

Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009

Renewable Fuels in Brazil
Cesar Behling Miranda
Embrapa Labex USA - Bioenergy





Why renewable fuels are used in Brazil

- *Energy security*
- *Climate change mitigation*
- *Lower emissions of pollutants*
- *Use of existing infrastructure – production and distribution*
- *Available land and climate for fuel-purpose crops*
- *Need of economic, social and sustainable agricultural production systems*



Interestingly...

Source: REE, 2009

USDA Secretary Priorities

#1 – Rural communities create wealth so they are self-sustaining, repopulating and thriving economically

2 – National Forest & private working lands are conserved, restored and made more resilient to climate change and are managed to enhance water resources

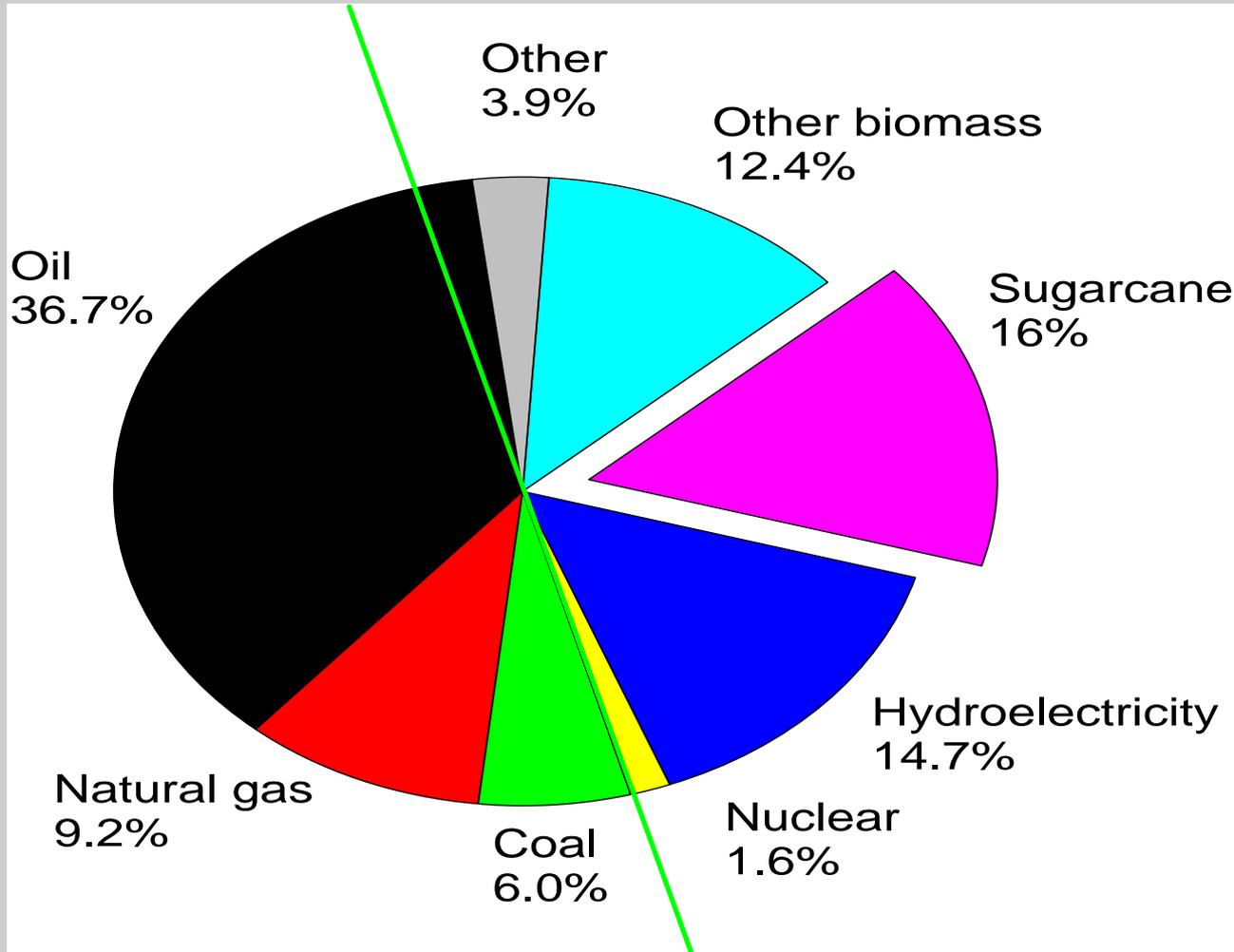
3 – America leads the world in sustainable crop production and biotech programs

....



