



Brazilian Bioethanol Science  
and Technology Laboratory



# **Biofuels: National, International Markets and the Contribution to the GHG Emission Reduction in Brazil**

**Manoel Regis L.V. Leal**

**V SEMINARIO LATINOAMERICANO Y DEL CARIBE DE BIOCOMBUSTIBLES**

**Santiago, Chile – 17 y 18 de Agosto de 2010**



Brazilian Bioethanol Science  
and Technology Laboratory

# Contents



Biofuels Global Picture

Biofuels in Brazil: Past and Future

International Market

GHG Emission Reduction in Brazil

## Motivation to Use Biofuels

**Environmental:** reduce GHG emissions and local pollution

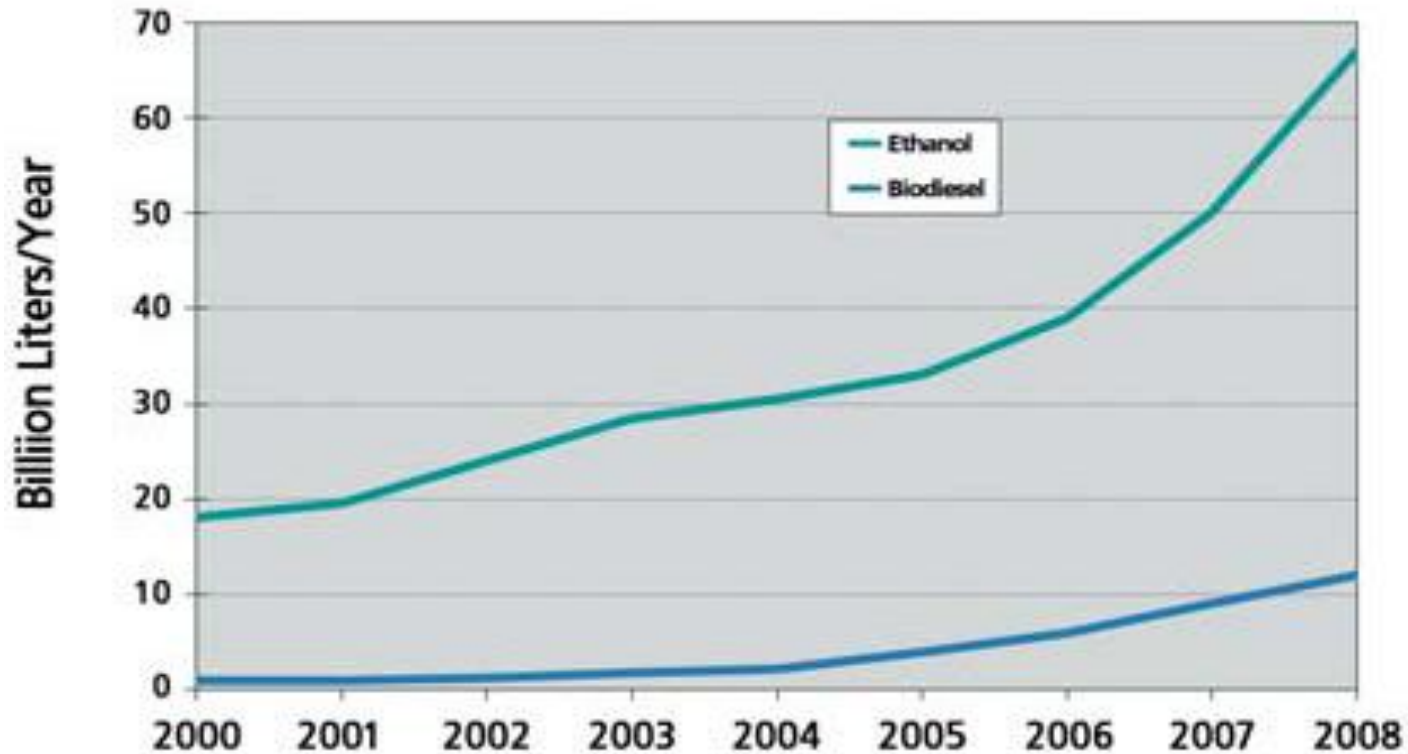
**Strategic:** energy security

**Social:** rural jobs and support for agriculture

**Economic:** high oil prices

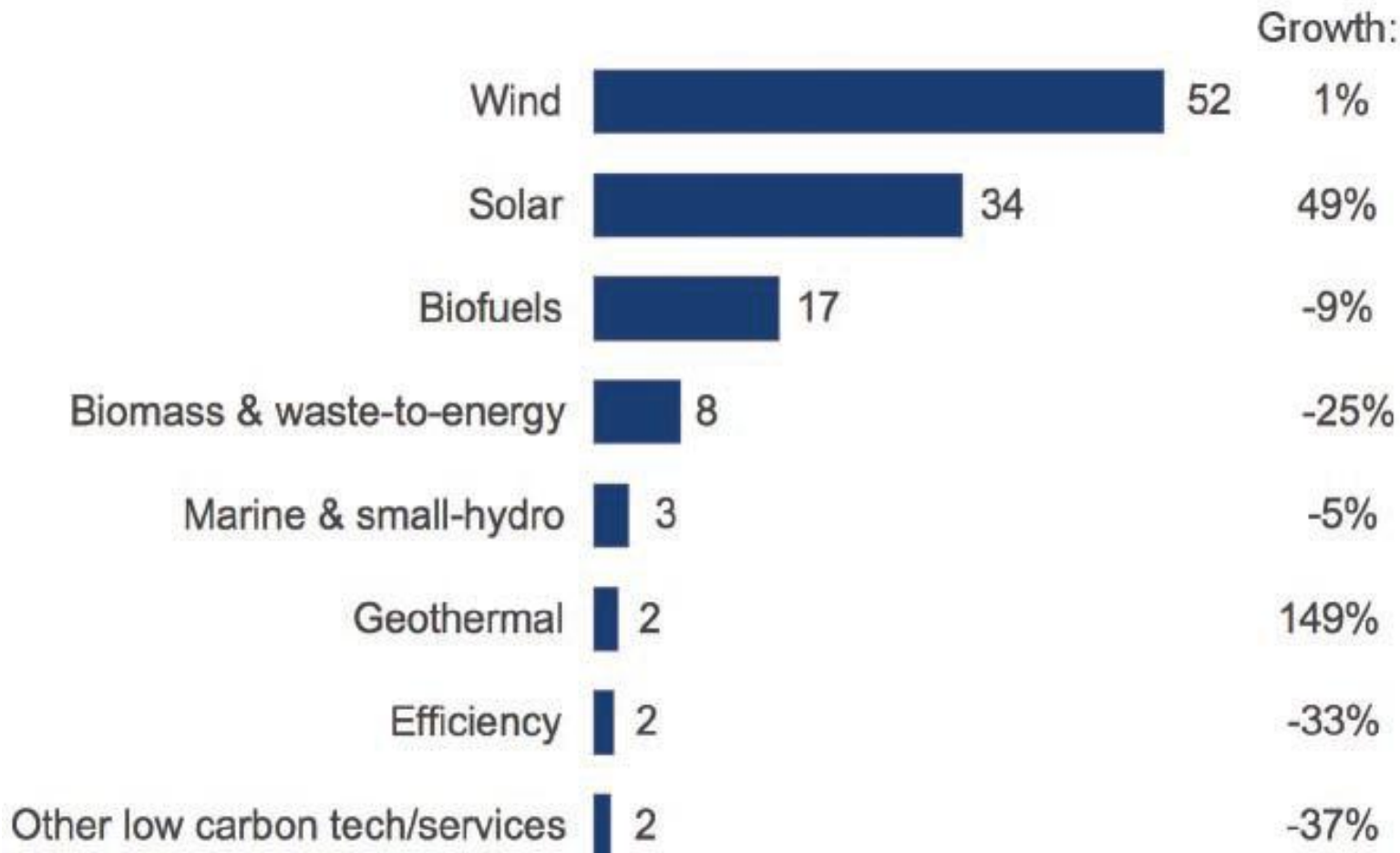
# World Biofuels

## Ethanol and Biodiesel Production, 2000–2008



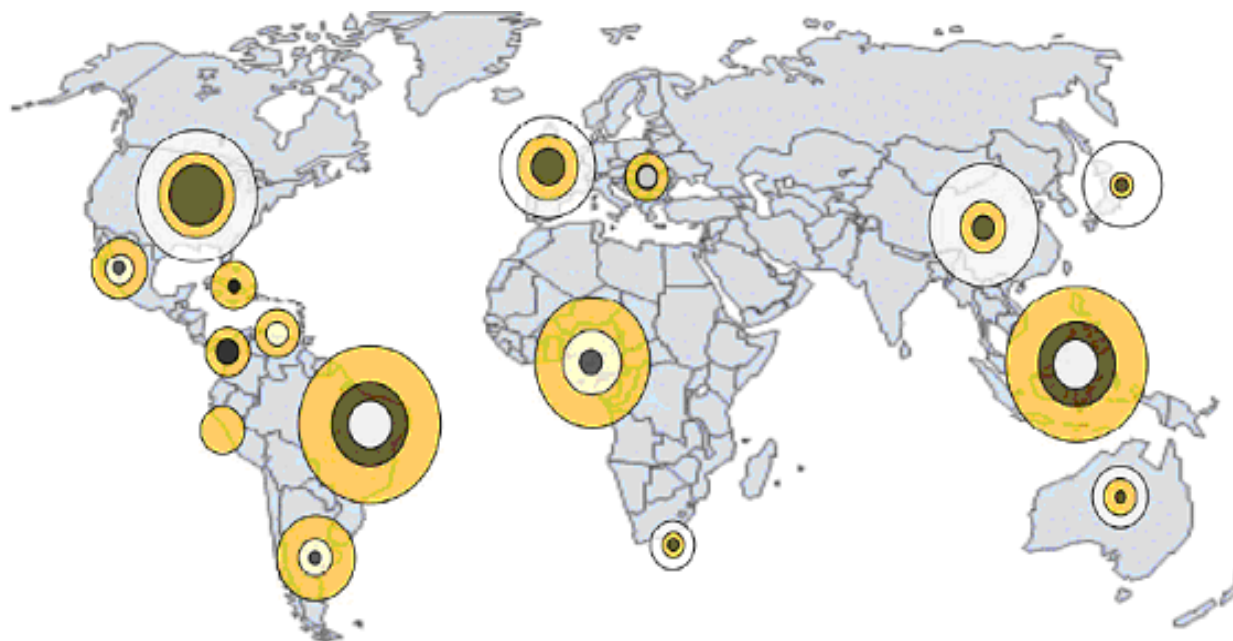
