REGSA

RENEWABLE ENERGIES IN BRAZIL
Universidade do Sul de Santa Catarina - UNISUL

José Baltazar S. O. de Andrade Guerra: Ph.D, professor, e-mail: Baltazar.Guerra@unisul.br

Luciano Dutra: Ph.D, professor, e-mail: luciano.dutra@unisul.br

Norma Beatriz Camisão Schwinden: MSc., professor, e-mail: normabcs1@gmail.com

Suely Ferraz de Andrade: MSc., professor, e-mail: suely.ferraz@unisul.br

Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

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Aqui o seu futuro acontece

Universidad de Chile

Project is funded by the European Union.

"The Brazilian energy policy is guided by objectives that aim to ensure access of all people to quality services at fair prices, while maintaining rigorous commitment to environmental preservation and sustainable management of natural resources. This policy contributes to both economic and social progress of the population and to maintain one of the cleanest energy matrices in the world."

(Tolmasquim , 2012)

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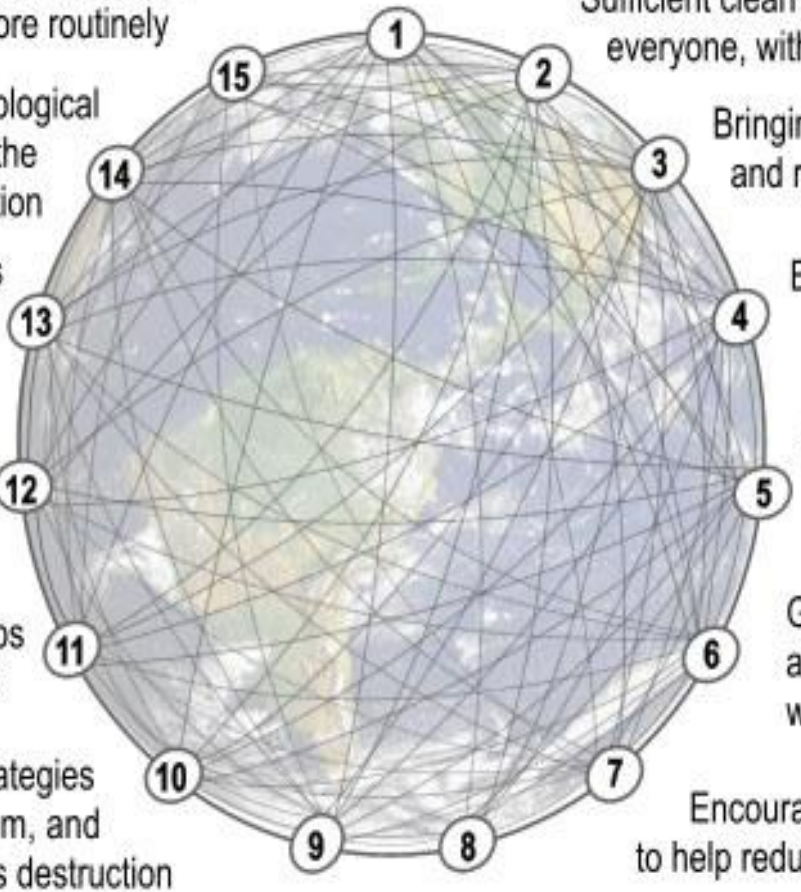
15 Global Challenges
facing humanity



1. Sustainable development achievable for all
2. Sufficient clean water for everyone, without conflict
3. Bringing population growth and resources into balance
4. Emerging genuine democracy from authoritarian regimes
5. Policymaking made more sensitive to global long-term perspectives
6. Global convergence of information and communications technologies work for everyone
7. Encouraging ethical market economies to help reduce the gap between rich and poor
8. Reducing the threat of new and reemerging diseases and immune microorganisms
9. Improving the capacity to decide as the nature of work and institutions change
10. Shared values and new security strategies reduce ethnic conflicts, terrorism, and the use of weapons of mass destruction
11. Changing status of women helps improve the human condition
12. Stopping transnational organized crime networks from becoming more powerful and sophisticated global enterprises
13. Meeting growing energy demands safely and efficiently
14. Accelerated scientific and technological breakthroughs to improve the human condition
15. Incorporating ethical considerations into global decisions more routinely

by the Millennium Project of the ACUNU
www.acunu.org

10 ways to restrain the destruction （IPCC）

1.Use adequate of the soil
2.More use of natural light
3.More use of alternative energy
4.Preference by public transportation
5.More industrial efficiency
6.More use of biofuels
7.Use of biogas waste
8.Use of natural farming techniques
9.Renovation of fleet
10.Change for use of clean energy

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Guiding principles: Energy brazilian sector

- Recognize hydroelectricity as a source priority for expanding energy supply and integrated management of the water supply

- Pursuing diversification considering the complementary nature of other sources

- Promoting universal energy supply

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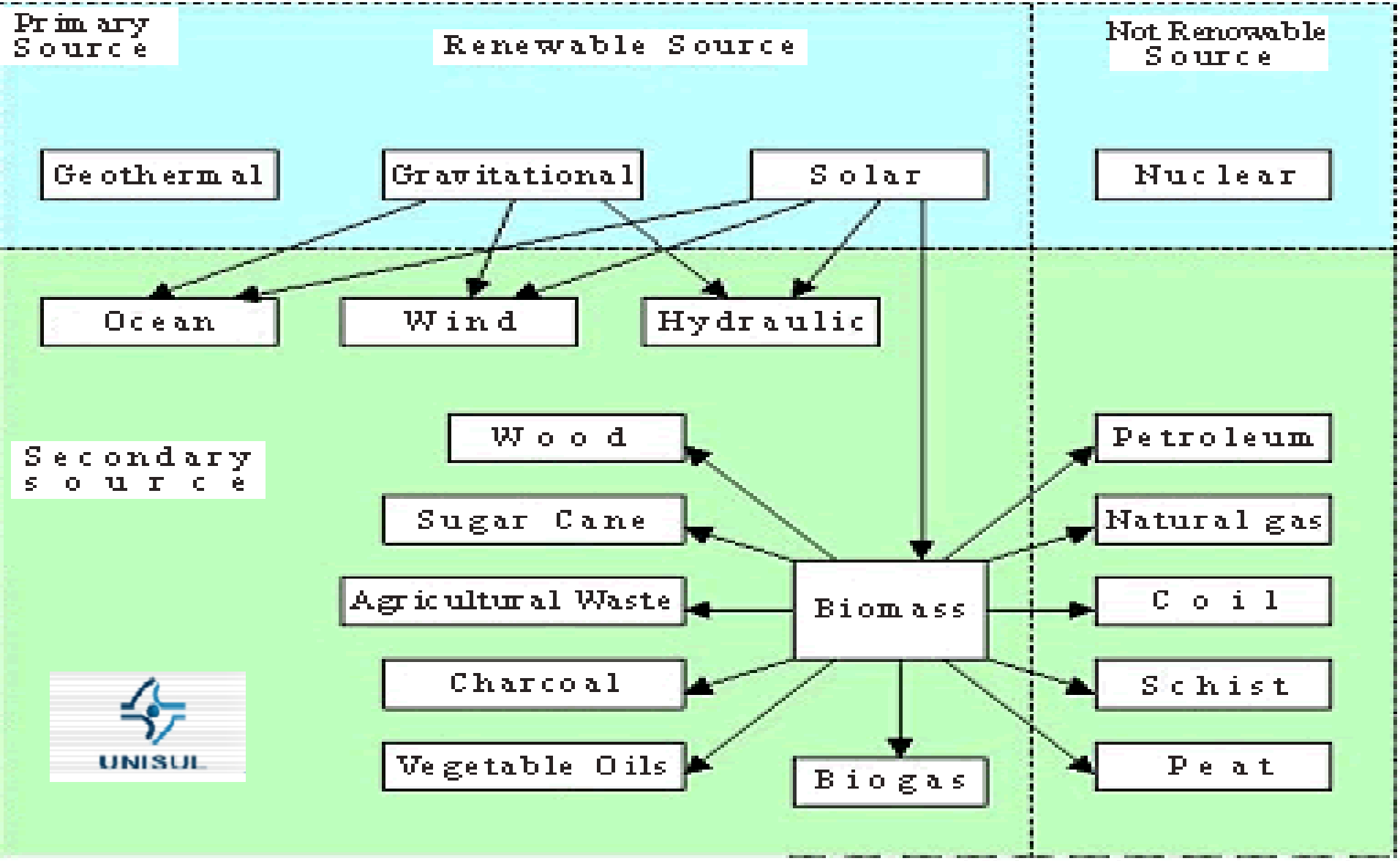
SOURCES OF ENERGY



Production and supply of primary energy

- ✓ The supply of primary energy is growing significantly in the last years.

- ✓ It rises from 190,615 toe in 2000 to 268,754 toe in 2010. This is a result of the new investments in generation that are happening in Brazil.

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REGSA Promoting Renewable Electricity Generation in South America

Domestic energy supply in 10^3 toe

IDENTIFICATION	1970	1980	1990	2000	2005	2006	2007	2008	2009	2010
NON-RENEWABLE ENERGY	27,858	62,387	72,298	112,376	121,350	124,464	129,068	136,616	128,710	146,425
OIL AND OIL PRODUCTS	25,251	55,393	57,749	86,743	84,553	85,545	**89,239**	92,410	92,559	100,992
NATURAL GAS	170	1,092	4,337	10,256	20,526	21,716	**22,165**	25,934	21,145	27,716
COAL AND COKE	2,437	5,902	9,615	13,571	13,721	13,537	**14,356**	14,652	11,572	13,860
URANIUM – U_3O_8	0	0	598	1,806	2,549	3,667	**3,309**	3,709	3,434	3,857
RENEWABLE ENERGY	39,088	52,373	69,702	78,239	97,314	101,880	108,760	116,022	115,260	122,329
HYDRAULIC AND ELECTRICITY(*)	3,420	11,063	20,051	29,980	32,379	33,537	**35,505**	35,412	36,966	37,659
FIREWOOD AND CHARCOAL	31,852	31,083	28,537	23,060	28,468	28,589	**28,628**	29,269	24,610	26,072
SUGARCANE PRODUCTS	3,593	9,217	18,988	20,761	30,147	32,999	**37,847**	42,866	44,447	47,785
OTHERS	223	1,010	2,126	4,439	6,320	6,754	**6,780**	8,475	9,237	10,813
TOTAL	66,945	114,761	142,000	190,615	218,663	226,344	**237,828**	252,638	243,970	268,754

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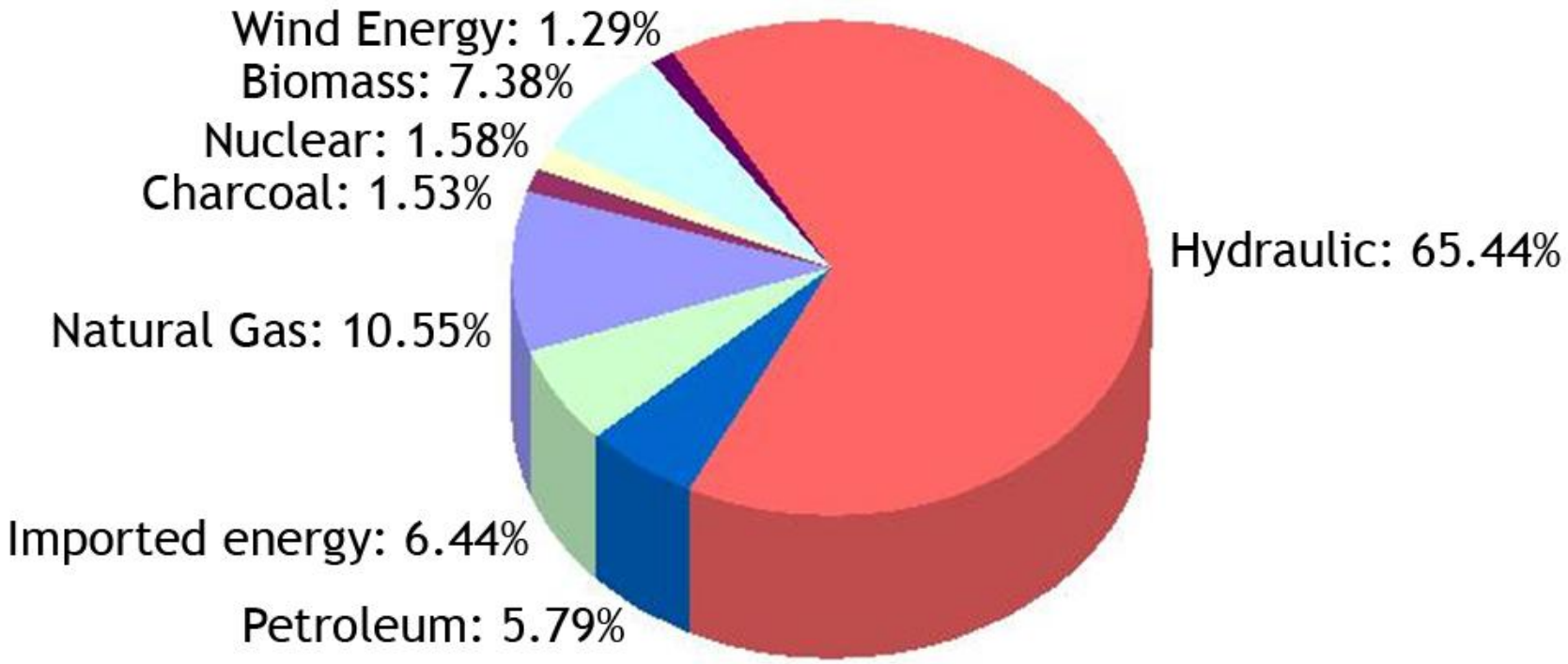
ENERGY EFFICIENCY