Brazil – Energy Sources

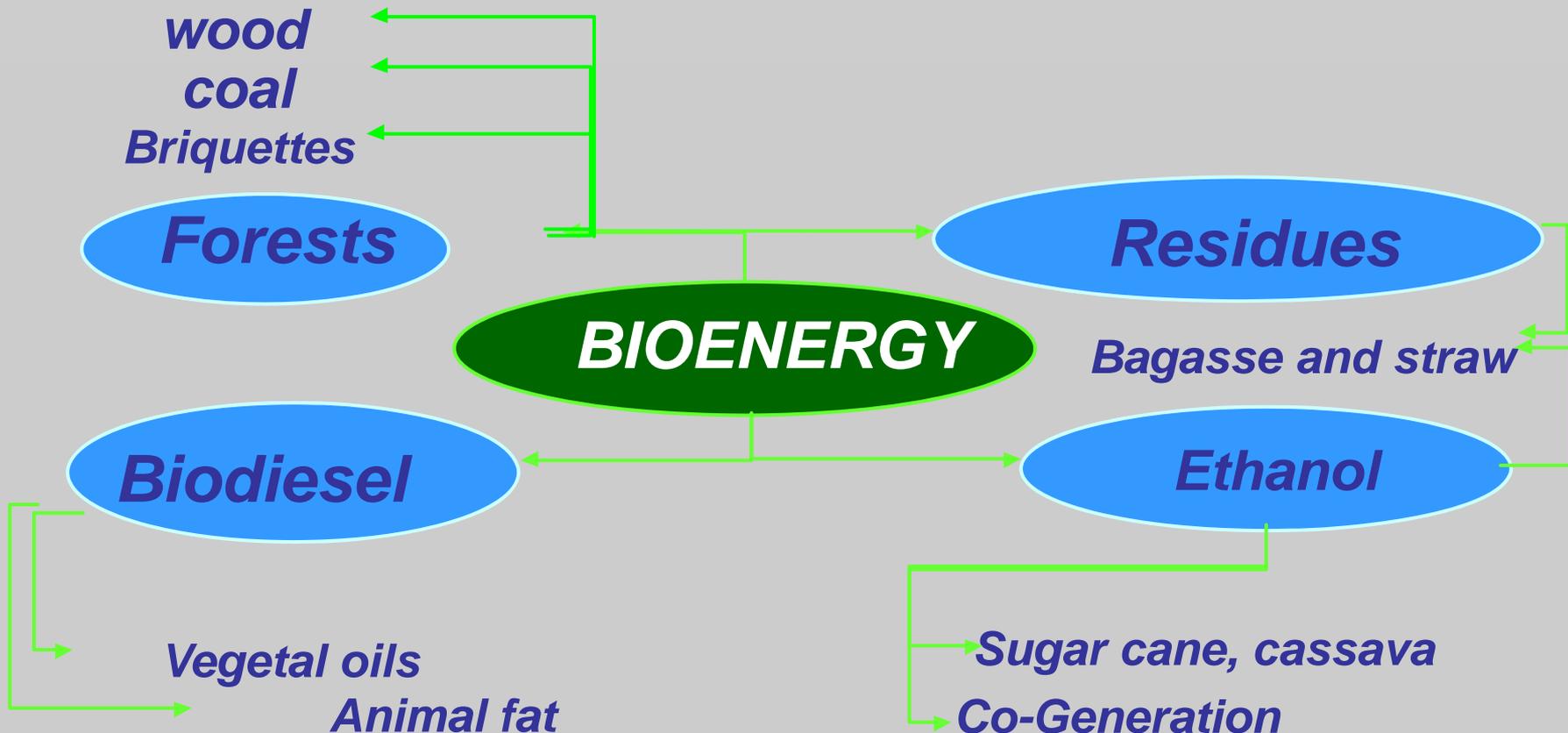
Adapted from the Brazilian Ministry of Mines and Energy; UNICA





Brazil - Bioenergy Production Matrix

Source: Filho, K.E., 2008





Ethanol usage evolution in Brazil

Adapted from *Filho, K.E. 2008*

1912: First Experiences with alcohol-fueled automobiles

1931: Anhydrous-gasoline mixture (up to 5%)

1938: Mixing compulsory

1966: Mixture gap increases to 5-10% (voluntary)

1975: Government launches the National Alcohol Program (*Proalcool*), based on:

increasing anhydrous-alcohol mixture in gasoline

launching the hydrated-alcohol-fueled car

1979 – 2002: Mandatory mixtures from 15 to 25%



Brazil – available fuel

Adapted from *Filho, K.E. 2008*

All domestic and imported vehicles with gasoline engines in Brazil, would have available:

- Regular and premium gasoline – both with anhydrous ethanol content of 20% to 25%**
- Hydrated ethanol - for cars with pure ethanol or flex-fuel engines**

