



# Sustainable Alternative Fuels in Brazil

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*ASTM Committee D02J  
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# Boeing Latin America Presence

7 Countries, 52 Employees



## Details

- BGS (18) – Argentina 1, Brazil 5, Chile 4, Colombia 2, Mexico 5, Panama 1
- BCA Supplier Quality (8) – North Mexico
- ET&T (9) – São Paulo, São Jose dos Campos
- SSG (3) – São Paulo & Mexico City
- BI & Comms (4) – Miami
- BGS Sales (3) – Brazil, Mexico & Miami
- BDS (3) – Mexico
- BDS Int'l Business Development (1) – Miami
- BGS Sales & Marketing (1) – Porto Alegre
- Int'l IT (1); Int'l HR (1) – São Paulo

## Customers



## Partnerships



## Research & Technology



## Suppliers

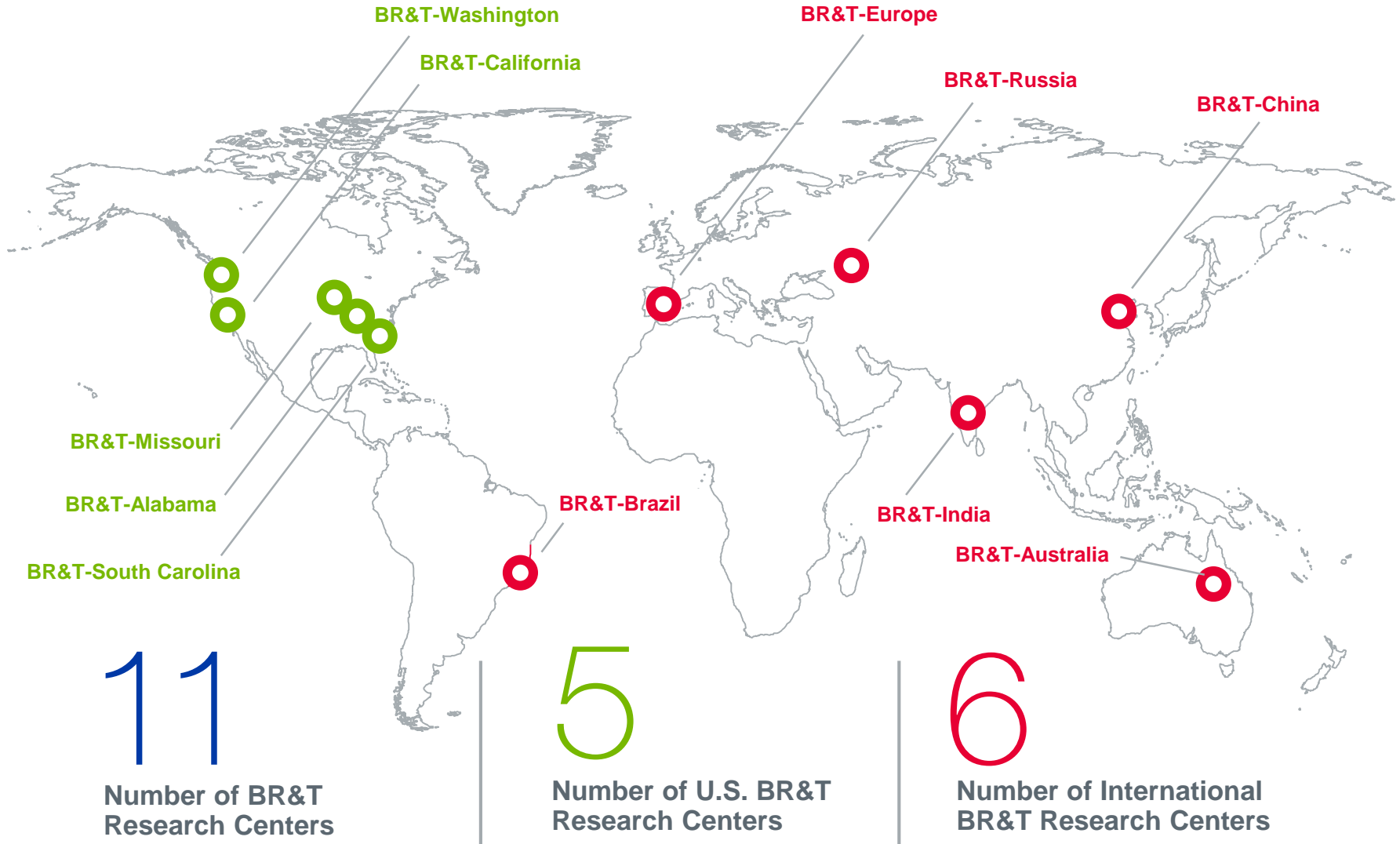