- **Brazil is a world leader in the use of renewable energy.**



Brazilian Energy Matrix
BIG 2012

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"The Brazilian electric system is unique in the world. Its flexibility allows that even the energy supply grows before the demand. This flexibility results from the giant hydraulic reserve that works like a enormous battery that can produce much more energy than normal consumption. Besides that, Brazil is one of the lower operational and environmental costs of the planet." (BNDES 2008)

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Brazilian energy matrix

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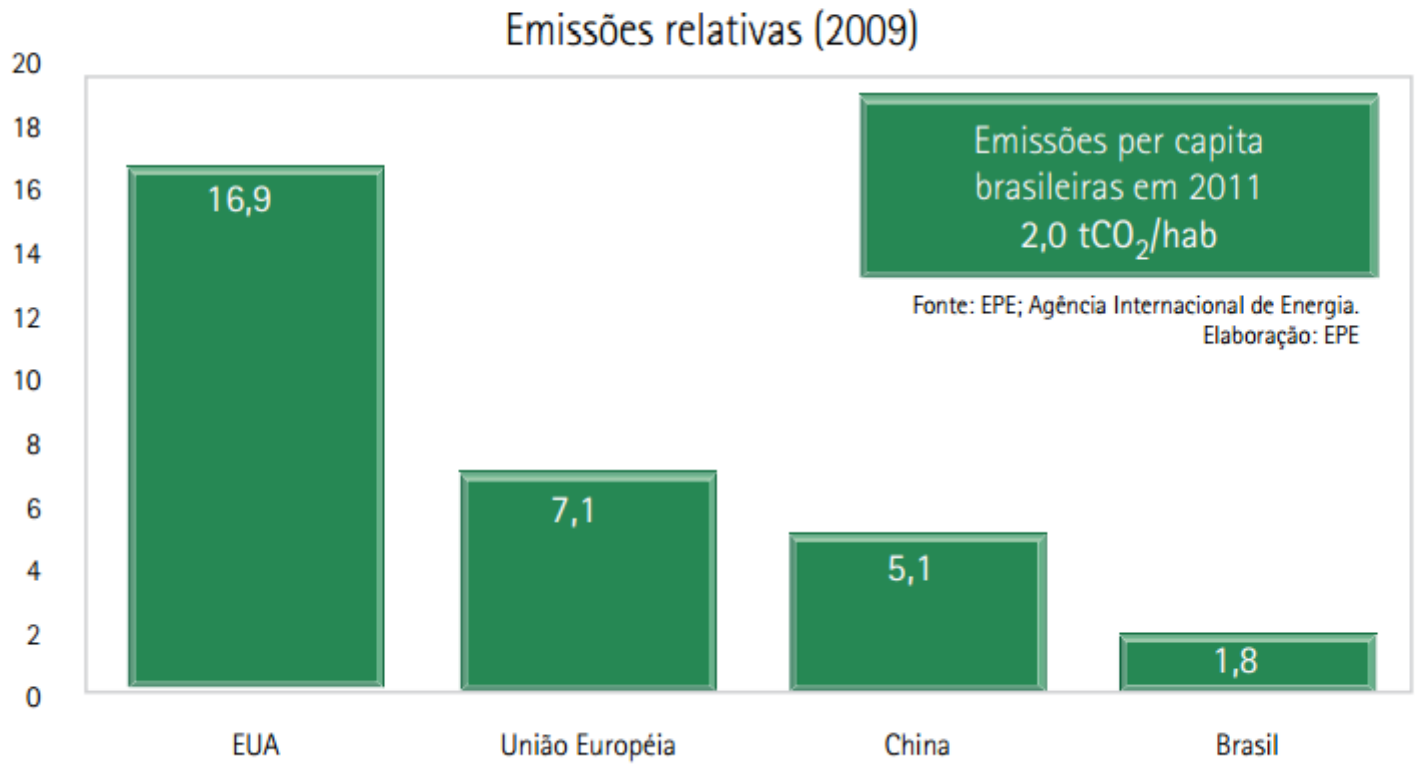
Emissões per capita de CO_2

Produzindo e consumindo energia, cada brasileiro emite, em média, 4 vezes menos do que um europeu, 9 vezes menos do que um americano e menos da metade do que emite um chinês.



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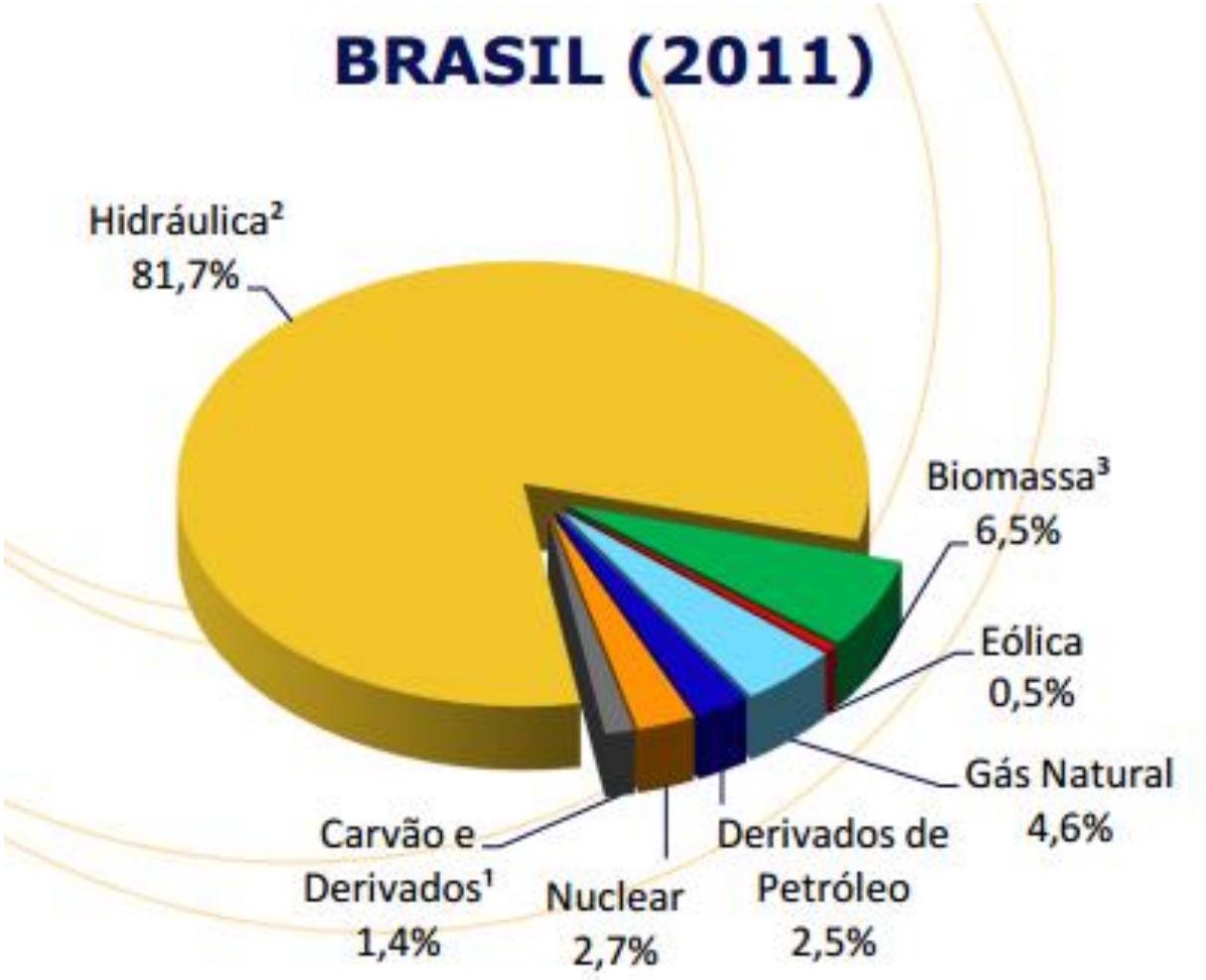
Electricity Generation



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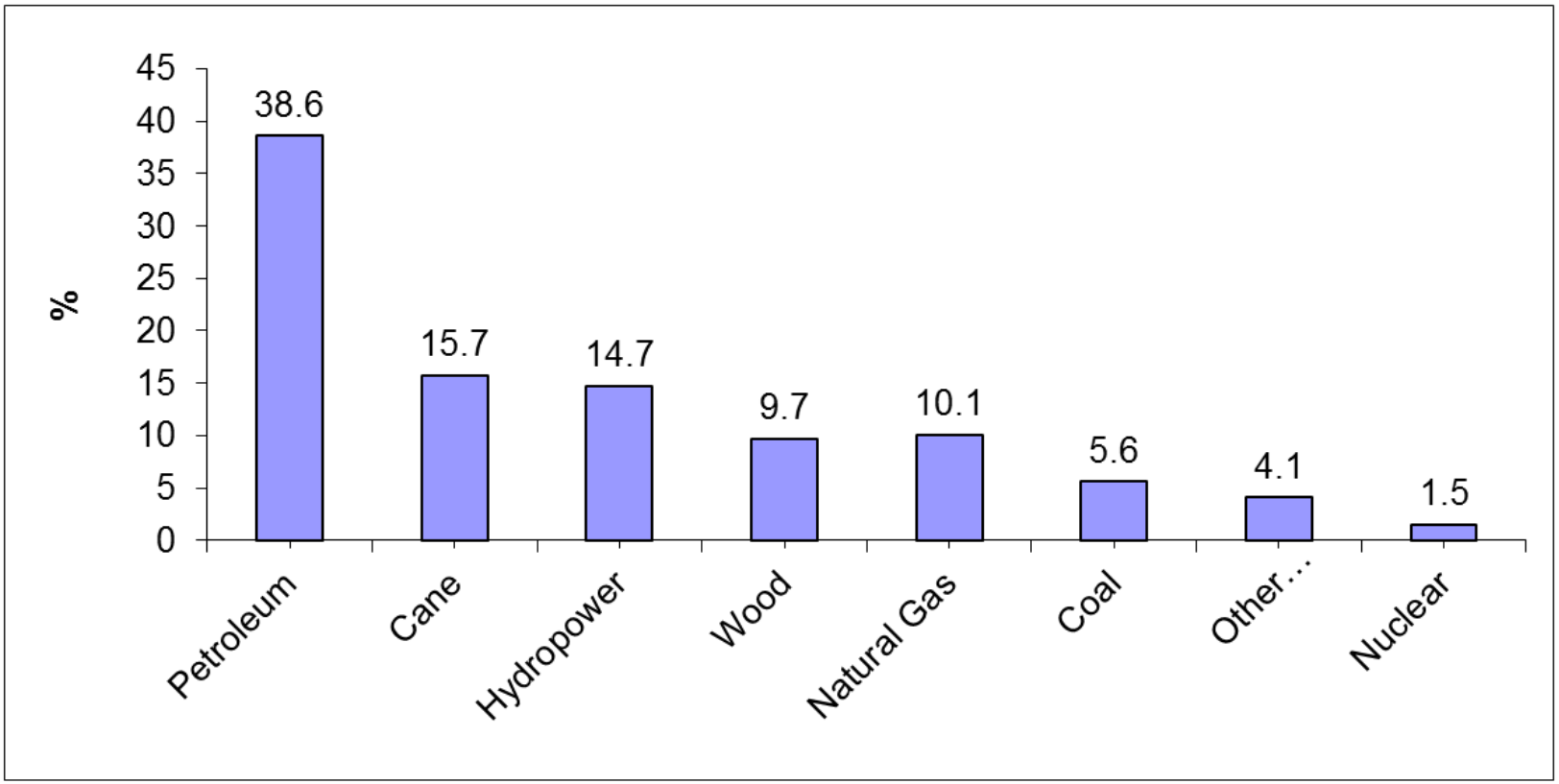
Capacity by Energy Source – Brazil- 2011