Source: UNEP, 2009

# World Investments in Renewable Energy (US\$ billion)



Source: UNEP, 2009

# World Biofuel Picture



- Feedstock potential based on land available for devotion to first generation biofuel feedstocks.
- Theoretical biofuel demand, assessed to be ~30% of liquid transport fuel consumption in 2006.
- Biofuel production capacity in place at year end 2006.

- Feedstock potential exceeds biofuel demand and surplus production capacity - so export.
- Capacity less than biofuel demand so investment in infrastructure warranted to encourage export potential.
- Feedstock constrained and capacity less than demand - so import.

Source: New Energy Finance [www.newenergyfinance.com](http://www.newenergyfinance.com)



# Biodiesel in Brazil

1980s: tentatives to introduce biodiesel

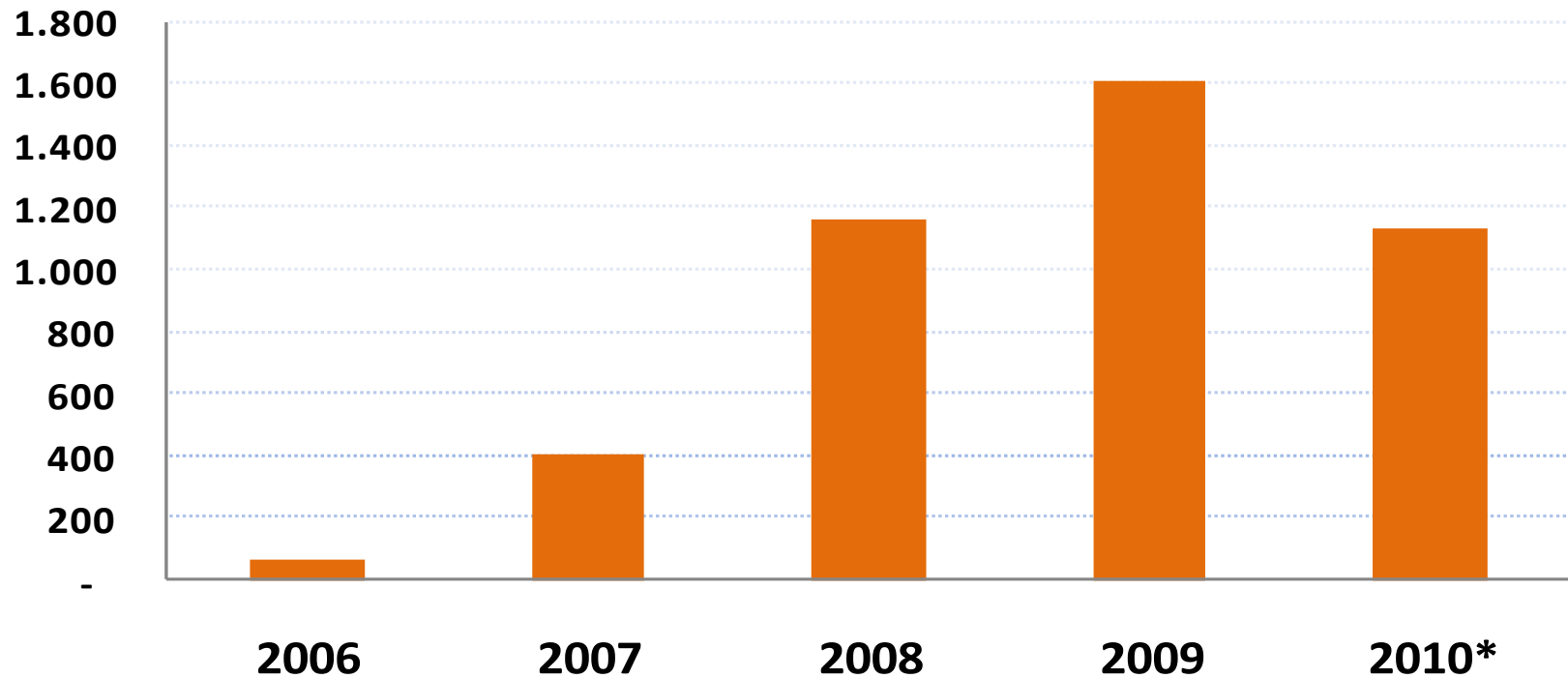
2004: PNPB – Programa Nacional de Produção e Uso de Biodiesel

