

U. S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration



Brazilian Biofuel Pipeline Experience

September 2008

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PLEASE NOTE:

- **Information is drawn from a 9/2007 PHMSA trip to Brazil**
 - **Agência Nacional do Petróleo (ANP)**
 - **Petrobras/TransPetro**
 - **Ethanol producers**
 - **Researchers**
- **Additionally, thanks to Marcelino Guedes F. Mosqueira Gomes, Director of Terminals and Pipelines PETROBRAS/TRANSPETRO for much of these presentation slides**



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Background: Brazil



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BRAZIL



Capital: Brasília

Official Language: Portuguese

System of Government: Democratic (100 million voters.)

Land Area: 3,286,470 square miles (**U.S. 3,537,438 square miles**)

Population: 170 million (**U.S. 300 million**)

Geography: Brazil is in east-central South America and occupies nearly 50% of the South American continent. Around 58% of Brazil is covered with forests, which include the largest rainforest in the world, located in the Amazon River basin.

Land Use: 58% forests, 22% pasture, 6% crops, 14% other use.

Biggest Cities: São Paulo (10.4 million), Rio de Janeiro (5.8 million), Salvador (2.4 million), Belo Horizonte (2.2 million), Brasília (2 million), Recife (1.4 million)

Oil Production/Consumption: CY 2006, 2,400 bbls/d (con), 2,300 bbls/d (prod)





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Brazil & Biofuels

- **Brazil is significantly ahead of the U.S. in the production, transportation, distribution and social education regarding biofuels**





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Brazilian Ethanol--Then

- **1970's Oil Crisis pushed Brazil to look at ethanol as energy source**
- **First alcohol- and ethanol-batched pipelines seen in 1975**
- **Some pipeline material problems seen in early 1980's**
 - **Rubber components such as seals and o-rings problematic**
 - **Inhibitor testing begins to mitigate corrosion seen only in the lab**



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Brazilian Ethanol--Now

- **Cars and light trucks use Flex Technology or run solely on alcohol**
 - All gasoline sold in Brazil for use by automobiles is E25 (i.e., 25% ethanol)
 - Older cars (1980's to 2003) run on alcohol (E25 gasohol)
 - Newer cars are Flex and can run on any mixture alcohol, blended ethanol/gasoline (25% E) or pure ethanol
 - Approximately \$1,000 can convert an older car to Flex
 - Some cars can also use Compressed Natural Gas with the conversion cost highly subsidized (70%) by the government



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Brazilian Biodiesel

- **Brazil is producing and refining a limited (no numbers provided) amount of biodiesel**
 - **Approximately 100% of bio-diesel moved by tanker truck over significant distances (1,000+ miles)**



