L16b) BIOFUELS FOR AIRPLANES: CAN IT BE TURNED INTO A GLOBAL COMMODITY?

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JET BIOFUELS: NEW GLOBAL COMMODITY?

- *INTERNATIONAL BODIES AND ACTIONS FOR CO_2 EMISSIONS REDUCTION*
- *APPROVAL AND CERTIFICATION OF "DROP-IN" JET BIOFUELS*
- *FAPESP'S PROJECT: "SUSTAINABLE AVIATION BIOFUEL FOR BRAZIL"*
- *PROJECT CONTEXT & DRIVES*
- *FEEDSTOCKS*
- *SUSTAINABILITY*
- *CONVERSION & REFINING PROCESSES*
- *JET FUEL LOGISTICS*
- *ECONOMIC GAPS AND NECESSARY ACTIONS*
- *CONCLUSIONS AND RECOMMENDATIONS*

Aviation Industry and CO_2 Emissions

- Vital engine of global economic growth supporting over 58 million jobs and US$2.4 trillion in gross domestic product
- Currently, aviation operations produce around 2% of human CO_2 emissions
- Expected average growth for the next 30 years about 4,5% p.a.
- The participation on CO_2 emissions could increase to 12% by 2050, unless some strong actions are taken

Aviation´s Global Stakeholders

- International Civil Aviation Organization (ICAO) - UN specialized agency for aviation comprising 191 member states;
- Air Transport Action Group representing:
  - Airports Council International
  - International Air Transport Association (IATA)
  - Civil Air Navigation Services Organisation
  - International Coordinating Council for Aerospace Industries Association
  - International Business Aviation Council

The Aviation Industry Vision

Aviation industry vision to reduce CO_2 emissions

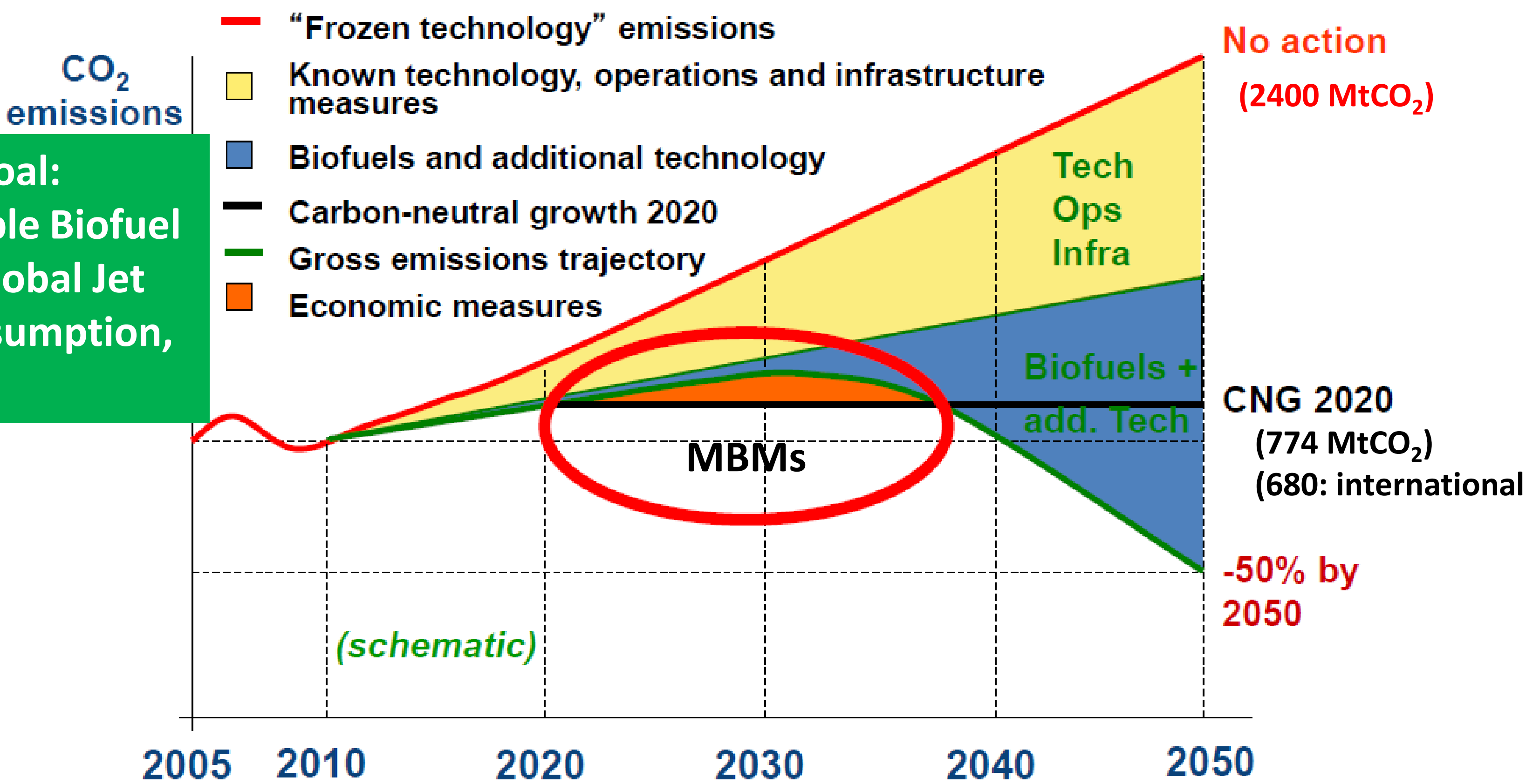
The aviation industry will have, in the next 20-40 years, a transition towards the use of sustainable biofuels in substitution of petroleum-based jet fuels. The use of biofuels in aviation will have to be effective, efficient, and advantageous from the environmental, social and economic points of view,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

Aviation´s Climate Actions
(Commitments at Climate Summit 2014 – UN)

1. New, more efficient, aircraft technology and sustainable alternative fuels;
2. Operational improvements to reduce CO_2 emissions from aircraft already in service;
3. Better use of infrastructure, particularly air traffic management; and
4. Designing an effective, global, market-based measure for international aviation.

