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Sustainable Aviation
Biofuels for Brazil

4th International Conference on Biofuels Standards: Current Issues, Future Trends

Sustainable Aviation Biofuels for Brazil
SABB Project Status

Francisco E. B. Nigro
Escola Politécnica
Universidade de São Paulo
Gaithersburg: Nov. 14th, 2012

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Presentation Outline

- SABB Project
- Brazilian Biofuels Context
- Construction of a Roadmap for Aviation Biofuels in Brazil
- Overview of Workshops (1st to 6th)
- Workshops to come
- Final Remarks

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SABB Project

Project objective – Comprehensive gap assessment of the technological, economic and sustainability challenges and of the opportunities to implement a sustainable aviation biofuels industry in Brazil

Methodology – Convene a broad-based stakeholder group to create a high level roadmap that builds on local and international knowledge in a series of workshops for:

- Scenario building and discussion
- Biophysical and techno-economic analysis
- Preparation of a public report with inputs for research, business and policy agendas

Project duration – 10 months starting on April/2012

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Stakeholders

BOEING
EMBRAER
FAPESP

AIAB
AMYRIS
ANDRITZ Pulp & Paper
BIOECA Brasil
BYOGY RENEWABLES
Embrapa Agroenergy
ergos tech renewable energy solutions
GE
GOL Linhas aéreas inteligentes
BRASIL
LanzaTech
life technologies
MOUNT RUNDLE FINANCIAL
NESTE OIL
NATIONAL WILDLIFE FEDERATION
BR PETROBRAS
RSB
SGB Seeds Genomics Biofuels
SINDICOM
solazyme
TERRABON
UNICAMP
USP

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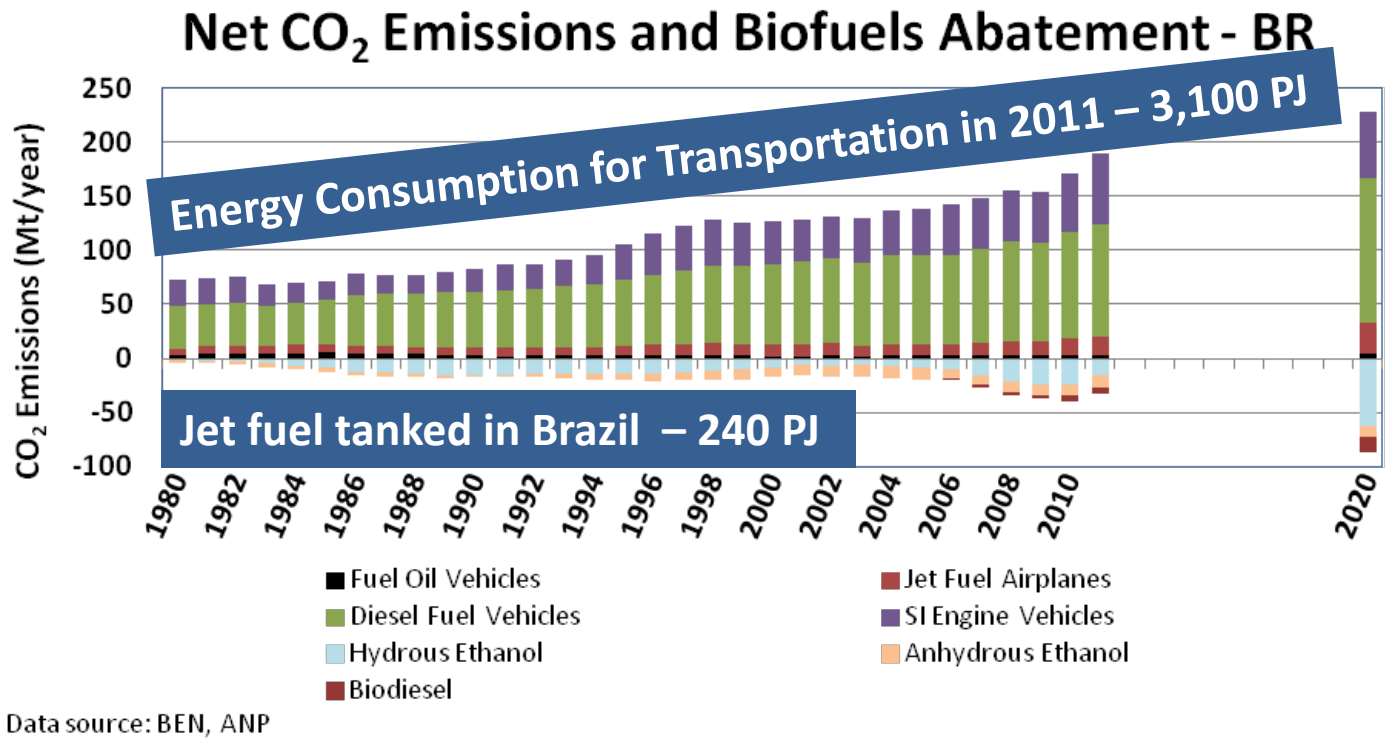
Brazilian Biofuels Context



- The **green scenario** for 2020 supposes that Brazil will be using B10 in all diesel fuel sold in the country, that 88% of the new autos sold will be flex-fuel and that hydrous ethanol will be priced competitive enough with gasohol to allow flex-fuel vehicles fleet to run 45% of time directly on ethanol.

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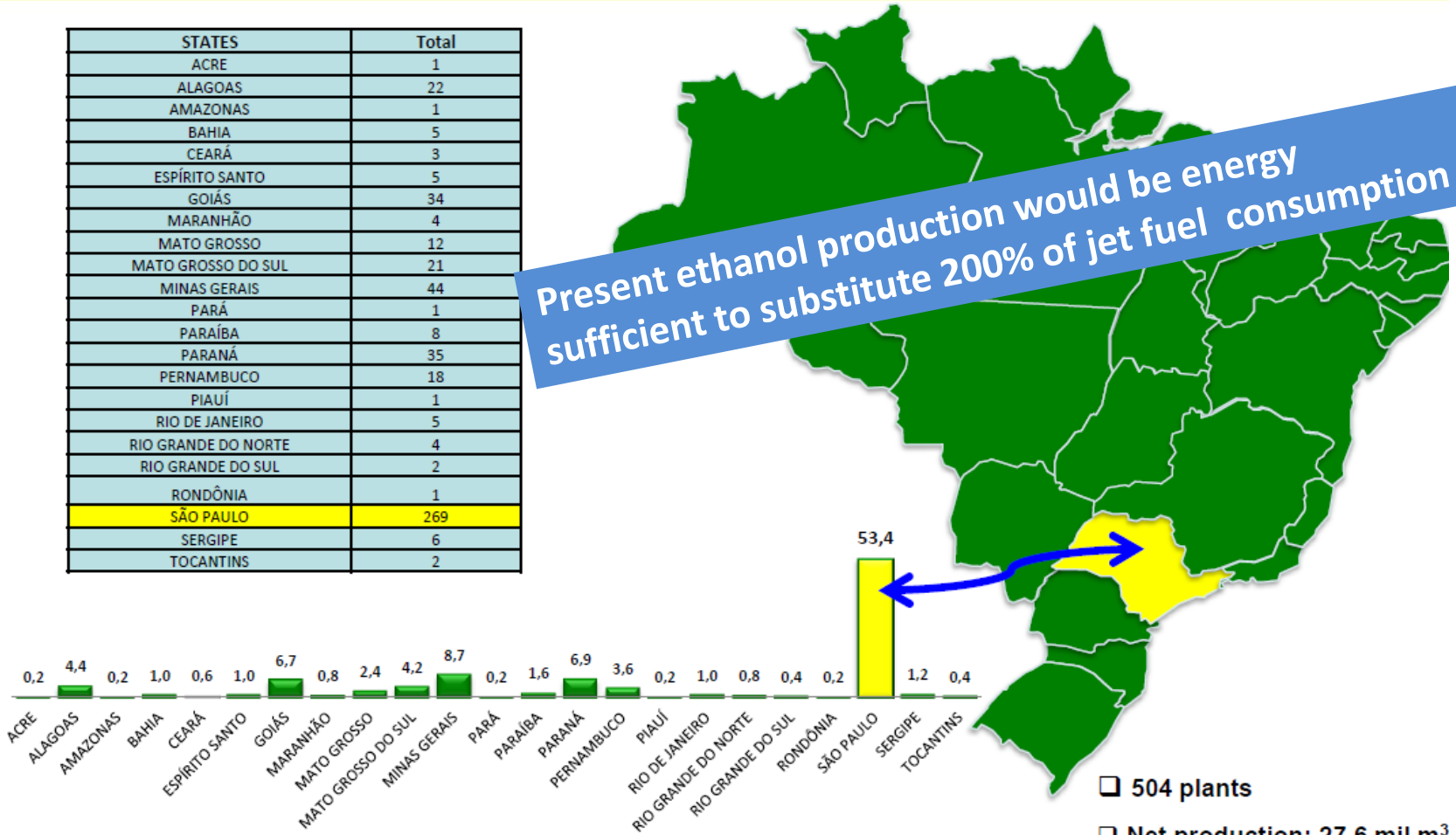
Brazilian Biofuels Context

