



Joint European-Latin American
Universities Renewable Energy Project

Trends in Biofuels in Latin America: A Green Future University of Chile

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FCFM-Department of Electrical Engineering



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Project is funded
by the European
Union

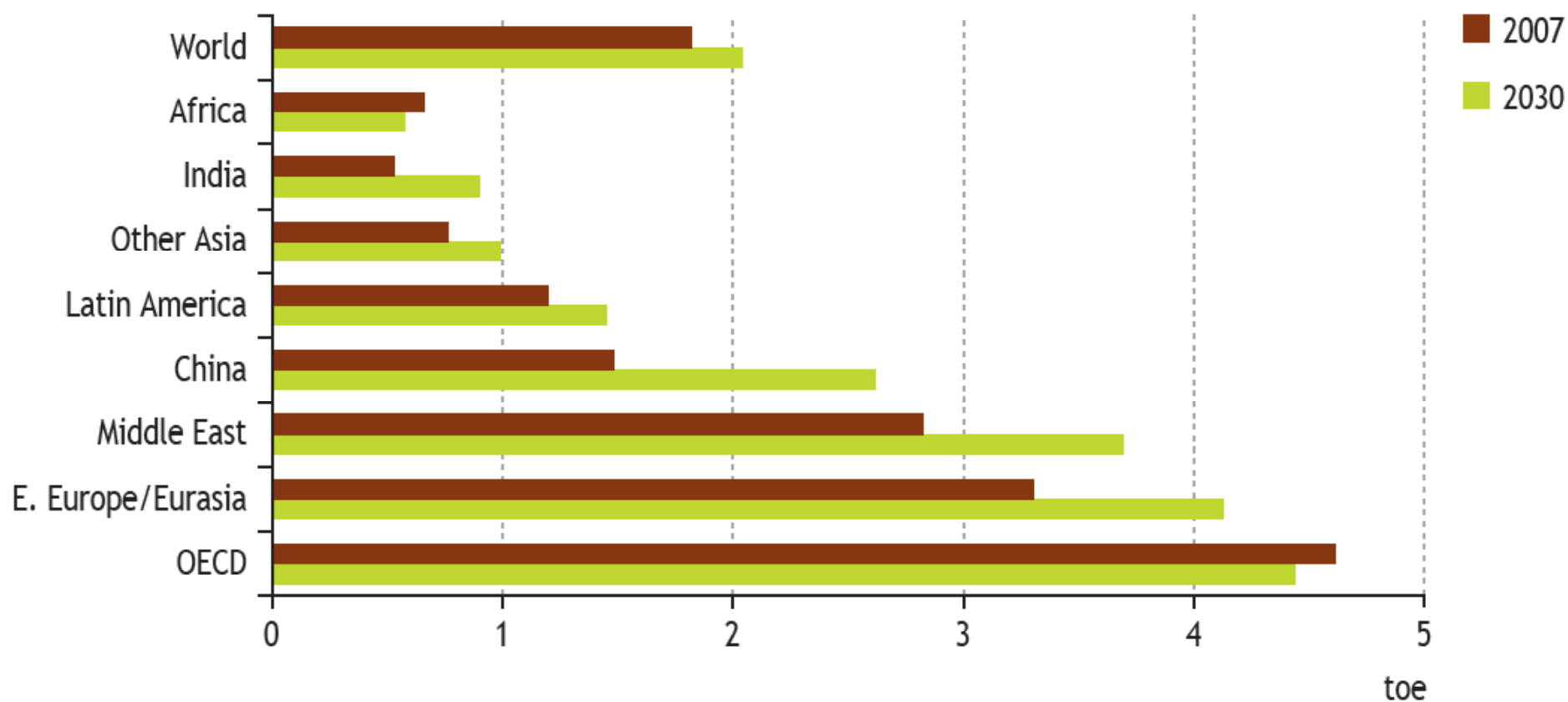
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Introduction

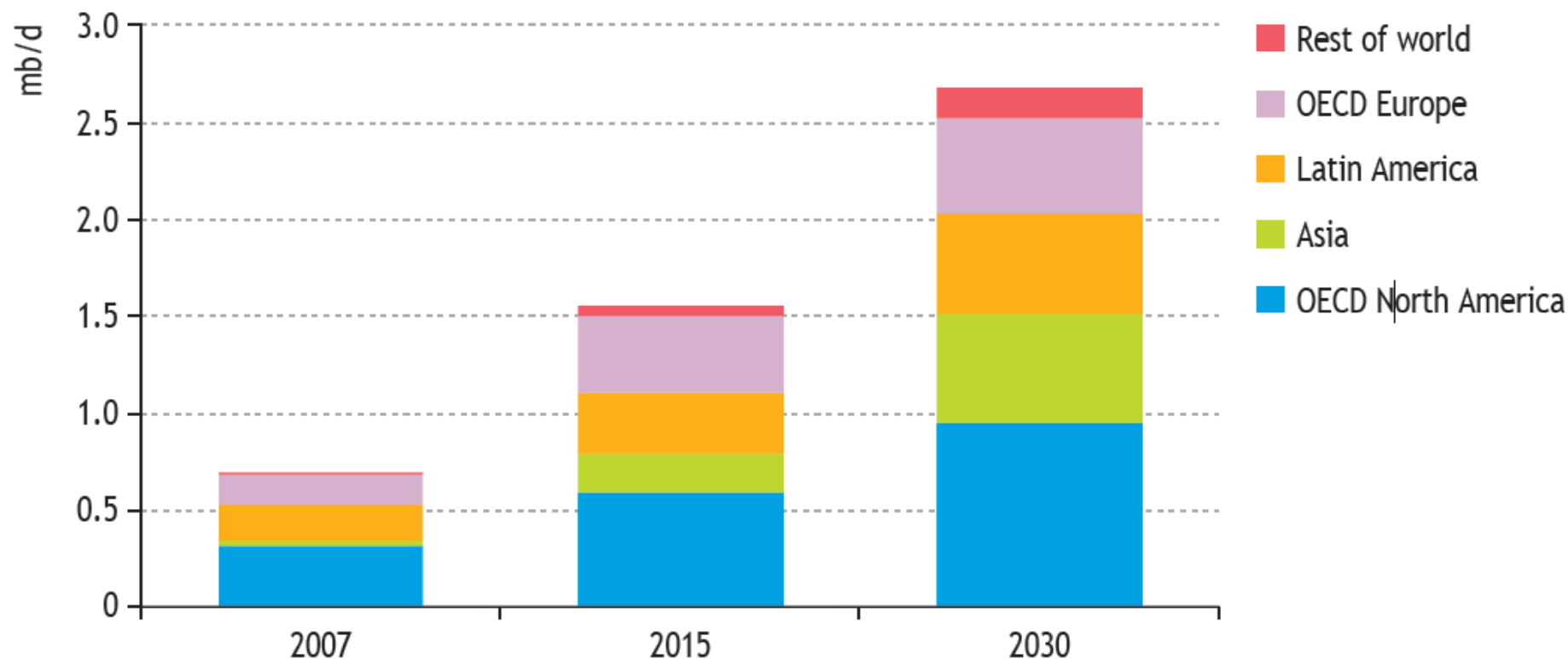
Figure 1.3 ● Per-capita primary energy demand by region in the Reference Scenario



Source: World Energy Outlook 2009 - GLOBAL ENERGY TRENDS TO 2030

Introduction

Figure 1.10 • Biofuels demand by region in the Reference Scenario



Note: On an energy-equivalent basis.