Climate Summit 2014 – UN Headquarters, New York, Sept./2014

Aviation´s Climate Actions



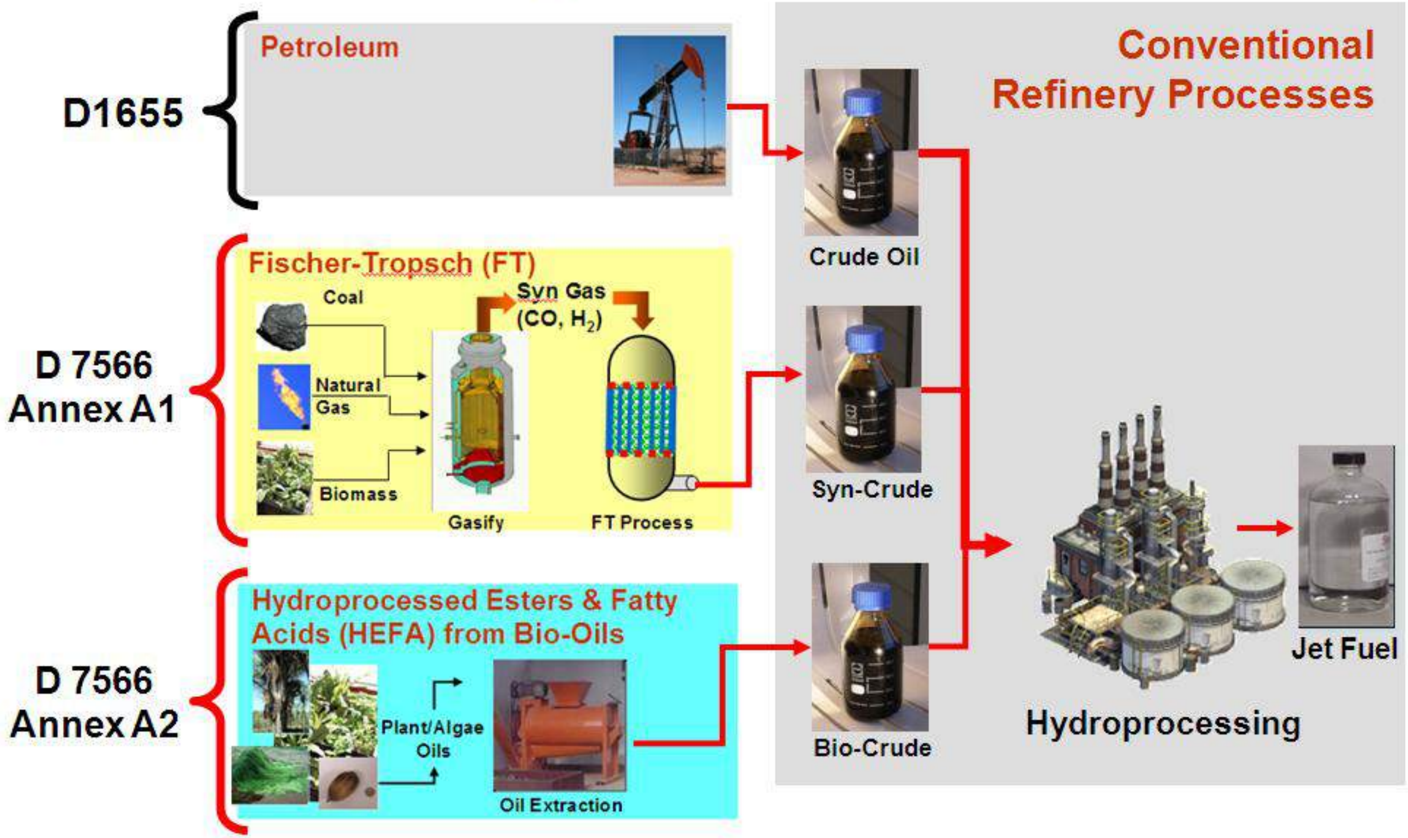
Boeing Goal: Sustainable Biofuel =1% of Global Jet Fuel Consumption, by 2016

Steele P. "Aviation Benefits Beyond Borders" ICAO Symposium on Aviation and Climate Change (May/2013)
Novelli P. "Sustainable Alternative Fuels for Aviation" ICAO, 2014

Approved Routes for Jet Biofuel

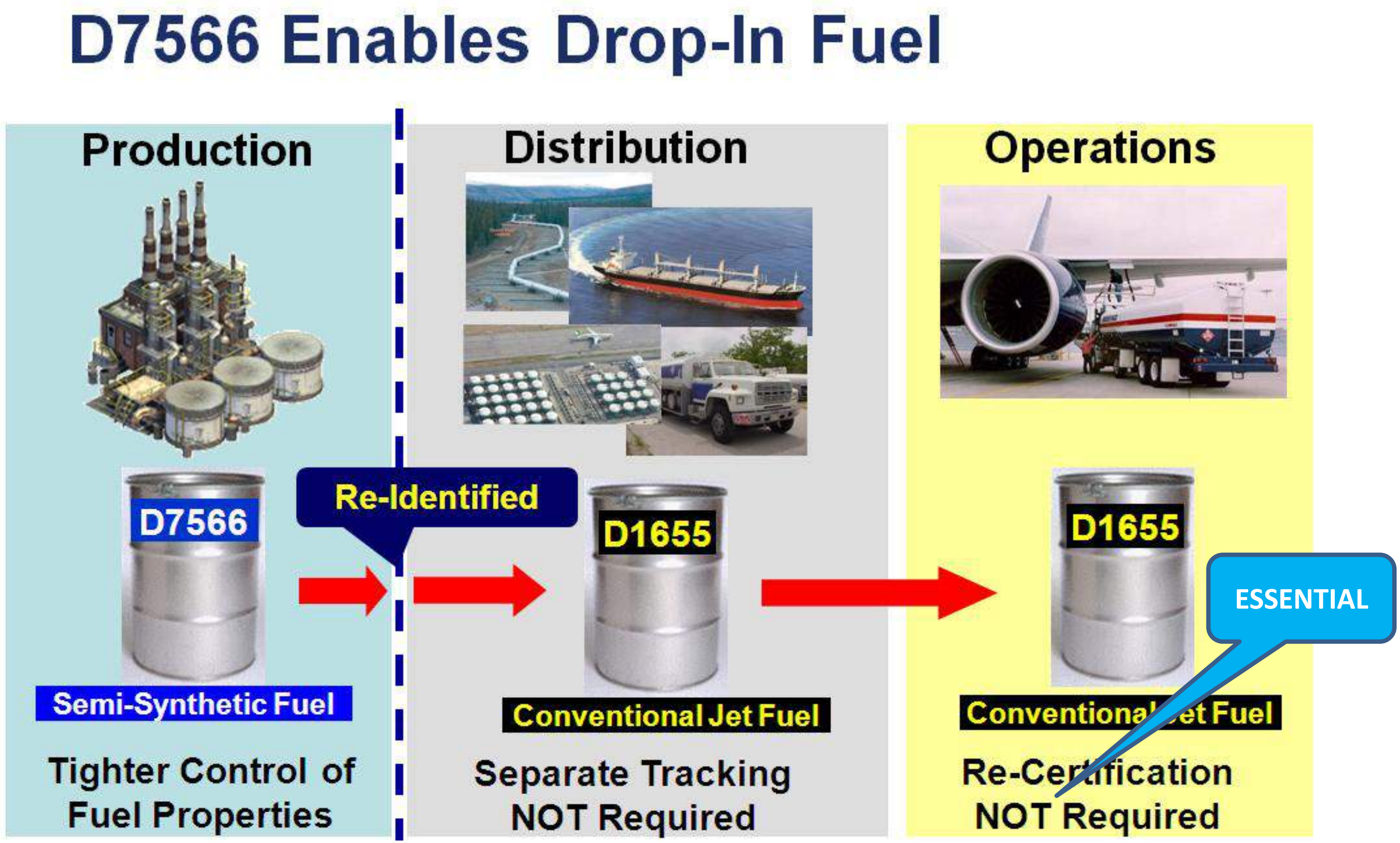
Jet biofuels must be hydrocarbons fully compatible with existing aircraft and fuel distribution facilities