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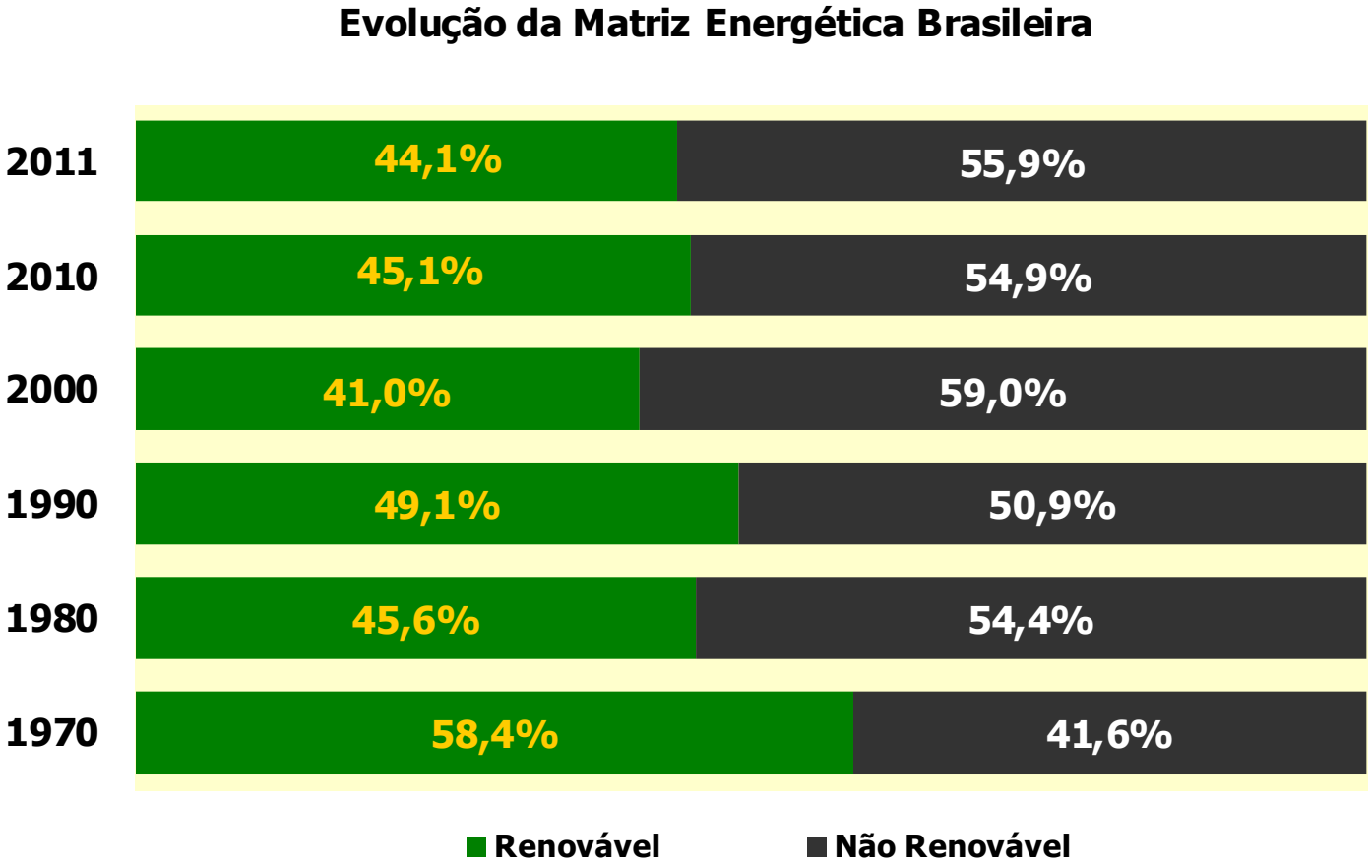
Evolution of the energy matrix



Fonte: EPE, BEN 2012

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OFERTA INTERNA DE ENERGIA	2011	2010
ENERGIA NÃO RENOVÁVEL	**55,9%**	**54,9%**
Petróleo e Derivados	38,6%	37,8%
Gás Natural	10,1%	10,2%
Carvão Mineral e Derivados	5,6%	5,4%
Urânio (U_3O_8) e Derivados	1,5%	1,4%
ENERGIA RENOVÁVEL	**44,1%**	**45,1%**
Energia Hidráulica e Eletricidade	14,7%	14,0%
Lenha e Carvão Vegetal	9,7%	9,7%
Produtos da Cana-de-açúcar	15,7%	17,5%
Outras Renováveis	4,1%	3,9%

Em 2011 ampliou-se para 88,9% devido às condições hidrológicas favoráveis e ao aumento da geração eólica

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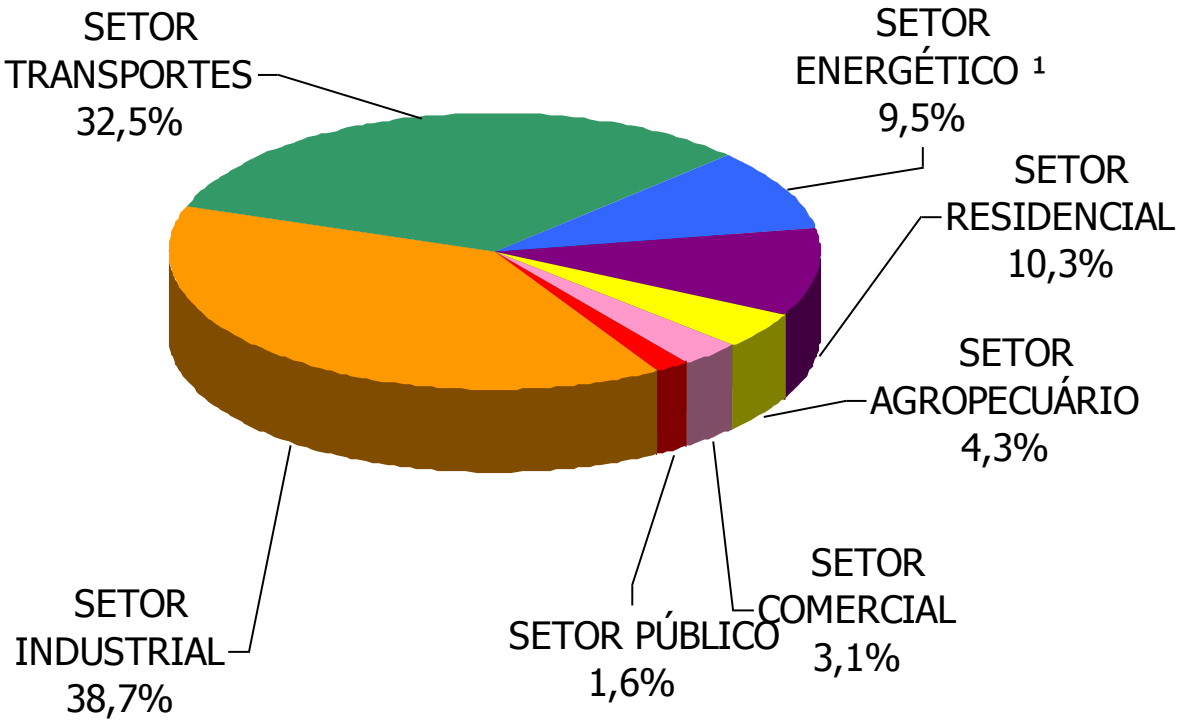
Energy Consumption by Sector



Fonte: EPE, BEN 2012

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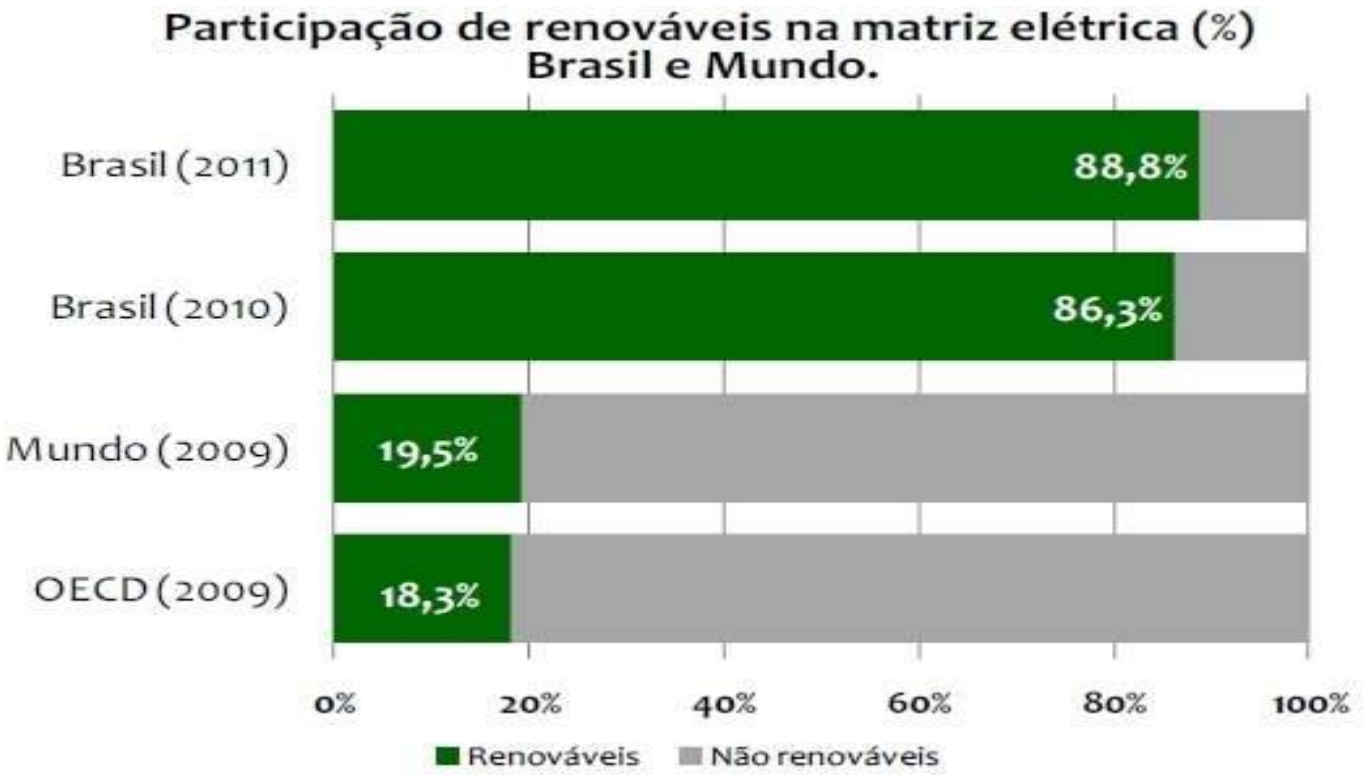
Brazilian Eletricity matrix

Energia elétrica limpa, pois 89% da energia vêm de fontes renováveis.