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Ethanol Feedstock



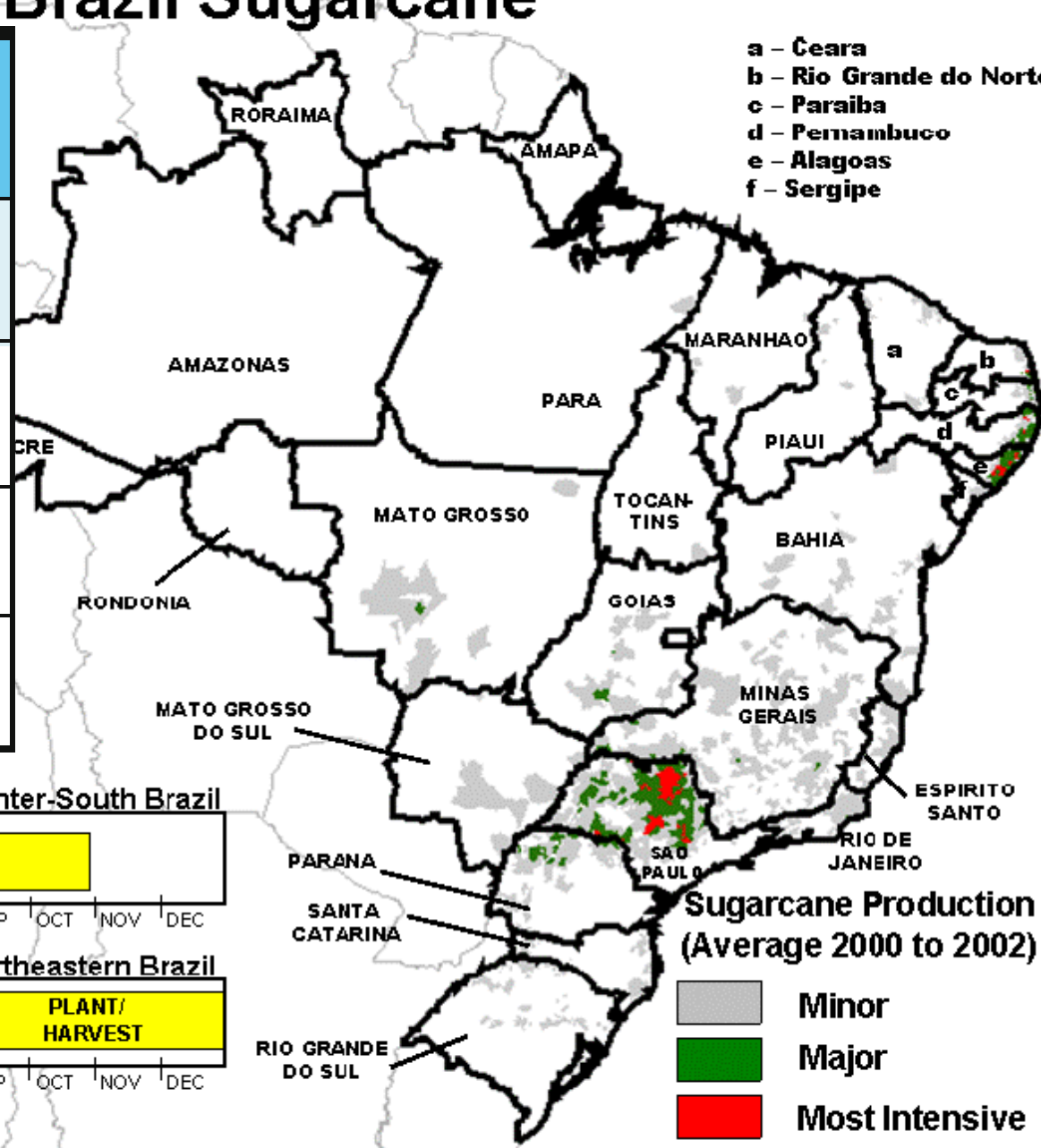
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Brazil Sugarcane

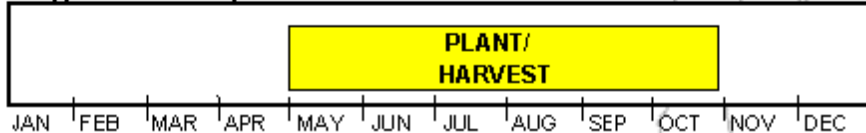
Regional production statistics

	South-Center	Northeast
Sugar cane	80-85%	15-20%
Raw sugar	60-65%	35-40%
Ethanol	80-85%	15-20%

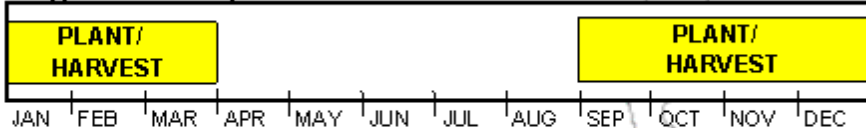
- a - Ceara
- b - Rio Grande do Norte
- c - Paraiba
- d - Pernambuco
- e - Alagoas
- f - Sergipe