## Community Engagement



# Research Centers

*Supporting innovation around the world 24/7*



# Protecting the Second Century

Supporting innovative product development



## Boeing Research & Technology (BR&T)

### BR&T-Brazil

**AERO - TECHNOLOGIES**

- Flight Ops Efficcy
- Aero-Sciences

**ECO-TECHNOLOGIES**

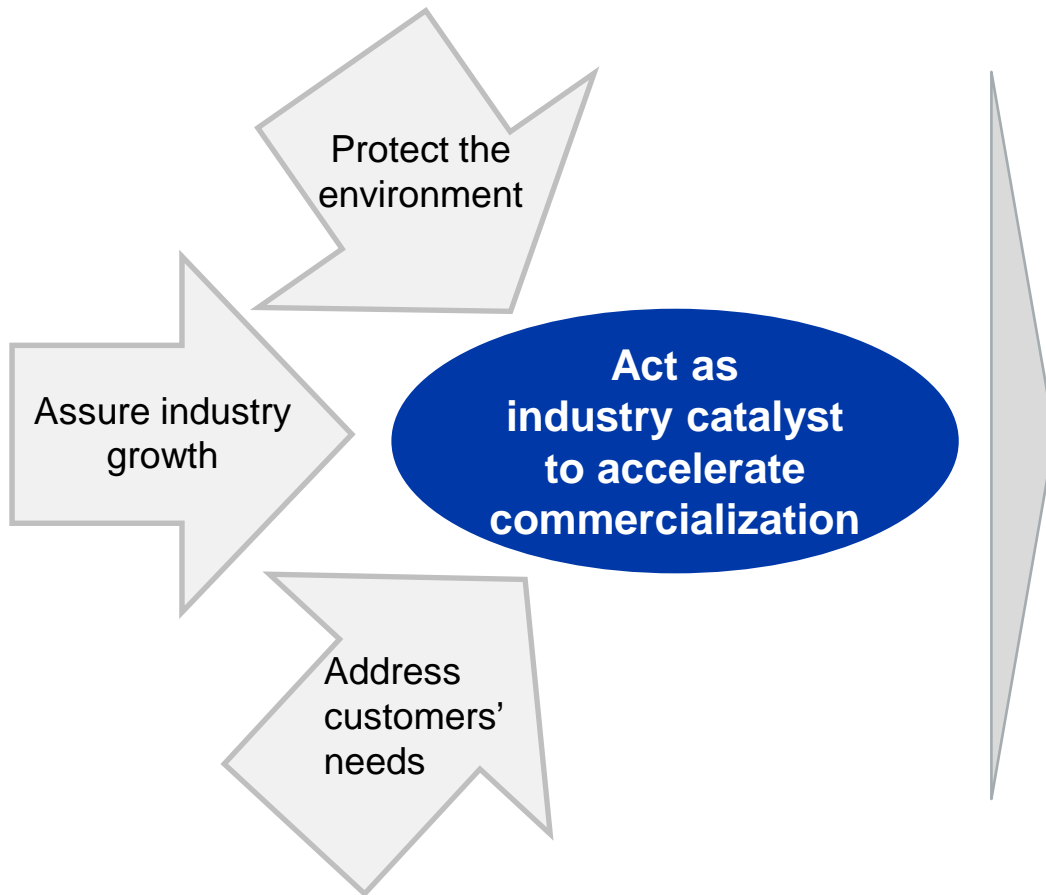
- Biofuels
- Materials

UNICAMP | USF | Stanford University | OAK RIDGE National Laboratory

Source: Boeing Overview, 2017

# Boeing's role and actions

## Boeing's role

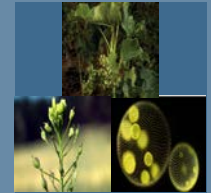


## Core activities

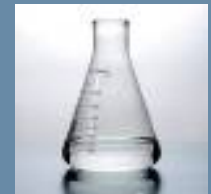
Support and advocacy



Feedstock and pathway R&D



Fuels approval



**Ultimate goal is to catalyze a vibrant commercial market**

# BR&T Brazil

## Collaborations

### Joint Research Center



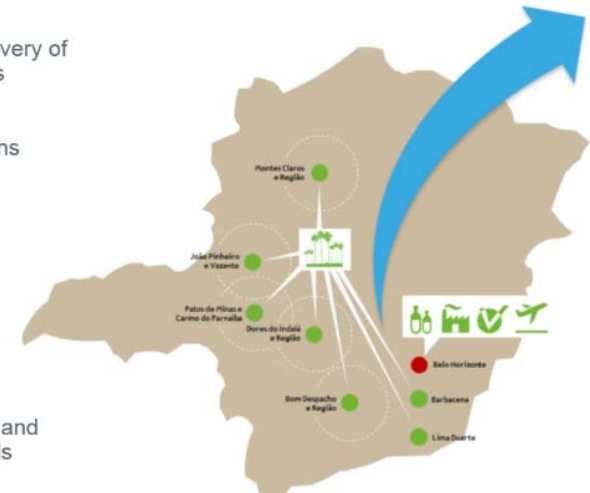