Ethanol Production

STATES	Total
ACRE	1
ALAGOAS	22
AMAZONAS	1
BAHIA	5
CEARÁ	3
ESPÍRITO SANTO	5
GOIÁS	34
MARANHÃO	4
MATO GROSSO	12
MATO GROSSO DO SUL	21
MINAS GERAIS	44
PARÁ	1
PARAÍBA	8
PARANÁ	35
PERNAMBUCO	18
PIAUÍ	1
RIO DE JANEIRO	5
RIO GRANDE DO NORTE	4
RIO GRANDE DO SUL	2
RONDÔNIA	1
SÃO PAULO	269
SERGIPE	6
TOCANTINS	2



- 504 plants
- Net production: 27,6 mil m^3

ANP presentation

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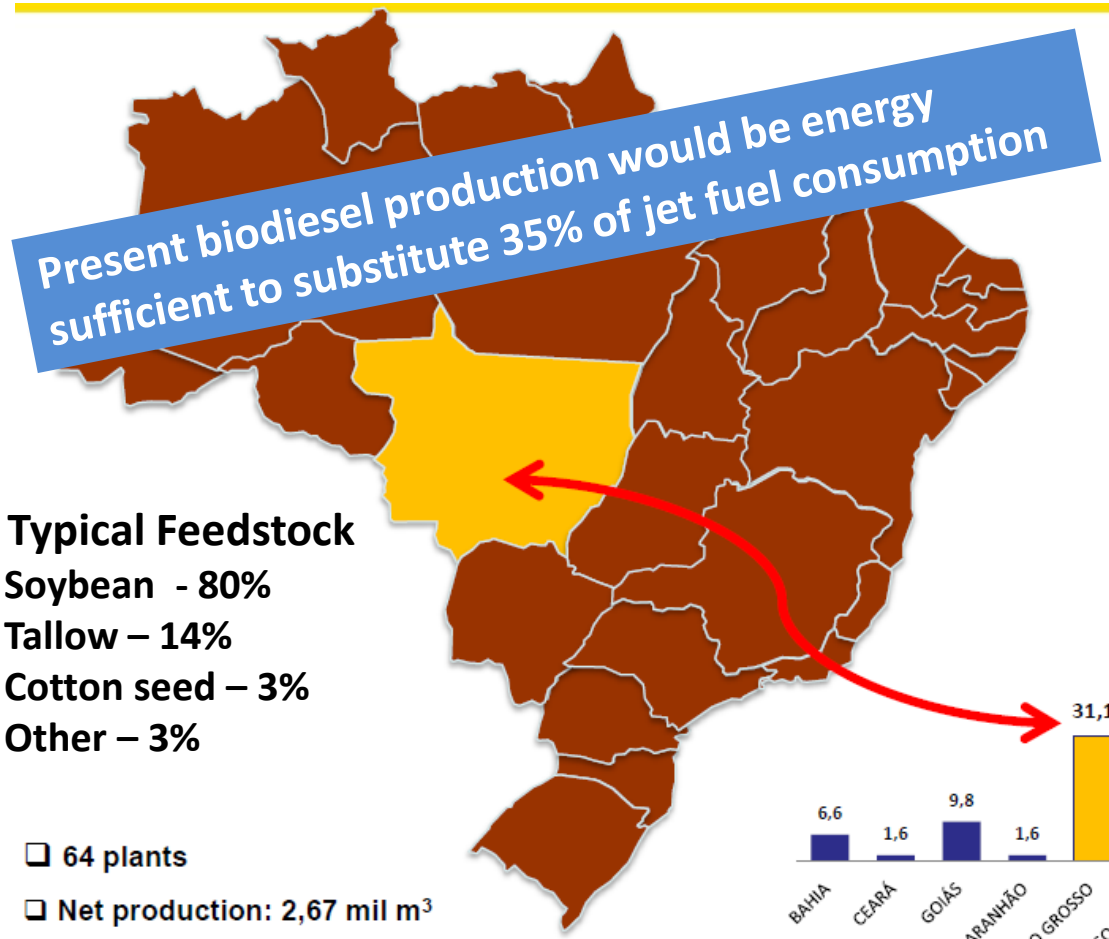
Brazilian Biofuels Context

Biodiesel Production

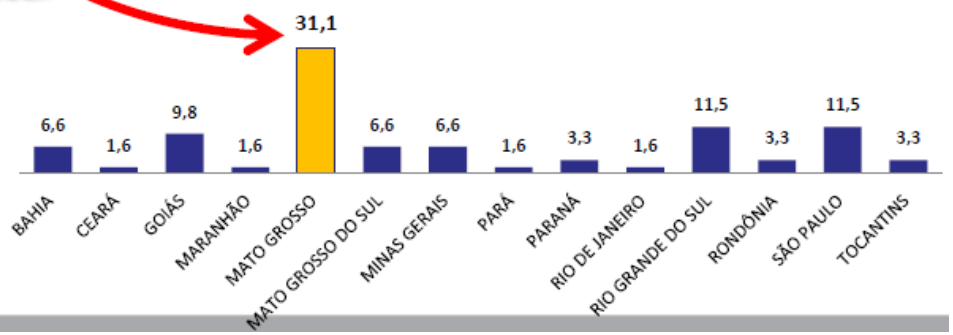


STATE	Total
BAHIA	4
CEARÁ	1
GOIÁS	6
MARANHÃO	1
MATO GROSSO	**19**
MATO GROSSO DO SUL	4
MINAS GERAIS	4
PARÁ	1
PARANÁ	2
RIO DE JANEIRO	1
RIO GRANDE DO SUL	7
RONDÔNIA	2
SÃO PAULO	7
TOCANTINS	2

Typical Feedstock

Soybean - 80%
Tallow – 14%
Cotton seed – 3%
Other – 3%

- 64 plants
- Net production: 2,67 mil m^3
- Nominal capacity: 7,03 million m^3/year