Sugarcane crop calendar for most of Center-South Brazil

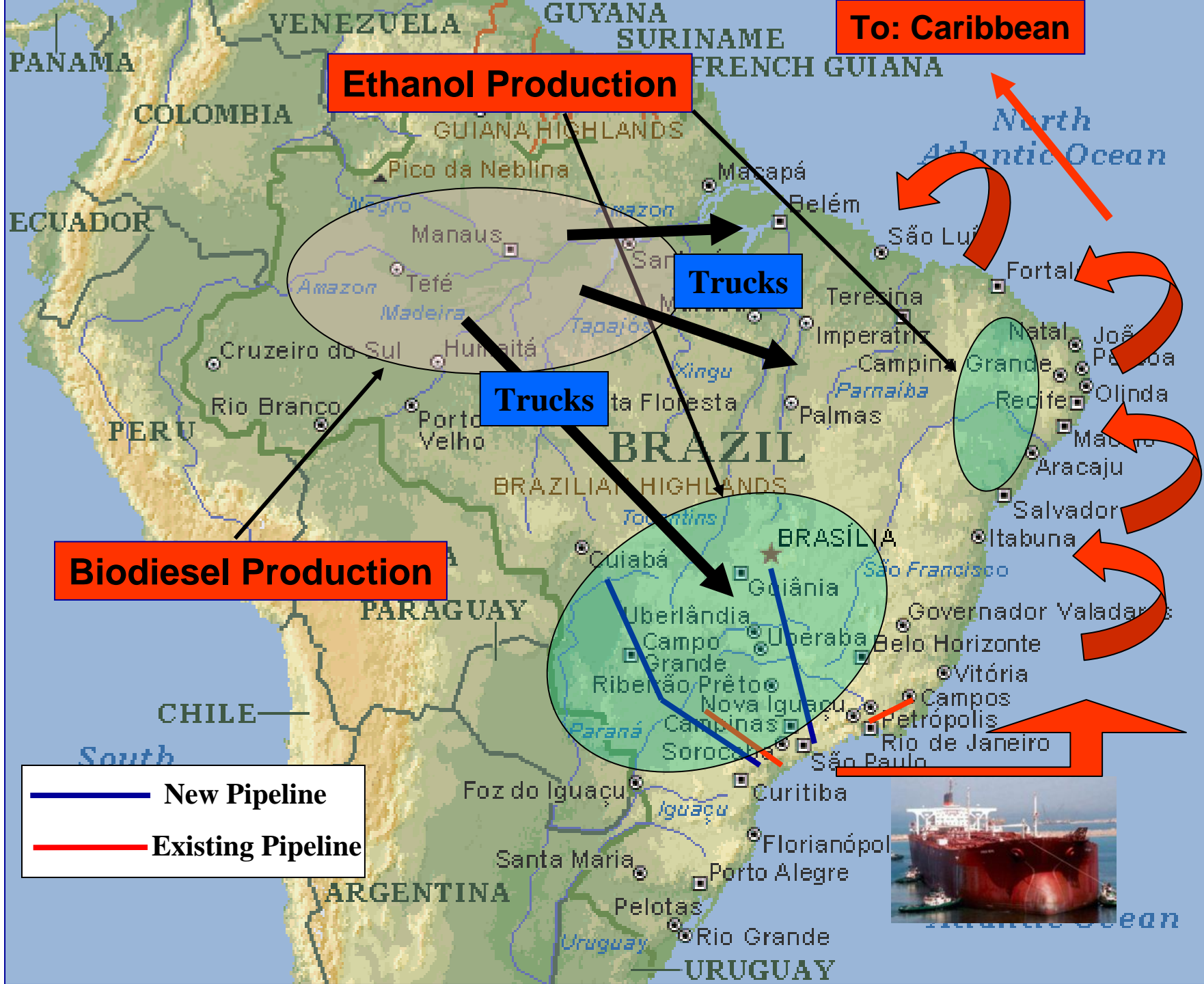


Sugarcane crop calendar for most of Northeastern Brazil



Sugarcane Production (Average 2000 to 2002)