ASTM Aviation Fuel Specifications



Maurice, L. **The Importance of a Roadmap for Aviation Alternative Fuels**. Presentation during International Seminar on Aviation Fuels – ANP, Rio de Janeiro, April, 2012;

Re-Identification of Jet Biofuel as Jet Fuel



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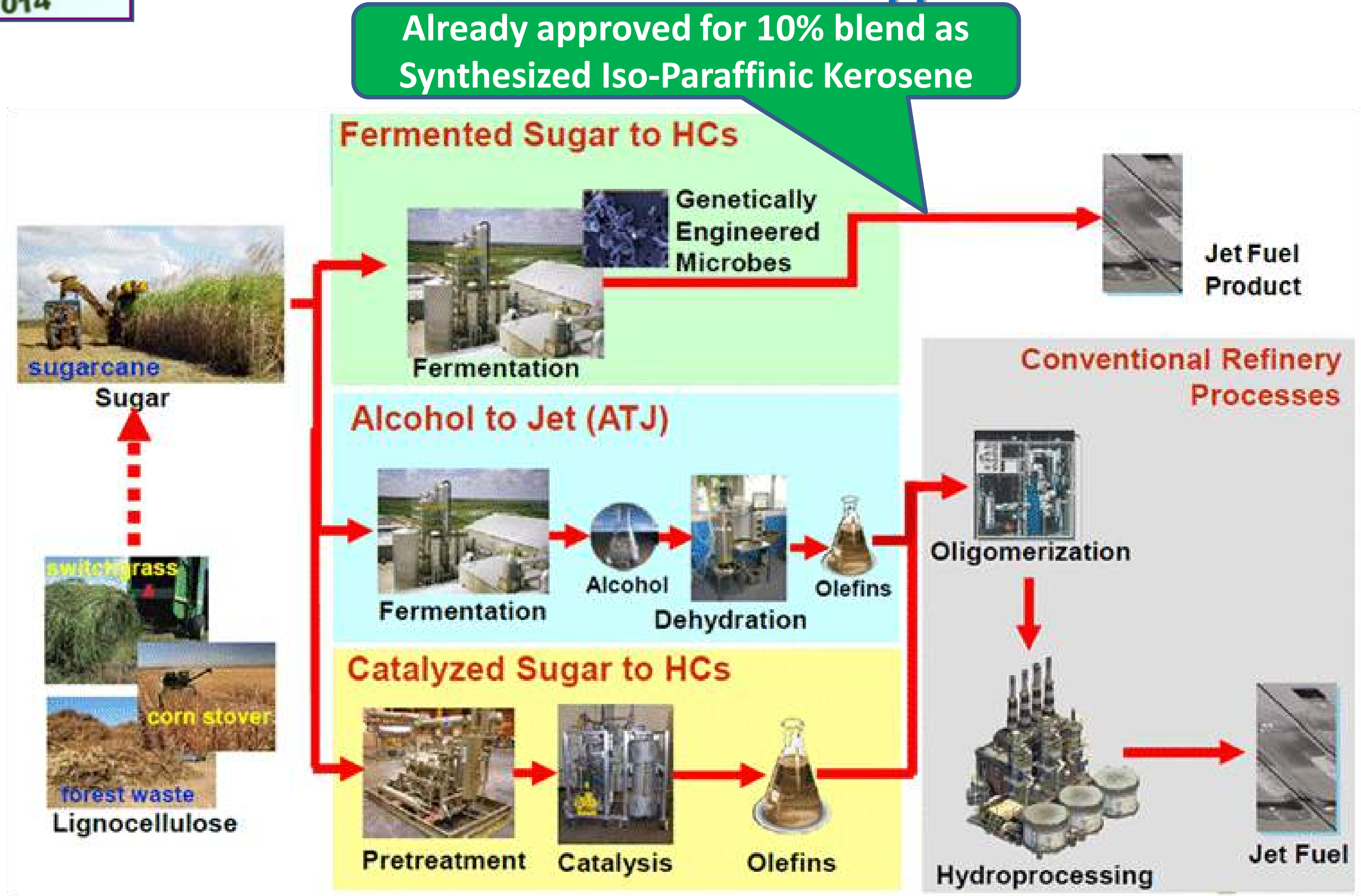
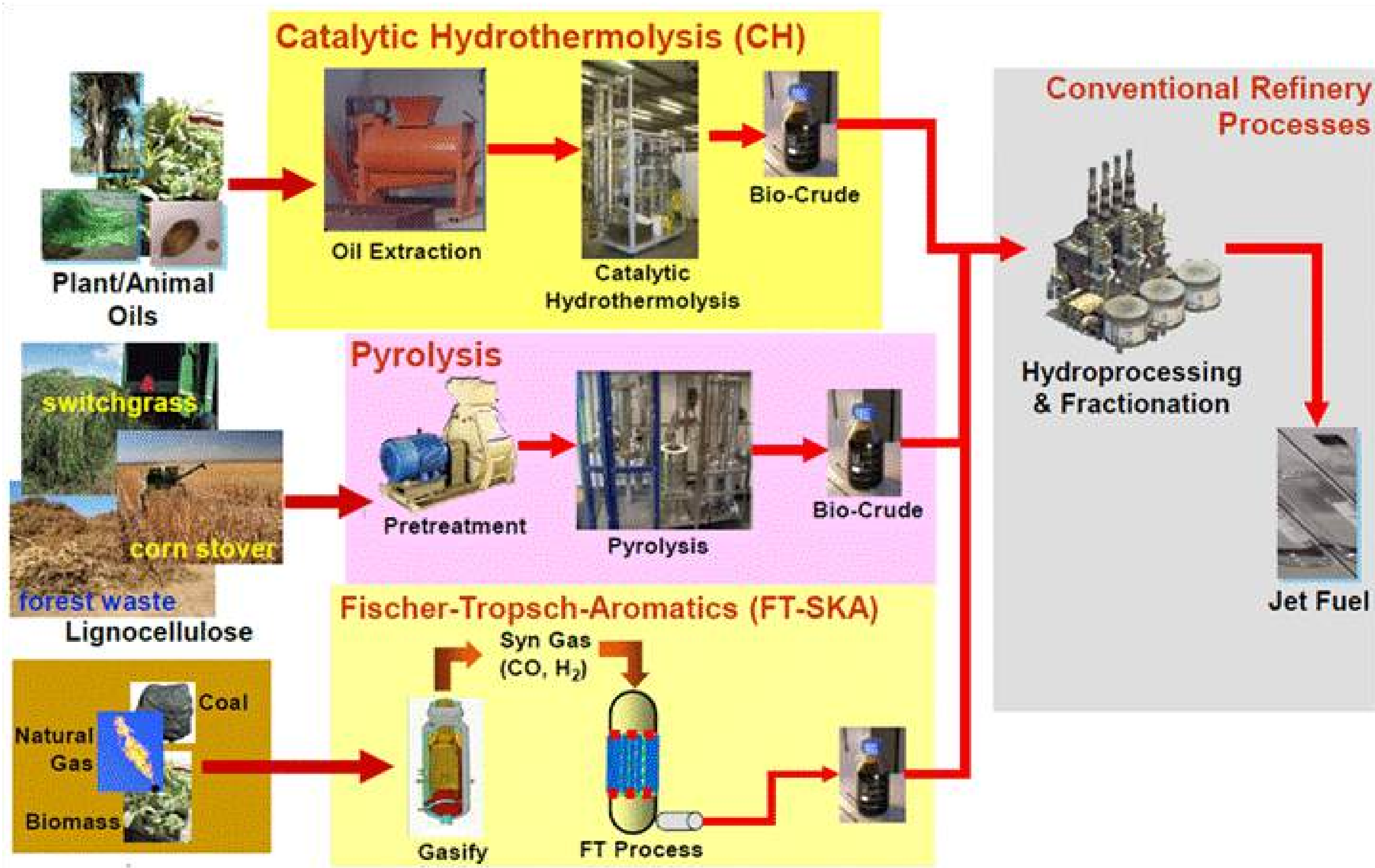
Routes Submitted for Approval