ANP presentation

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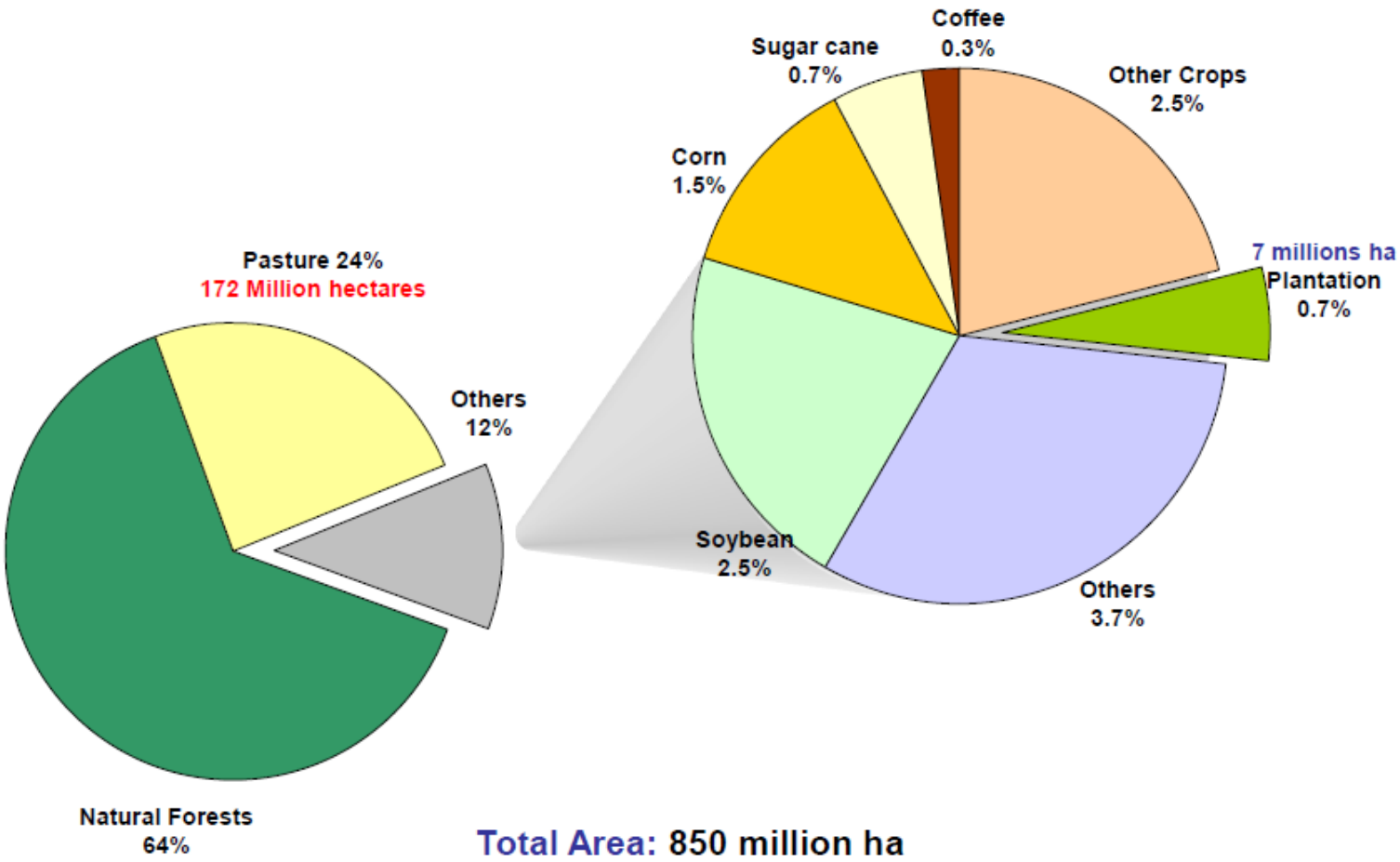
Brazilian Biofuels Context

Land Occupation



ESALQ- USP Presentation ; IBGE 2005

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Construction of a Technology Roadmap for Aviation Biofuels

Problem

Develop a sustainable aviation biofuel, with high GHG mitigation potential, that meets jet fuel performance requirements, requires no changes to airplanes, engines or infrastructure, and can be mixed or alternated with petroleum based jet fuel.

Scope

Identify the existing gaps or challenges involved in sustainable biofuels for aviation and create a public report that:

- Identifies barriers and opportunities
- Identifies alternative paths and actions to be pursued with respect to feedstocks, processing and delivery
- Identifies economic and environmental sustainability levels
- Provides a fact based input for future research agenda, business and policy decisions

Leadership, sponsorship and resources

SABB Steering Committee, Stakeholders and Research Team; Workshops.

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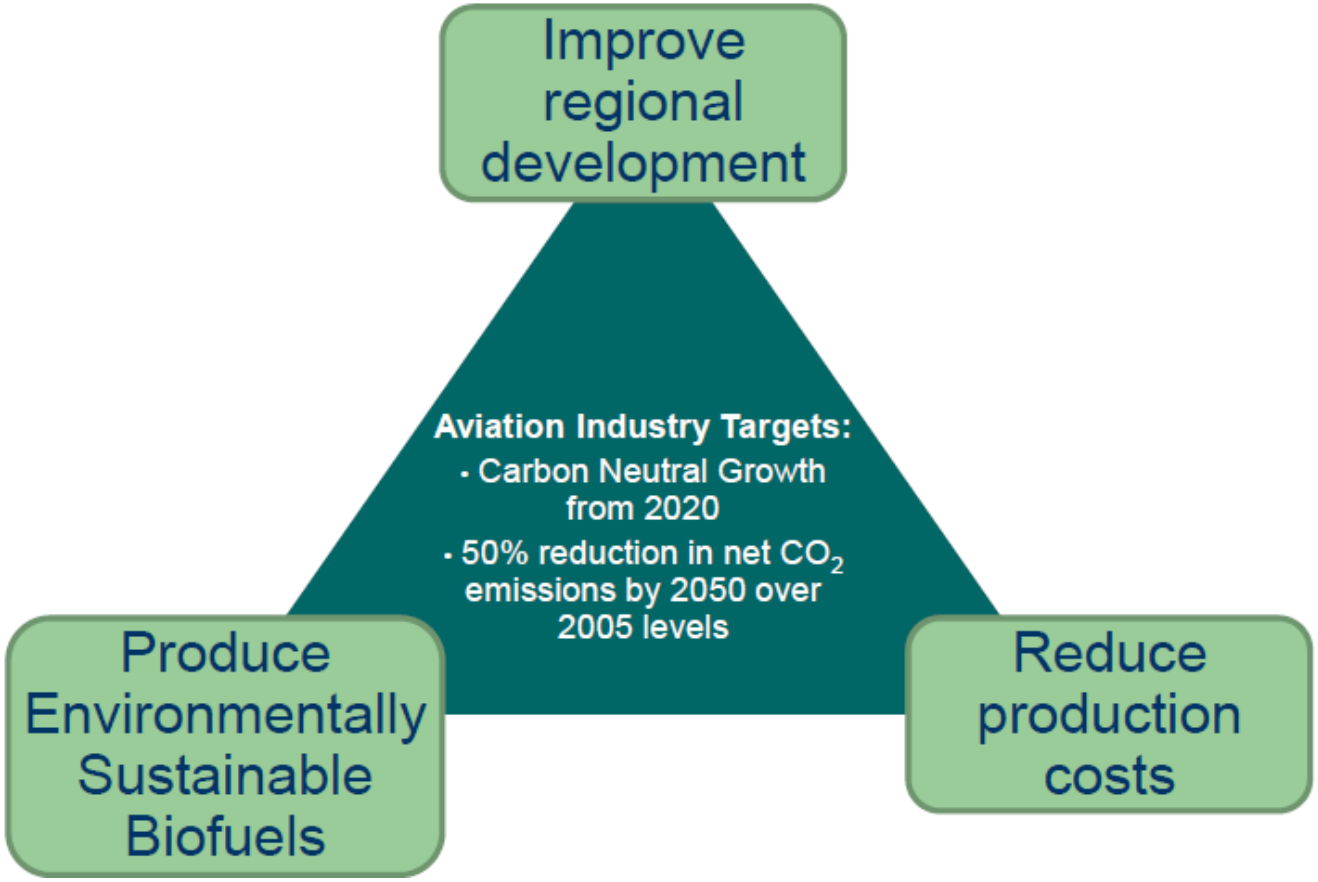
Sustainable Aviation Biofuels for Brazil

1st Workshop: Project Overview – FAPESP, São Paulo, April 25th & 26th

Vision

The aviation industry will have, in the next 20-40 years, a gradual transition towards the use of sustainable biofuels in substitution to jet fuels. The use of biofuels in aviation will have to be effective, efficient, and advantageous from the environment, social and economic points of view, searching to consolidate the expansion of the aviation industry worldwide.



