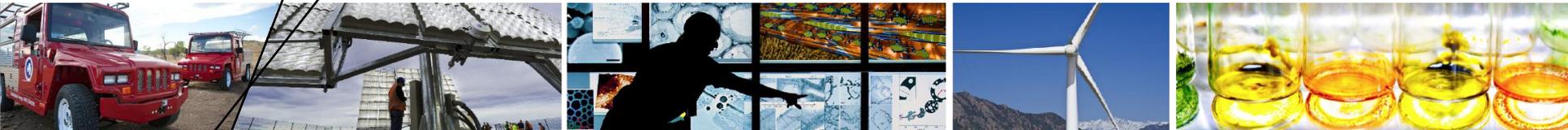


# U.S. and Brazil Bilateral Collaboration on Biofuels



**Biomass 2012:  
Confronting  
Challenges, Creating  
Opportunities**

## **Session 1-E:**

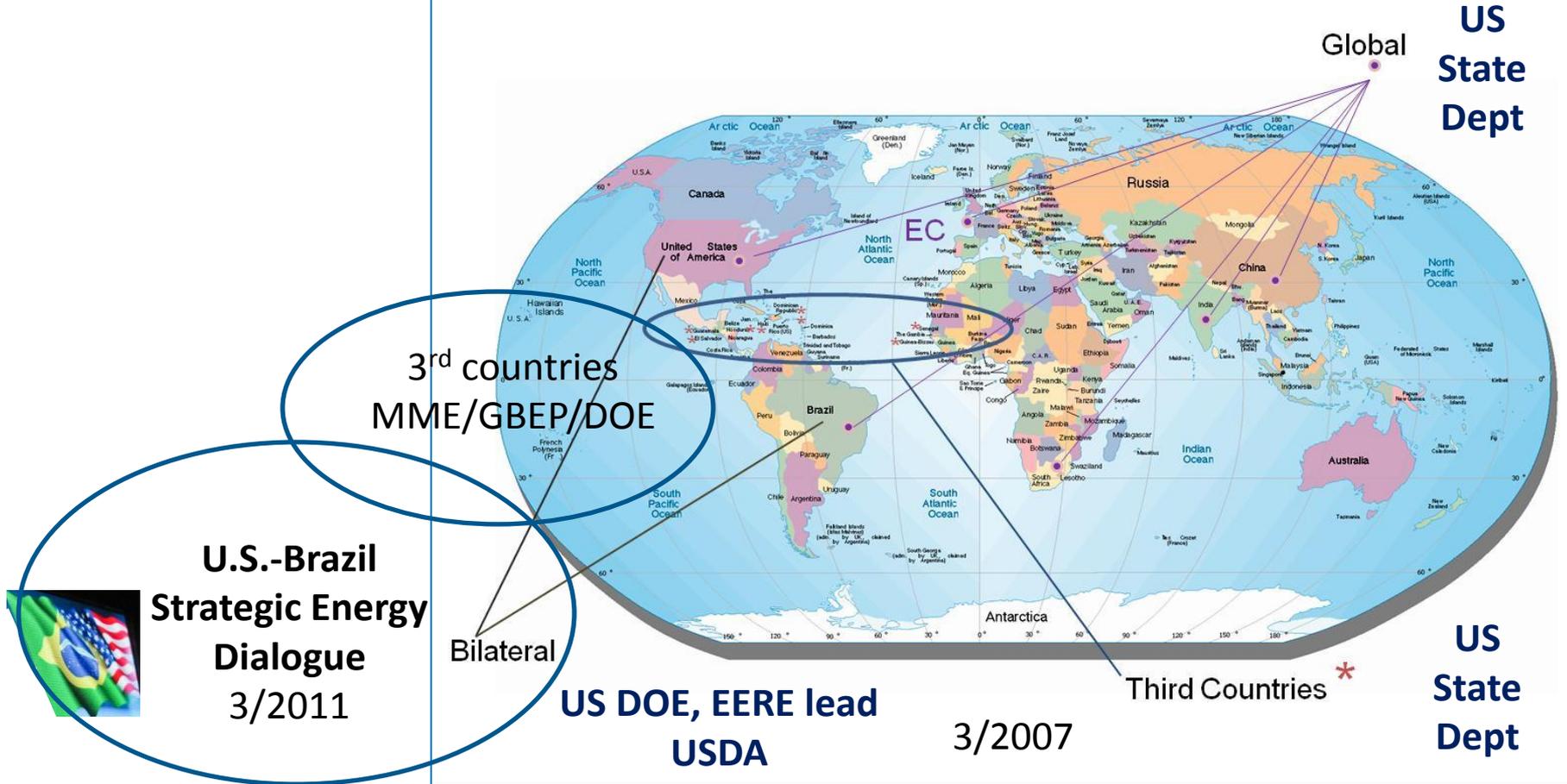
**International Cooperation to Develop  
Global Bioenergy Capacity Panel**

**Helena Chum, NREL Research Fellow**  
**[Helena.Chum@nrel.gov](mailto:Helena.Chum@nrel.gov)**

**July 9, 2012**

# Cooperation Frameworks

## U.S. – Brazil MOU to Advance Cooperation on Biofuels



**Brazilian governmental Ministries: Science, Technology and Innovation (MCTI); Mines and Energy (MME); Development, Industry and Foreign Trade (MDIC); Agriculture, Livestock and Supply (MAPA) led by the Department of Energy of the Ministry of Foreign Relations**

# Joint Lignocellulosic R&D Areas Defined

Brazilian Delegation at NREL  
September 12, 2007

Reciprocal Visits to Define Areas



Participants reached a better understanding of each country's capabilities and limitations in the production of biofuels