### GOL Airlines

360+ flights with SAF FIFA World Cup 2014

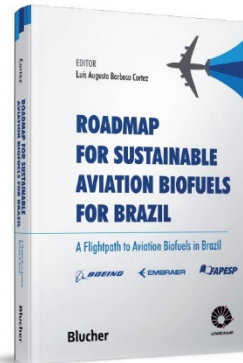


## Regional Platforms

-  Planting and Recovery of Preservation areas
-  Oils and Fats Metropolitan regions
-  Bio Refinery Airport area
-  Certification UFMG
-  Blending Off-take
-  Exports of bio-oils and Renewable jet fuels



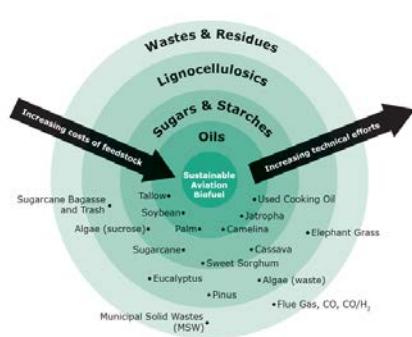
## Research Network



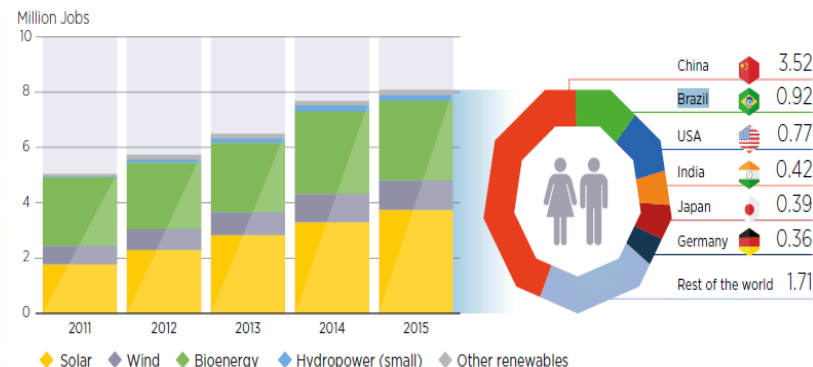


# SAF in Brazil

Brazil, "the biomass country"



2<sup>nd</sup> largest employer in renewable energy



**With only 0.5% of its territory Brazil replaced 1/3 of its gasoline needs with ethanol from sugarcane**

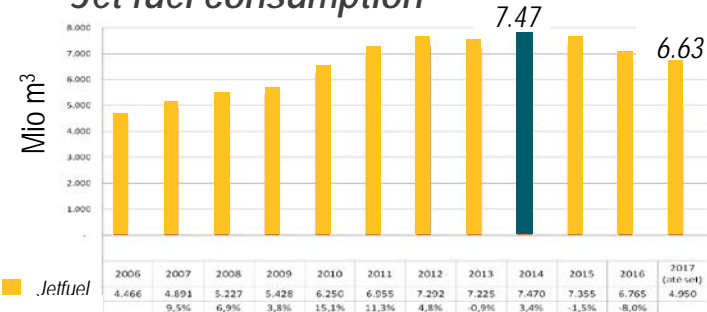
Source : Roadmap for Sustainable Aviation Biofuels in Brazil , 2015