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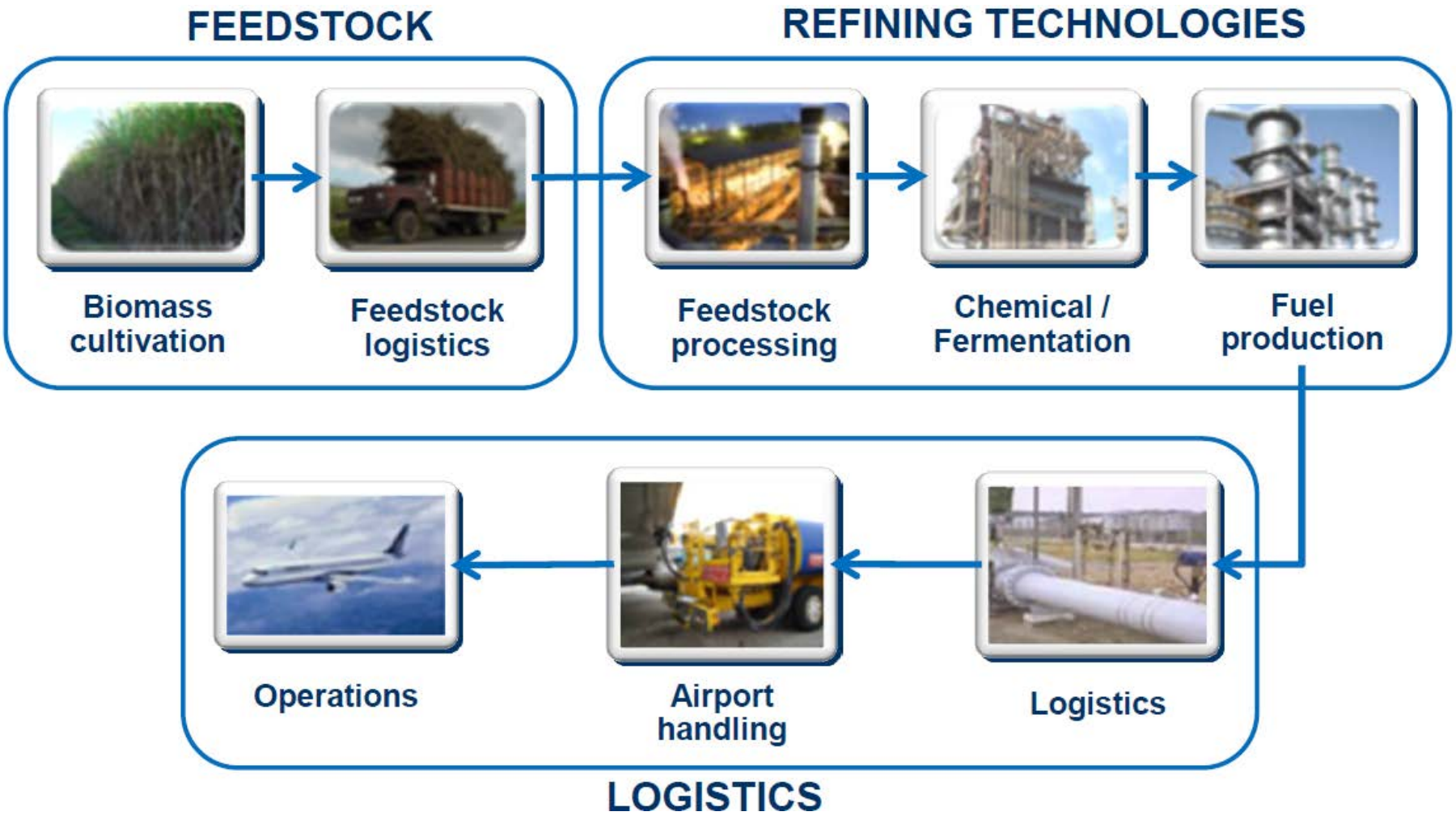
1st Workshop: Project Overview – FAPESP, São Paulo, April 25th & 26th



1st Workshop: Project Overview – FAPESP, São Paulo, April 25th & 26th

Themes of Workshops

2nd – Feedstocks

3rd – Refining Technologies

4th – Sustainability

5th – Policy and Incentives

6th – Logistics and Support

7th – R&D and Commercialization Gaps

8th – Briefing to Stakeholders

9th – Project Conclusion

Feedstocks Evaluated

Sucrose/starch bearing

- Sugarcane
- Sweet Sorghum
- Cassava

Oil bearing

- Soybean
- Palm
- Jatropha
- Camelina
- Photosynthetic Algae
- Sunflower
- Peanut
- Rapeseed
- Other Palm Trees

Lignocellulosis

- Eucalyptus
- Paulownia
- Sugarcane Bagasse
- Grasses
- Forestry & Wood Residues
- Industrial Forestry Residues
- Agricultural Residues