Source: World Energy Outlook 2009 - **GLOBAL ENERGY TRENDS TO 2030**

Introduction

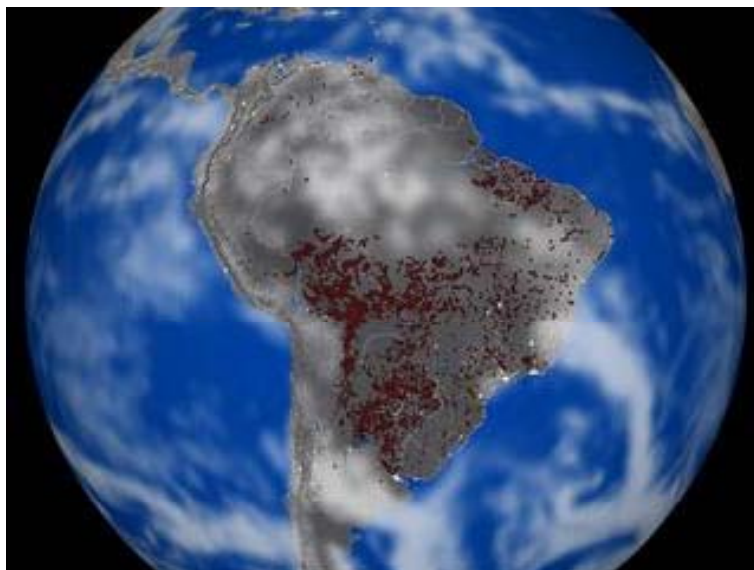
Natural Conditions of LA for Biomass production:

- Abundant land extensions
- Good quality of land
- Water availability
- Weather conditions
- Brazil has a strong ethanol program and technology

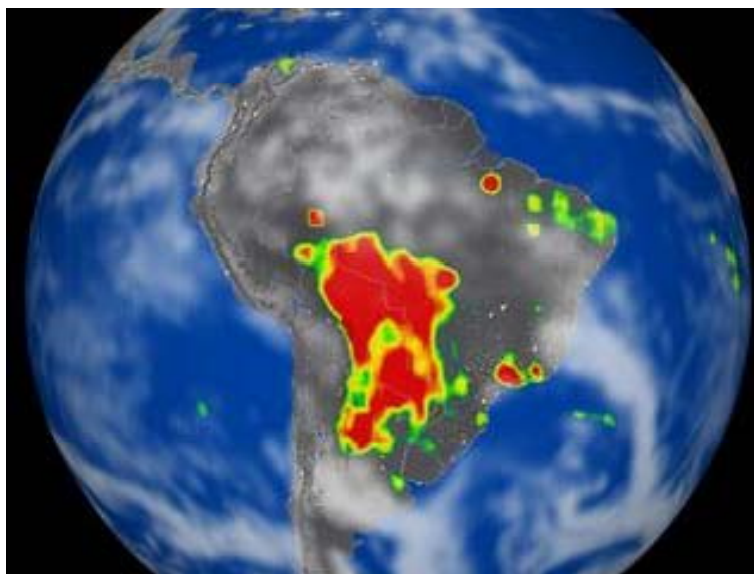
Introduction

Risks:

- Threat for natural ecosystems
- Displacement of small farmers and natives
- Competition for water
- Increase in the price of soil
- Impact on food production-increase in price