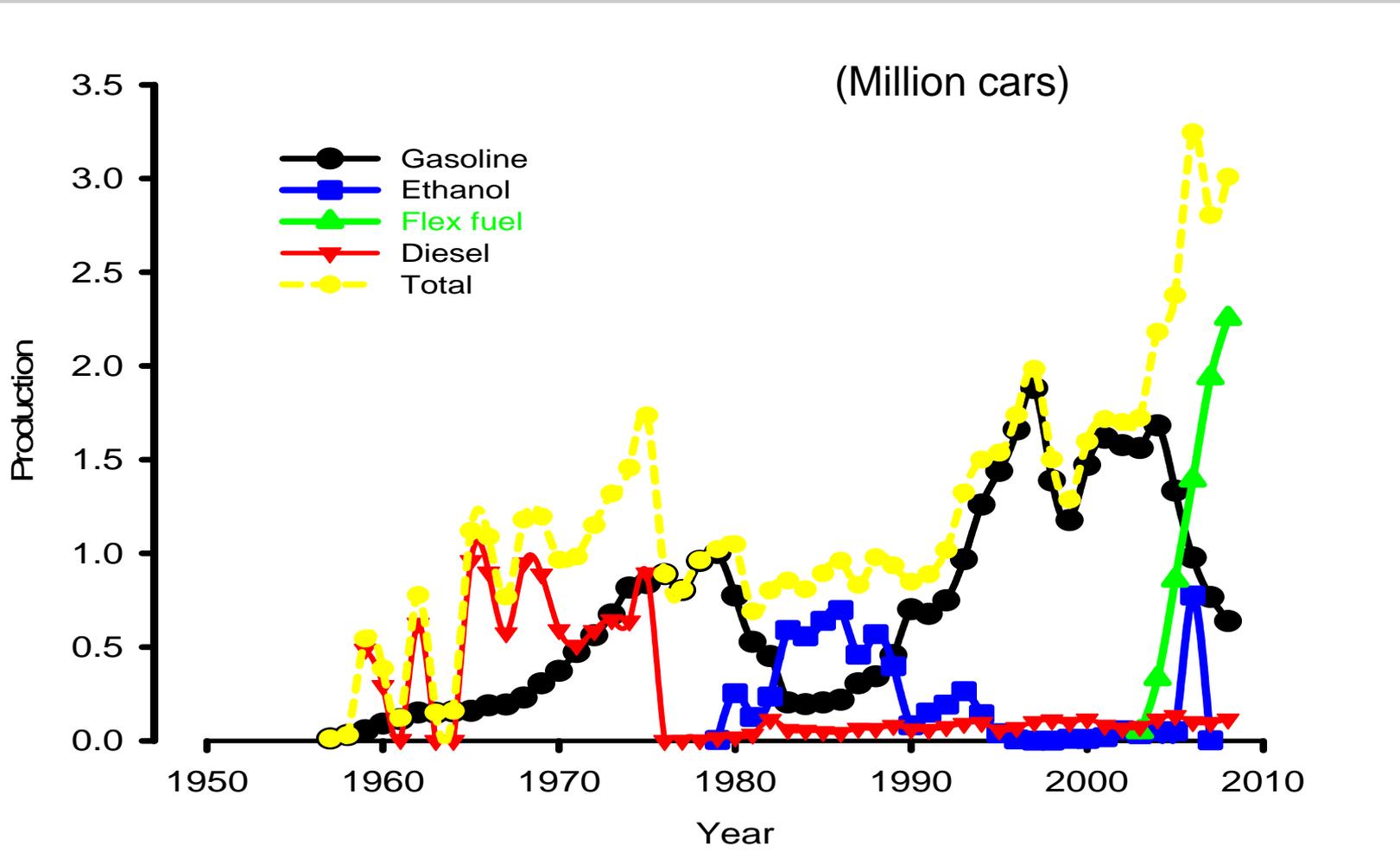
**** Brazilian flex-fuel cars: use 100% ethanol or variable blends of ethanol and regular or premium gasoline***