Geração hidráulica responde por 74,0% da oferta



Fonte: EPE, BEN 2012

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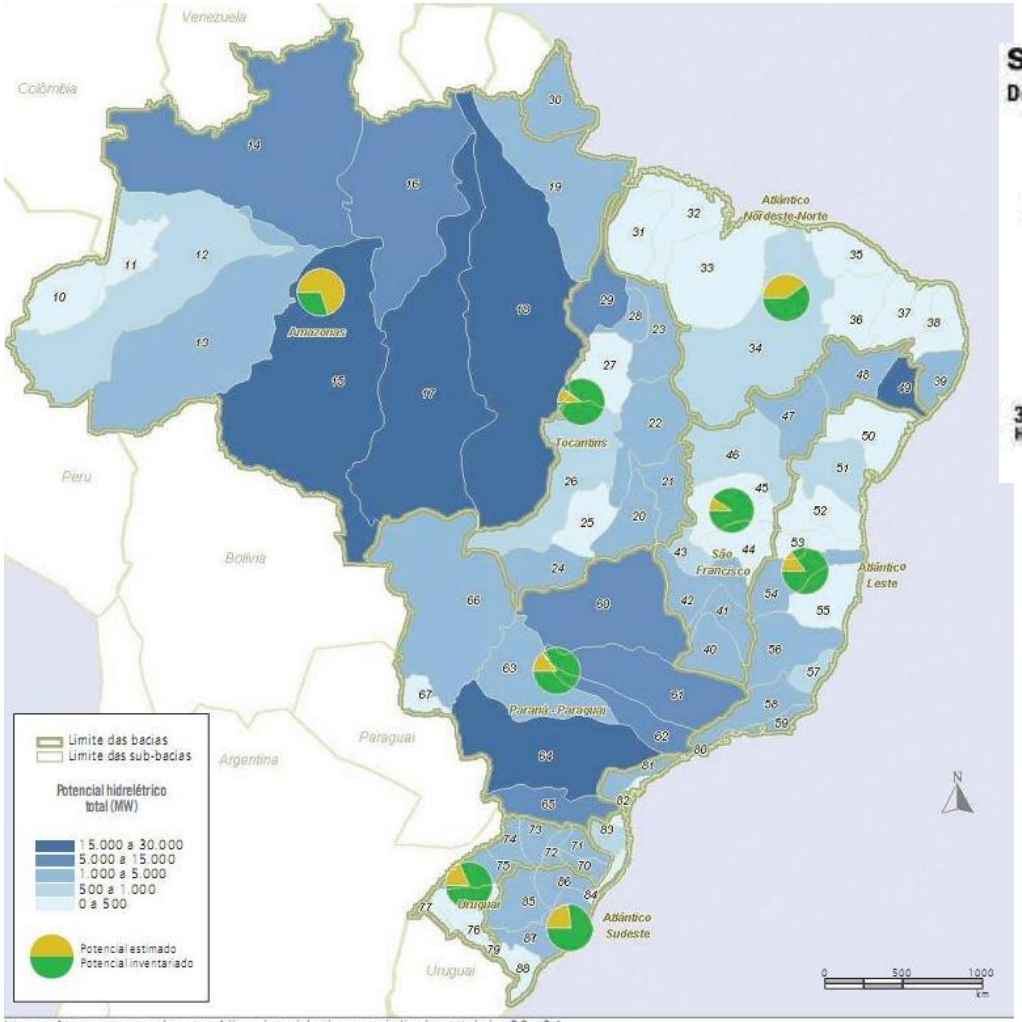
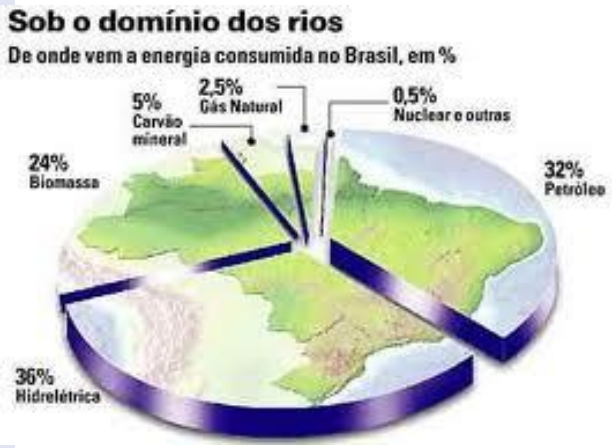
HIDRAULIC POTENTIAL



ota: os números correspondem aos códigos das sub-bacias, como indicado nas tabelas 3.2 e 3.4.

Figura 3.2 *– Potencial hidrelétrico brasileiro por sub-bacia hidrográfica*



Potential: 260 GW
Limiting environmental: 80 GW

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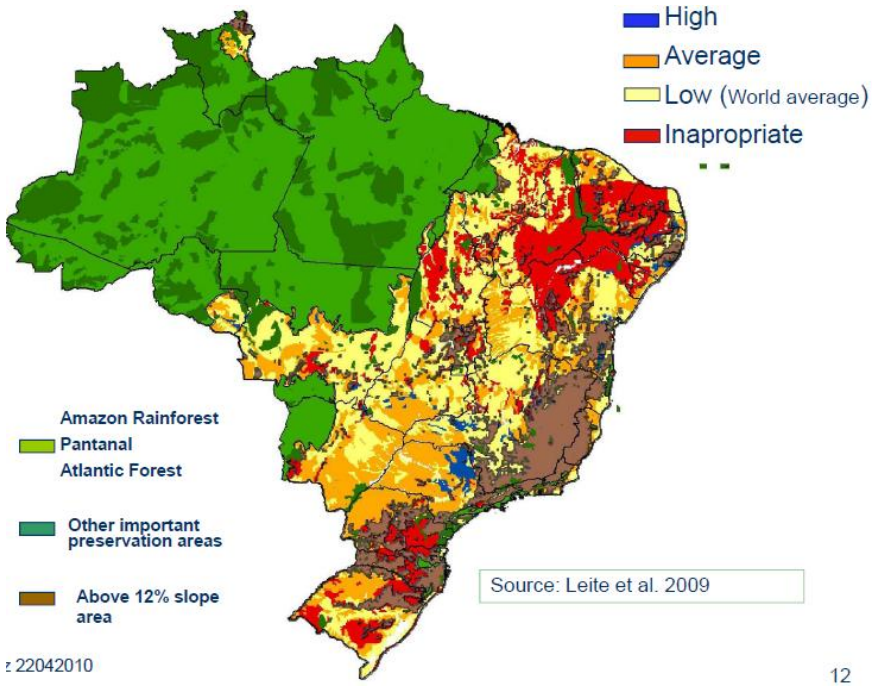
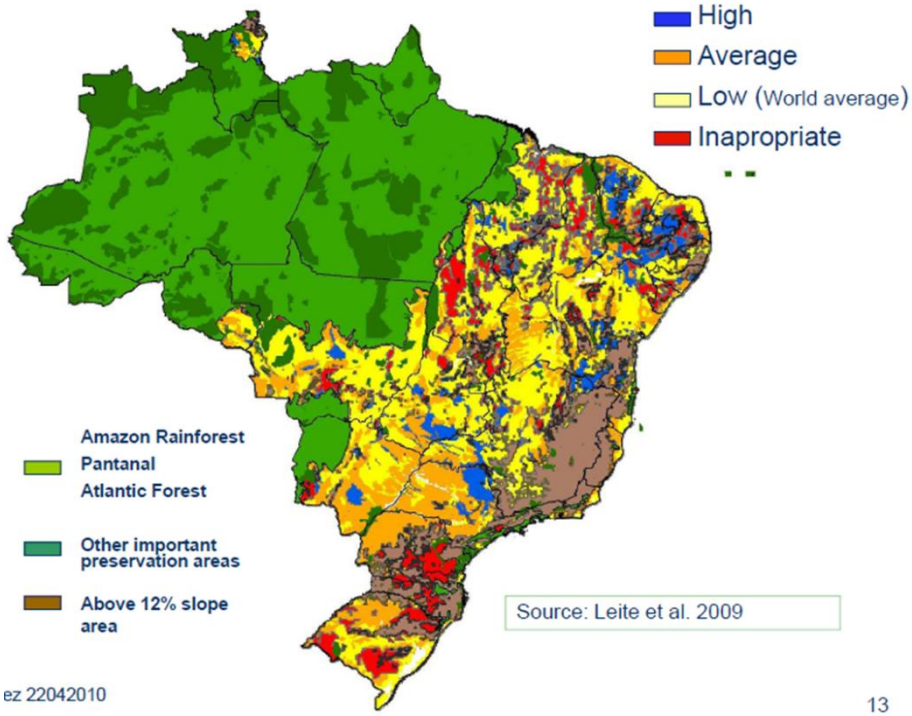
Fonte: EPE 2012

POTENTIAL OF BIODIESEL E BIOMASS



WITHOUT IRRIGATION



WITH IRRIGATION

Fonte: MME, 2011

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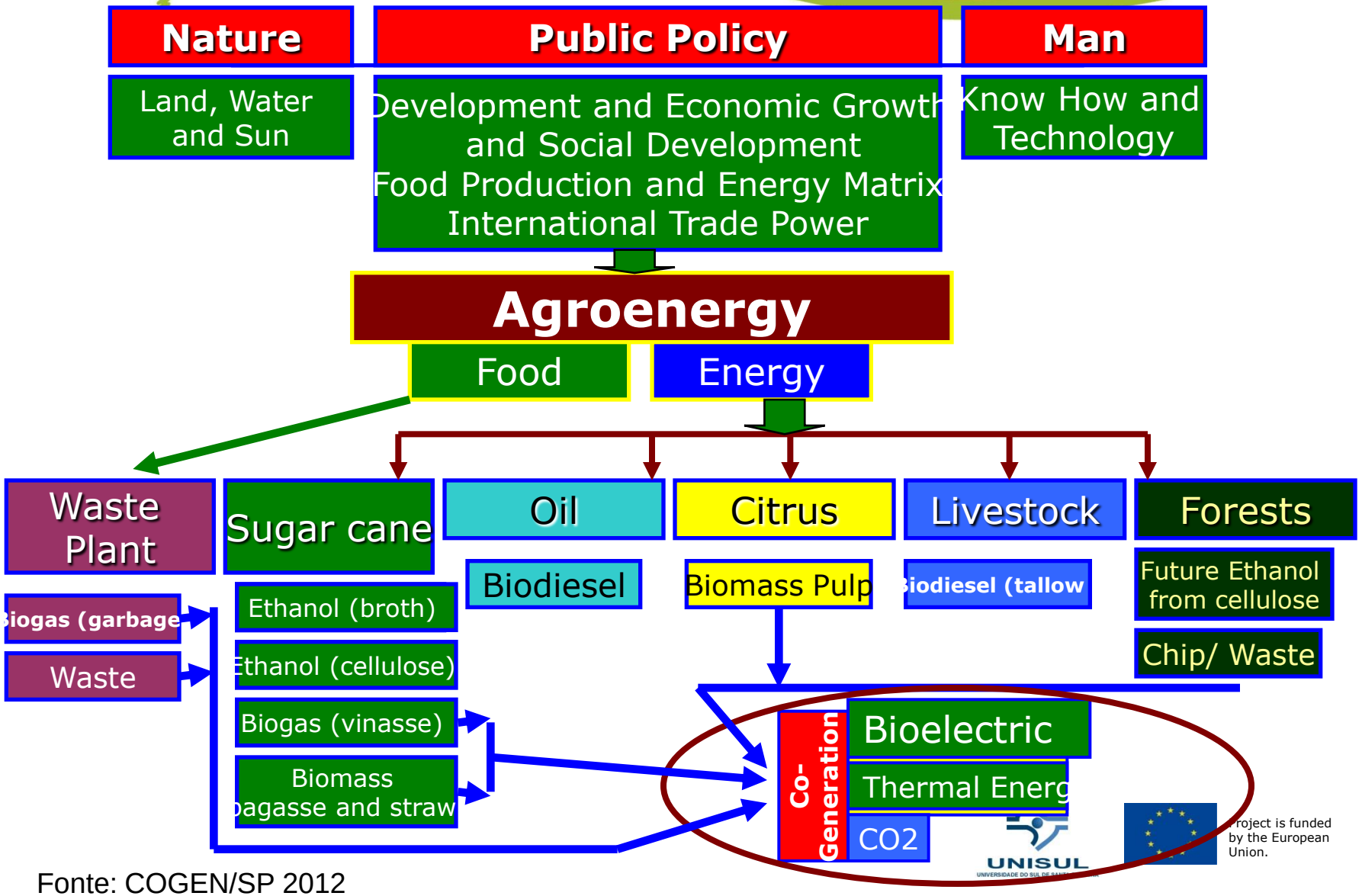
Agroenergy - New Paradigm of Matrix Energy