Blending rate increased progressively from 2% in 2005 to 5% in 2010 (no plans to increase)

Tax reduction depending on feedstock, region of production of feedstock and type of agriculture (family or agribusiness)

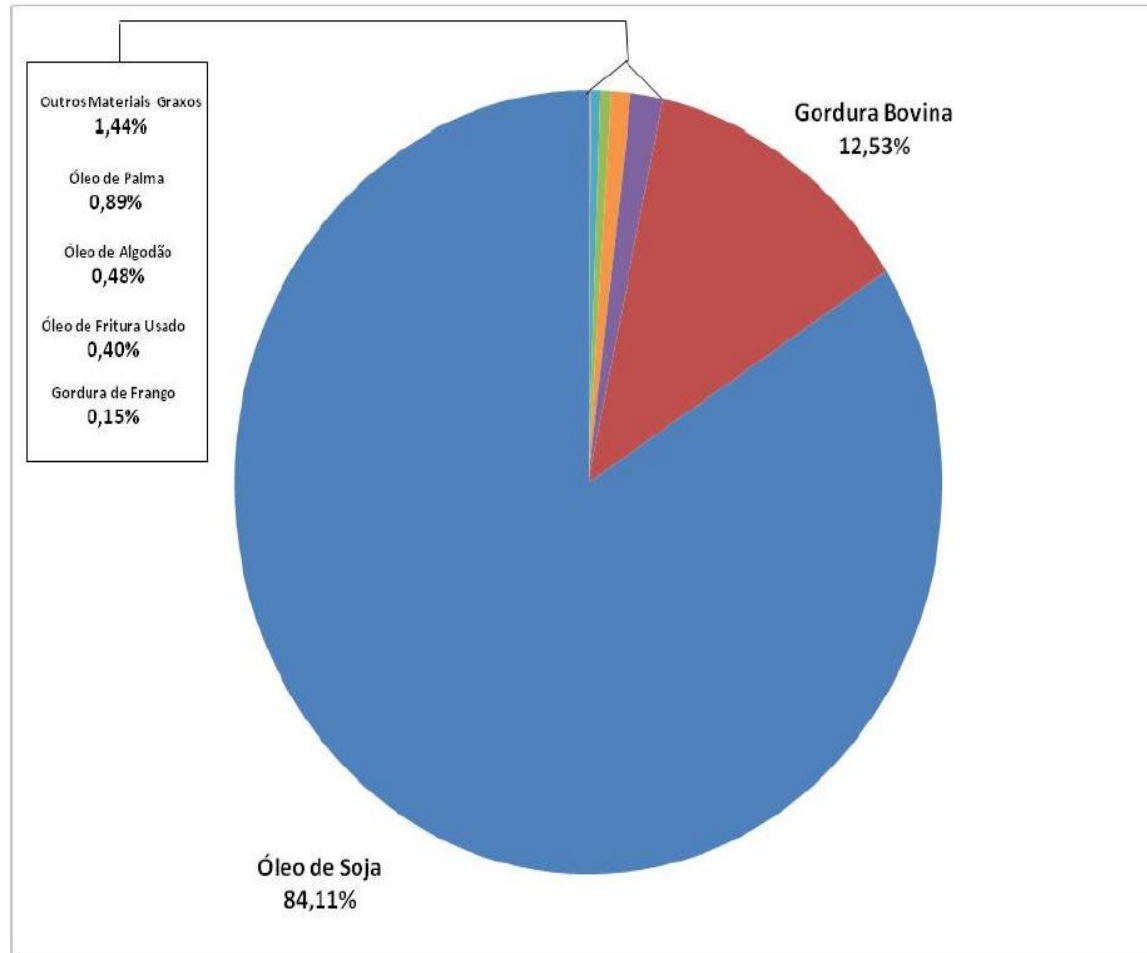
Biodiesel sales via periodic auctions

# Brazilian Biodiesel Production Evolution



# Biodiesel Feedstock Profile

## MATÉRIAS-PRIMAS UTILIZADAS PARA PRODUÇÃO DE BIODIESEL



Mês de referência: Junho/2010

# Biodiesel Demand Projections

	2010	2014	2019
Biodiesel demand (kL/year)	2,506	3,155	4,194
Blends %	5	5	5

Source: EPE, 2010



1920s: first trials with fuel ethanol

1931: 5% ethanol blend in all imported gasoline (mandate)

1933: IAA was created

1938: 5% mandate extended to all gasoline

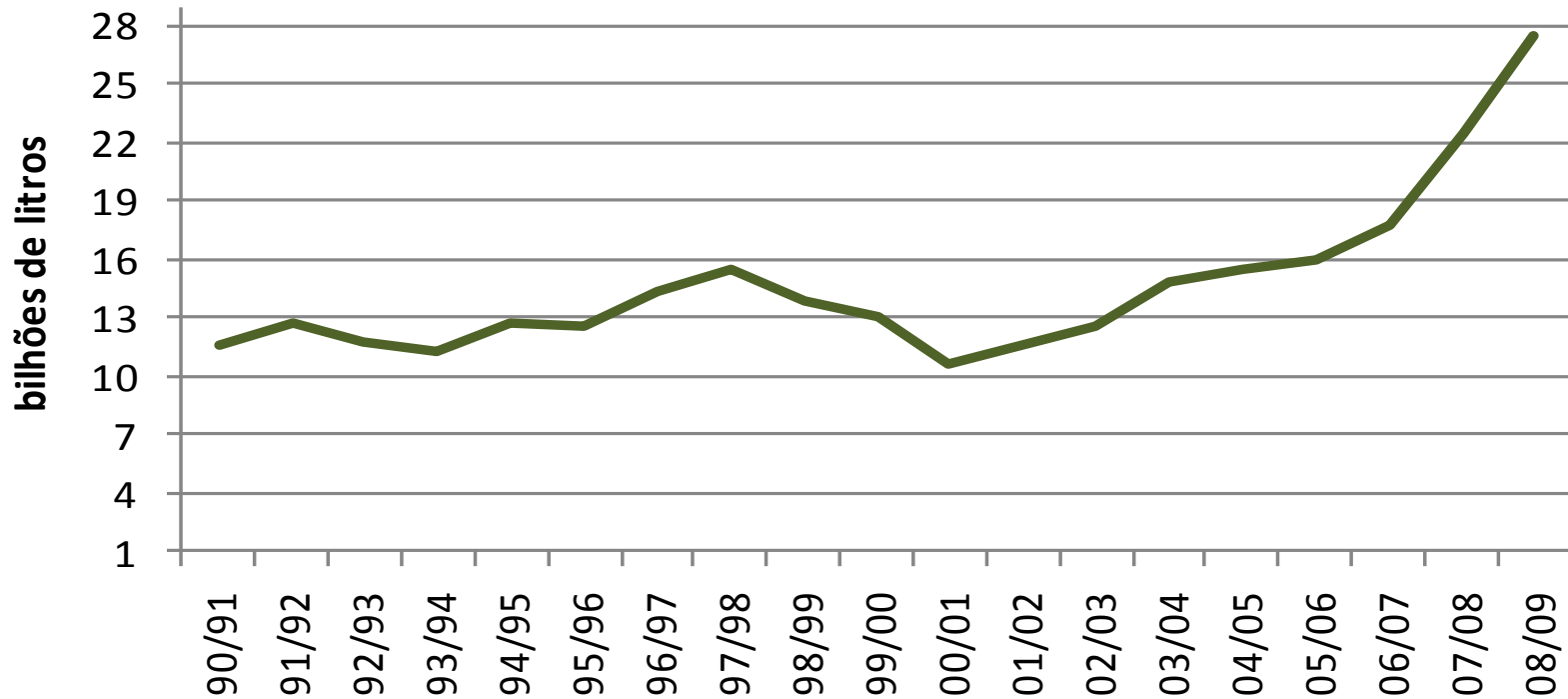
1975: ProÁcool – Programa Nacional do Álcool