Wastes

- CO-rich Gases,
- Municipal Solid Waste,
- Used Cooking Oil,
- Tallow
- Sewage

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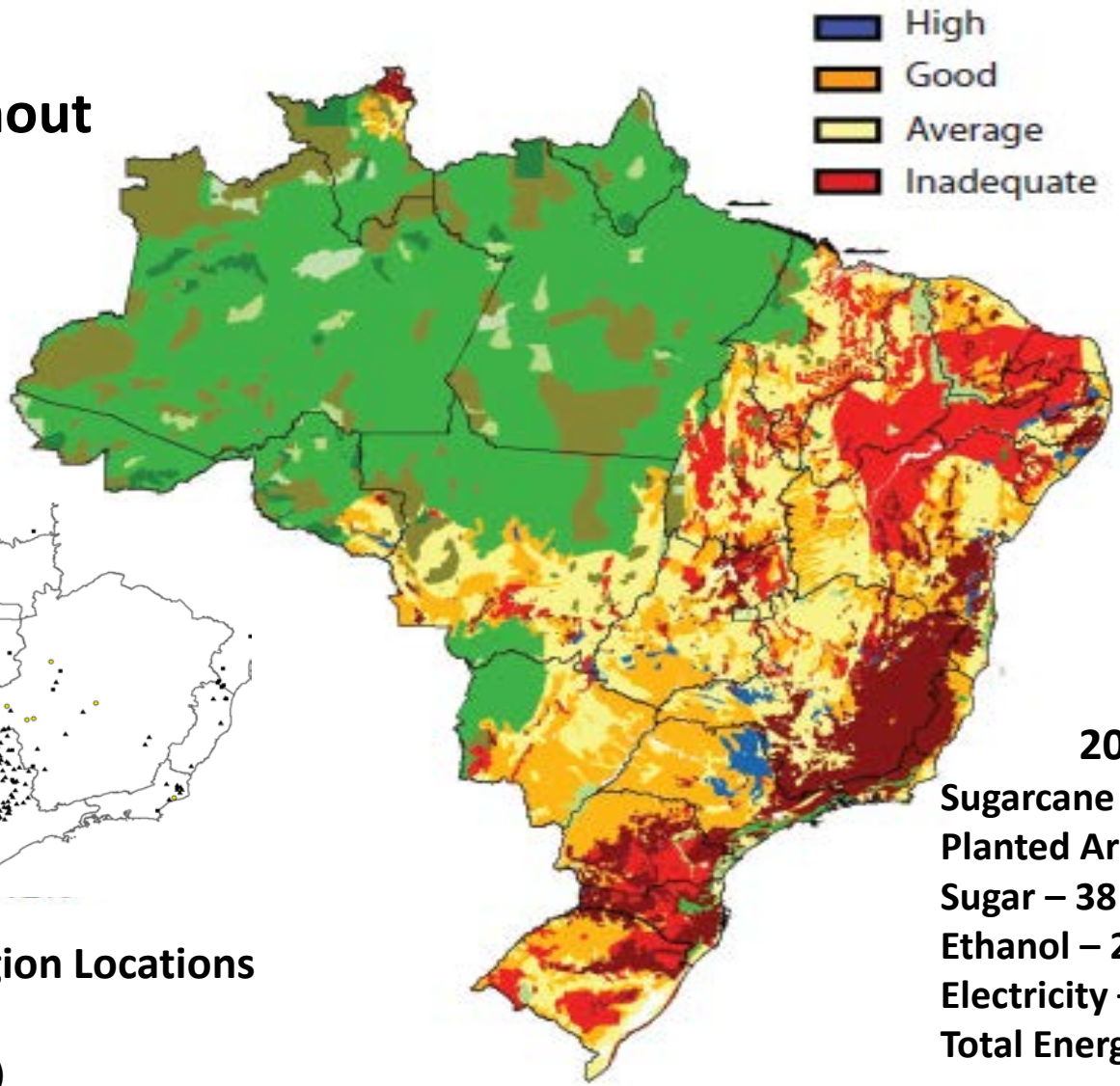
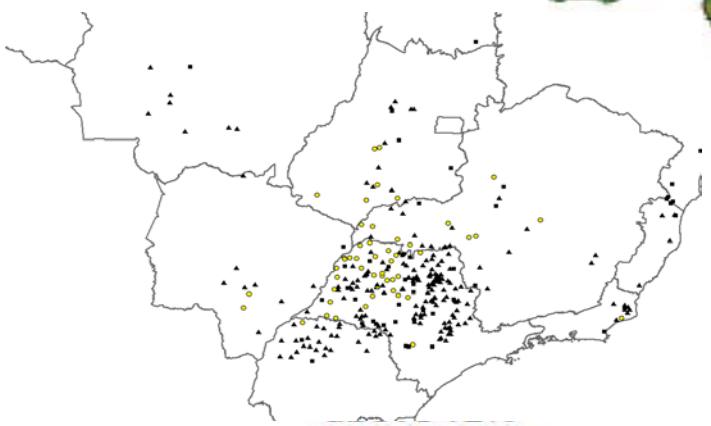
2nd Workshop: Feedstocks – ESALQ, Piracicaba, May 22nd & 23rd

Sugarcane without Irrigation





Center- South Region Locations

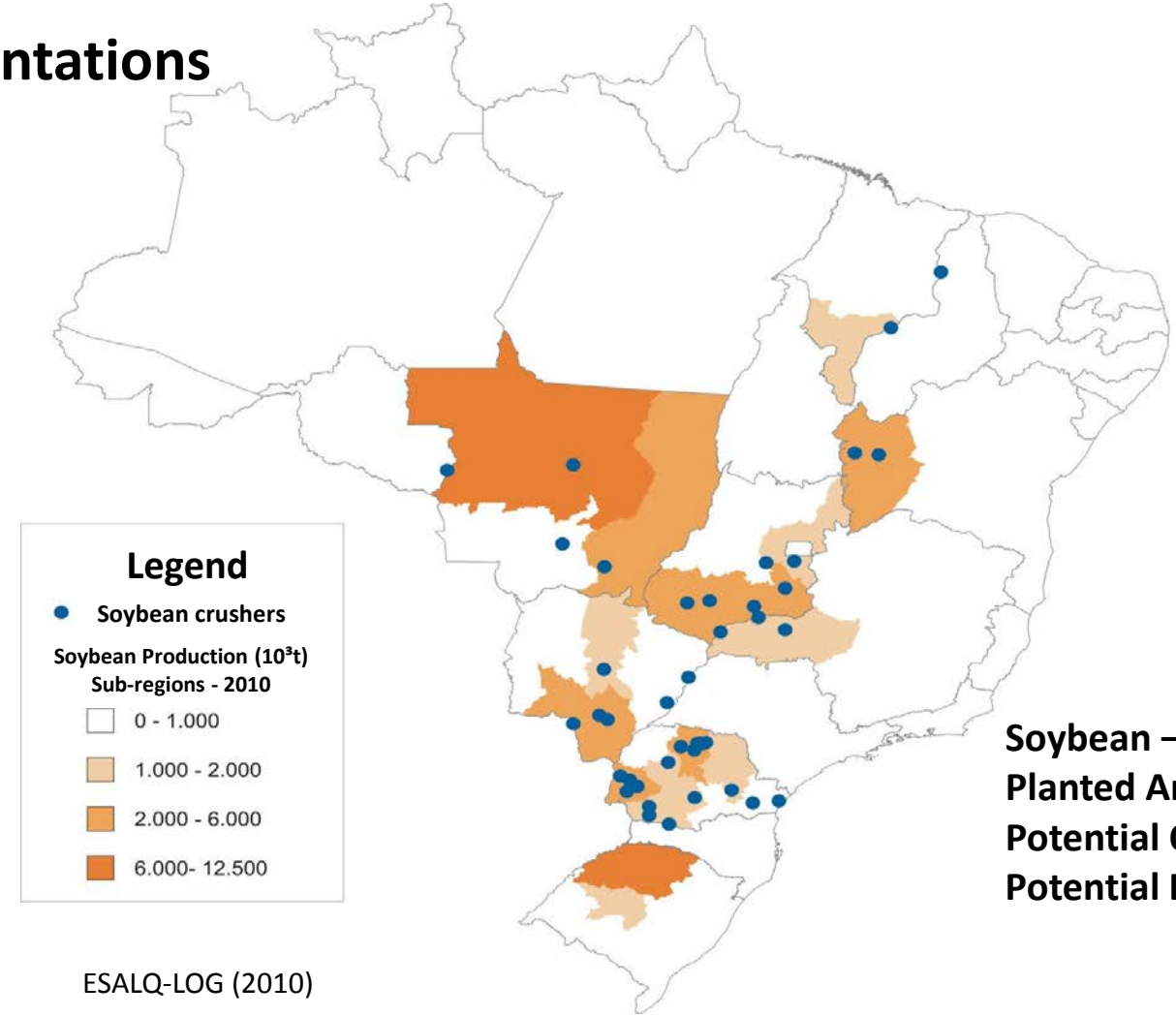
CTC & NIPE (2006)

2011

Sugarcane – 620 Mt
Planted Area – 9 Mha
Sugar – 38 Mt
Ethanol – 27 Mm³
Electricity – 1 GW_{avg}
Total Energy – 600 PJ