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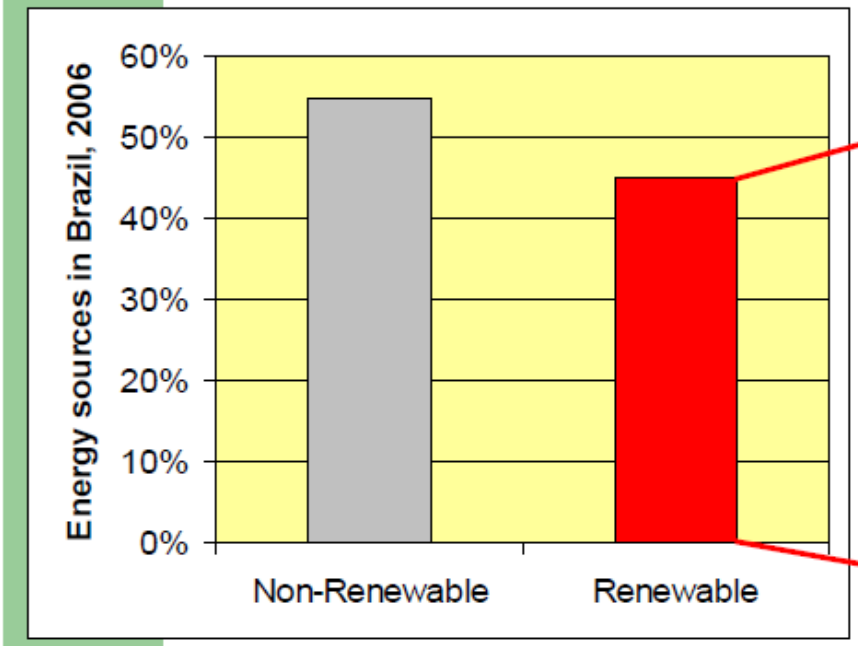
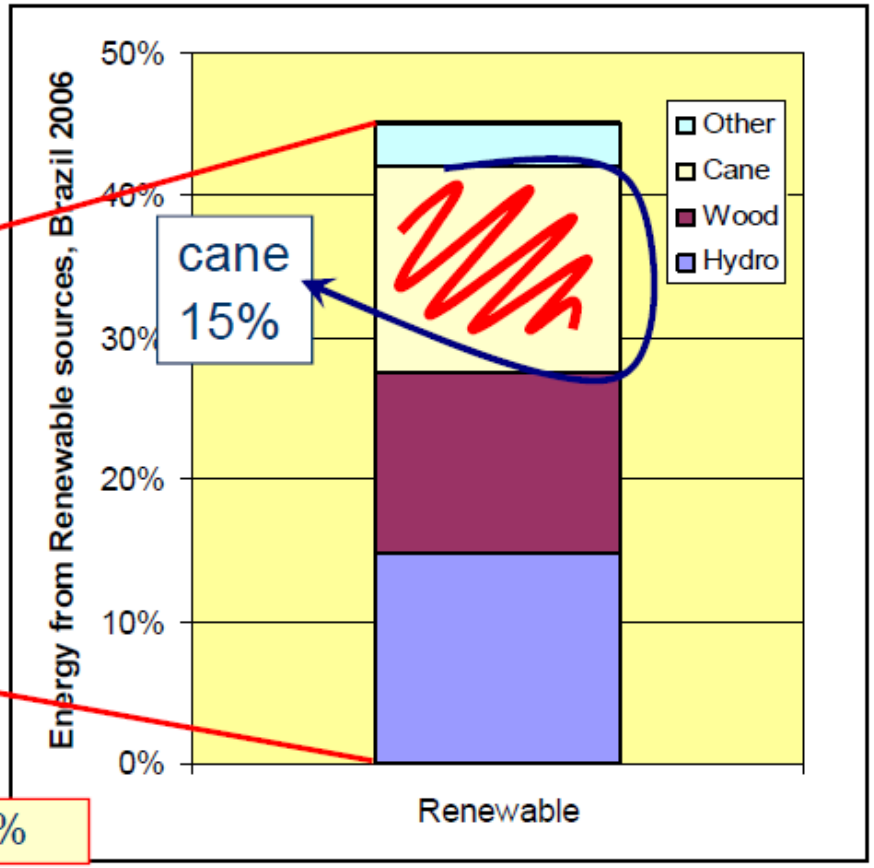
Fonte: COGEN/SP 2012

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

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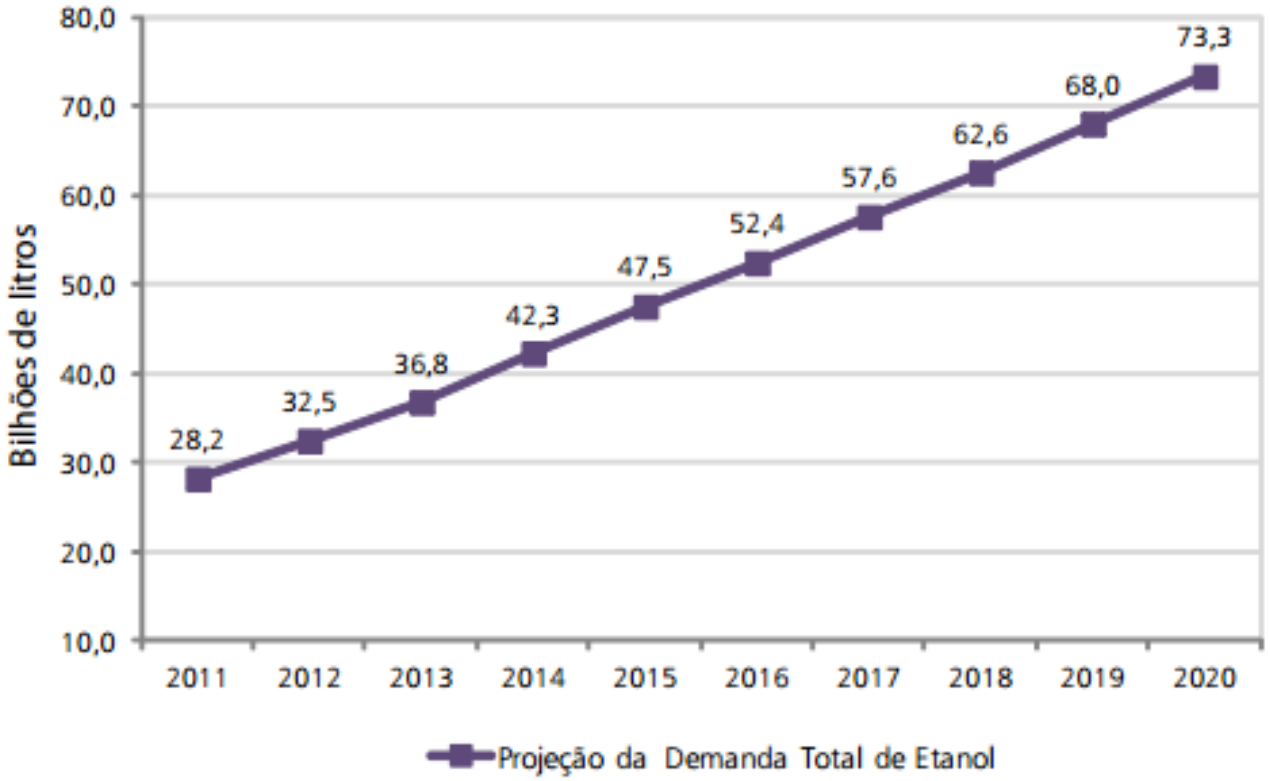
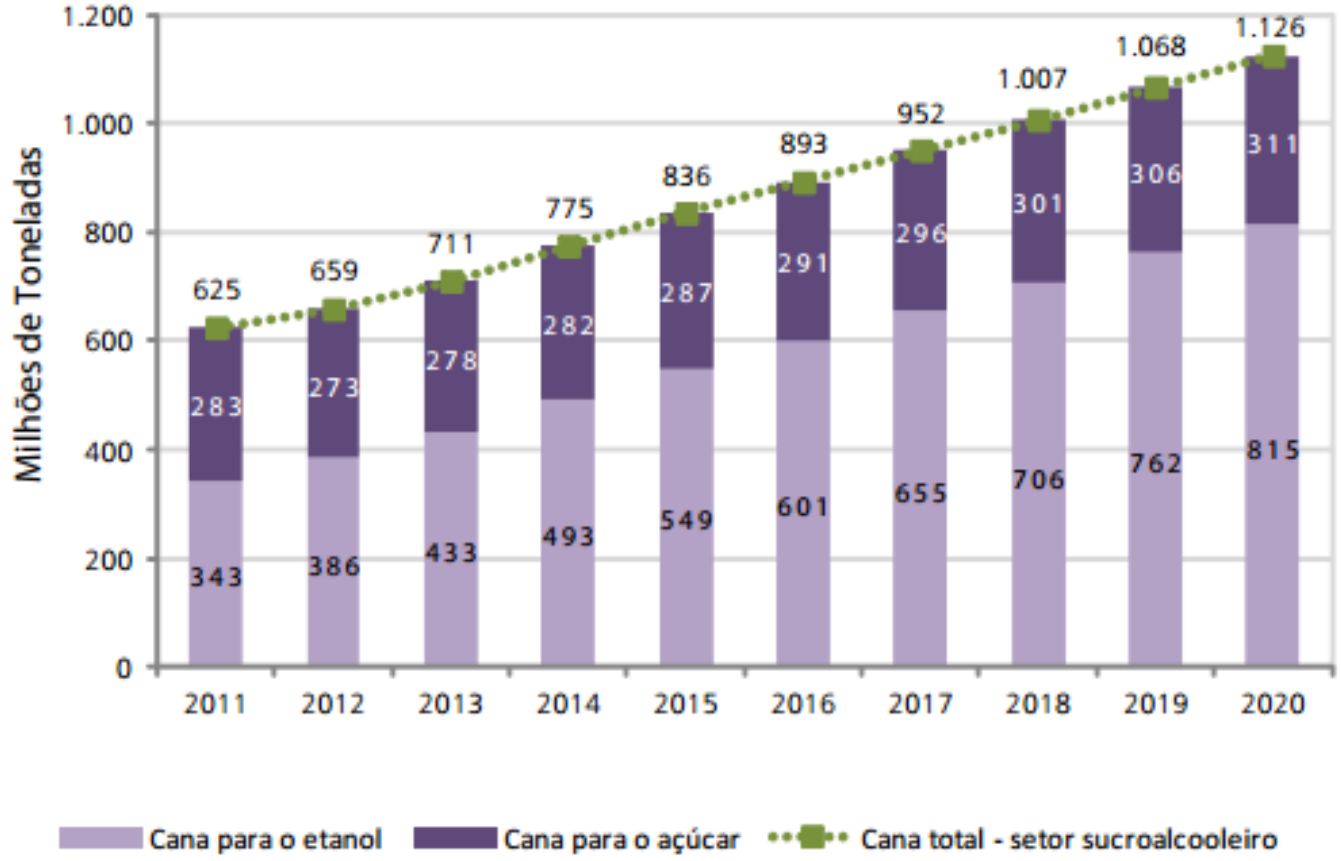
Prospects Sector Sugarcane

Gráfico 111 – Projeção da demanda total de etanol – 2011-2020



Fonte: EPE [143]

Gráfico 112 – Quantidade de cana para atender a demanda de etanol e açúcar.



Fonte: EPE e MAPA [154]

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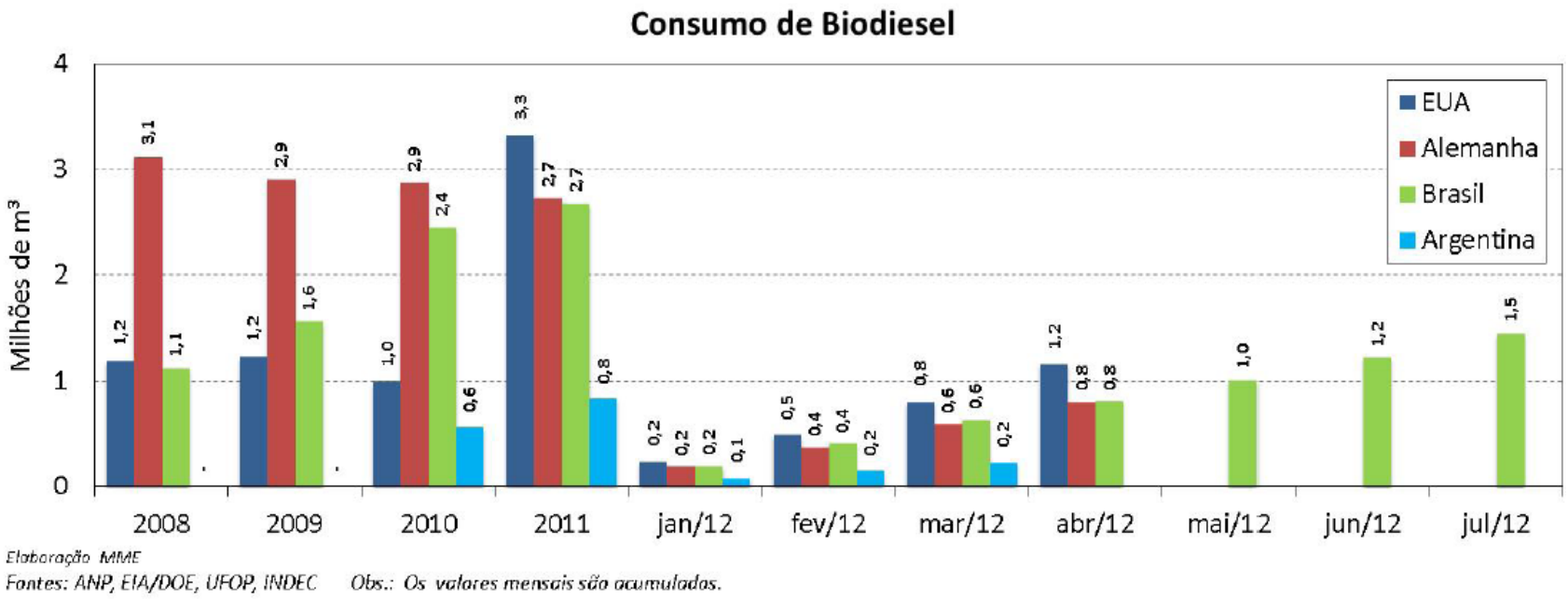
Biodiesel consumption