1986: cold oil shock; loss of Government interest

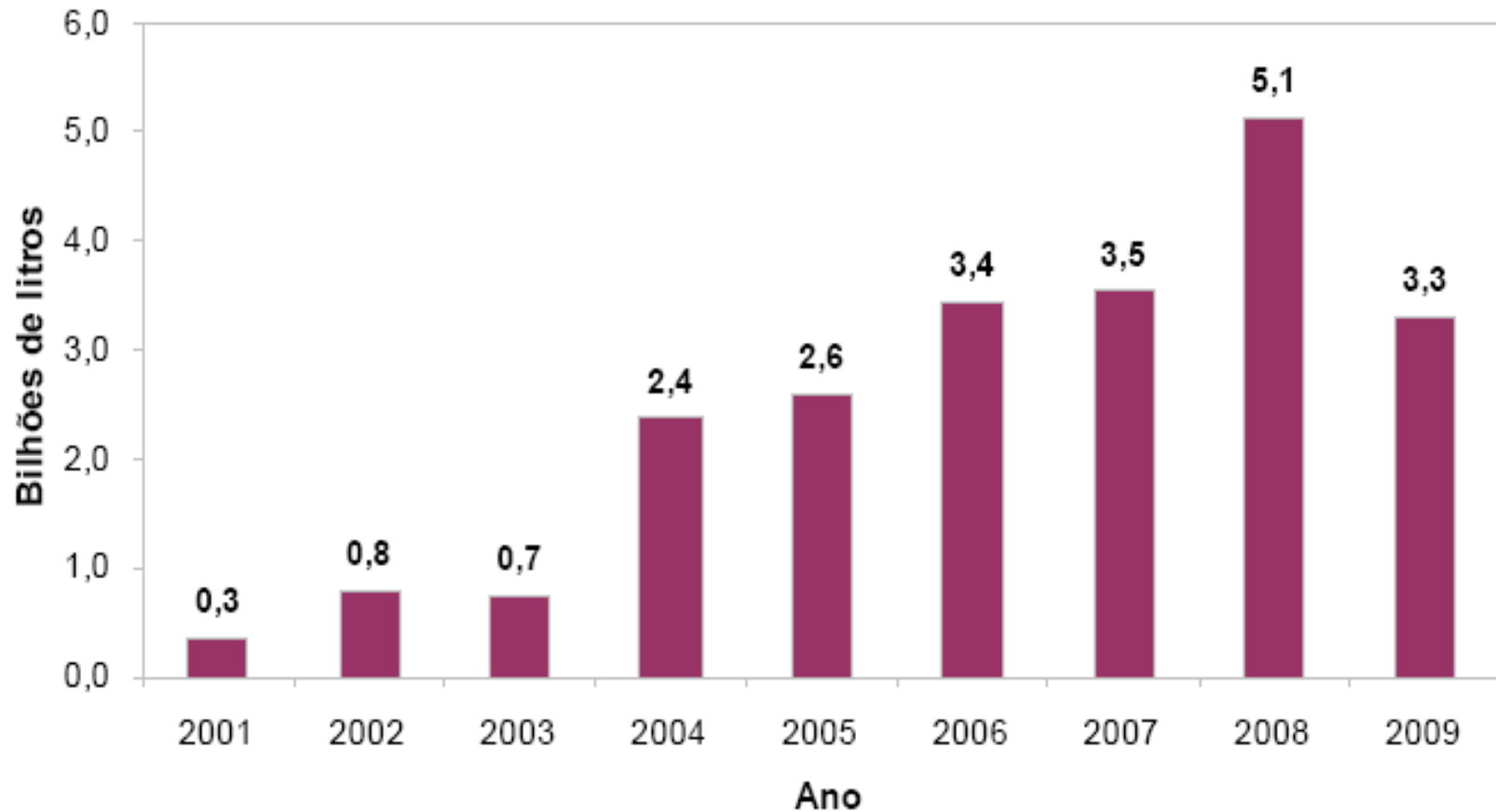
2001: end of Government control (except blend mandate of 20 – 25% ethanol in all gasoline)