Fires seen from space on October 7, 2004

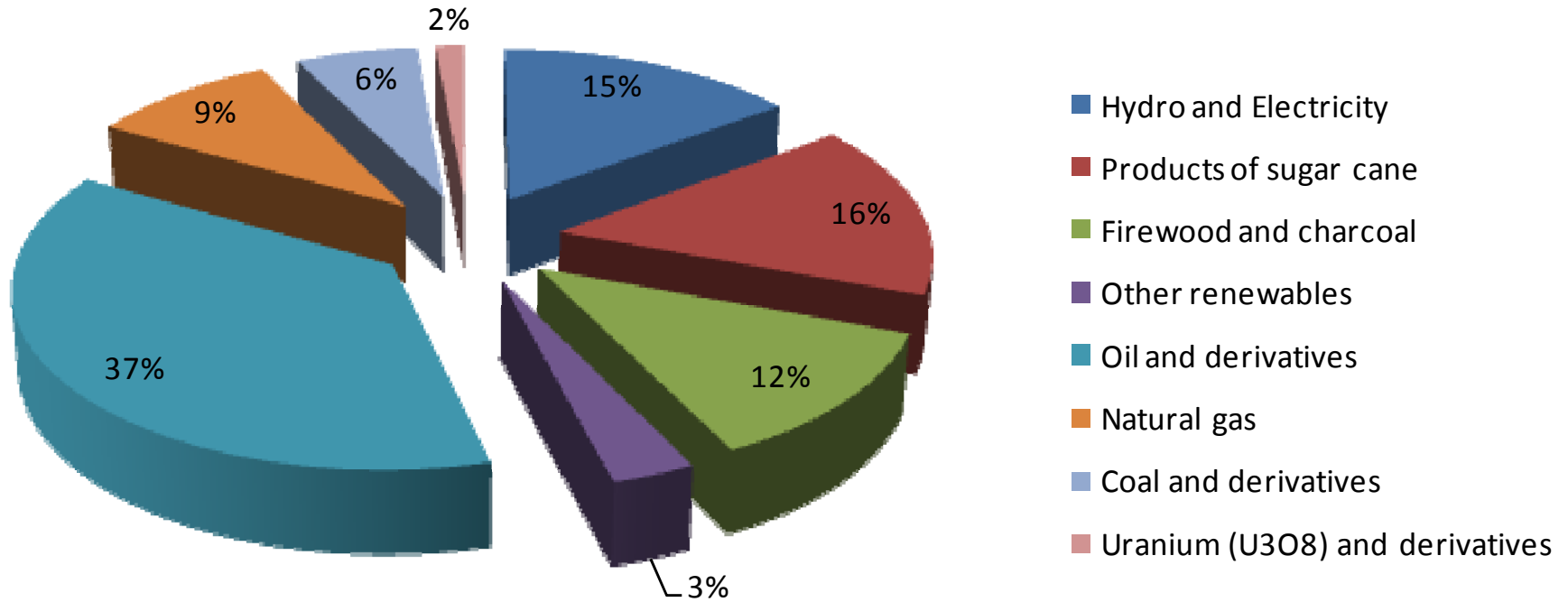


Aura measures NO₂ concentration over South America on October 7, 2004

Brazil-The Ethanol Case



BRAZILIAN EXPERIENCE: 1925

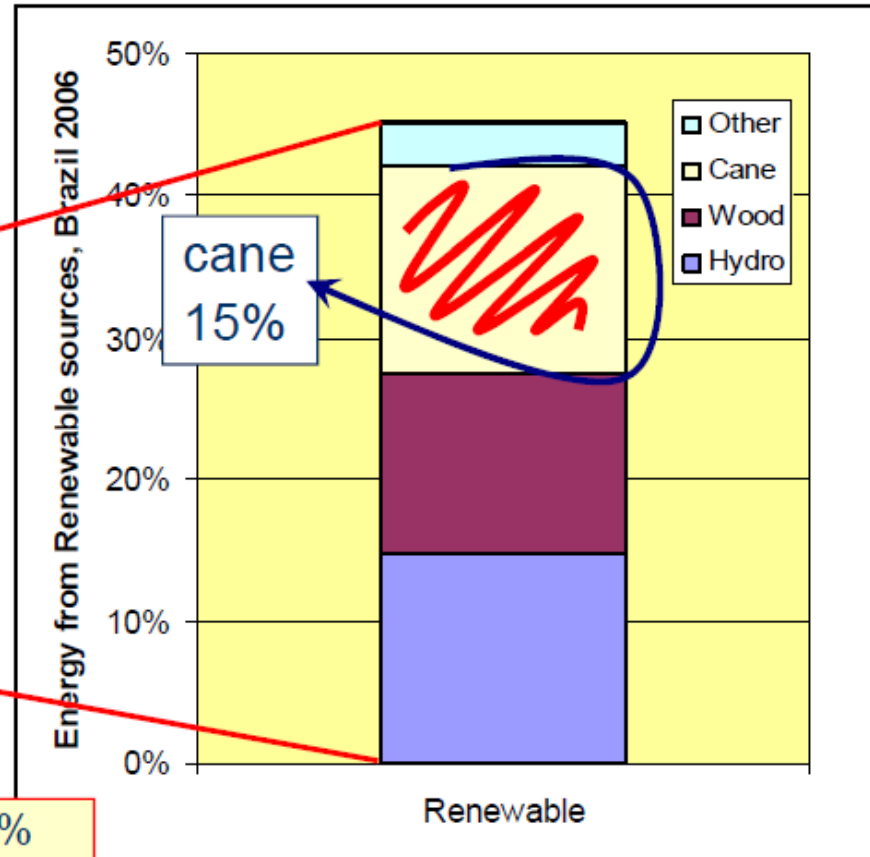
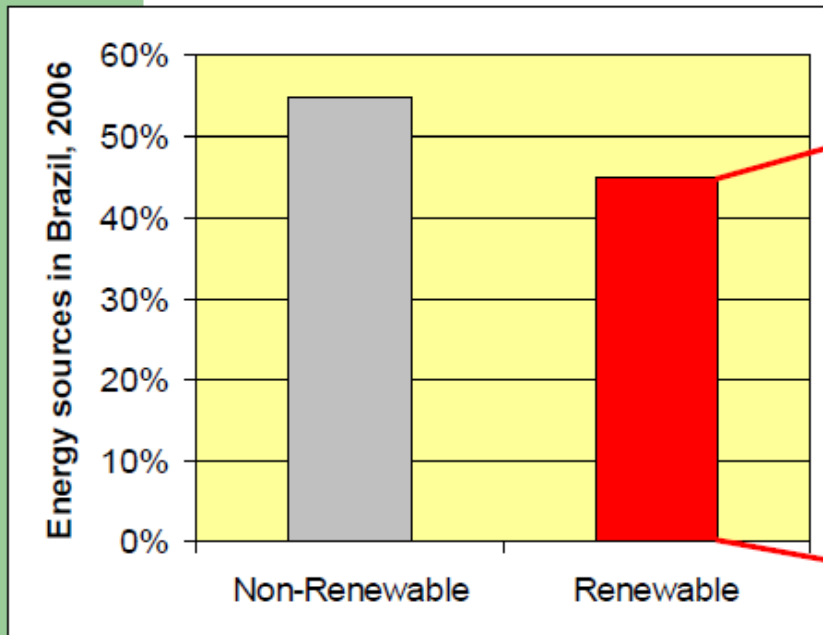


Source	2006	2007
Renewable	101.879	109.656
Hydro and Electricity	33.537	35.505
Products of sugar cane	32.999	37.847
Firewood and charcoal	28.589	28.628
Other renewables	6.754	7.676
Nonrenewable	124.465	129.102
Oil and derivatives	85.545	89.239
Natural gas	21.716	22.199
Coal and derivatives	13.537	14.356
Uranium (U3O8) and derivatives	3.667	3.309
Total	226.344	238.758

Source: Energy Balance Brazil

Brazil's energy matrix

46% of Brazil's energy comes from renewable sources



Renewables in Brazil: 46%; World: 13%; OECD: 6%

From C.H. Brito Cruz. <http://www.fapesp.br/eventos/bioen0809/brito.pdf>

Agricultural land and Ethanol Production

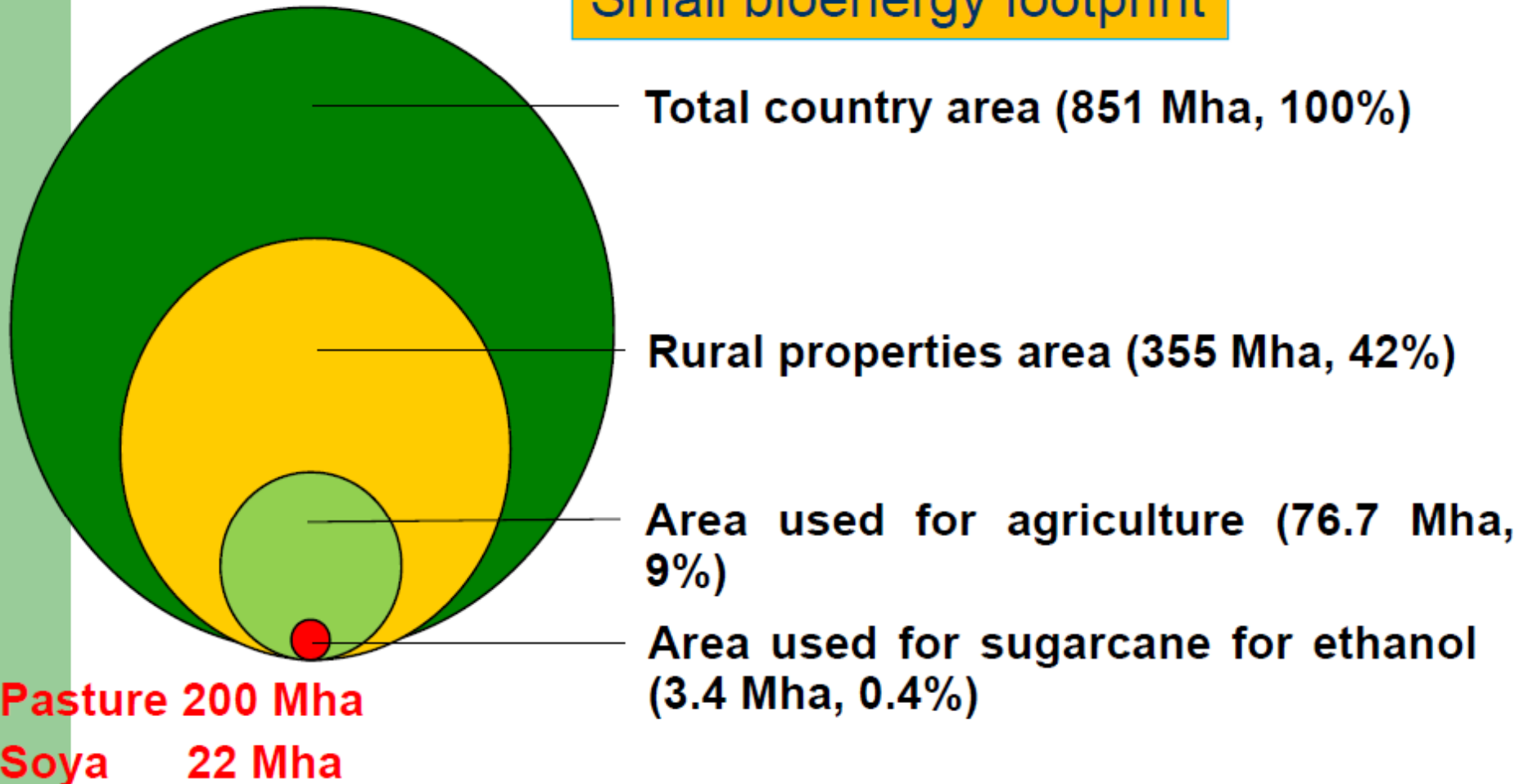
Agricultural Land in Brazil (2007) (*)		
	Million Acres	Percent of Total Agricultural Land
Cultivated Land (all crops)	190	19,2%
Soybeans	51	5,1%
Corn	35	3,5%
Sugarcane (all uses)	19	1,9%
Sugarcane for ethanol	8,4	0,8%
Pastures	426	43,0%
Available Land	261	26,4%
Total & Potential Agric. Land	990,4	100,0%

(*) Total arable land excludes the Amazon Forest, the wetlands of the Pantanal, and other preservation areas, in addition to areas not traditionally suitable for agriculture due to topography, soil restrictions, etc.