Biodiesel: Consumo em Países Selecionados



Elaboração MME
Fontes: ANP, EIA/DOE, UFOP, INDEC *Obs.: Os valores mensais são acumulados.*

Biodiesel produzido no país atingiu 2.672.760 m³

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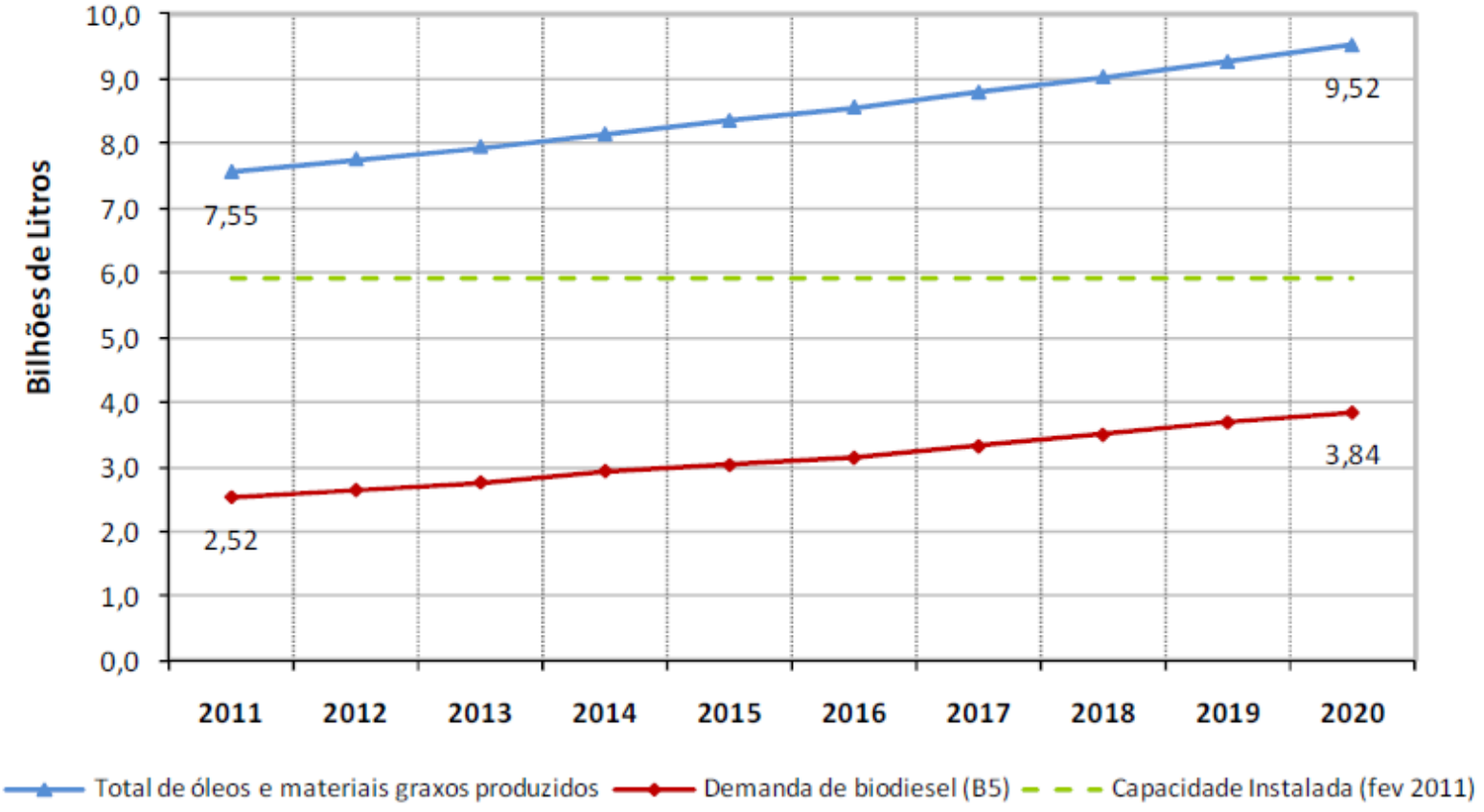
Estimated demand for biodiesel



Fonte: ANP

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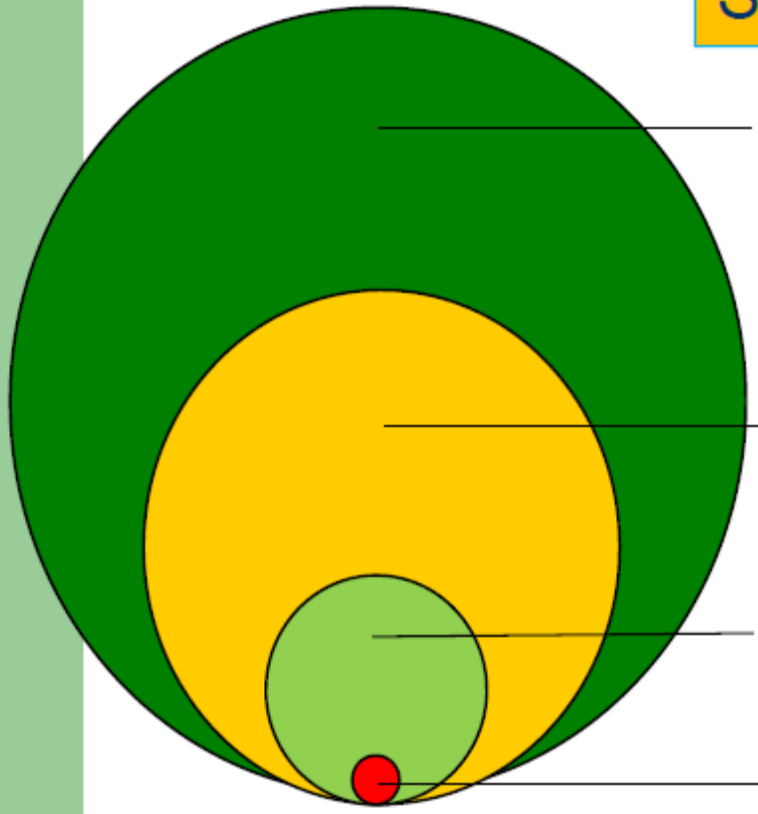
Small bioenergy footprint



Total country area (851 Mha, 100%)

Rural properties area (355 Mha, 42%)

Area used for agriculture (76.7 Mha, 9%)

Area used for sugarcane for ethanol (3.4 Mha, 0.4%)

Pasture 200 Mha

Soya 22 Mha

Source: Horta Nogueira e Seabra (2008)

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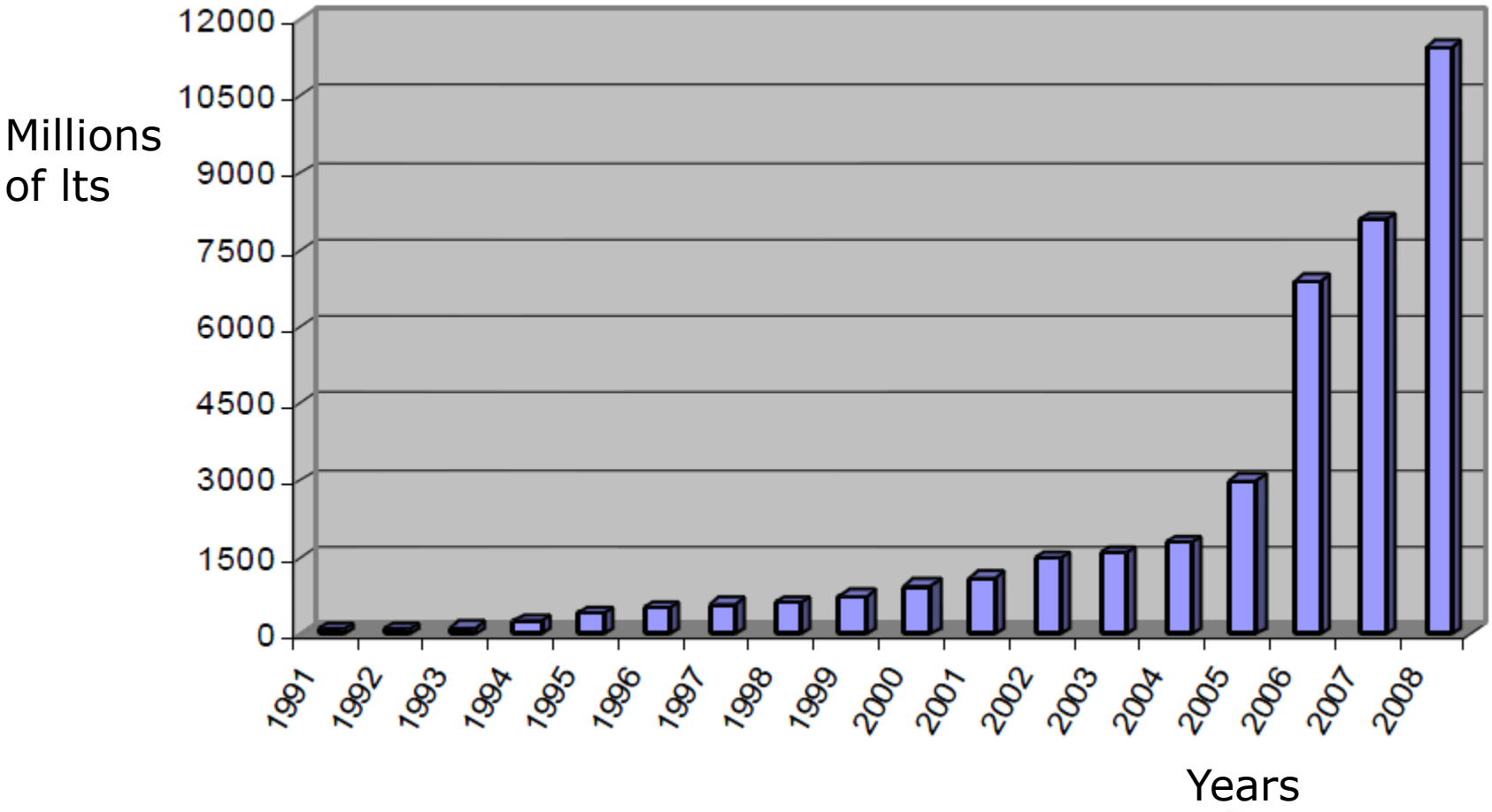
World Ethanol Production



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COMPARISON OF BRAZIL AND U.S. ETHANOL INDUSTRIES

• **Brazil-Sugarcane**	• **United States-Corn**
• The sugar (sucrose) in sugarcane can be converted directly into ethanol	• The starch in corn is first converted into sugar. Then the sugar is converted into ethanol
• Sugarcane is planted every six years using cuttings	• Corn is planted every year using seeds
• Sugarcane provides five cuttings over six years and then is replanted	• Corn is harvested once each year
• An acre of sugarcane produces about 560 gallons of ethanol	• An acre of corn produces about 420 gallons of ethanol
• Sugarcane-ethanol can be produced cheaper than corn-ethanol	• Corn-ethanol is more expensive to produce than sugarcane-ethanol
• Brazil has great potential for expanding sugarcane acreage without limiting the acreage of other crops	• U.S. expansion of corn acreage will come at the expense of reduced soybean and other crop acres