2003: Introduction of FFV

# Brazilian Ethanol Production Evolution

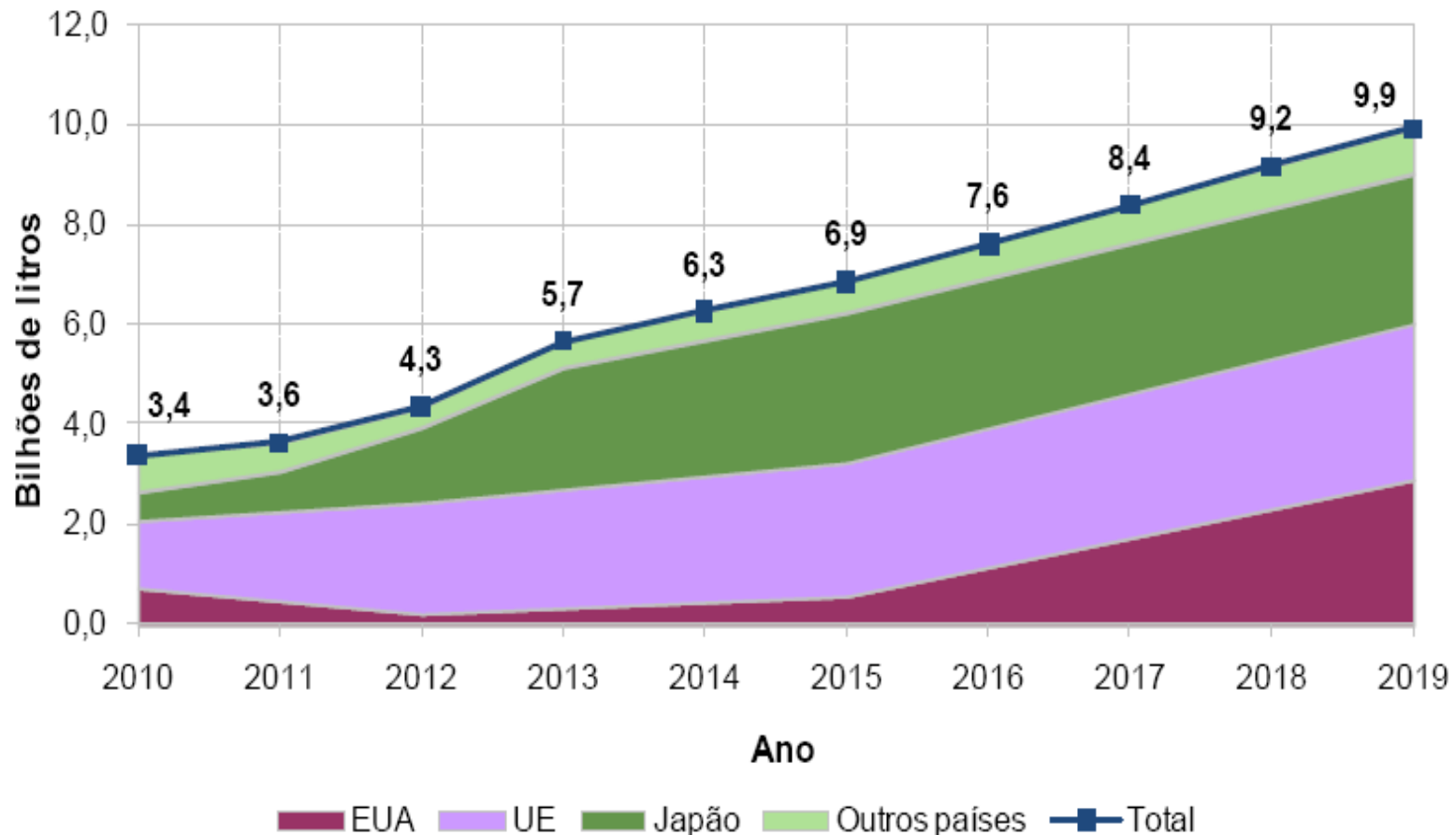


# Brazilian Ethanol Exports



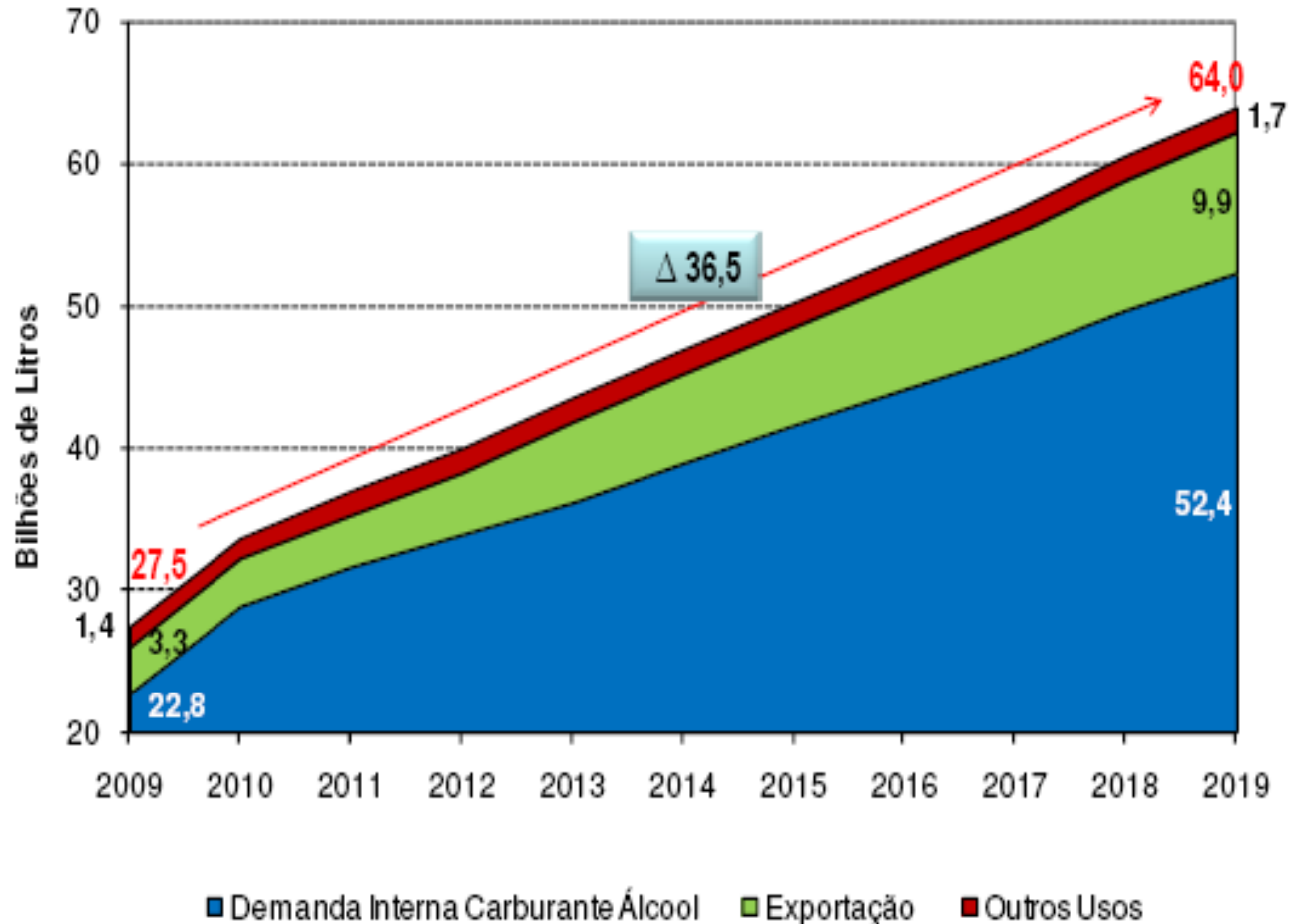
Source: EPE, 2010

# Projections for Brazilian Ethanol Exports



Source: EPE, 2010

# Total Ethanol Demand



Source: EPE, 2010

## Ethanol International Market

Main markets: high gasoline consumers (USA, EU, Japan, China)

Laws, regulations, mandates

Barriers: tariffs, certification, other

Biofuels characteristics: GHG abatement potential, production cost (US\$/L), GHG abatement cost (US\$/t CO<sub>2</sub>eq.), sustainability

Second generation (2G) participation

World Gasoline Consumption 2006( Billion L)

Region	GL	%
USA	517	42.6
EU-27	143	11.8
China	71	5.8
OECD	836	68.8
World	1,215	100,0

Source: IEA, 2007

World Ethanol Production 2007 (Billion L)

Region	GL	%
USA	24.6	49.6
Brazil	19.0	38.6
EU	2.2	4.4
ROW	3.8	7.7
World	49.6	100.0

Source: F.O.Licht

## Main Biofuels Regulations

**USA** - Energy Independence and Security Act of 2007 (RFS2): 136 GL of biofuels in 2022 (mainly ethanol)

**California** - Low Carbon Fuel Standard (LCFS): reduce GHG emissions by 10% in transport in 2020

**EU** – Renewable Energy Directive: 20% of renewable energy and 10% of biofuels in transport (energy basis) in 2020 (estimated ethanol demand of 15 GL)