- Minor
- Major
- Most Intensive



Ethanol Production

To: Caribbean

Trucks

Trucks

Biodiesel Production

New Pipeline
Existing Pipeline





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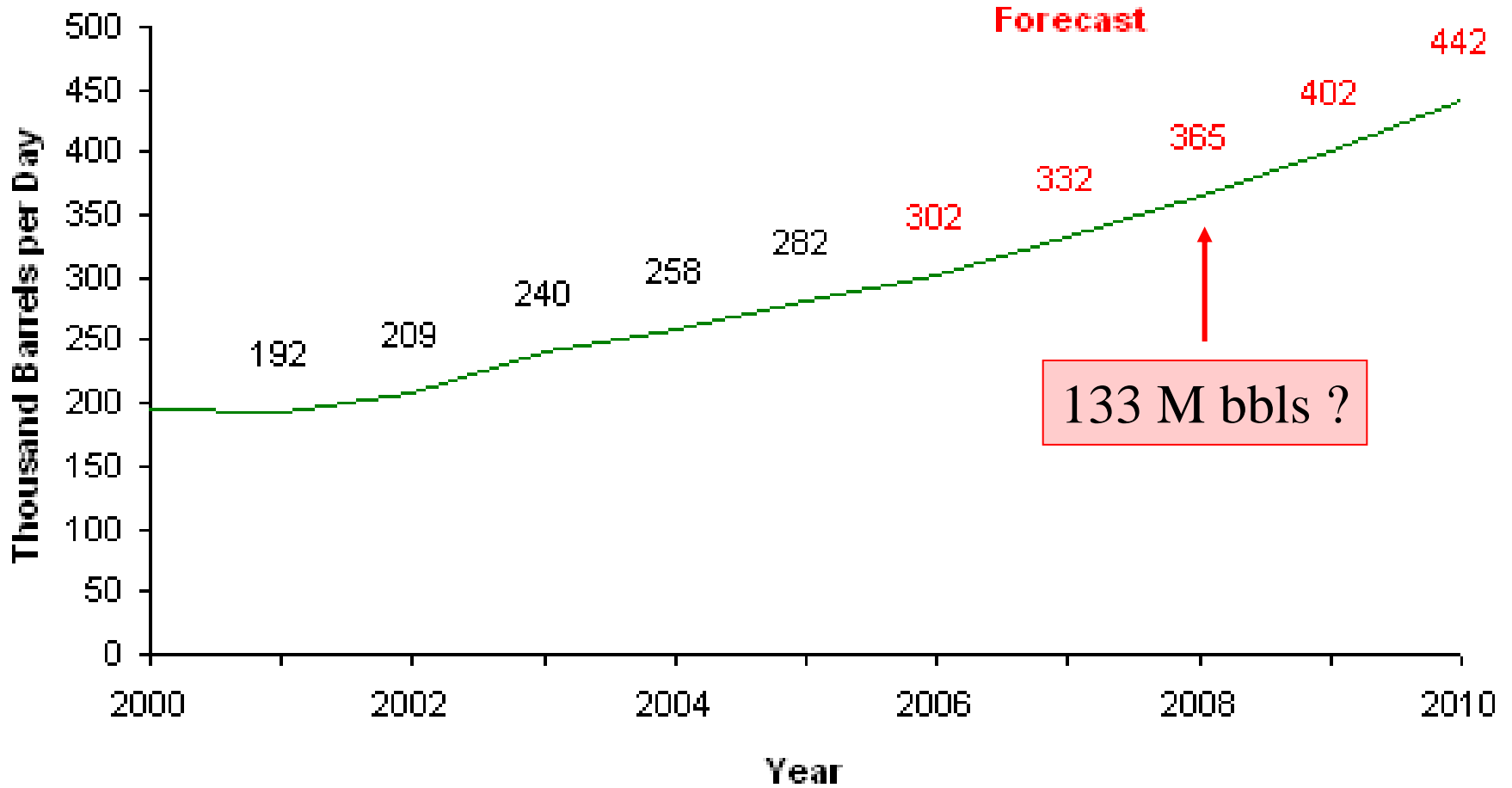
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Ethanol Production & Pipeline Transportation