2nd Workshop: Feedstocks – ESALQ, Piracicaba, May 22nd & 23rd

Soybean Plantations



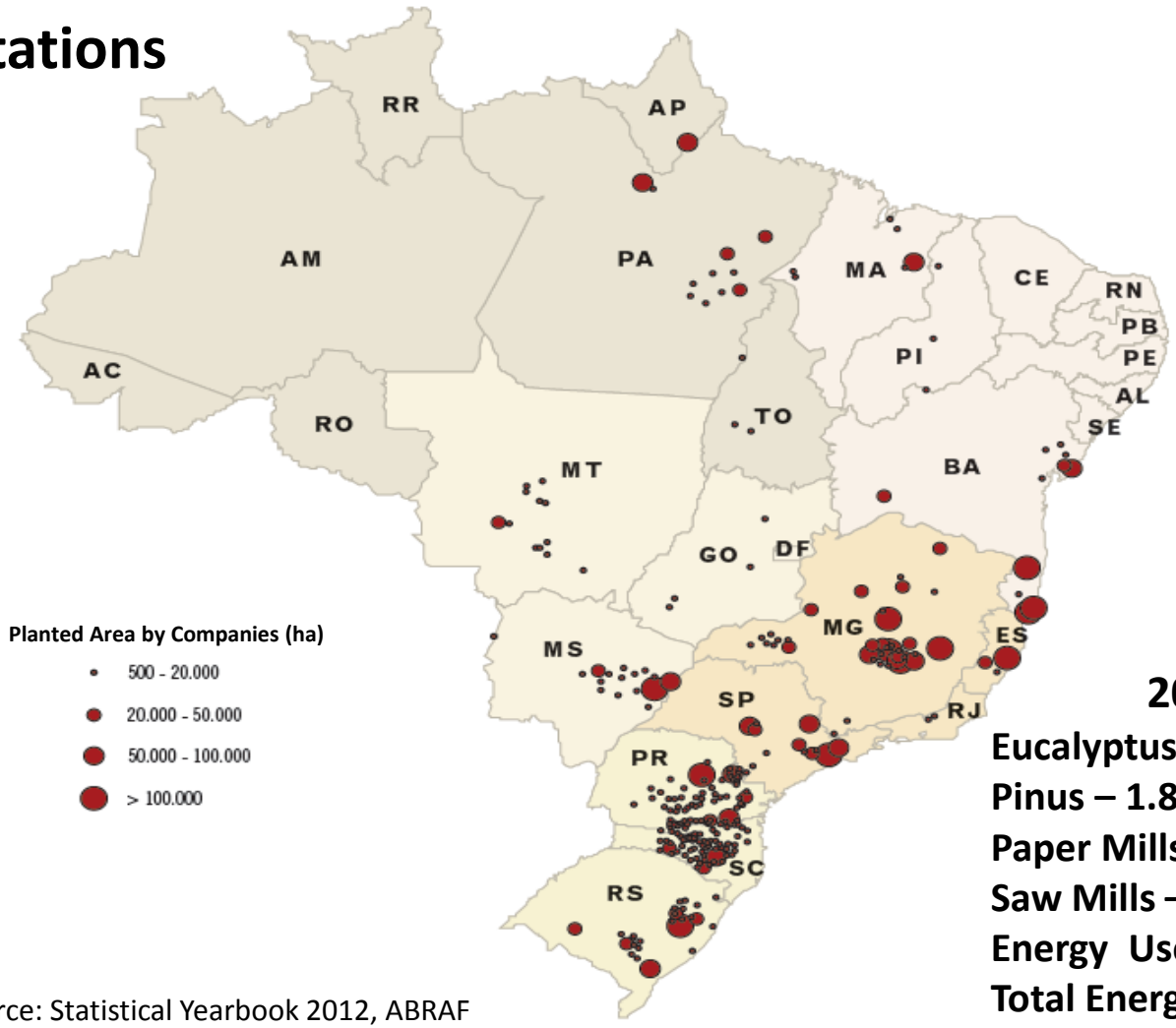
ESALQ-LOG (2010)

2011

Soybean – 69 Mt
Planted Area – 25 Mha
Potential Oil – 13 Mm³
Potential Energy – 480 PJ

2nd Workshop: Feedstocks – ESALQ, Piracicaba, May 22nd & 23rd

Forest Plantations



2011

Eucalyptus – 4.7 Mha
Pinus – 1.8 Mha
Paper Mills – 45 Mm³
Saw Mills – 26 Mm³
Energy Use – 128 Mm³
Total Energy – 830 PJ

source: Statistical Yearbook 2012, ABRAF

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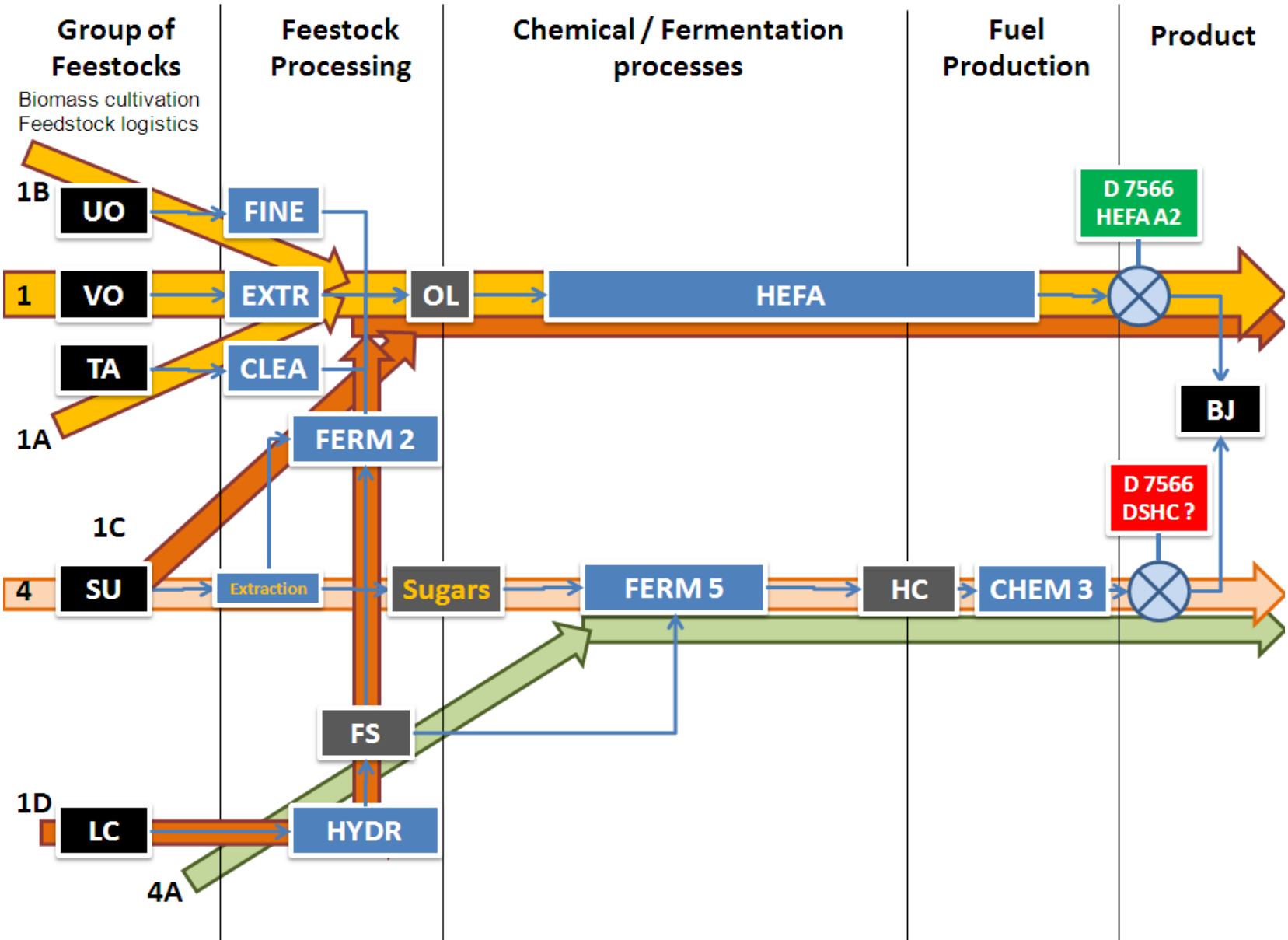
3rd Workshop: Process Technology – UNICAMP, Campinas, July 11th & 12th