Rumizen, M. **Alternative Jet Fuel Approval**. Presentation during 4th International Conference on Biofuels Standards – NIST, Gaithersburg, November, 2012.

Routes Submitted for Approval (cont.)



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Widely accepted procedures

ASTM D4054 - ***Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives***

ASTM D7566 - ***Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons***

"Drop-in biofuels" are biofuels that when blended with conventional jet fuel up to the ratio defined by the fuel specification, can use the same supply infrastructure and do not require adaptation of aircraft or engines.

In Brazil, ANP Resolution Nr 20/2013 endorses ASTM Standards

SUSTAINABLE AVIATION BIOFUELS FOR BRAZIL

Flightpath for Aviation Biofuels in Brazil

Unless stated otherwise the following data were pulled out from Fapesp's Project:
Sustainable Aviation Biofuels for Brazil

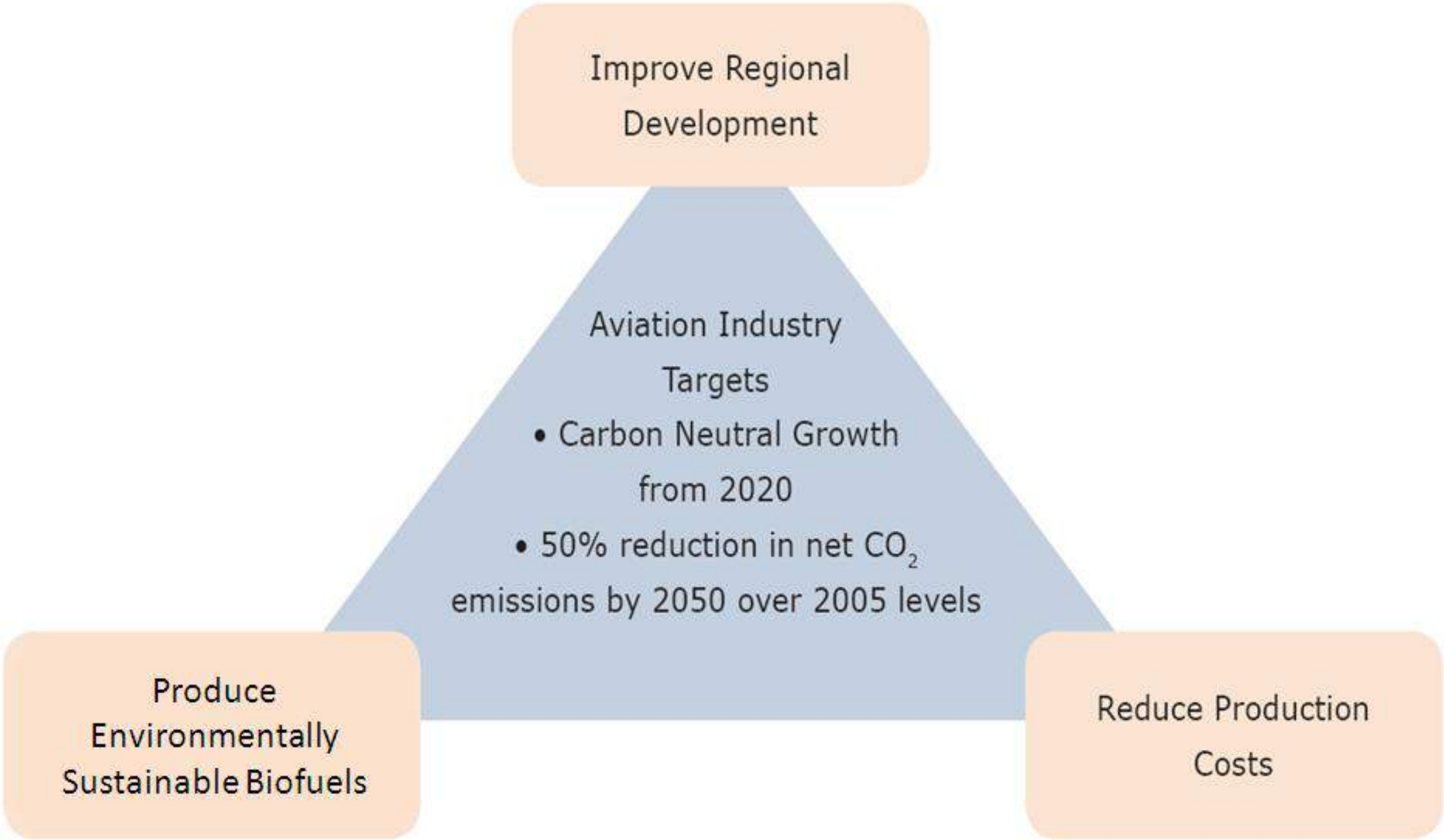
"Roadmap for Sustainable Aviation Biofuels for Brazil" full report coordinated by Cortez is being printed

an initiative of
Boeing, Embraer, FAPESP e UNICAMP

BOEING EMBRAER FAPESP UNICAMP

Project Stakeholders

Goal: to establish a Roadmap for Jet Biofuels - BR



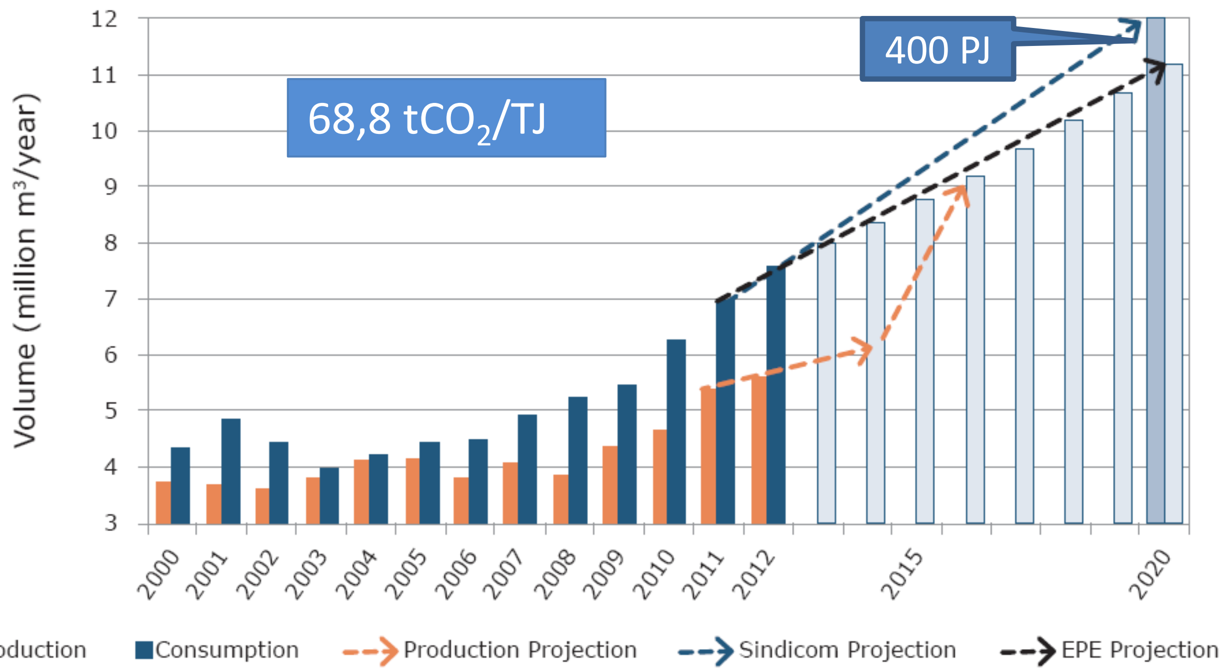
Jet Fuel Consumption Perspectives in Brazil

Civil Aviation Perspective

- The civil aviation is absolutely essential to the global economy;
- In Brazil air transportation is growing rapidly, higher than the global average, and is currently forecasted to become the 4th largest domestic air traffic market in the world by 2014;