**Japan:** allow 3% ethanol blend and may mandate 10% in the future

Country	Mandate
Australia	E2 in New South Wales, increasing to E10 by 2011; E5 in Queensland by 2010
Argentina	E5 and B5 by 2010
Bolivia	B2.5 by 2007 and B20 by 2015
Brazil	E22 to E25 existing (slight variation over time); B3 by 2008 and B5 by 2013
Canada	E5 by 2010 and B2 by 2012; E7.5 in Saskatchewan and Manitoba; E5 by 2007 in Ontario
Chile	E5 and B5 by 2008 (voluntary)
China	E10 in 9 provinces
Colombia	E10 and B10 existing
Dominican Republic	E15 and B2 by 2015
Germany	E5.25 and B5.25 in 2009; E6.25 and B6.25 from 2010 through 2014
India	E5 by 2008 and E20 by 2018; E10 in 13 states/territories
Italy	E1 and B1
Jamaica	E10 by 2009
Korea	B3 by 2012
Malaysia	B5 by 2008
Paraguay	B1 by 2007, B3 by 2008, and B5 by 2009; E18 (or higher) existing
Peru	B2 in 2009; B5 by 2011; E78 by 2010
Philippines	B1 and E5 by 2008; B2 and E10 by 2011
South Africa	B8-E10 and B2-B5 (proposed)
Thailand	E10 by 2007 and B10 by 2012; 3 percent biodiesel share by 2011
United Kingdom	E2.5/B2.5 by 2008; E5/B5 by 2010
United States	Nationally, 130 billion liters/year by 2022 (36 billion gallons); E10 in Iowa, Hawaii, Missouri, and Montana; E20 in Minnesota; B5 in New Mexico; E2 and B2 in Louisiana and Washington State; Pennsylvania 3.4 billion liters/year biofuels by 2017 (0.9 billion gallons)
Uruguay	E5 by 2014; B2 from 2008-11 and B5 by 2012

Note: Table shows binding obligations on fuel suppliers; there are other countries with future indicative targets that are not shown here; see the Biofuels Policies section. Some mandates shown may be delayed by market issues. Mandates in some U.S. states only take effect in future years or under certain future conditions, or apply only to portions of gasoline sold. Source: All available policy references, including the IEA online Global Renewable Energy Policies and Measures database and submissions from report contributors.

# IEA Biofuels Reference Scenario (Mtoe)

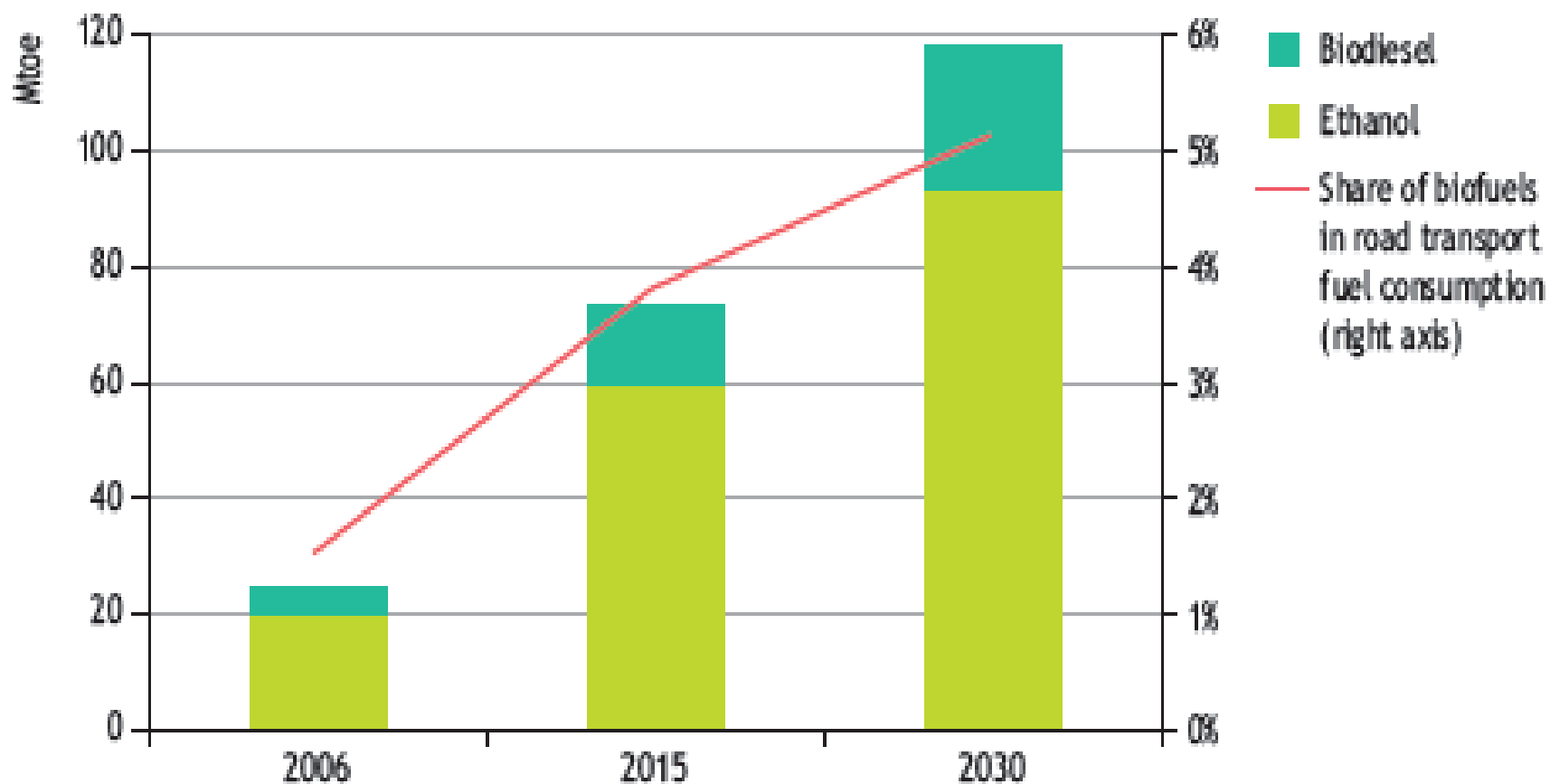
## Biofuels Demand By Region (Mtoe/year)

	2006	2015	2030	2006-2030*
OECD	16.9	49.5	72.5	6.3%
North America	11.3	32.9	46.8	6.1%
Europe	5.5	15.8	24.7	6.5%
Pacific	0.1	0.8	0.9	10.3%
Non-OECD	7.5	24.0	46.0	7.9%
E. Europe/Eurasia	0.0	1.1	1.5	16.8%
Asia	0.8	7.6	17.9	14.0%
Middle East	0.0	0.3	0.8	n.a.
Africa	0.0	0.7	1.1	n.a.
Latin America	6.6	14.4	24.7	5.6%
World	24.4	73.5	118.5	6.8%
European Union	5.5	16.6	25.9	6.7%

\* Annual average rate of change.