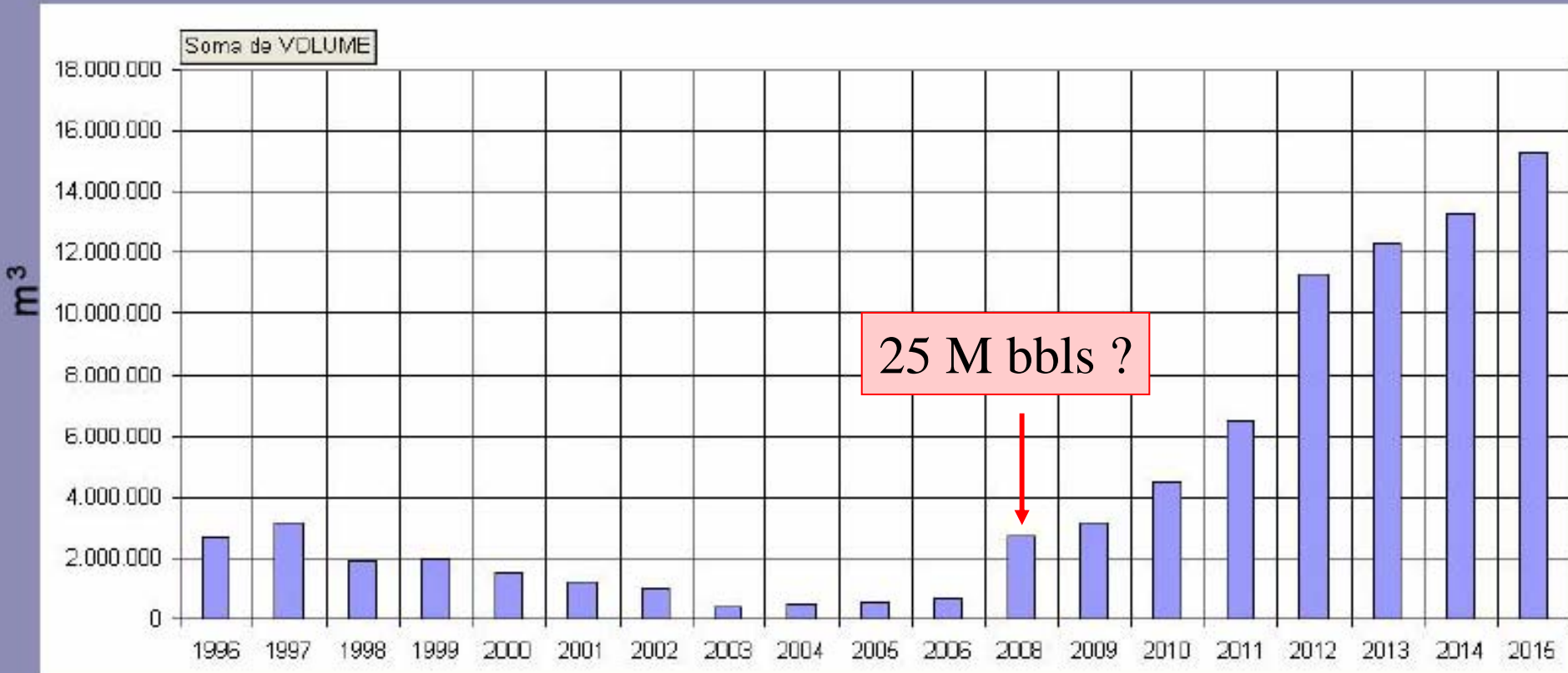
Brazil's Ethanol Production, 2000-2010



Source: Brazil Ministry of Agriculture; EIA *Short Term Energy Outlook*; internal EIA estimates

VOLUMES OF ETHANOL TRANSPORTED BY MULTI-PRODUCT PIPELINES

2008 Estimate: Only 19% moved in multi-product pipelines



Hydrous & Anhydrous Ethanol



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Brazilian Ethanol--Now

- **Brazil exporting limited amounts of blended ethanol (10% Ethanol & 90% Gasoline) to U.S. through Caribbean countries to circumvent U.S. tariff on ethanol imports**
- **Only a small portion of agriculture lands used to grow sugarcane are utilized, leaving vast amounts of untapped, new future production areas**
- **Estimated that ethanol production in Brazil could expand 8 or 9 fold**



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Over 30 Years of Ethanol Transportation Experience