Energy and Aviation

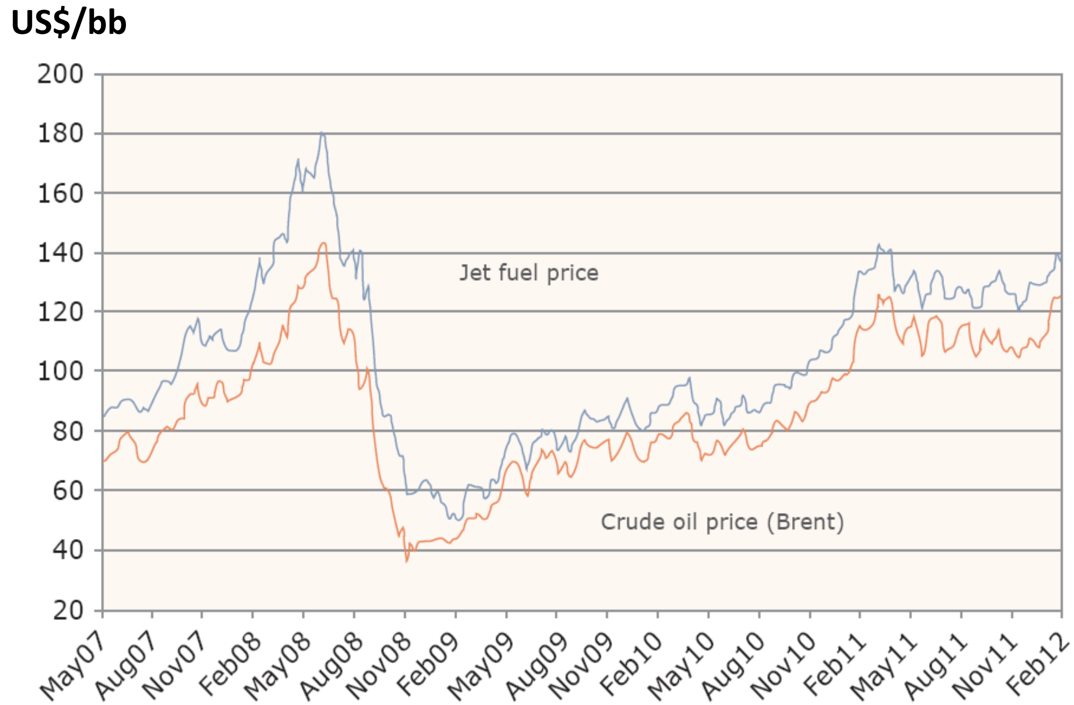
- The energy demand of the aviation industry is almost totally focused on petroleum-based jet fuel made to be used in jet turbines with efficiency and safety.



Energy Cost and Aviation

Energy and Aviation

- Fuel represents the most important operational cost for an airline. As a world average fuel currently represents 34% of the operational costs (compared with 10-15% in the past decade), but in Brazil it is higher, representing around 40% of the operational cost for the airlines.



Source: IATA 2012

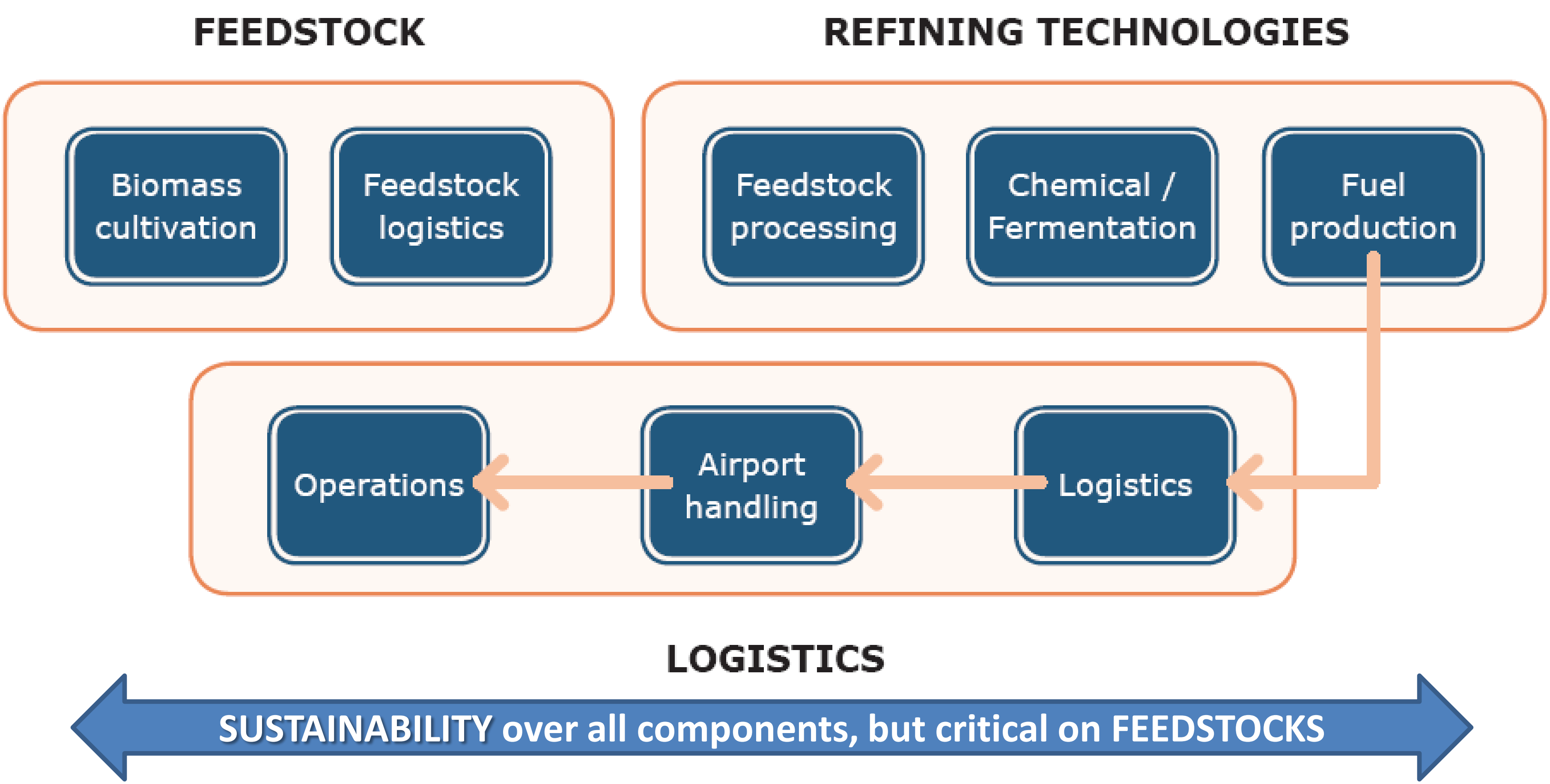
Brazilian Experience on Liquid Biofuels

- about half of the total primary energy comes from renewable sources, mainly hydro, sugarcane and wood. The importance of the sugarcane bioenergy is high; in 2011 it accounted for 15.7% of the national energy supply (42.8 Mtoe), and in the road transportation sector, biofuels were responsible for about 19% of the total energy consumption;
- In 2013, pure ethanol can be used by 20 million Brazilian vehicles (mostly cars with flex-fuel engines), around 50% of the national light vehicle fleet;