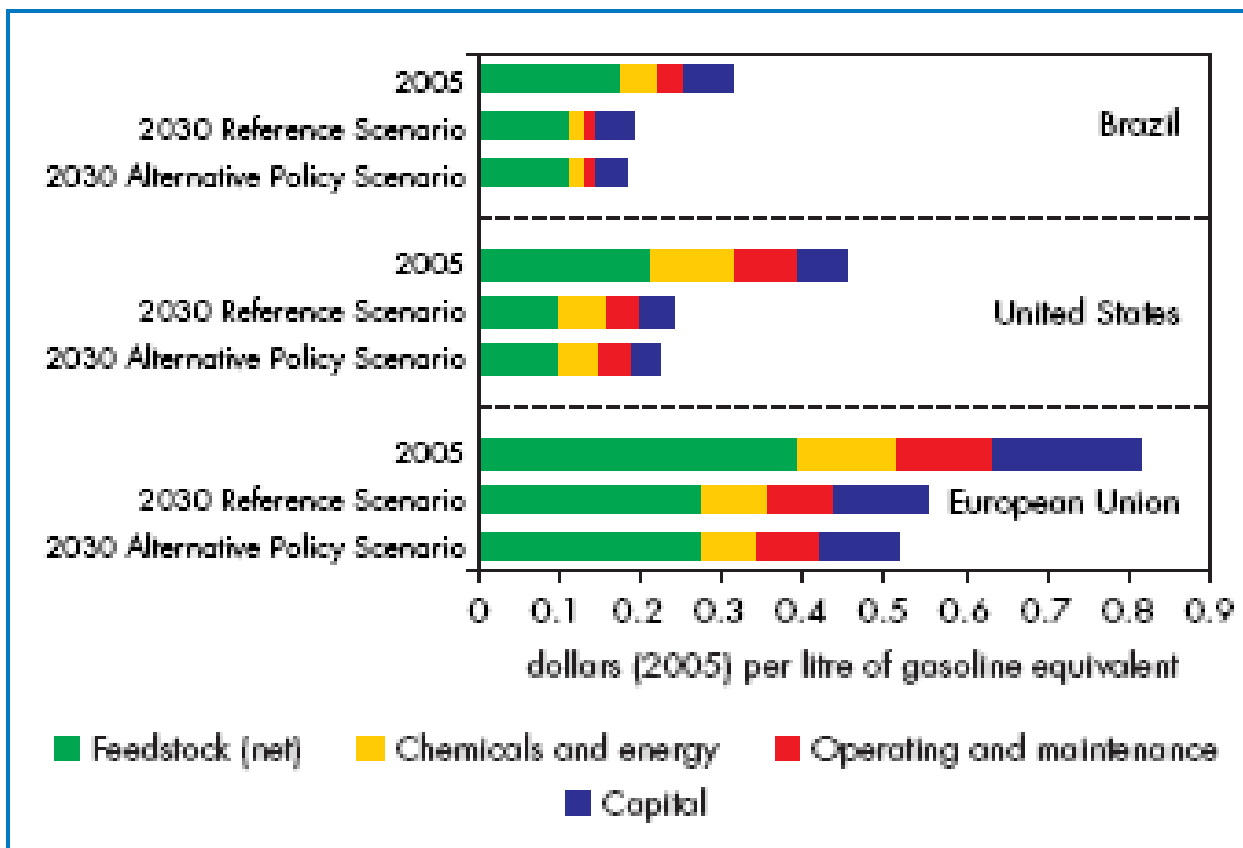
Source: World Energy Outlook 2008 (IEA)

# World Demand By Biofuel – Reference Scenario



Source: World Energy Outlook 2008 (IEA)

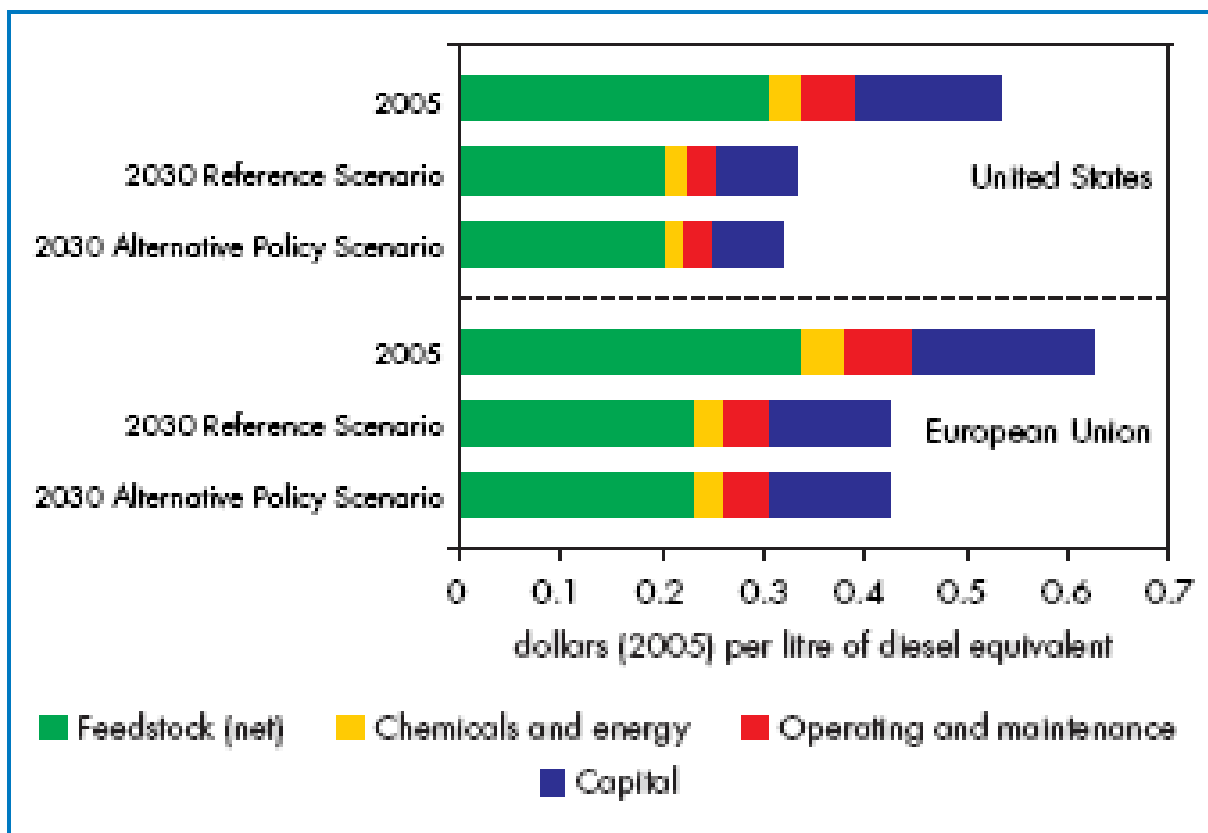
## Ethanol production costs (US\$/L gasoline equivalent)



Note: In contrast to Figure 14.7, the costs shown in this chart include current rates of subsidy to crops and ethanol production.

Source: IEA analysis in conjunction with the Energy Economics Group of the Vienna University of Technology.