**** USA, Canada and Sweden Flex-fuel cars: 100% gasoline or E85 (85% gasoline plus 15% ethanol)***



Brazil vehicles production

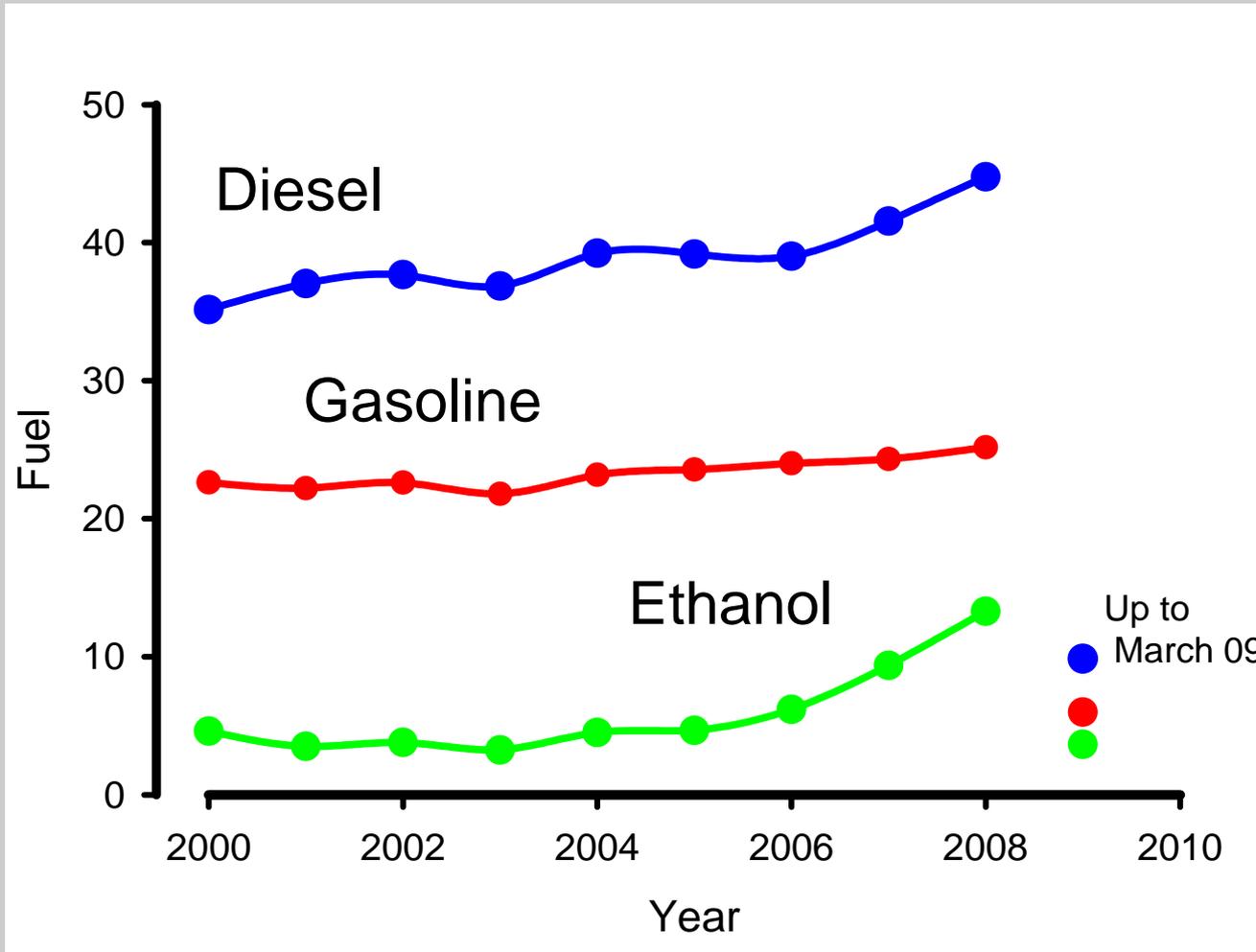
Adapted from ANFAVEA





Retail sales of selected fuels in Brazil (Million liters)

Adapted from ANP, 2009





Sugarcane production areas



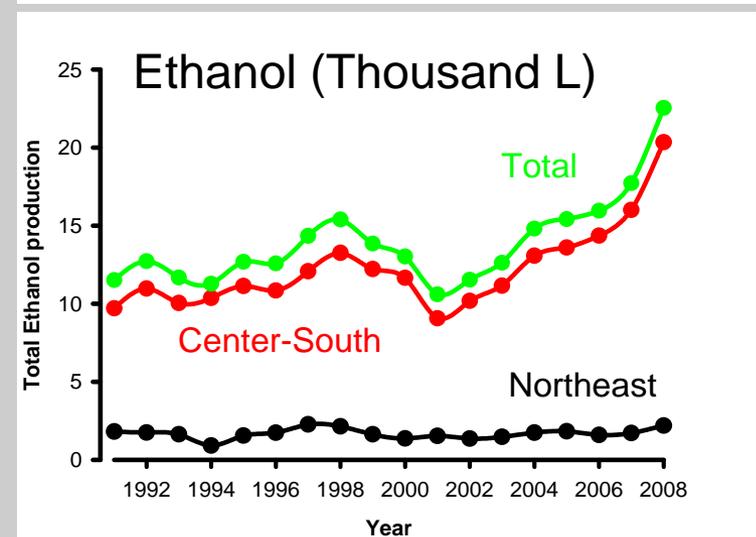
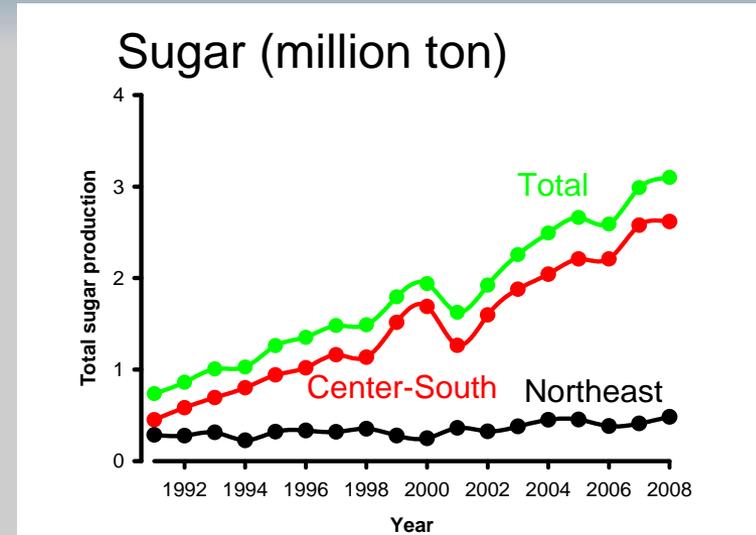
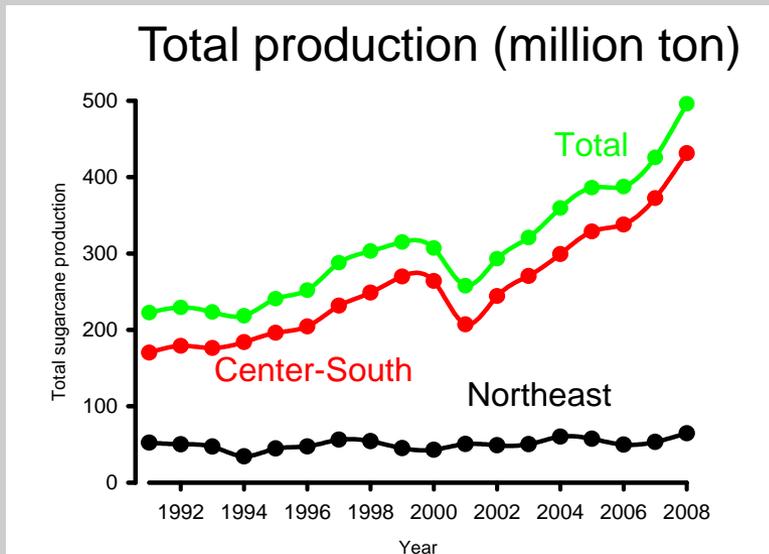
Northeast
(20% total
production)