Sources:

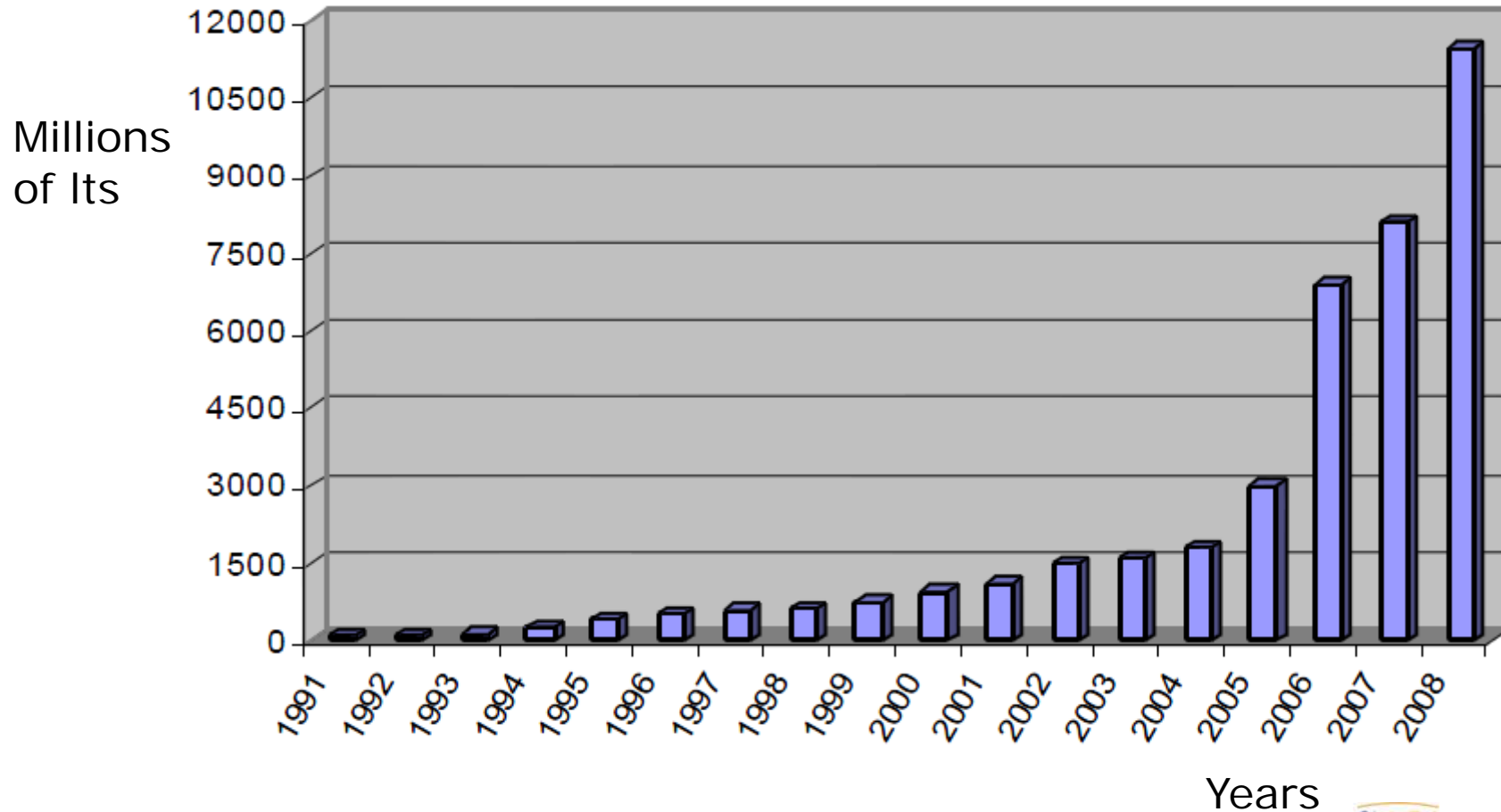
- Renewable Fuels Association
- USDA Foreign Agricultural Service, 2008
- GAIN report BR8013

Small bioenergy footprint



Source: Horta Nogueira e Seabra (2008)

World Ethanol Production



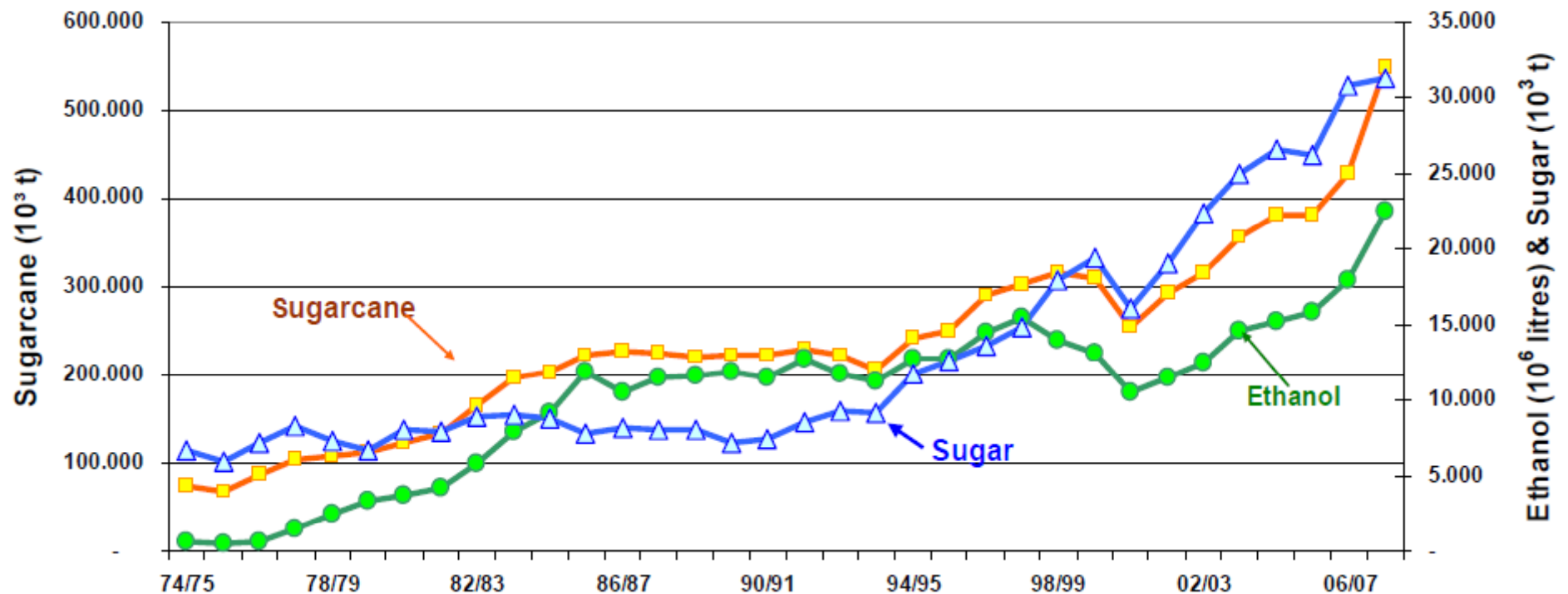
Brazil established a dynamic relation between Research and Production particularly after 1975, involving government and private sectors

- *Sugarcane, an excellent energy crop*
- *Creation of the “Brazilian Model” combining efficient sugar and ethanol production*

World Fuel Ethanol Production (2007)

Country	Million Gallons
USA	6499
Brazil	5019
European Union	570
China	486
Canada	211
Other	316
Total	13101

Brazil increased ethanol production and, at the same time, it increased its sugar production



Source: Luís Cortez (UNICAMP)

Comparison of Brazil and U.S. Ethanol Industries

Brazil-Sugarcane

The sugar (sucrose) in sugarcane can be converted directly into ethanol

Sugarcane is planted every six years using cuttings

Sugarcane provides five cuttings over six years and then is replanted

An acre of sugarcane produces about 560 gallons of ethanol

Sugarcane-ethanol can be produced cheaper than corn-ethanol

Brazil has great potential for expanding sugarcane acreage without limiting the acreage of other crops

United States-Corn

The starch in corn is first converted into sugar. Then the sugar is converted into ethanol

