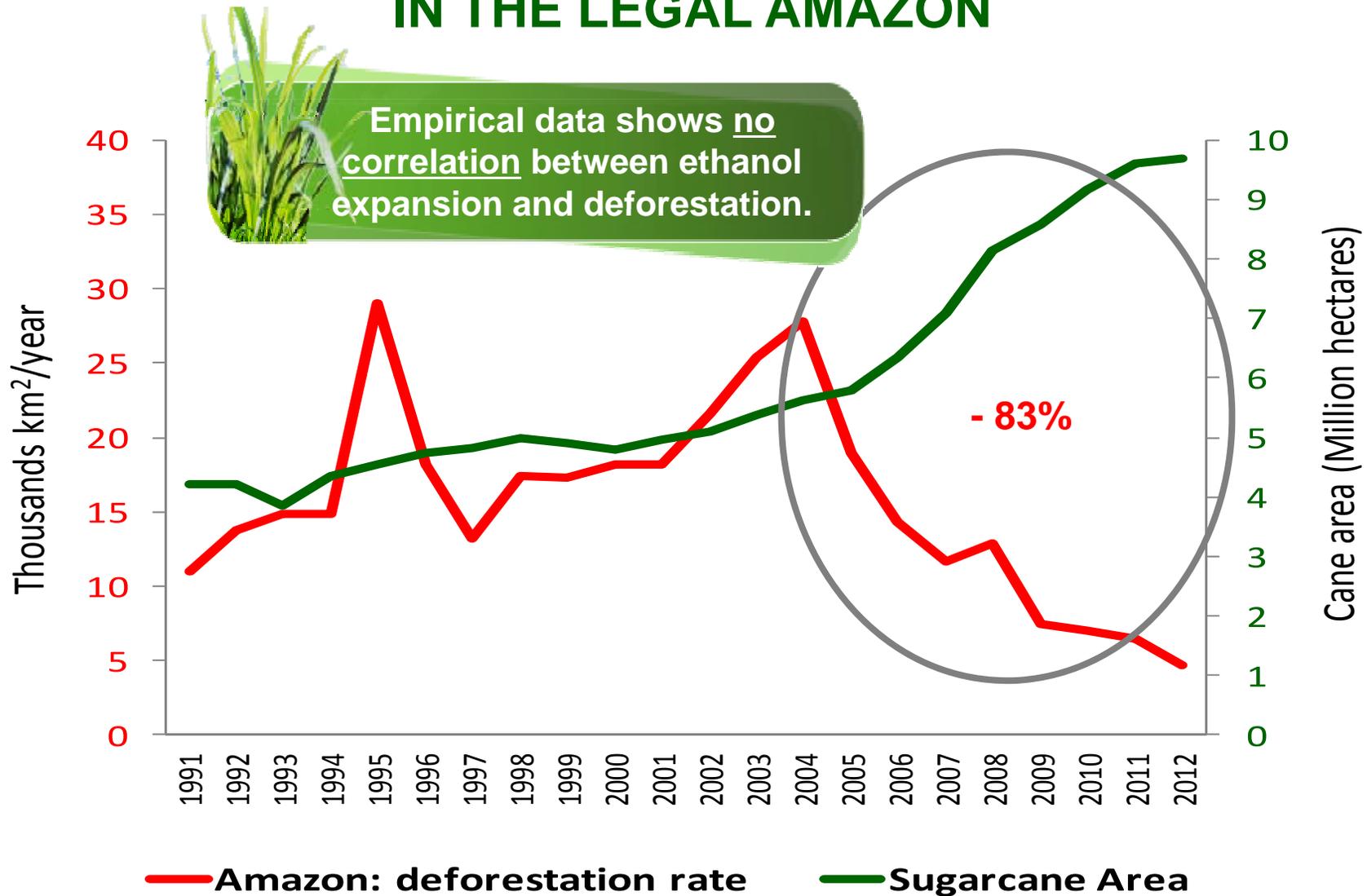
(1000 ha)	2002	2012	Variation	CAGR (%)
Pasture area (1000 ha)	184,037	180,785	-3,252	-0.14%
Herd (1000 Head)	185,349	213,239	27,890	0.98%
Meat production (1000 MT)	7,139	9,748	2,609	2.64%
Livestock yield (kg of meat/ha)	39	54	15	2.78%
Milk production (1000 liters)	24,172	33,996	9,824	3.6%
Milk production per cow (liters/cow)	1,286	1,479	193	1.4%

Sources: IBGE, UFMG, INPE, BIGMA Consulting, ICONE. Elaborated by ICONE. Study available at:

<http://www.iconebrasil.org.br/projetos/detalhes/41>



# SUGARCANE AREA AND ANNUAL DEFORESTATION RATE IN THE LEGAL AMAZON



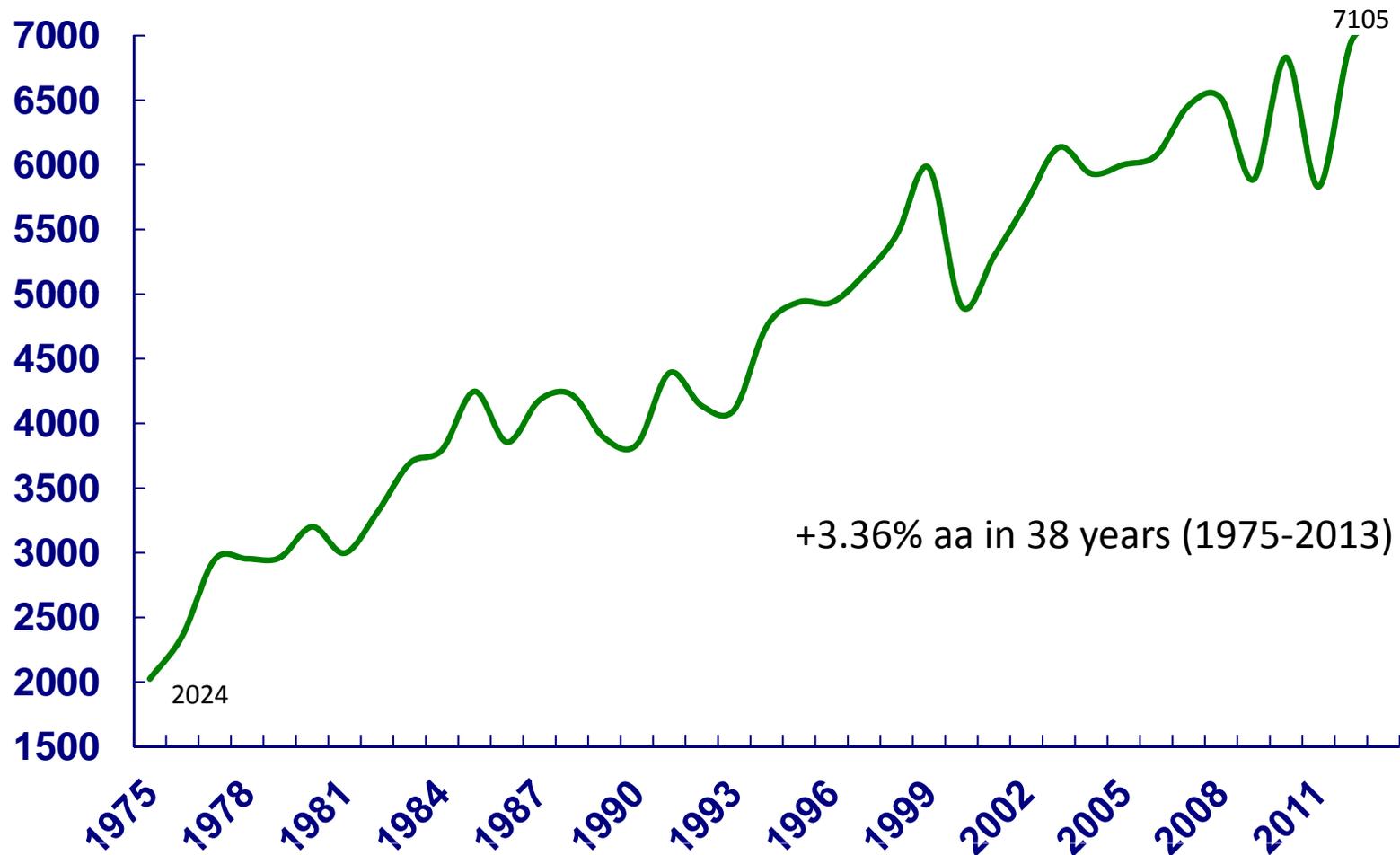
Sources: INPE / PRODES (deforestation rates) and IBGE and UNICA (sugarcane area).

In the last 38 years, agroindustrial productivity rose more than 3-fold.

However, potential is to double until 2020, and quintuple in the long run.