Ethanol Export Supply Chain



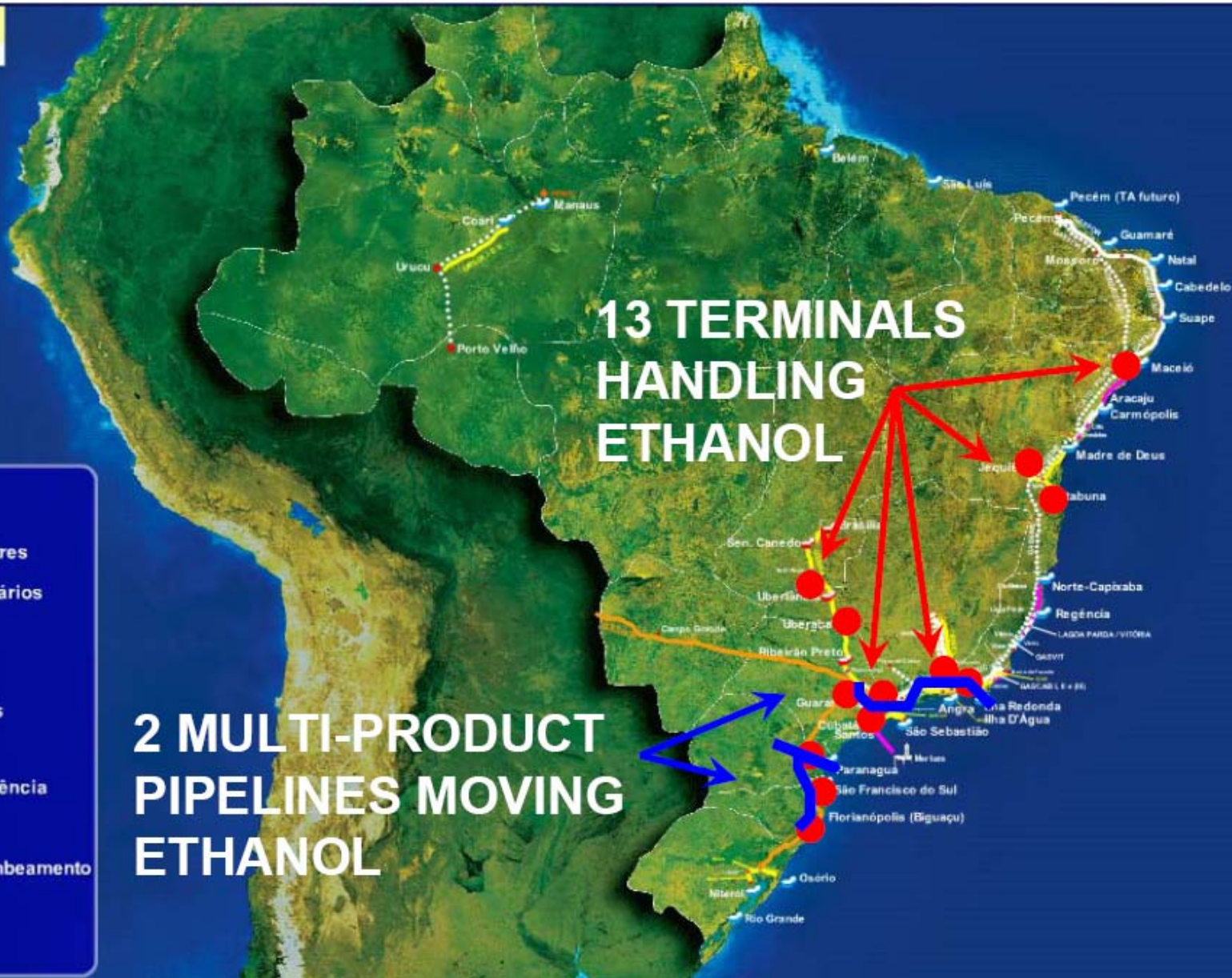
PETROBRAS Multimodal Leadership

- Gathering Centers
- Pipelines
- Terminals
- Shipments



PETROBRAS LOGISTICS TODAY

MALHAS



13 TERMINALS
HANDLING
ETHANOL

2 MULTI-PRODUCT
PIPELINES MOVING
ETHANOL

- Plataformas
- Terminais Terrestres
- Terminais Aquaviários
- Oleodutos
- Gasodutos
- Gasodutos futuros
- Gasbol
- Dutos de Transferência
- Refinarias
- Compressão / Bombeamento
- City Gates
- UPGNs

SINCE PETROBRAS EXPERTISE SPANS A WIDE RANGE OF VERY SPECIFIC ISSUES REGARDING ETHANOL, SOME OF THEM ARE LISTED BELOW:

- 1. "No-Water" Contamination Procedures***
- 2. Proper Pipeline Batch Sequencing***
- 3. Ethanol Corrosion Controls (including SCC) and NACE's analysis***
- 4. Development of Tank Covers***
- 5. Coating Developments for Storage Tanks and Tankers***
- 6. Quality degradation aspects and solutions***
- 7. Inert Gas Solutions for Tankers***
- 8. Develop Blending Operations***
- 9. Interface Treatment and Handling***
- 10. Special Firefighting Needs***
- 11. Materials Compatibility***
- 12. Pipeline Integrity Program***
- 13. Corrosion Inhibitors***



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Brazilian Ethanol--SCC

- **Petrobras/Transpetro claims no corrosion or Stress Corrosion Cracking problem in batched or dedicated alcohol/ethanol pipelines**
 - **Huge investment in inhibitor programs and strict QA/QC practices**
 - **Current inhibitor testing is underway to address new production area specificities such as microbial content**
 - **Approximately \$3-4 million current (CY 08 & 09) investment in inhibitor research**
 - **All new storage tanks lined with a specially-designed coating to complement inhibitor program**
 - **No internal pipeline coatings are used**