Corn is planted every year using seeds

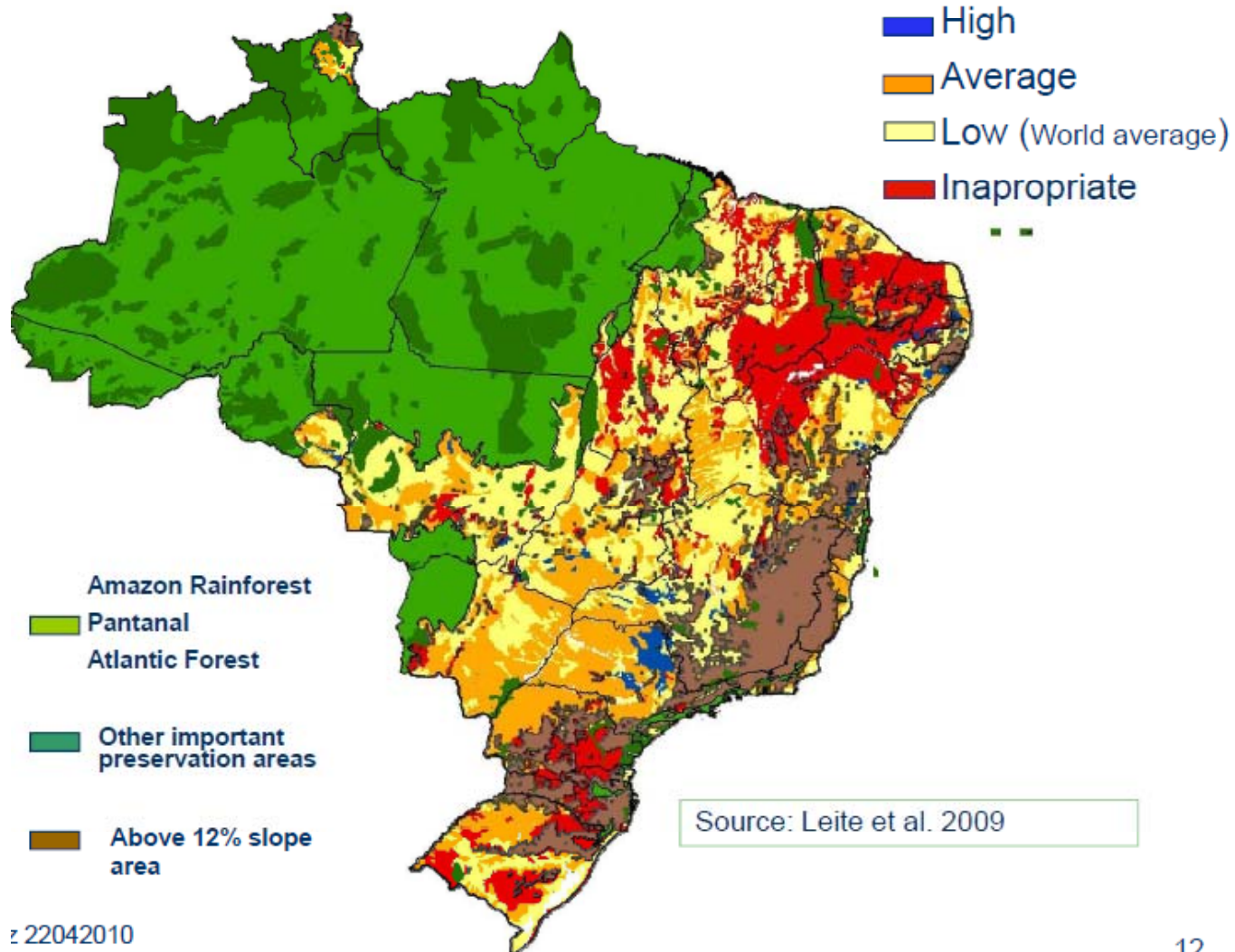
Corn is harvested once each year

An acre of corn produces about 420 gallons of ethanol

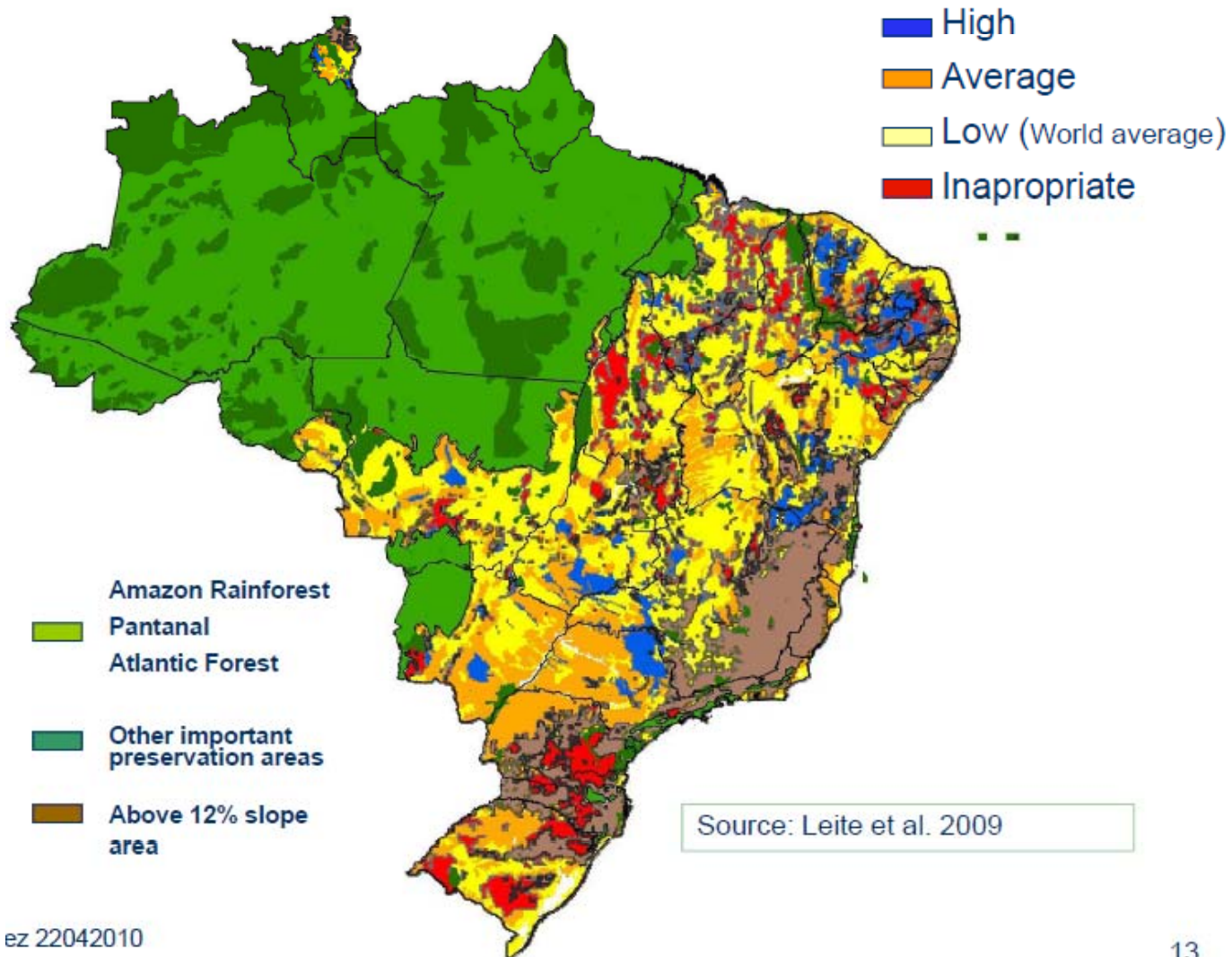
Corn-ethanol is more expensive to produce than sugarcane-ethanol

U.S. expansion of corn acreage will come at the expense of reduced soybean and other crop acres