Brazil's exceptional advantage

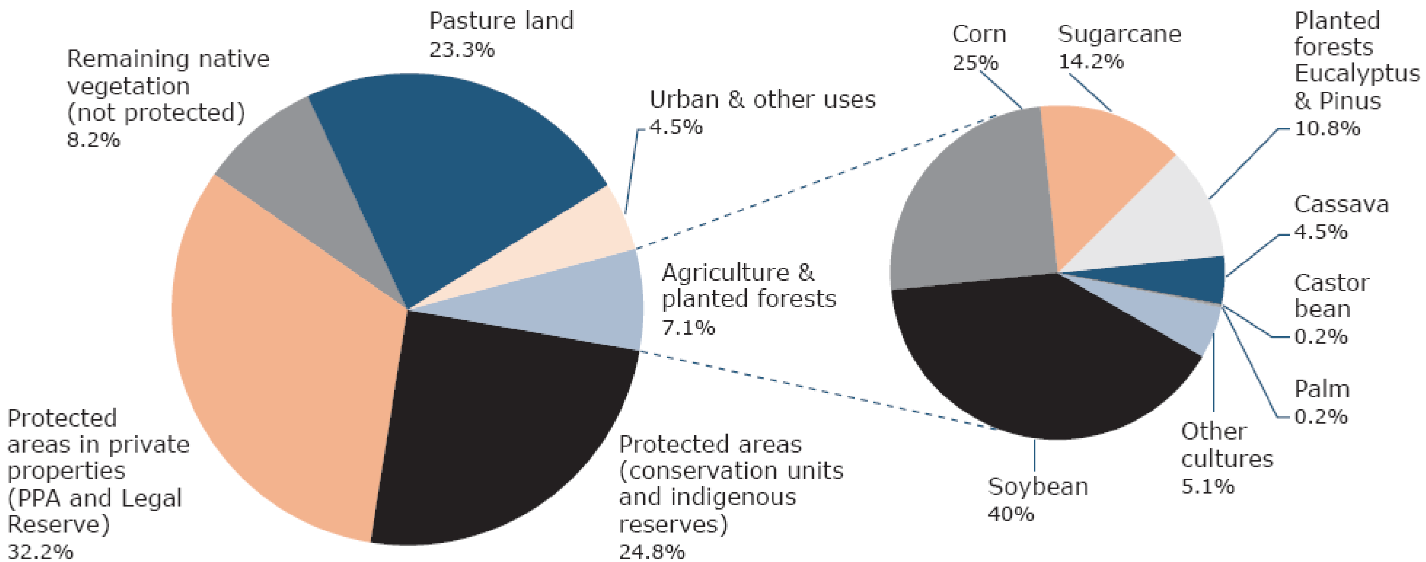
Using only 0.5% of its territory to produce sugarcane bioethanol, Brazil is substituting nearly 1/3 of the fuel energy consumed by its light vehicle fleet.