Center-South
(80% total
production)



Brazil - Sugarcane

Adapted from UNICA





Brazil - Biodiesel

Adapted from *Filho, K.E. 2008*

- *1970 - First experiences (high vegetable oil prices)*
- *1980 - First biodiesel patent in the world*
- *2003 - Federal Government Working Group*
- *2003 - Inter-ministerial Executive Committee*
- *2004 - Biodiesel Program launched*
- *2005 - Research nets established*
- *2006 - Creation of Embrapa Agroenergia, leading research agency*



Ethanol vs Biodiesel

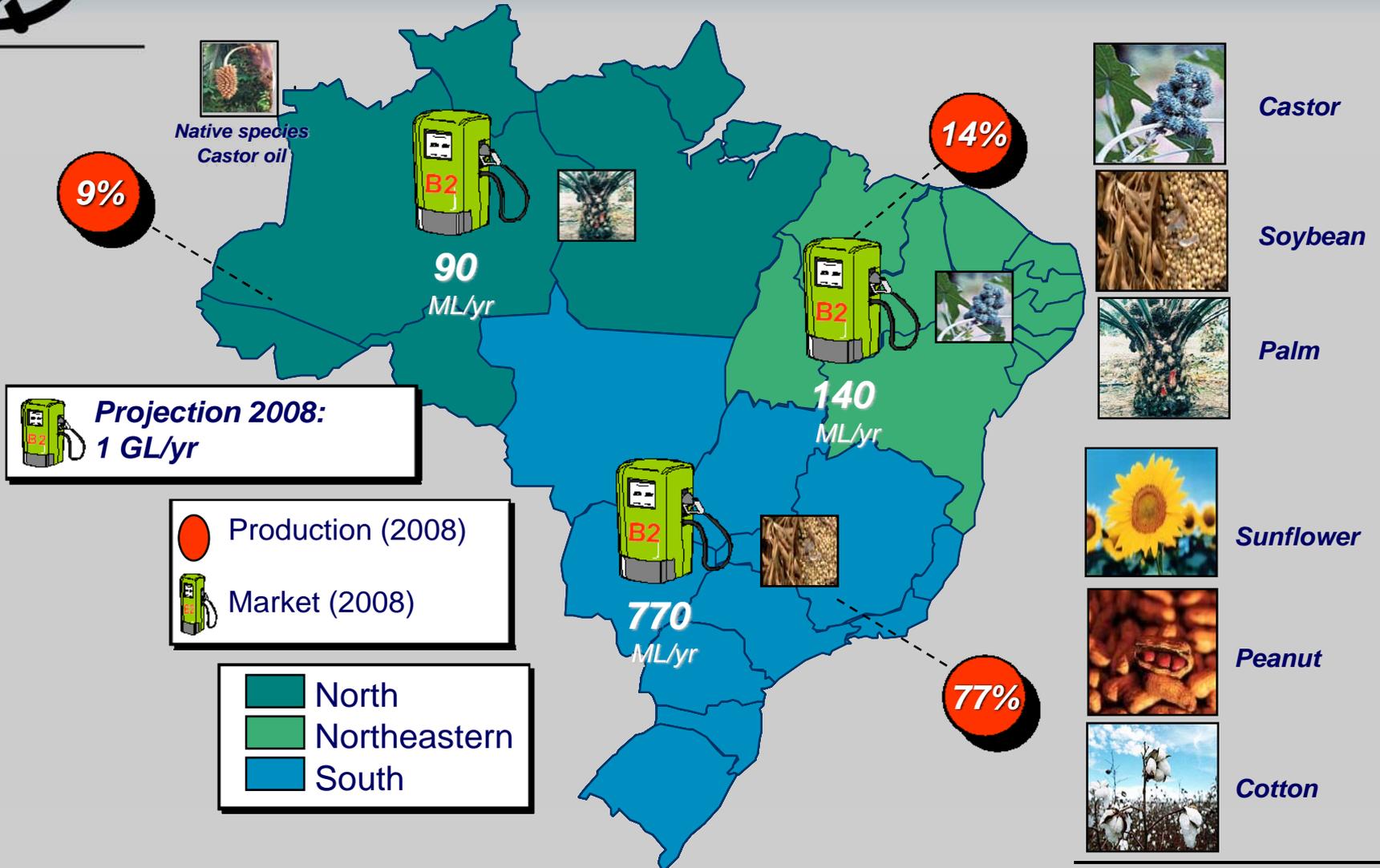
Adapted from *Filho, K.E. 2008*

- *Alcohol (1975): mainly due to economic demand*
- *Biodiesel (today):*