POTENTIAL FOR SUGAR CANE PRODUCTION: SOIL AND CLIMATE - *WITHOUT IRRIGATION*



POTENTIAL FOR SUGAR CANE PRODUCTION: SOIL AND CLIMATE - *WITH IRRIGATION*



- It is feasible to produce in Brazil the equivalent of 5% gasoline used in the world by 2025
- Expansion of ethanol production in Brazil will occur basically on pasture land
- Therefore, is essential to “organize” other agricultural activities: pasture land (200 Mha); soya (22 Mha), bioethanol sugarcane land (4 Mha)
- Bioethanol sugarcane can help to optimize land use in Brazil (reduce pasture land while maintaining beef production and expanding biofuels production)



Colombia-Ethanol and Biodiesel

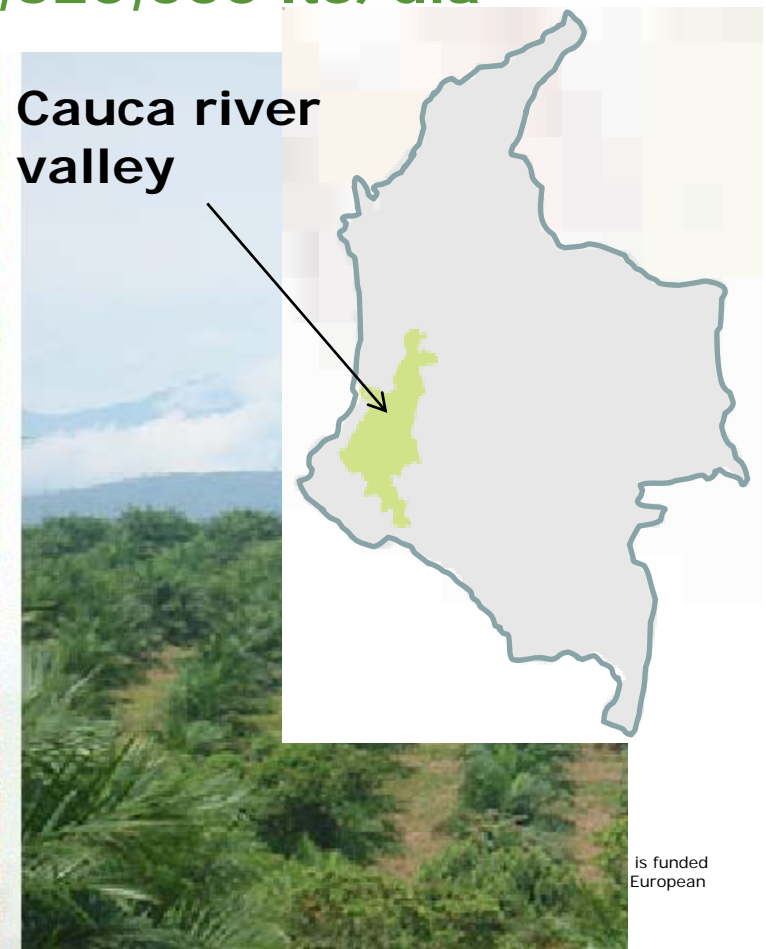


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- Biomass program started in 2004
- Sugar cane production (2008): 1,050,000 lts/día
- Future projects in construction: 1,620,000 lts/día



Cauca river valley



is funded
European

- Biodiesel production is based on the tree oil palm
- 4,600 lts per ha
- Consumption mainly own transport sector



- In construction plants with 790000 lts/day
- Biodiesel production for internal use only (no exports yet)



Region	Biodiesel Production		Area ha
	Capacity Ton/year	Capacity lts/day	
North, Codazzi	50000	168719	11000
North, Santa Marta	136000	458904	30000
East, Facatativa	100000	337437	22000
Total	286000	965060	63000

Futures trends in Colombia:

- **To foster the deployment of ethanol and biodiesel**
- **Promote export**
- **To increase production efficiency**
- **Focus on transport demand**