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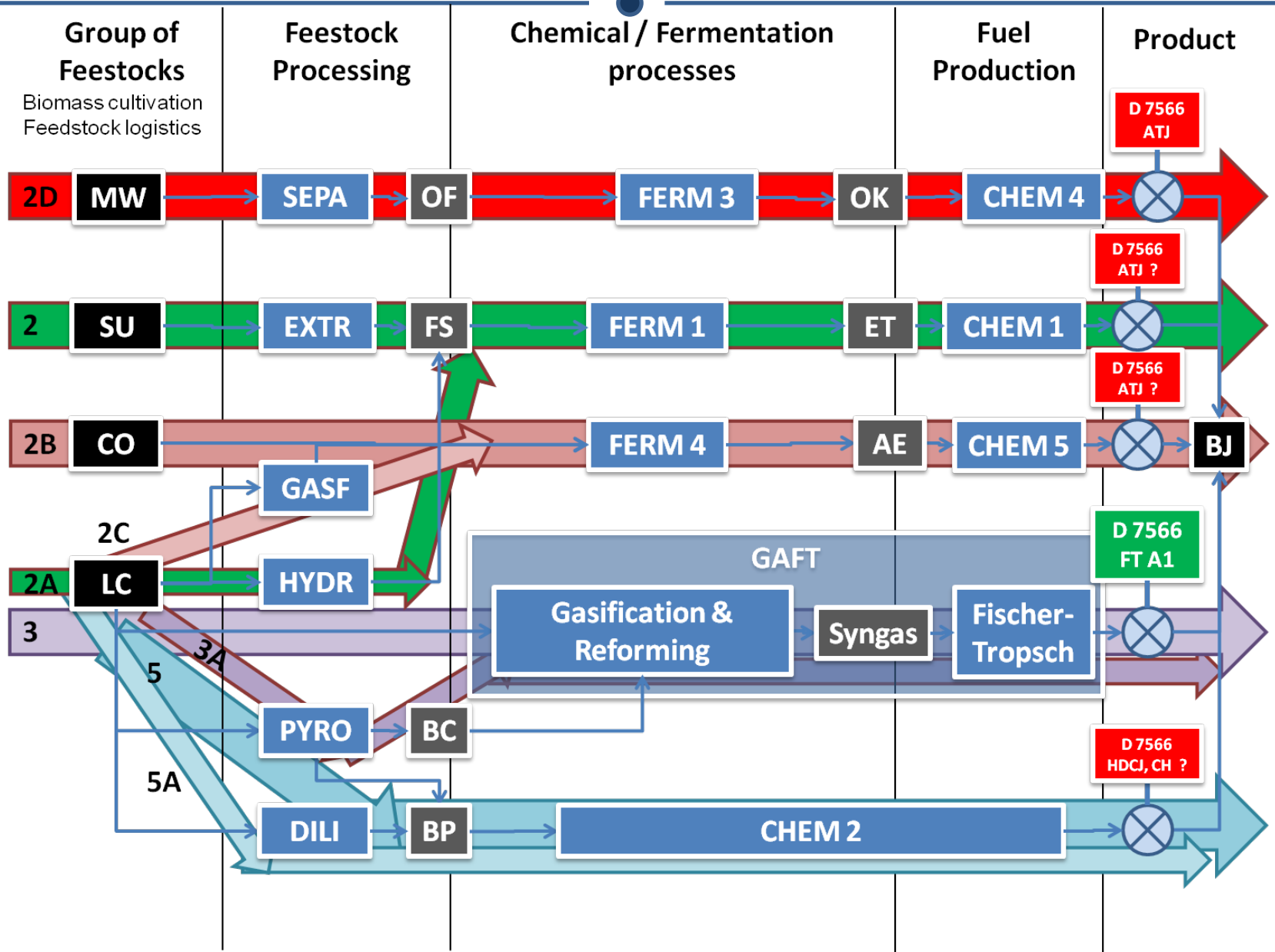
3rd Workshop: Process Technology – UNICAMP, Campinas, July 11th & 12th



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4th Workshop: Sustainability – FIEMG, Belo Horizonte, August 22nd & 23rd

Evaluation of **Social**, **Environmental** and **Economic** aspects of **Sustainability** for principal feedstock of each class: Sugar/starch; Oil bearing; Cellulosic; and Wastes

Laws and International Conventions
Land Rights
Employment, Wages and Labor Conditions
Human Health and Safety
GHG emissions
Biodiversity and Ecosystems
Soil
Water
Air
Waste

Crop Management and Agrochemical Use
Direct Land Use Changes
Social and Environmental Impact Assessment
Rural and Social Development
Contractors and Suppliers
Engagement and Communications with Stakeholders
Economic Viability and Production and Processing Efficiency
Food Security

Large organized production sectors shown to be more law compliant than small farm agriculture: Importance of treating **Sustainability** as a **Process** and not a **Snap Shot**

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5th Workshop: Policy & Incentives – Embrapa, Brasilia, Sept. 12th & 13th

Objective: Analyze and discuss the relevant institutional aspects, such as the government role on regulatory and incentive issues