Dedini

CTBE

Usina da Pedra

U.S. Delegation (DOE, USDA) in Brazil, May 30-June 6, 2008

## Sharing Best Practices

1. Biomass chemical characterization/  
NREL
2. Techno-economic analysis (TEA) models/NREL; Lifecycle (LCA) methodology GREET/ANL
3. Biofuels Sustainability ORNL/ANL/NREL

# Good analytical results = good biofuel process cost data

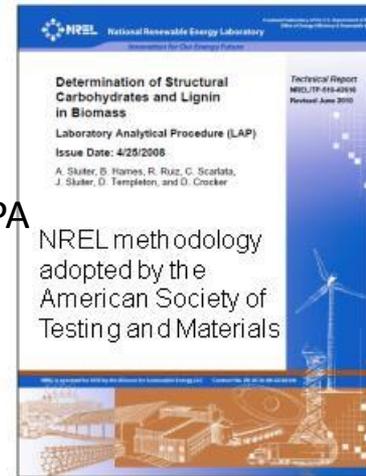
## BRAZIL - Analytical Round Robin (2011-2012)

1. CENPES: R&D Center of Petrobras, Rio de Janeiro (RJ)
2. CTBE: Brazilian Bioethanol Science and Technology Lab. , Campinas/ Ministry of Science, Technology and Innovation (MCTI)
3. CTC: Sugarcane Technology Center, Piracicaba (private sector)
4. EMBRAPA AGROENERGIA: Brazilian Company on Agronomy Research, Brasilia/MAPA
5. INT: National Institute of Technology (MCTI), RJ
6. IPEN: Institute of Nuclear and Energy Research, São Paulo
7. IQ/UNESP: Chemistry Inst., State University of São Paulo, Araraquara
8. EEL/USP: Engineering School, Lorena, University of São Paulo (USP)
9. IQSC/USP: Chemistry Inst., São Carlos, USP
10. INMETRO = National Institute of Metrology, Quality, and Technology, RJ/ Ministry of Development, Industry and Foreign Trade

## USA – Training, Homogeneous Bagasse Sample Preparation & Round Robin Analysis Audit and Joint Paper Preparation

- NREL: National Bioenergy Center (NBC), Biomass Analysis

Advanced training on 9/20-24/2010 for 5 expert professionals for CTBE, CTC, INMETRO; Demo comparative analytical results by CENPES and NREL and of the need for methodology standardization and reference samples  
Regular course on 9/27–10/1 for EMBRAPA, IPEN, UNESP, INT



<http://ts.nist.gov/measurement-services/referencematerials/index.cfm>

# ***Systems Integration and Modeling – Joint Analysis Research 2007-2012***



- **Brazilian industrial benchmark sugarcane to ethanol and electricity (up to 44 mills data) of 2005/6 developed TEA/LCA scenarios increasing bagasse utilization to more power or more power and ethanol. J. Seabra's thesis at UNICAMP under I. Macedo – thesis/paper (2008 Brazilian thesis).**

**Seabra US training:**

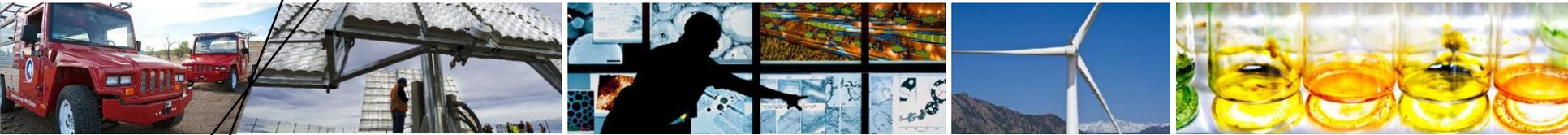
- **US ANL in LCA GREET – adapted key parameters to Brazilian conditions and learned methodology**
- ***GREET methodology adopted by RFS and California LCFS and ANL training enabled Brazilian researchers, industry and academia to demonstrate better practices of their mills with the appropriate technologies***
- **US NREL training in TEA for advanced modeling with Aspen models and analyze configurations for bagasse to ethanol mills – TEA paper and biochemical and thermochemical ethanol (2010 paper)**
- **Brazilian industrial benchmark (up to 168 mills data) of 2009/10; LCA data for coproduction of sugar, ethanol, and electricity and scenarios to 2020 with Monte Carlo uncertainty analysis on LCA (2011 Brazil and US paper)**
- ***U.S. trained an outstanding Brazilian professional now training Brazilians and expanding training and analysis of sugarcane ethanol production in African countries***

**TEA/systems modeling training of CTBE researchers at NREL continues**

# Conclusions on Global Bioenergy Capacity

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- **Bilateral collaboration expanded networks of R&D in underpinning analyses of lignocellulosic conversion to biofuels, enabling common understanding of processes, economics, environmental impacts, some sustainability parameters, and standards**
- **Researchers and government managers committed to building mutually supportive partnerships championed work, recognized by both countries (e.g., U.S.-Brazil CEO Forum that reports to both countries' Presidents, Council on Competitiveness)**
- **Collaborations leverage US and Brazilian investments and impact trade indirectly through standards and sharing mutual best practices**
- **Brazilian and US industries operating in Brazil benefit from the human resource development**
- **Supports global bioenergy capacity development**



**Five years of collaborative research were only possible with continued support of DOE/EERE Office of the Biomass Program and EERE International Programs and the efforts at NREL, ANL, ORNL and collaborators, U.S. State Dept facilitating personnel exchanges, and Brazilian government institutions MCTI, MME, MDIC, MAPA, and the Department of Energy of the Ministry of Foreign Relations and their associated research and strategic institutions, industry, academia, and associations**