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POTENTIAL OF BIOMASS

Today: 16.6 GW

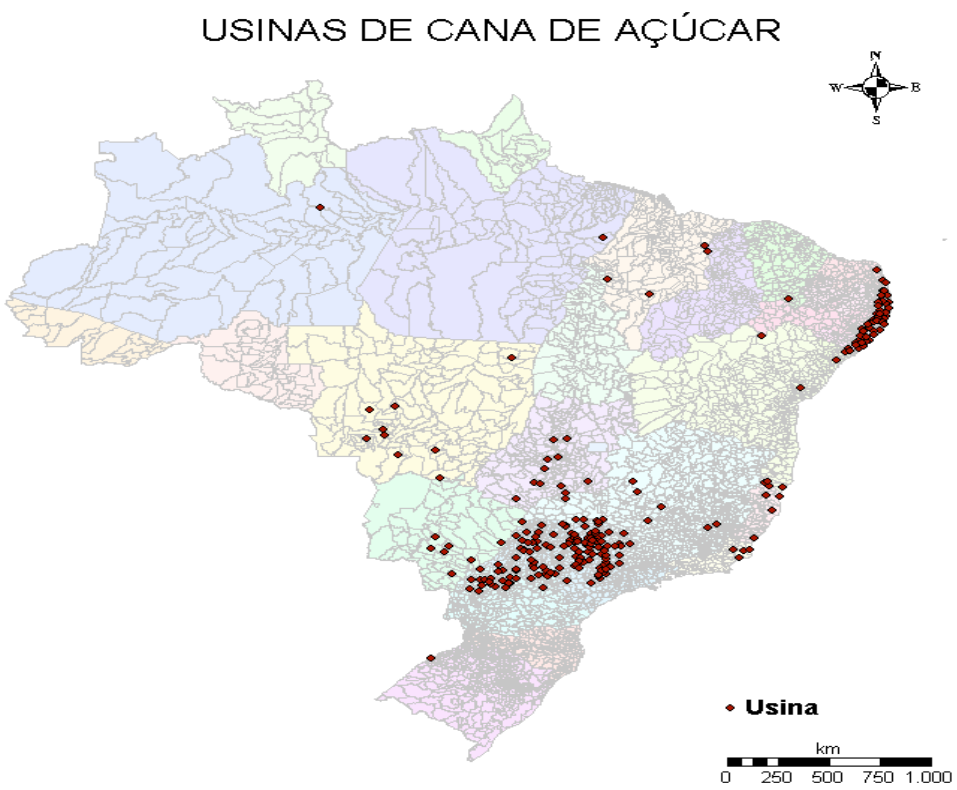
Potential: 22.3 GW

Competitive cost:

Installation:

U$ 2,000.00 / kW

Energy: U$ 65 / MWh



Fonte: MME, 2011

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Promoting Renewable Electricity Generation in South America

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Potential Waste: Agribusiness

Montantes estimados de resíduos sólidos e efluentes gerados pelo setor agrosilvopastoril e potencial energético desses resíduos. Ano base 2009.			
	Resíduos (milhões de T/ANO)	**Efluentes (milhões de m3/ANO)**	**Potencial Energético (MW/ANO)**
Agroindústrias associadas às principais culturas			
Cana-de-açúcar (bagaço e torta de filtro)	201,4	-	16.464
(vinhaça)	-	604.2	-
Soja	41,9	-	3.422
Milho	29,4	-	2.406
Laranja	8,8	-	-
Trigo	3,0	-	238
Arroz	2,5	-	175
Total de 13 culturas	**291,1**	**604.2**	**22.999**

Fonte: IPEA 2012

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Potential Waste: Livestock

Montantes estimados de resíduos sólidos e efluentes gerados pelo setor agrosilvopastoril e potencial energético desses resíduos. Ano base 2009.			
	Resíduos (milhões de t/ano)	**Efluentes (milhões de m3/ANO)**	**Potencial Energetico (MW/ANO)**
Bovinos	1.655,4	-	1.032
Aves	28,0	-	136
Suínos	20,4	-	122
Total	**1.703,8**	-	**1.290**

Fonte: IPEA 2012

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Potential Waste: Livestock

Montantes estimados de resíduos sólidos e efluentes gerados pelo setor agrosilvopastoril e potencial energético desses resíduos. Ano base 2009.			
	Resíduos (milhões de T/ANO)	**Efluentes (milhões de m3/ANO)**	**Potencial Energético (MW/ANO)**
Indústrias primárias associadas às criações animais			
Abatedouros	1,7	101,5	11,2
Graxarias	-	6,8	0,8
Laticínios	-	13,2	2,6
Total	**1,7**	**121,5**	**14,6**

Fonte: IPEA 2012

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Potential Waste: Silviculture

Montantes estimados de resíduos sólidos e efluentes gerados pelo setor agrosilvopastoril e potencial energético desses resíduos. Ano base 2009.			
	Resíduos (milhões de T/ANO)	**Efluentes (milhões de m3/ANO)**	**Potencial Energético (MW/ANO)**
Silvicultura			
Colheita de madeira em tora	15,7	-	650
Processamento mecânico de madeira	22,9	-	954
Total	**38,5**	**-**	**1.604**

Fonte: IPEA 2012

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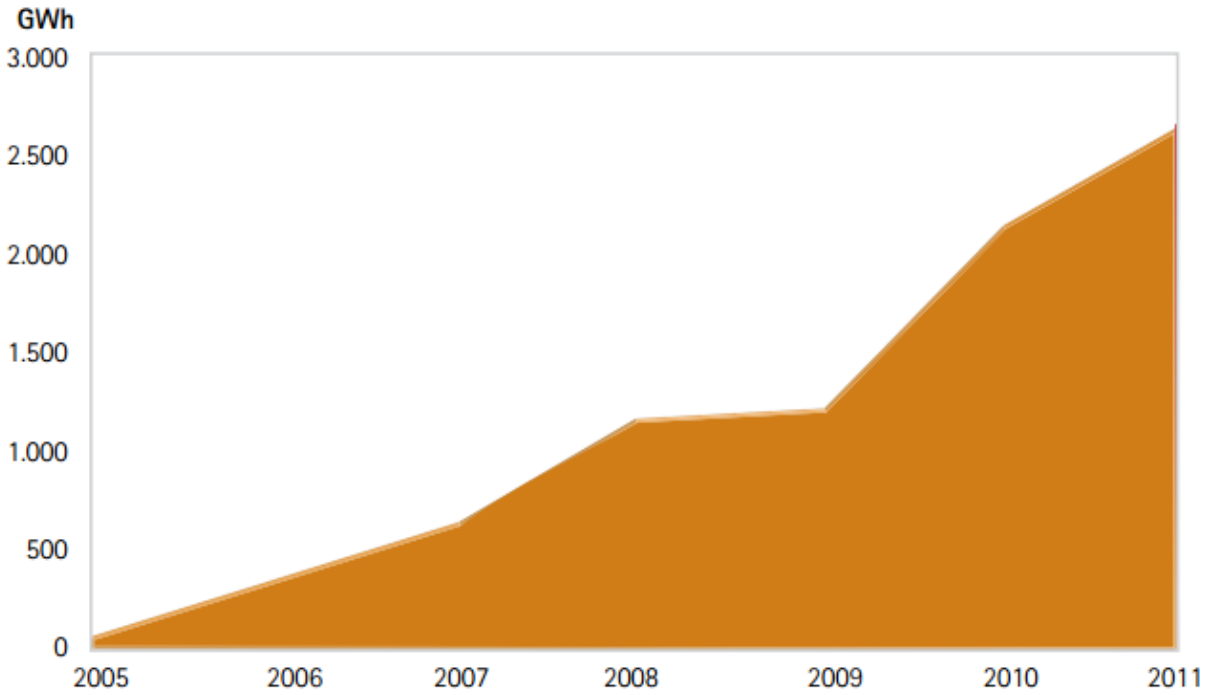
Evolução da geração eólica

em GWh

2005	2006	2007	2008	2009	2010	2011	Δ% 2011/2010
74	342	668	1.183	1.238	2.177	2.705	24,3%



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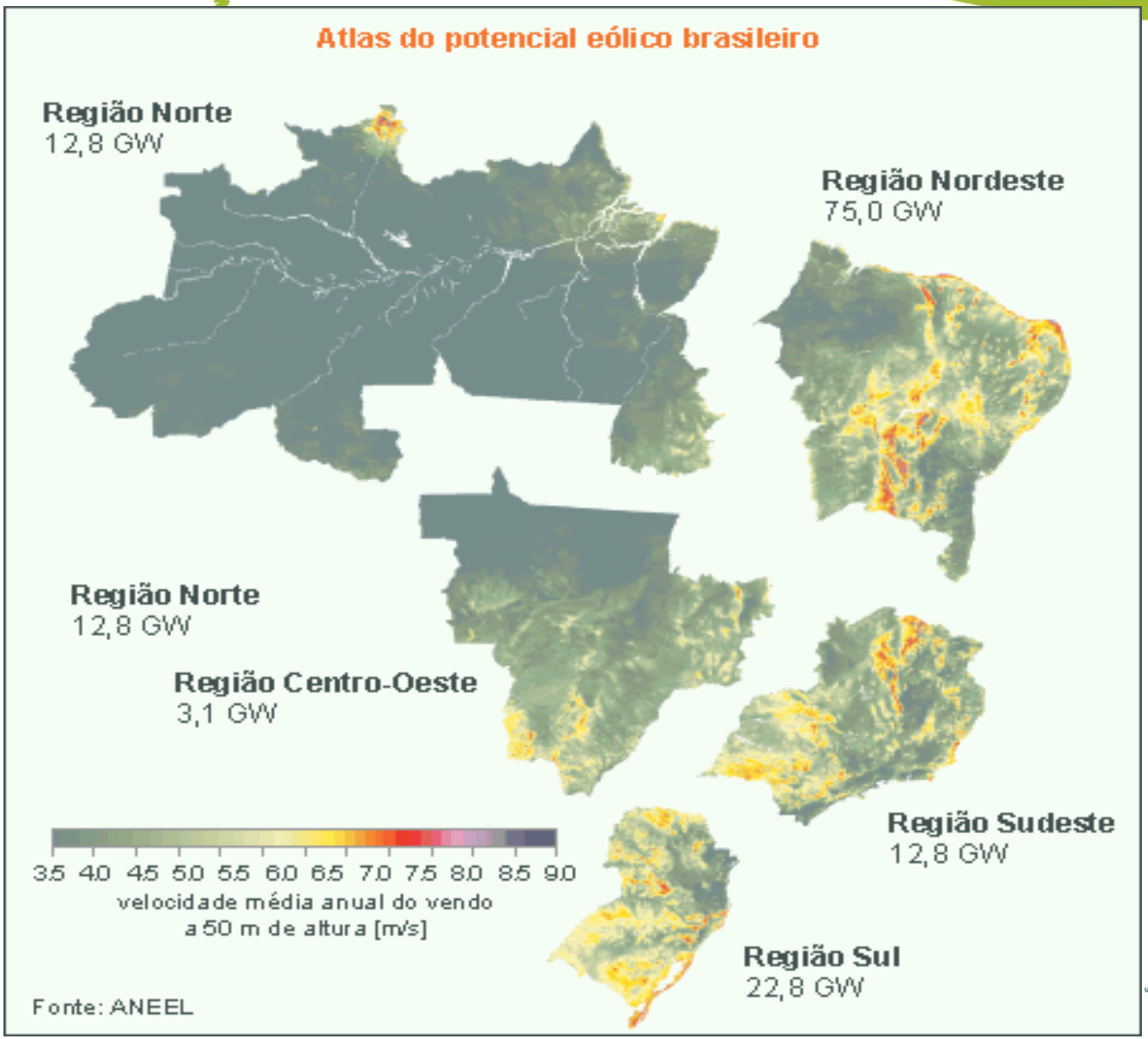

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O mapa das eólicas

Nordeste concentra 76% dos parques a serem construídos até 2014

Estado	Número de parques	Potência (em MW)
Bahia	52	1.391
Ceará	54	1.489
Paraíba	13	65
Paraná	2	1,5
Pernambuco	8	99
Piauí	4	93,5
Rio de Janeiro	2	163
Rio Grande do Norte	83	2.383
Rio Grande do Sul	49	1.284
Santa Catarina	13	232
Sergipe	1	30
Total	**281**	**7.231**