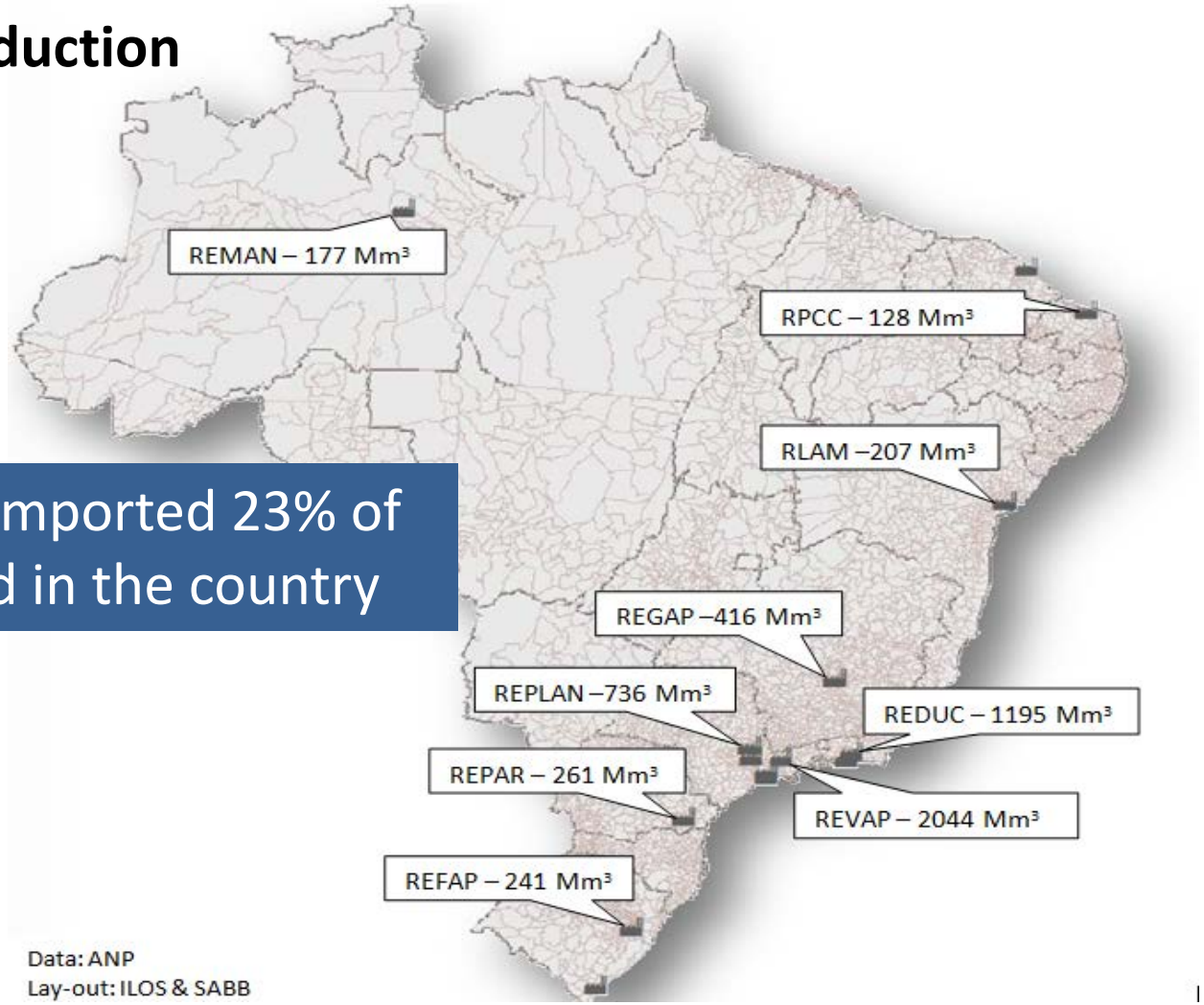
- ANP – "National Agency of Petroleum, Natural Gas and Biofuels" is revising ANP ACT 37/2009 to allow the commercial use of jet biofuels that conforms with ASTM D7566
- BNDES –"National Bank for Development" is financing demonstration and industrial plants that can produce jet biofuel in Brazil
- FINEP – the federal government "Studies and Projects Finance Organization" has several credit lines for stimulating science, technology and innovation both in research institutions and private companies.
- FAPESP – "Sao Paulo Research Foundation" is a major stakeholder of this project through BIOEN (Bio-energy Program) and intends to support a FAPESP CEPID (Research, Innovation and Dissemination Center) on the subject.

Demonstration Flights during Rio+20

- Gol Airlines flew from São Paulo a Boeing 737-800 on a Bio-SPK HEFA/Jet A1 blend according to ASTM D7566
- Azul Airlines flew from Viracopos an Embraer 195 on a blend of DSHC (Direct Sugar to Hydrocarbon)/ Jet A1, produced in the country by Amyris

Avião da Azu é abastecido com combustível à base de cana-de-açúcar em Campinas (Foto: Isabela Leite/G1)

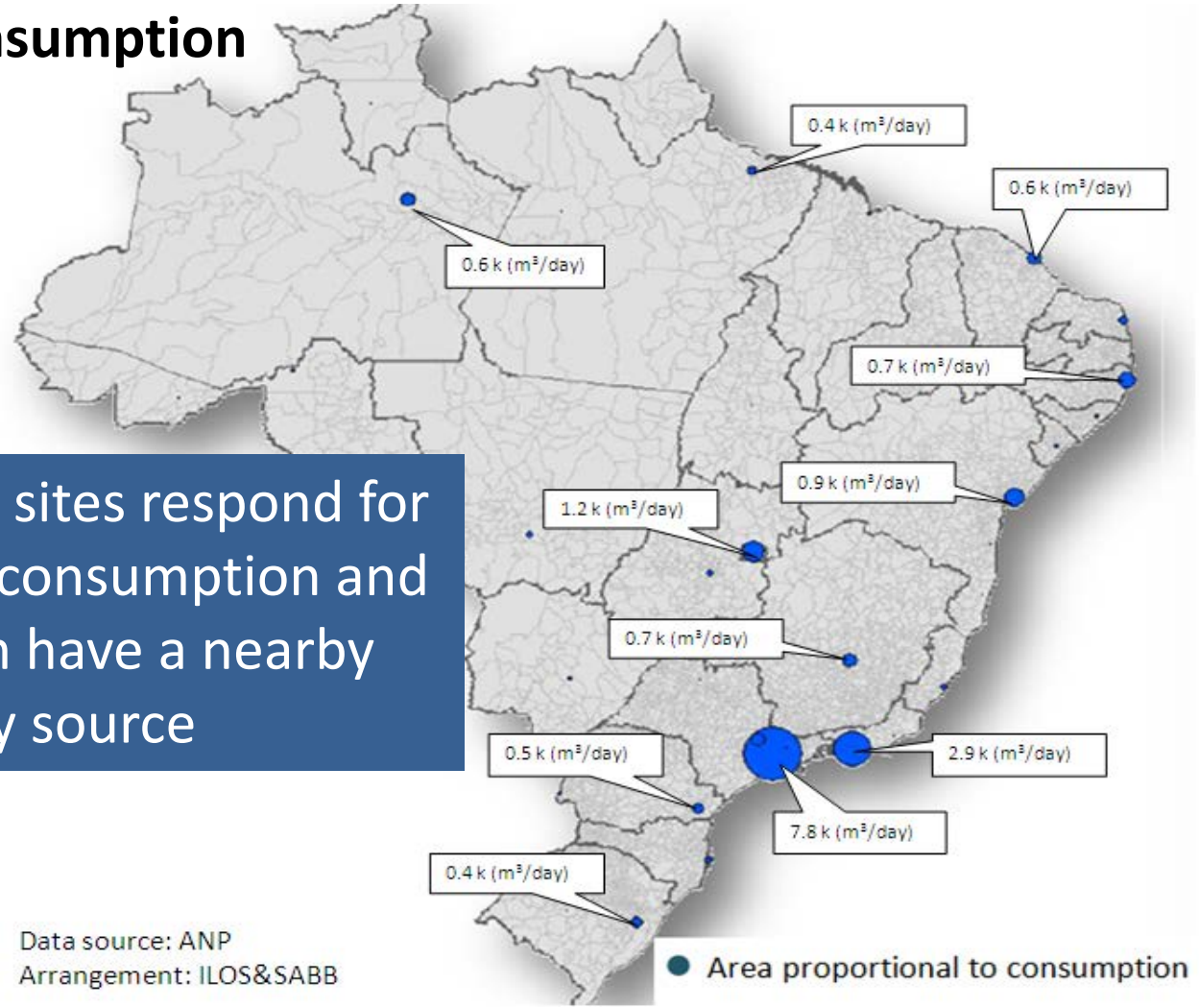
Jet Fuel Production



In 2011 Brazil imported 23% of jet fuel tanked in the country

6th Workshop: Logistics & Support – ANP, Rio de Janeiro, Oct. 17th & 18th

Jet Fuel Consumption



The pinpointed sites respond for 88% of jet fuel consumption and most of them have a nearby supply source

Data source: ANP
Arrangement: ILOS&SABB

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Next Workshops and Final Remark

- R&D and Commercialization Gaps – Nov. 28th & 29th
- Briefing to Stakeholders – Dec. 12th & 13th
- Project Conclusion – Feb/2013

The Roadmap construction process has been essential to coordinate the actions of government and private sectors to implement a sustainable aviation biofuels industry in Brazil