 - ✓ *economic: high crude oil prices again, although dependence is now quite low*
 - ✓ *social: needs for jobs and permanent settlement of families in the countryside*
 - ✓ *environmental: introduction of another renewable and friendly fuel*



Brazil - Biodiesel

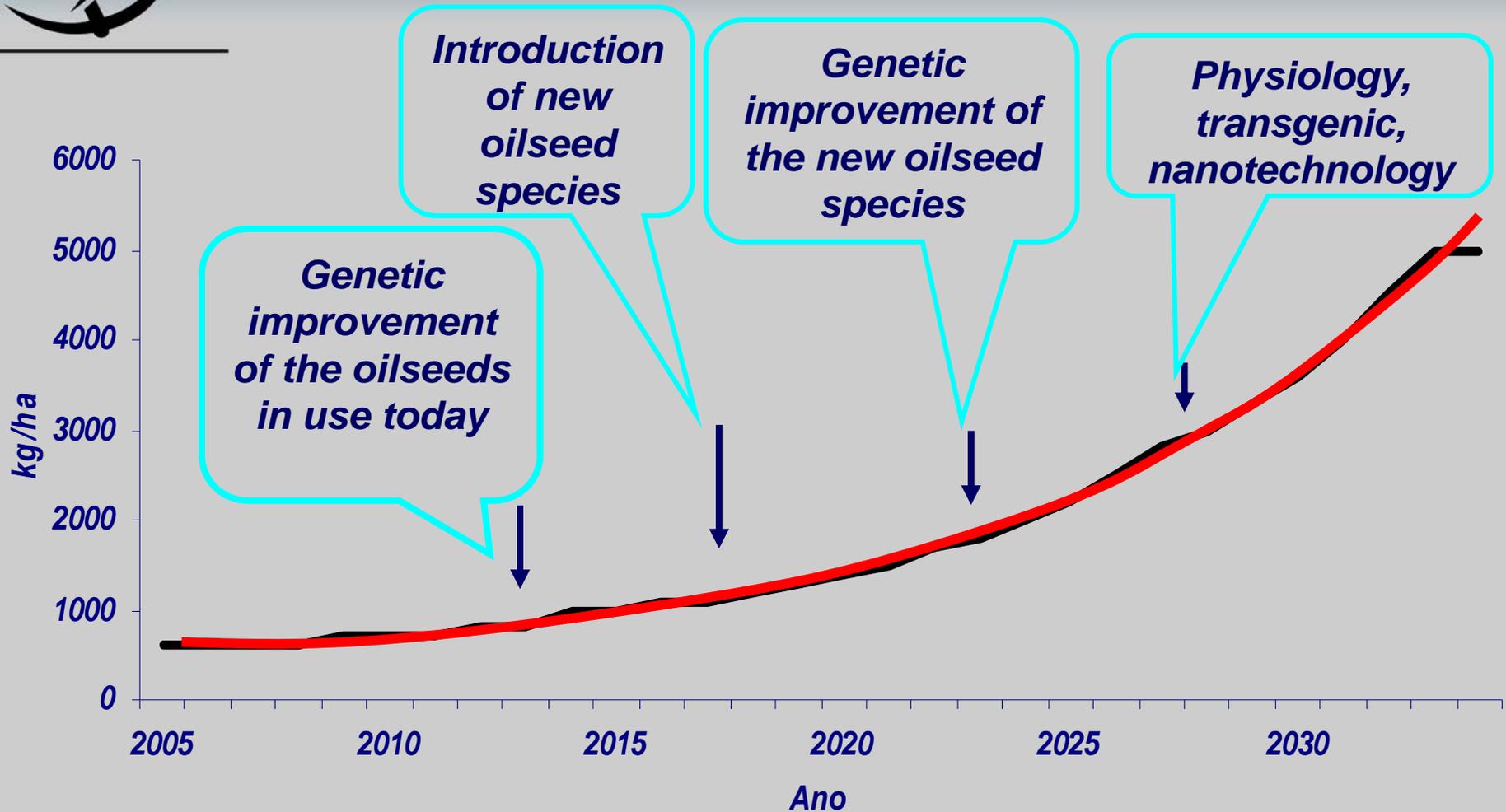
Adapted from *Filho, K.E. 2008*





Improvements

Source: Gazzoni, 2006





Available potential mapped areas for

Adapted from *Filho, K.E. 2008*

- ✓ *Palm Oil – 30 millions ha*
- ✓ *Babaçu Palm – 17 millions ha*
- ✓ *Buriti Palm – 2 millions ha*
- ✓ *Agropastoral systems – 20 millions ha*
- ✓ *Arable area not explored - 100 millions ha*