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Brazilian Ethanol--Regulators

- **ANP is the oil and gas regulator and is only 10 years old having operation divisions for various subjects such as biofuels**
 - **They only incorporate QA/QC standards into their limited ethanol pipeline regulations**
 - **Ethanol pipelines are currently highly unregulated but new laws are planned to increase oversight**



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Future Exports



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Ethanol Pipeline Projects

Petrobras Ethanol Pipeline Projects	km	MM US\$
RIO DE JANEIRO CORRIDOR		
REPLAN/SP - Ilha d'Água/RJ (REVAMPING)	exists	50
SÃO PAULO CORRIDOR		
REPLAN/SP - Guararema/SP	170	200
Guararema/SP - São Sebastião/SP	125	200
Buriti Alegre/GO - REPLAN/SP	627	500
Tietê/SP Waterway Pipeline	200	500
SOUTH CORRIDOR		
Ethanol Pipeline Campo Grande/MS - Paranaguá/PR	920	600
Multi-product Pipeline REPAR/PR - Campo Grande (MS) - Cuiabá (MT)	1.440	1.200
TOTAL	3.482	3.250

Brazilian PAC (Accelerated Development Program)

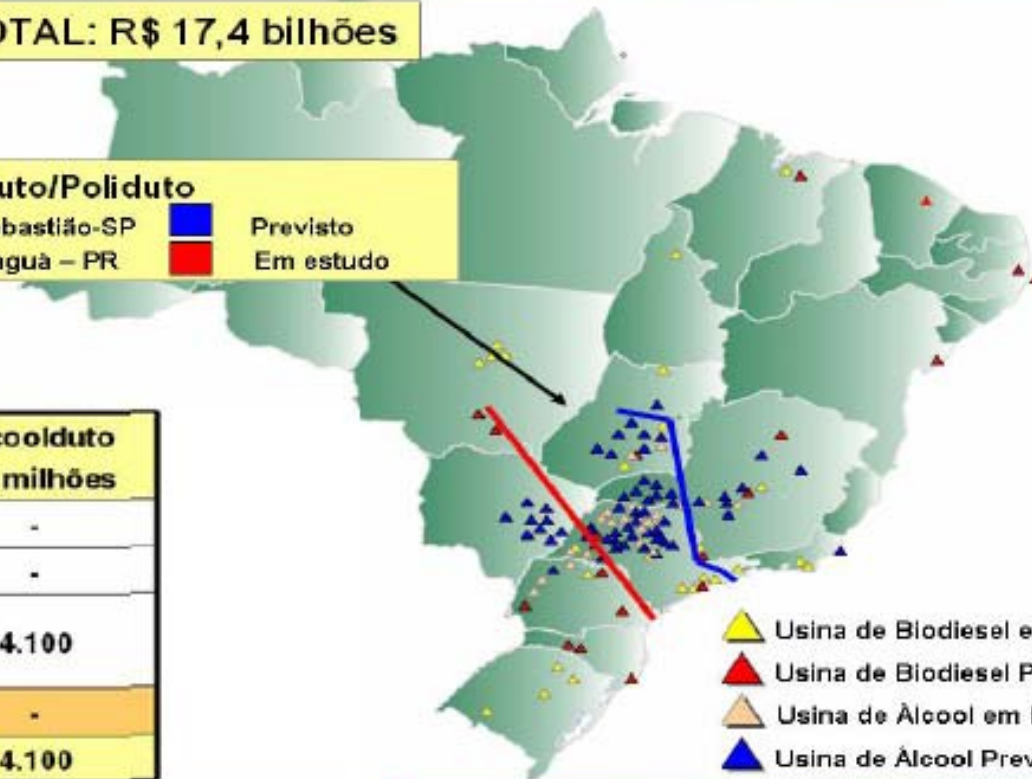
BIOCOMBUSTÍVEIS - ETANOL

INVESTIMENTO TOTAL: R\$ 17,4 bilhões

Alcoolduto/Poliduto

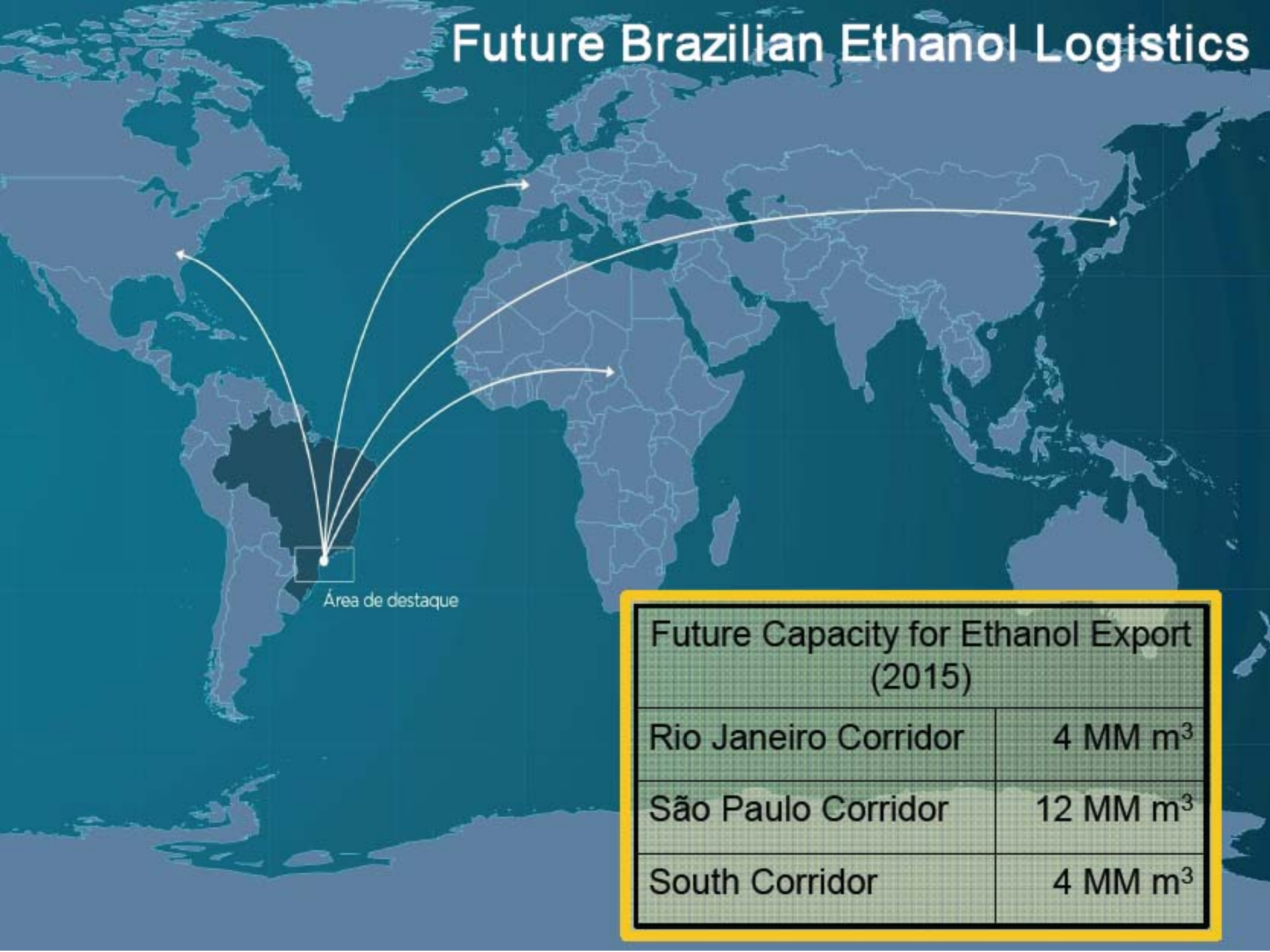
Senador Canedo-GO - São Sebastião-SP ■ Previsto
Guiabá-MT - REPAR - Paranaguá - PR ■ Em estudo

	Etanol R\$ milhões	Alcoolduto R\$ milhões
N	-	-
NE	-	-
CO	2.984	4.100
SE	8.500	
S	628	-
Total	12.112	4.100



- ▲ Usina de Biodiesel em Implantação
- ▲ Usina de Biodiesel Prevista
- ▲ Usina de Álcool em Implantação
- ▲ Usina de Álcool Prevista

Future Brazilian Ethanol Logistics



Área de destaque

Future Capacity for Ethanol Export (2015)

Rio Janeiro Corridor	4 MM m ³
São Paulo Corridor	12 MM m ³
South Corridor	4 MM m ³



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Thank You!

Questions?