Roadmap Components



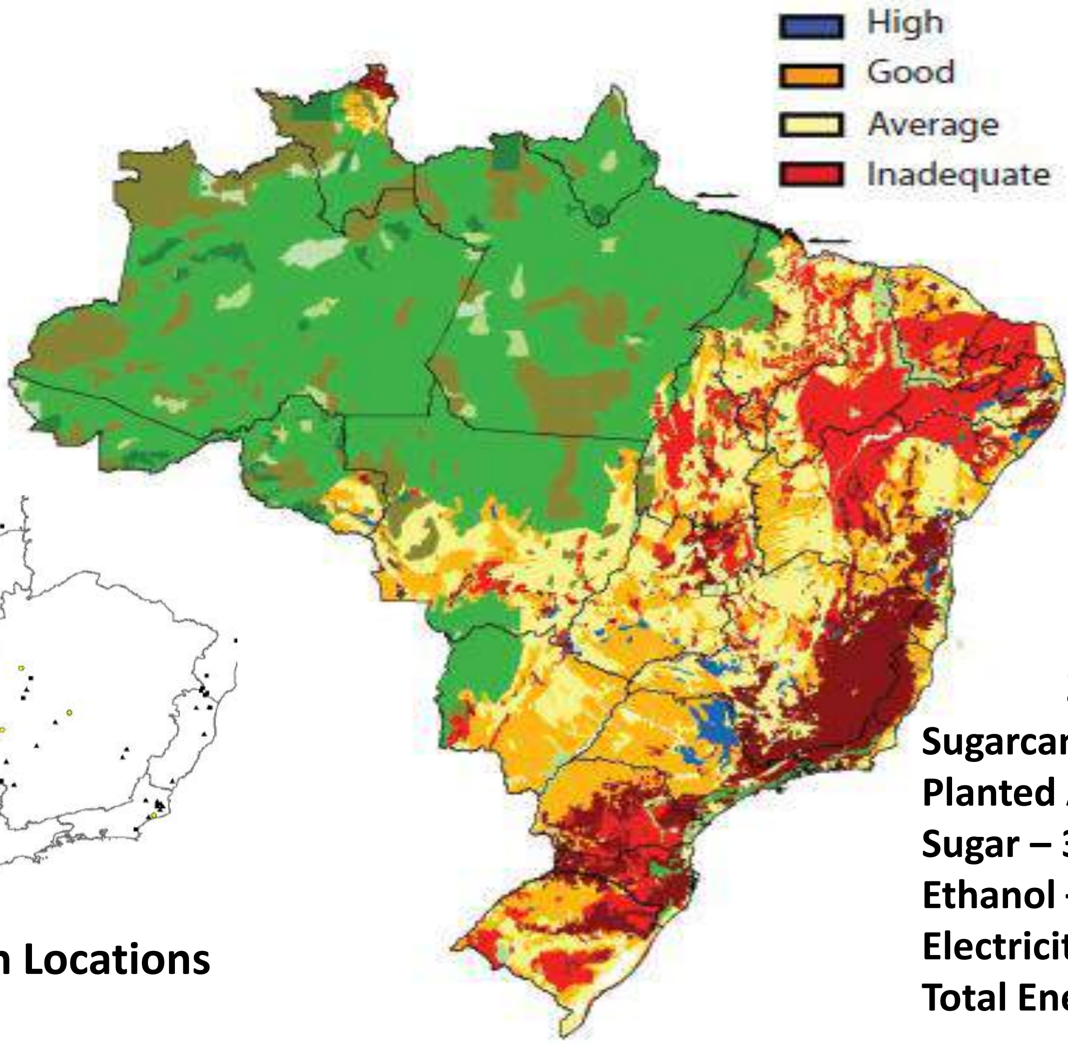
Feedstocks

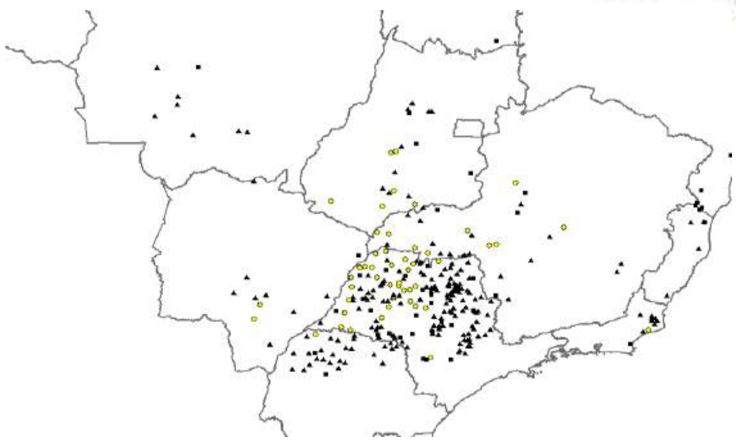
- Brazil has a strong agricultural tradition and is among the world's leading producers and exporters of many agricultural products, and this relevant position was attained due to abundant land, good climate conditions, long-term investment in research and development, and an entrepreneurial private sector.