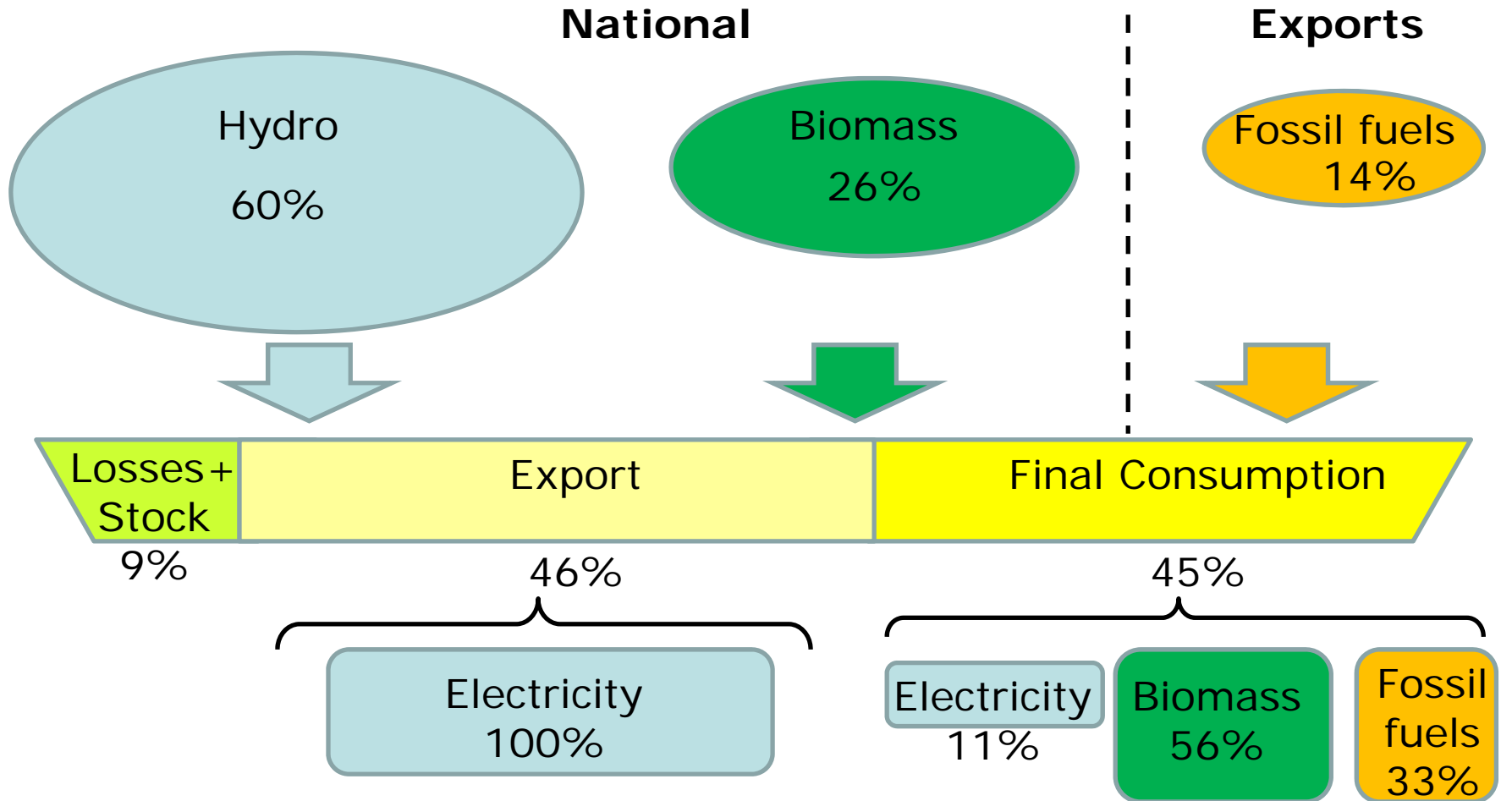
Paraguay: Hydro-methane project

Main Features of Paraguay

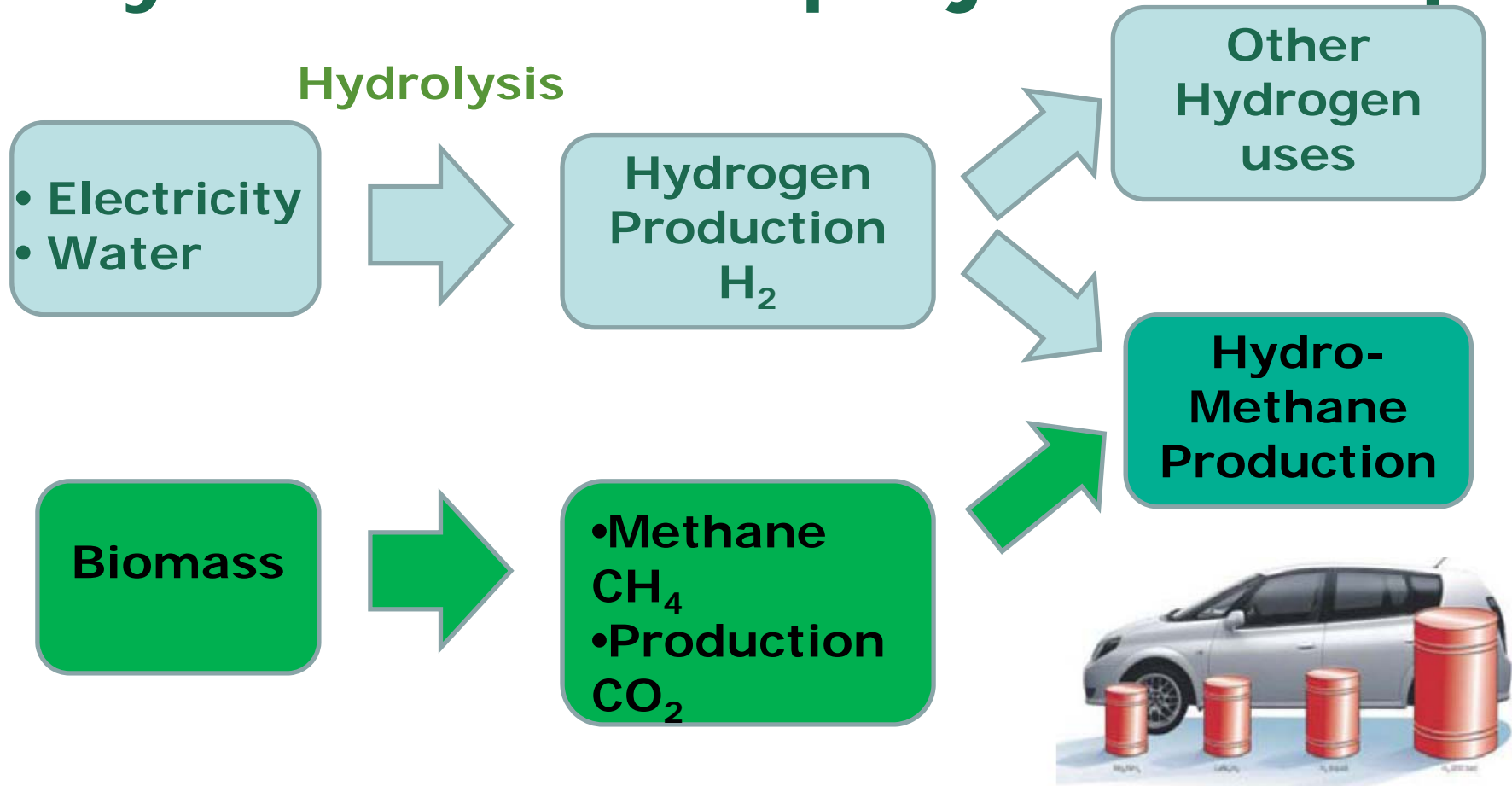
- Is the only country in the region with high surplus of energy
- The country is mainly agricultural, it does not have demand for its energy production
- It has enormous water reservoirs
- It is the country with the highest rate of water availability per capita on earth

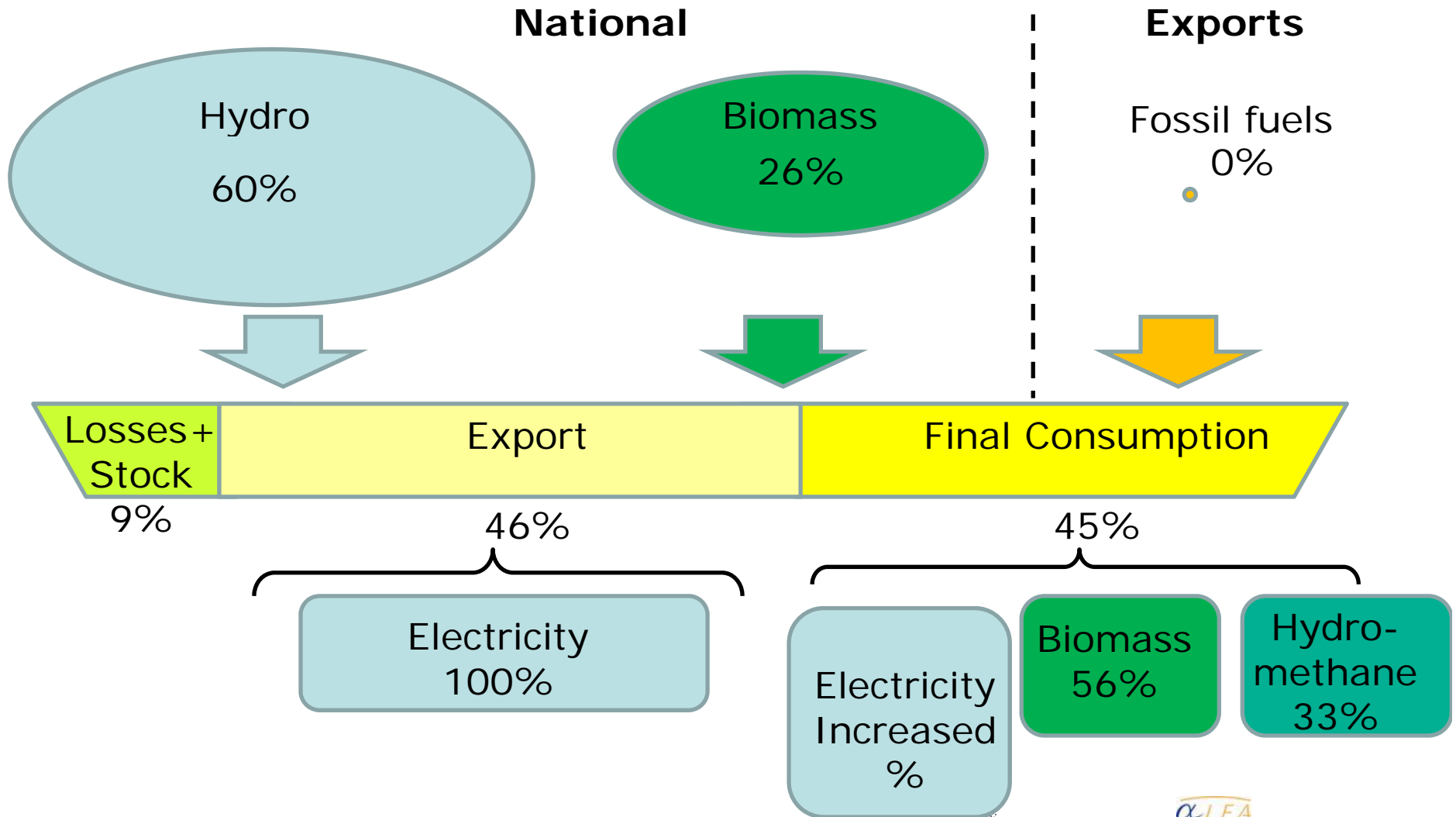


What to do with so much clean energy?