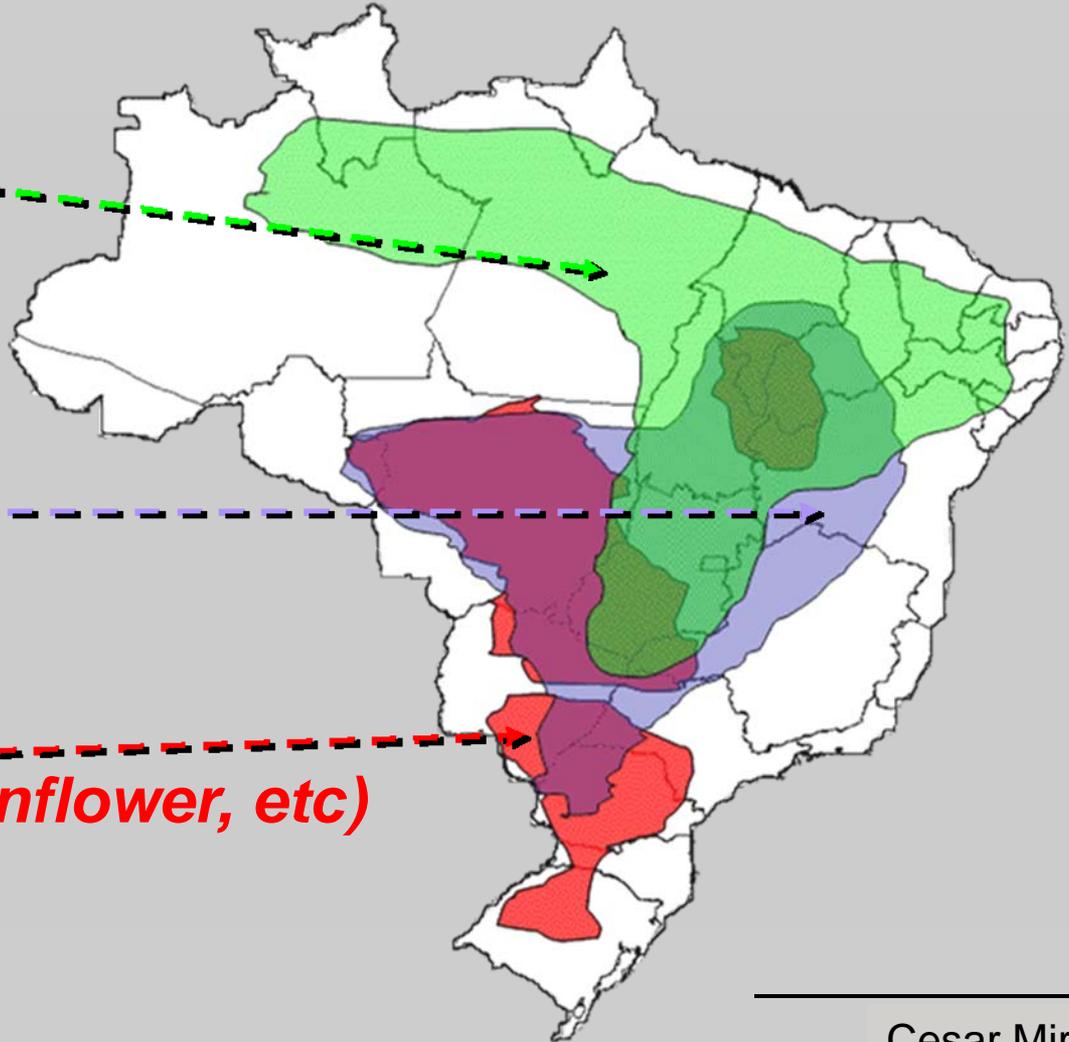
Potential for expansion of oil crops area in Brazil

Source: Filho, K.E. 2008

Perennial oil crops

Savanna expansion

Present (soybean, sunflower, etc)