Brazil total area: 850 Mha

Sugarcane without Irrigation





Center- South Region Locations

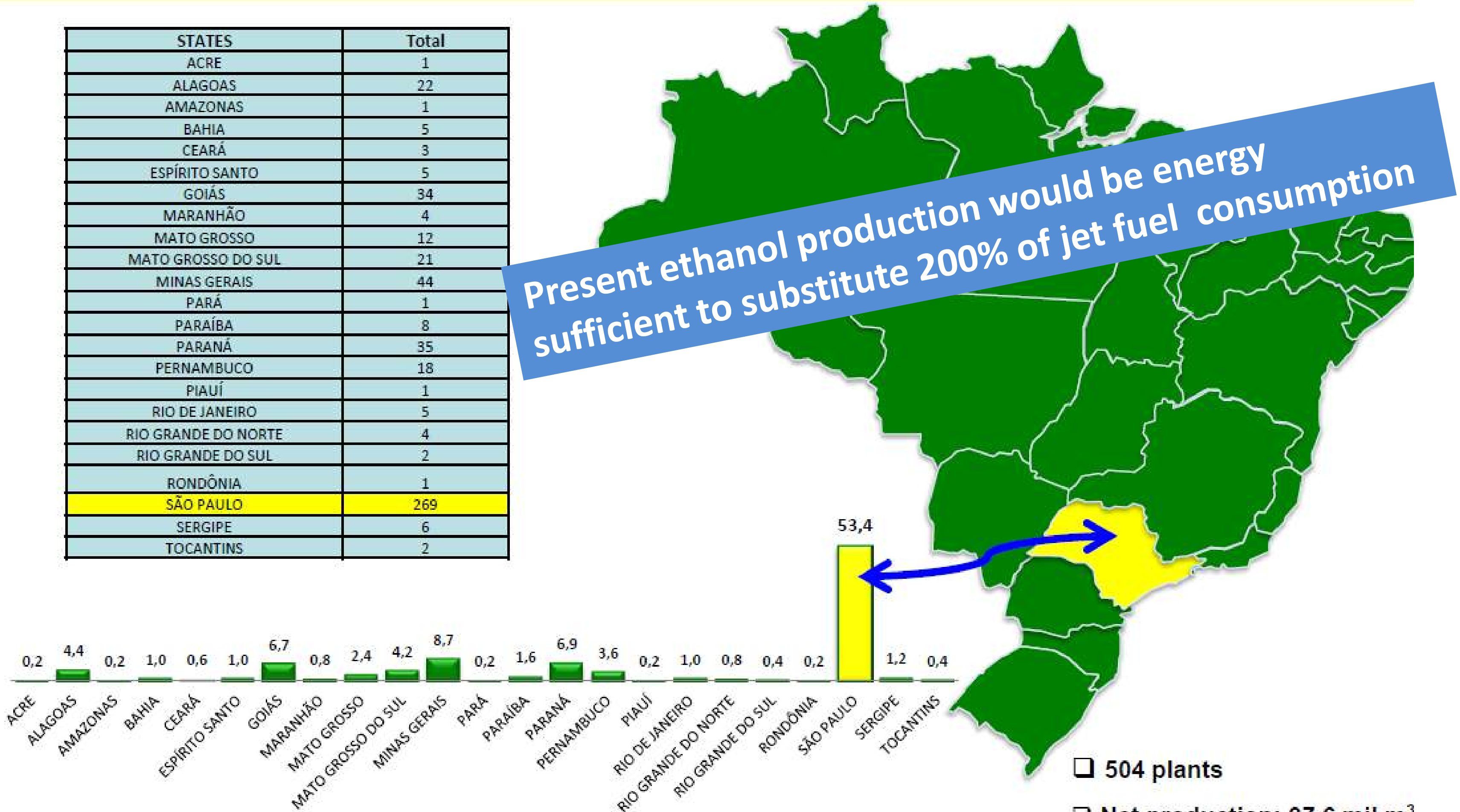
CTC & NIPE (2006)

2011

Sugarcane – 620 Mt
Planted Area – 9 Mha
Sugar – 38 Mt
Ethanol – 27 Mm^3
Electricity – 1 GW_{avg}
Total Energy – 600 PJ

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