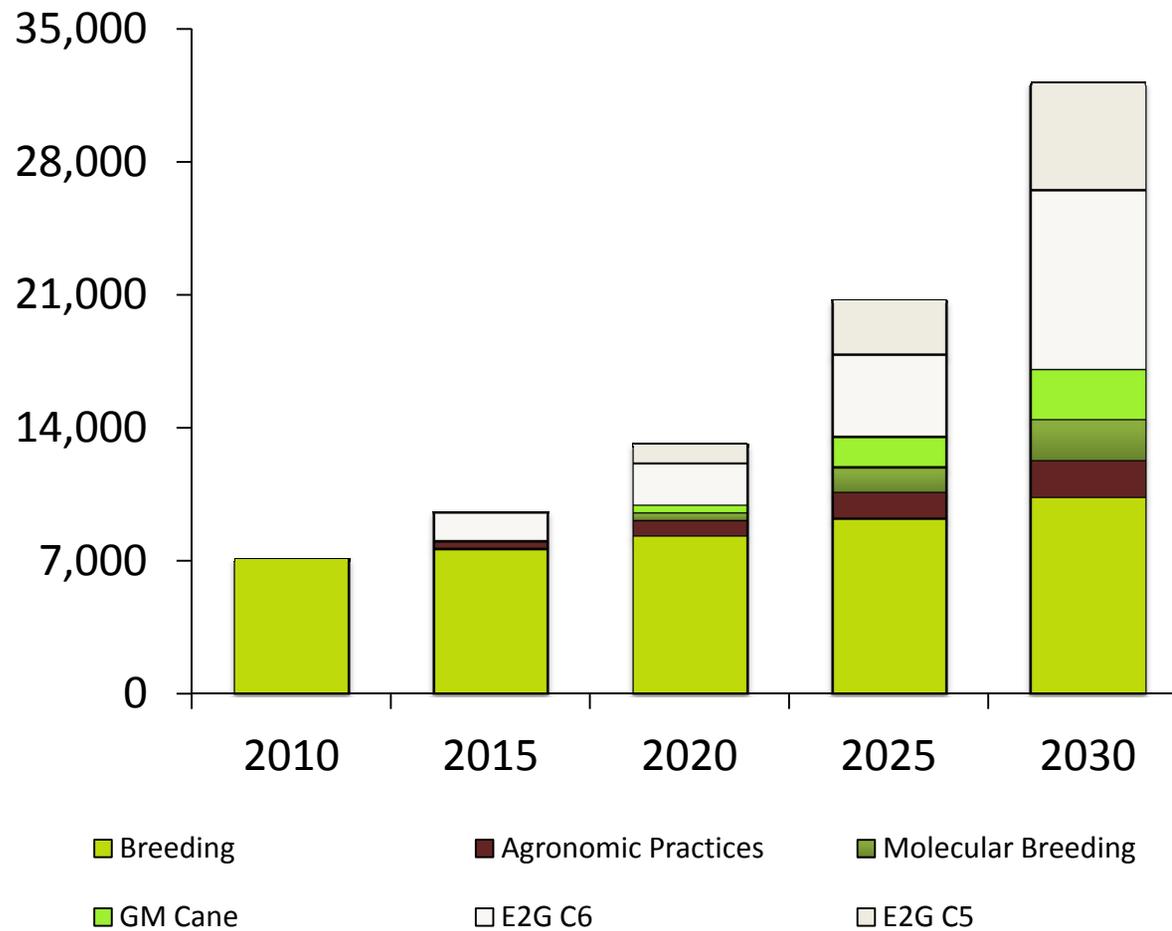
# Agroindustrial Yield - Brasil

(in liters of hydrous ethanol equivalent per hectare)



Source: DATAGRO

# Potential Productivity is >30,000 liters/ha (2030)



Source: CTC

# Final Message

- Investments tend to concentrate on increased energy efficiency, and cost reduction measures.
- Industry is changing rapidly, with investments in mechanization and more efficient transport infrastructure (rail and pipeline).
- Supply of sugar & ethanol will grow from:
  - large stock of productivity still to be implemented;
  - Use of cane residues which until recently were wasted/burnt.
- Ethanol is still underpriced for its superior qualities as fuel. Regulation should aim at internalizing into prices these positive externalities.
- There is a large area available for expansion of cane in Brazil and other cane producing countries.
- Brazil is serving as demonstration effect for initiatives in other countries -- Colombia, Peru, Paraguay, Argentina, Dom.Republic, El Salvador, India, Thailand, Angola, Tanzania, Zambia and others -- which will soon be participating in an enlarged world ethanol market.

[www.datagro.com](http://www.datagro.com)

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**21 - 22 October 2013**

**13th International Datagro Conference on Sugar and Ethanol**  
Grand Hyatt São Paulo, Brazil / **São Paulo Sugar Dinner Week.**

**14 May 2014**

**8<sup>th</sup> ISO DATAGRO New York Sugar & Ethanol Conference**  
Waldorf=Astoria Hotel, New York, NY / **New York Sugar Dinner Week.**

**July 2014**

**3<sup>rd</sup> Sugar & Ethanol Summit – Brazil Day**

IoD - Institute of Directors / organização: DATAGRO e Ministério das  
Relações Exteriores (MRE)  
London, U.K.