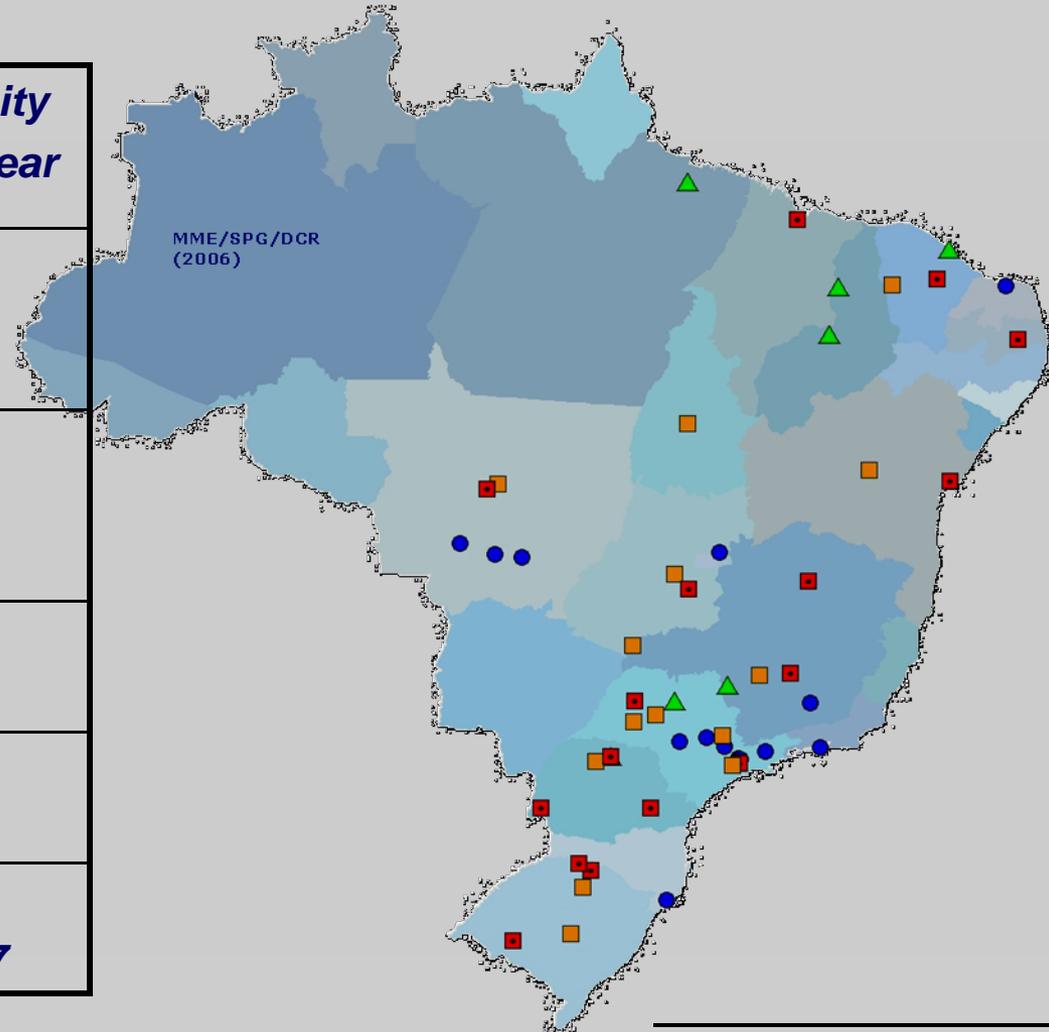




Biodiesel – plants production potential

Adapted from *Filho, K.E. 2008*

Biodiesel plants	Number of units	Capacity MML/year
Under commercial operation	7	91
Under Licensing process	15	366
Under construction	15	813
New projects	15	687
Total	52	1957





Ethanol - challenges

Adapted from *Filho, K.E. 2008*

- ✓ *Promotion of agri-ecological zoning for sugarcane in the new expansion areas*
- ✓ *Development of technologies that promote symbiotic nitrogen fixation*
- ✓ *Development of technologies that use sugarcane stems and leaves (second generation biofuels)*
- ✓ *Development of new products and processes based on alcohol chemistry and the use of sugarcane biomass*



Biodiesel - challenges

Adapted from *Filho, K.E. 2008*

- ✓ *Prospection of new species with increased energy density and broad soil and climatic adaptation*
- ✓ *Promotion of agri-ecological zoning of conventional and potential oleaginous species*
- ✓ *Development of cultivars, varieties and hybrids of conventional and potential oleaginous species*
- ✓ *Development of systems aiming the improvement of oil extraction activities and the use of co-products and residues.*
- ✓ *Usage of biotechnology techniques to introduce new characteristics*



Forests - challenges

Adapted from *Filho, K.E. 2008*

- ✓ ***Development of technologies that will make possible the establishment of energy forest in areas unsuitable for agriculture and in areas degraded due to bad agricultural management***
- ✓ ***Development of agri-forest arrangements suitable for for small farmers***
- ✓ ***Use of geographic information system technology in planning the use of energy from forest biomass***



Residues and wastes - challenges

Adapted from *Filho, K.E. 2008*

- ✓ ***Generation of technologies that use agricultural and forest residues to produce energy***
- ✓ ***Development of technologies that use residues from energy production for other purposes, such as correcting soil acidity or increasing soil fertility***



Conversion - challenges

Adapted from *Filho, K.E. 2008*

- ✓ *Improvement of oil extraction methods, especially from small and medium-sized plants*
- ✓ *Development and improvement of technological paths for biodiesel production*
- ✓ *Development of studies on the catalysts and reagents used in industrial processes*



Many thanks

Cesar Behling Miranda
Embrapa Labex USA Bioenergy
Brazil

Grain, Forage & Bioenergy Research Unit
215 Biochemistry Hall, University of Nebraska
Lincoln, NE, 68583-0737

Voice: 402 472-9654
Fax: 402 472-4020