Fonte: ABEEólica

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SOLAR POTENTIAL

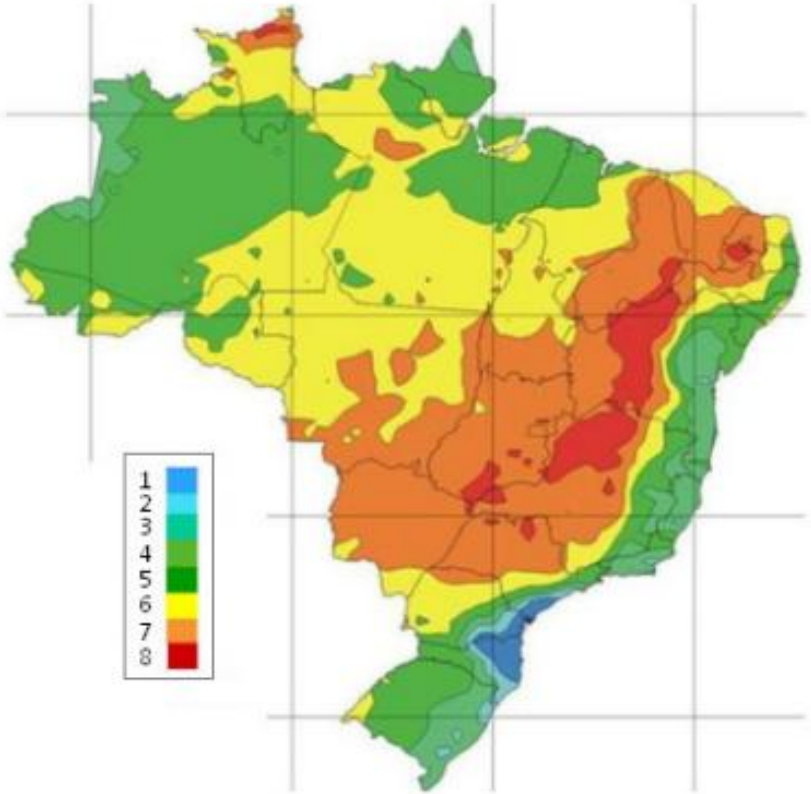

Fig. 28. Irradiação solar do Brasil para o plano inclinado

Fonte: Adaptado do Atlas Brasileiro de Energia Solar – 2006

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Brazil has one of the largest reserves in the world of silicon

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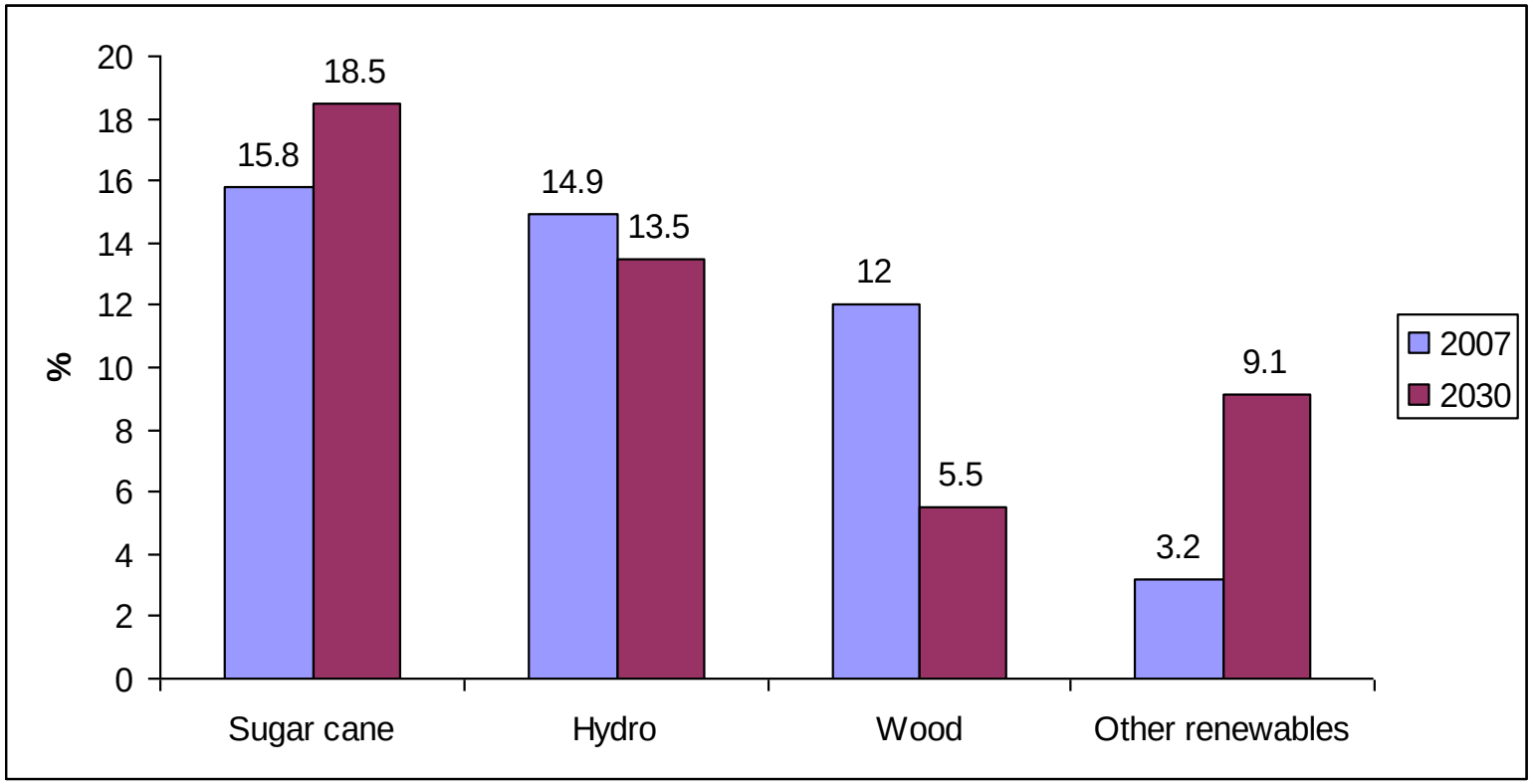
Renewable energy forecast Brazil – 2007-2030



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Renewable energy forecast Brazil – 2030

- Supply – 2007
  - Total: 239 million toe
  - Renewable: 110 million toe (45,9%)

- Supply – 2030
  - Total: 557 million toe
  - Renewable: 259 million toe (46,5%)

Fonte: MME/BEM (2008) e PNE 2030.

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Synthesis of trends in the Brazilian Energy Sector (2007-2030)

- Increase in use of natural gas (9% - 15%);
- Decrease in the use of wood and vegetal coal (12% - 5%)
- Increase in the use of sources from agriculture (cane [ethanol]; H-BIO and biodiesel (17% - 24%)
- Hydro participation will not change significantly.
- Increase in both coal and nuclear participation.

Fonte: MME/BEM (2008) e PNE 2030.

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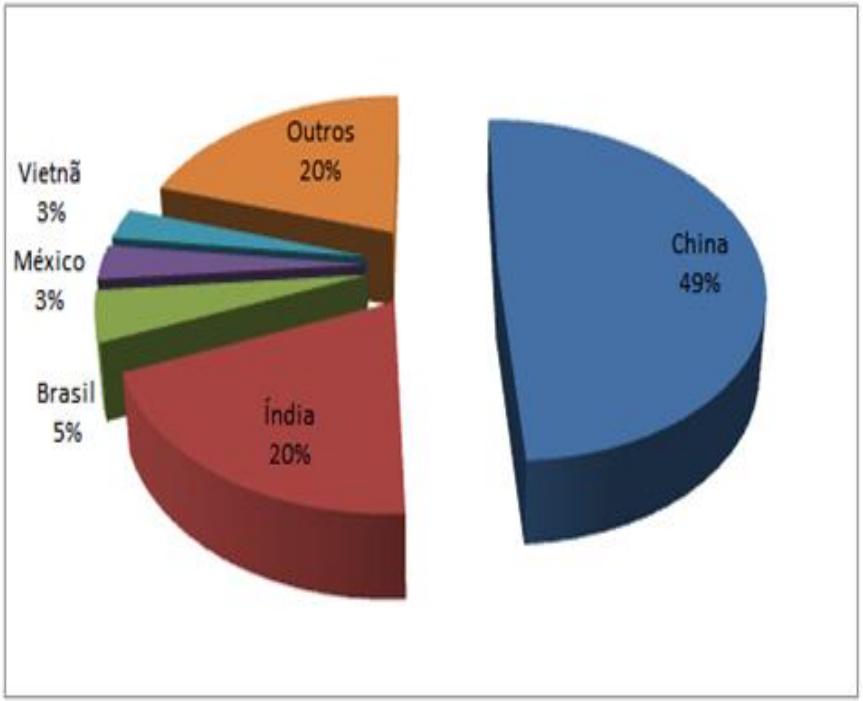
Brazilian Emissions (10^3 t CO_2e) [MME 2012]

Projetos de MDL registrados até 12/07/2012

País	Quantidade
China	2127
Índia	855
Brasil	204
México	141
Vietnã	127
Outros	875
Total	**4329**



Fonte: http://cdm.unfccc.int/Statistics/index.html

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CHALLENGES FOR RENEWABLES IN BRAZIL

- Internalization of the benefits of economic analyzes energy;
- Adequacy of the system and logistics distribution network and transmission;
- Training of human resources and awareness of society;
- Reduced costs of equipment and materials engineering by increased production on an industrial scale: industrial policy

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Energy efficiency and renewable sources

- Energy efficiency has been considered as the main option (higher potential and lower costs).
- The largest share of unconventional renewable energy sources was "financed by energy savings" (cost of keeping costs lower than offer)

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ENERGY EFFICIENCY

- **Renewable resources are easily accessible and plentiful.**

Sun energy	20 times
Wind power	3 times
Hydropower	3 times
Biomass	0.2 times
Ocean energy	0.15 times

Potential of renewable energy sources in the country
EREC 2010

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- ✓ 2006: Brazil was a founding member from the International Partnership in Energy Efficiency (Parceria Internacional para Cooperação em Eficiência Energética - IPEEC) established with the EU

- ✓ In 2007, Brazil was in a privileged position in comparison to other countries when we observe its energy matrix in terms of CO_2e emissions. Only 1.5% of the greenhouse gases emissions are generated by the brazilian electric system (in the rest of the world it is 24%).

- ✓ 2009: The national policy on climate change (Política Nacional sobre a Mudança do Clima - PNMC), established a voluntary compromise to reduce the greenhouse gases emissions between 36.1% and 38.9% from the values projected until 2020.

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INVITATION:

REGSA International Conference

April 2014

Florianópolis – Santa Catarina – Brasil

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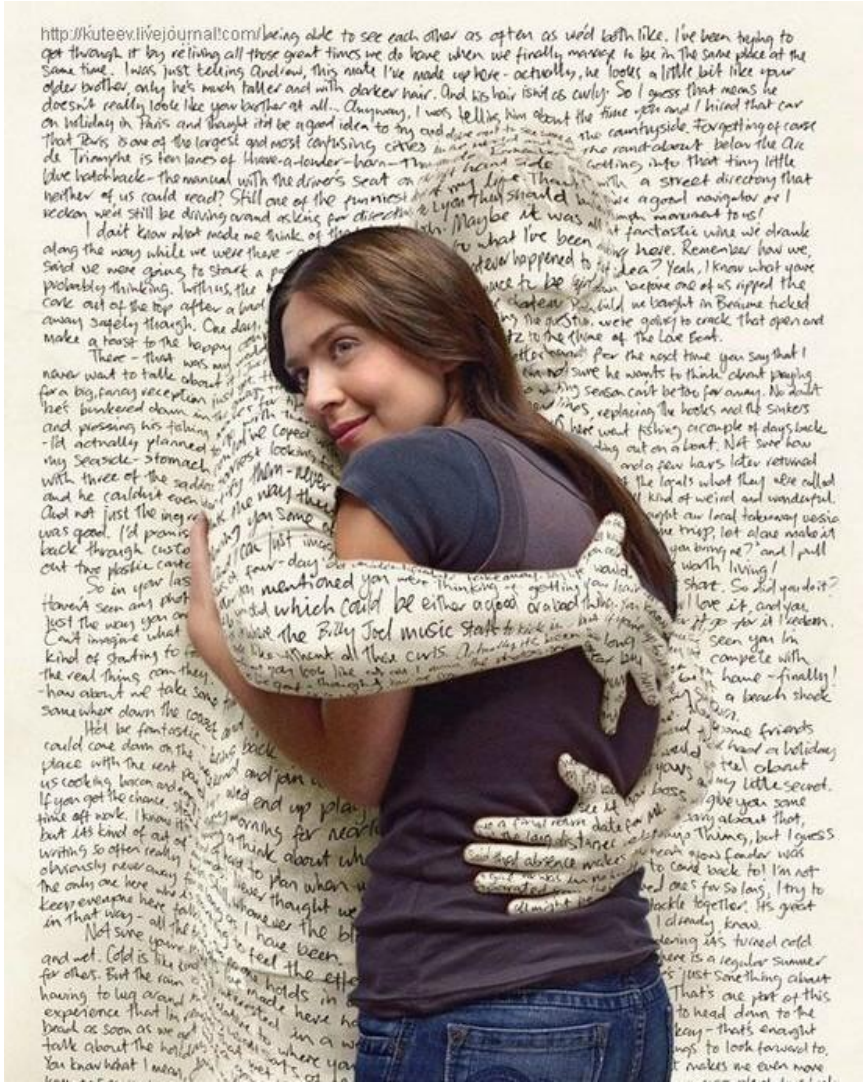

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