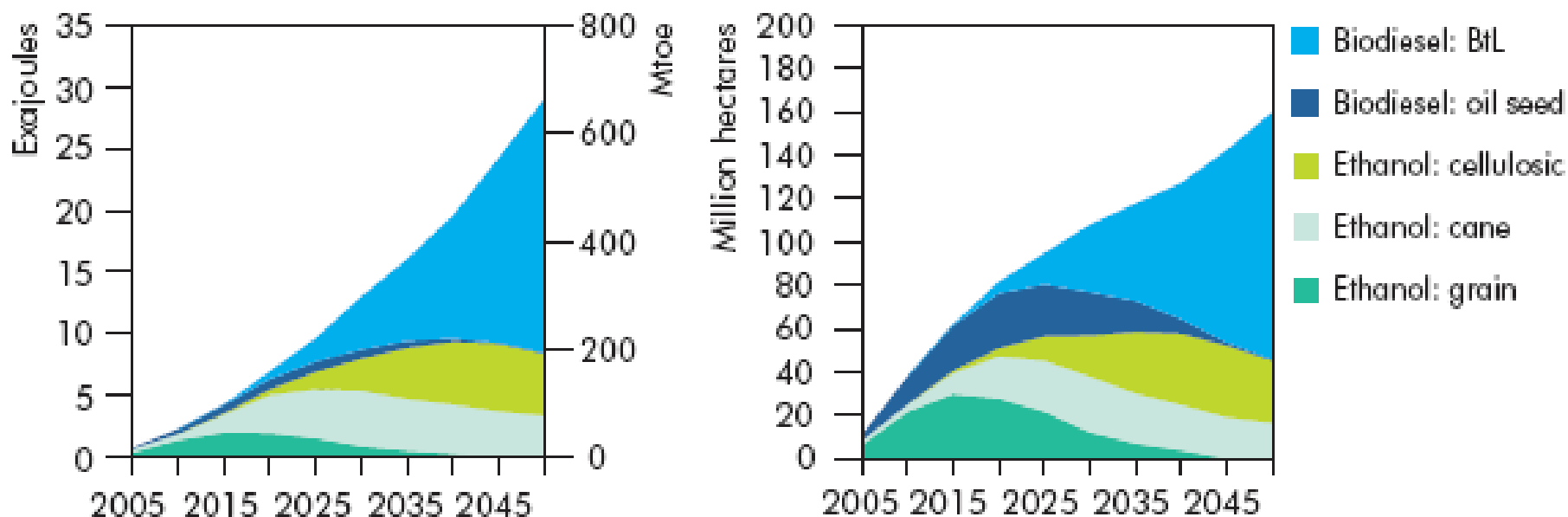
## Biodiesel production costs (US\$/L diesel equivalent)



Note: In contrast to Figure 14.7, the costs shown in this chart include current rates of subsidy to crops and ethanol production.

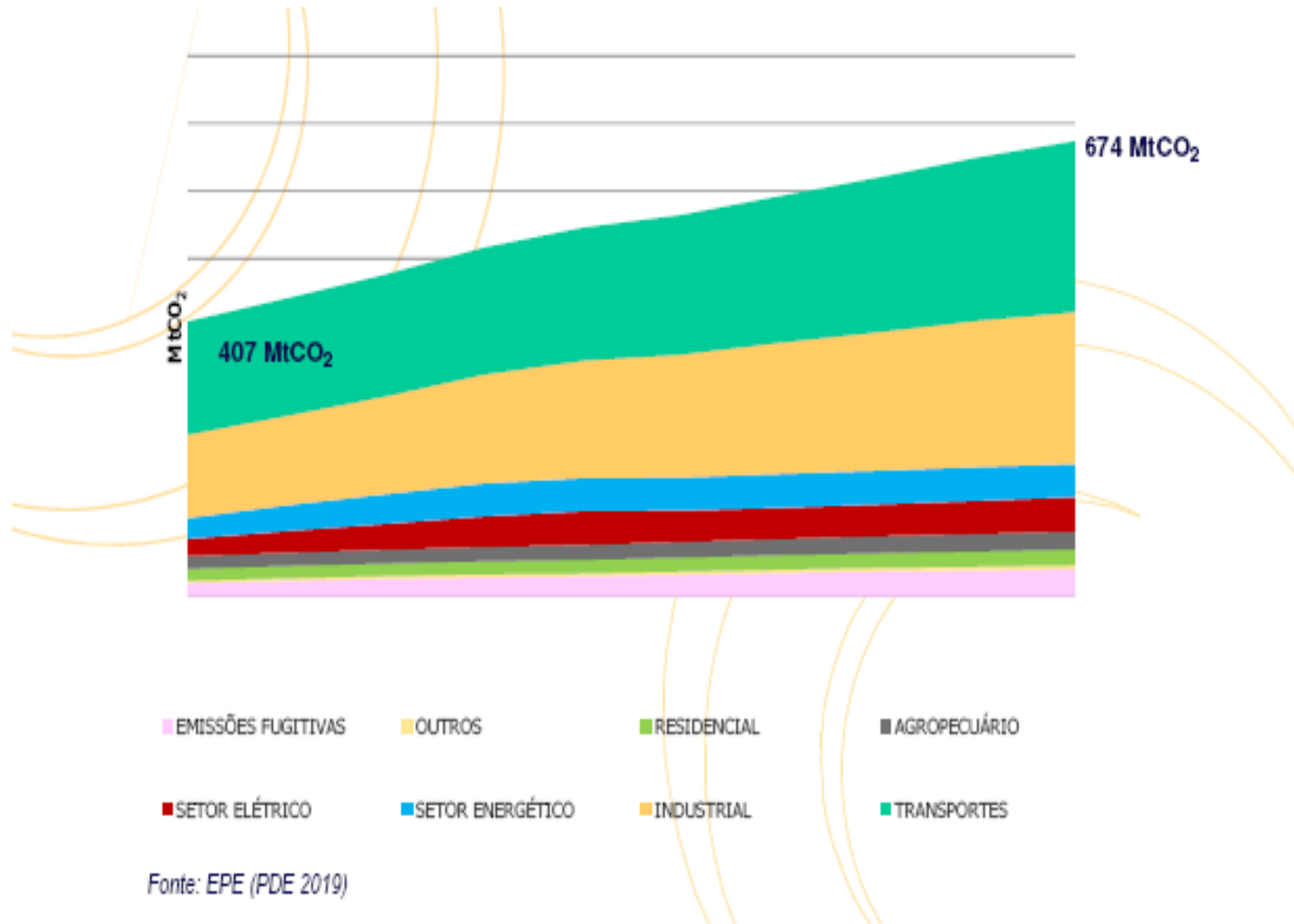
Source: IEA analysis in conjunction with the Energy Economics Group of the Vienna University of Technology.

## Biofuels Outlook – IEA BLUE Scenario



Source: IEA, 2008

# Brazilian GHG Emissions By Sector



# GHG Emissions Abatement By The Use of Ethanol

	2010	2019
Hydrous ethanol consumption (Billion L/yr)	22.5	47.3
GHG emissions reduction (Mt CO <sub>2</sub> eq./yr)	49.0	130.6
Anhydrous ethanol consumption (Billion L/yr)	6.5	5.1
GHG emissions reduction (Mt CO <sub>2</sub> eq./yr)	15.1	15.0
Total GHG emissions reduction (Mt CO <sub>2</sub> eq./yr)	64.1	145.6

Source: Prepared with data from EPE (2010) and Macedo et al. (2008)

Note: Land Use Change Emissions (Direct and Indirect) not included

- Biofuels are not equal: production costs, GHG abatement potential, energy balance (RE/Fossil energy), natural resource demand, sustainability
- There is a role for biofuels in the future; not all presently in use will survive in the long term
- Second generation biofuels are likely to have an important contribution, but there are uncertainties
- An international market is still to be developed: protectionism is the main barrier



Thank you for your attention!

[regis.leal@bioetanol.org.br](mailto:regis.leal@bioetanol.org.br)