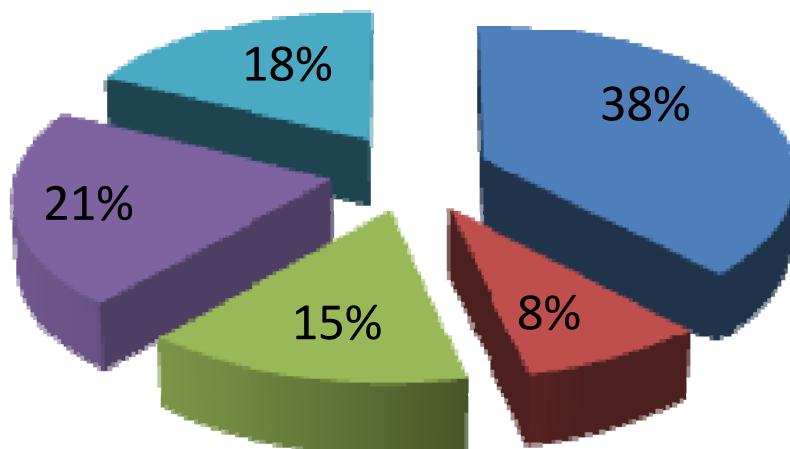
Hydro-methane project concept





Chile: Starting the use of Biomass

- Chile is a major producer and exporter of wood and wood products, mainly pulpwood, roundwood, wood chips and pellets.
- There is an installed capacity of over 100.000 tonnes.
- High transport costs appear to be the greatest impediment to exporting pellets. The domestic market for pellet consumption is underdeveloped.



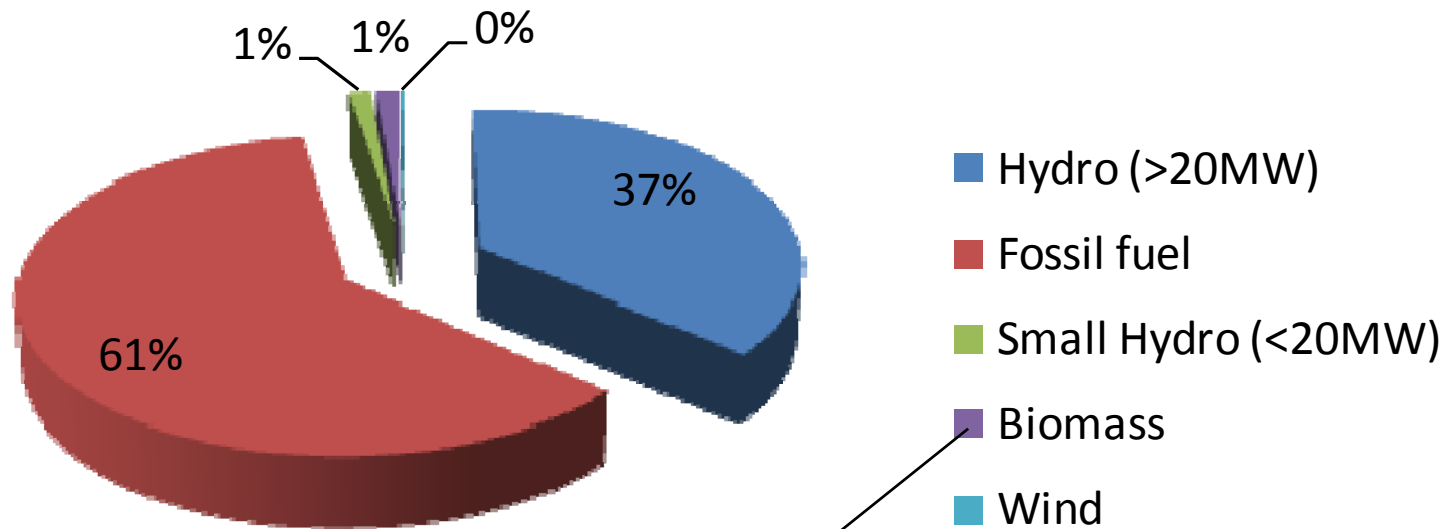
- Oil
- Natural Gas
- Carbon
- Hydroelectricity
- Firewood and others

Energy Matrix (in kTOE)

Source	2006	2007	2008
Oil	11.683	10.616	11.042
Natural Gas	7.247	4.272	2.479
Coal	3.443	4.086	4.370
Hydroelectricity	7.224	5.700	6.085
Firewood and others	4.730	4.984	5.117
Total	36.333	31.664	31.101

Source: Energy Balance Chile

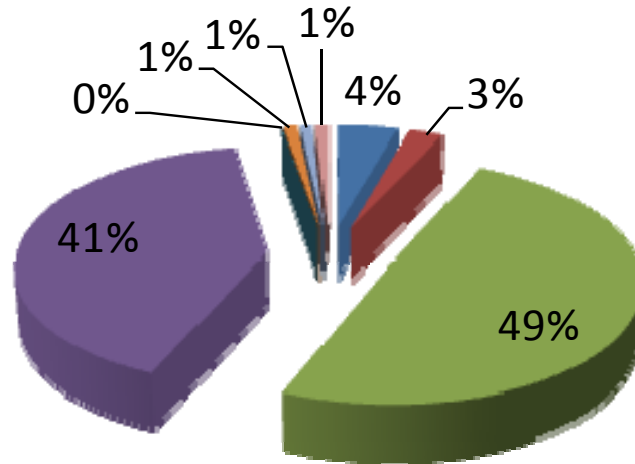
Chile's energy matrix



Chile's electricity matrix

- Potential for Purin (pork, poultry industry)
- Use of by product of Pulp and paper industry (black alcohol)

ARGENTINA: Starting the use of Biomass



- Hydroelectricity
- Nuclear
- Natural Gas
- Oil
- Coal
- Firewood
- Bagasse
- Other primary

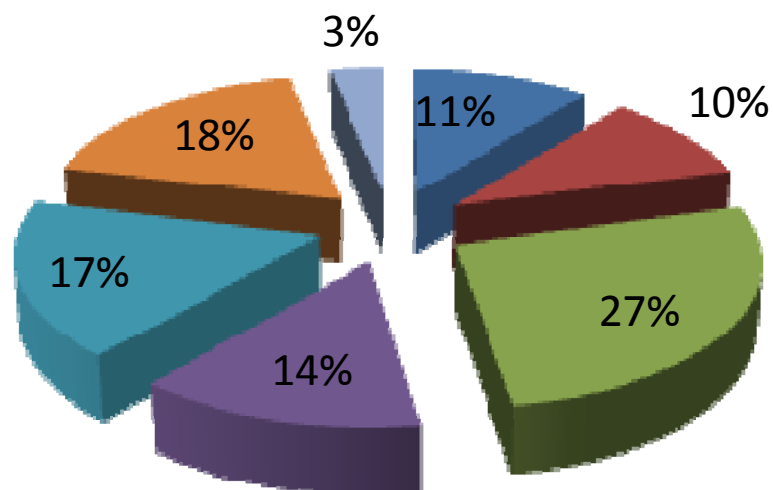
Energy Matrix 2005 (in kTOE)

Source	Primary Energy
Hydroelectricity	3.683
Nuclear	2.089
Natural Gas	41.064
Oil	33.934
Coal	15
Firewood	843
Bagasse	710
Other primary	702
Total	83.040

Source: Energy Balance Argentina

Argentina's energy matrix

BOLIVIA: Starting the use of Biomass



- Electricity
- LPG
- Diesel Oil
- Gasoline
- Natural Gas
- Biomass
- Other Derivatives

Energy Matrix (in kTOE)

Fuel	2005	2006	2007
Electricity	2649,78	2840,17	3067,4
LPG	2658,6	2752,49	2839,16
Diesel Oil	6439,81	7070,76	7588,44
Gasoline	2960,67	3268,04	3891,1
Natural Gas	3792,59	4319,81	5025,64
Biomass	4942	5015	5037
Other Derivatives	1098,43	1093,26	947,45
Total	24541,88	26359,53	28396,19

Source: Energy Balance Bolivia

Bolivia's energy matrix



Project is funded by the European Union

Conclusions

- Abundant land extensions
- Good quality of land
- Water availability
- Excellent weather conditions
- LA has a variety of biomass development
 - Brazil-strong ethanol program and technology
 - Colombia-Strong potential
 - Paraguay-Energy surplus