Brazil second largest biofuels producer

Biofuel	2013	2014	2015	2016	2017
Ethanol	21.441	24.085	28.797	26.201	25.562
Biodiesel (B100)	2.929	3.410	4.005	3.799	4.302
<b>Total</b>	<b>24.370</b>	<b>27.495</b>	<b>32.802</b>	<b>30.000</b>	<b>29.864</b>

(billion liters) (domestic market sales)

Jet fuel consumption

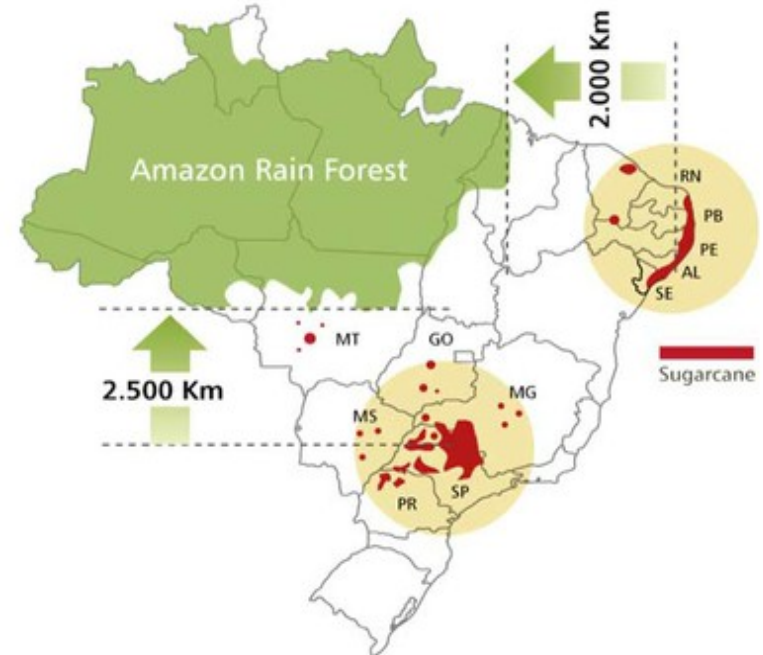


Source: ANP (2018)

# SAF in Brazil

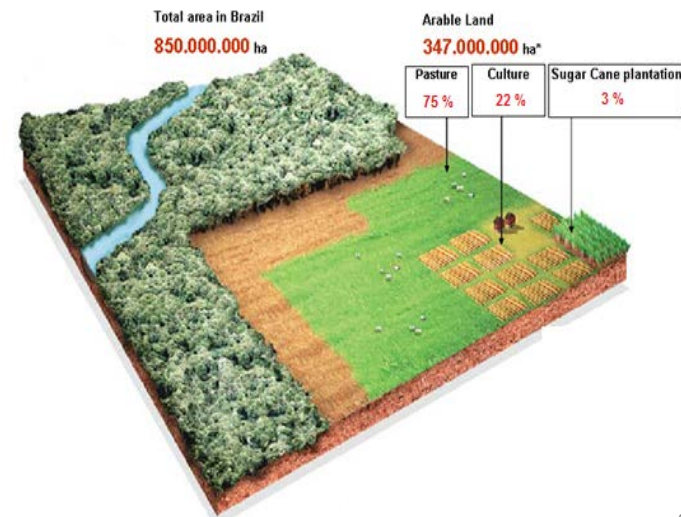
## Sustainability

- Identification of suitable and no-go areas
- Almost 90 percent sugarcane production is in South-Central and Northeastern Brazil.
- Both producing regions are located some 2,000 to 2,500 km away from Amazon.
- No sugarcane expansion in sensitive ecosystems like the Amazon, the Pantanal wetlands
- 60 percent of new sugarcane production on pastures; 40 percent expands on cropland



## Certification of Sustainability – International Standards

(i) Laws and International Conventions	(ii) Waste production and disposal
(iii) Land Rights	(iv) Crop Management and Agrochemical Use
(v) Employment, Wages and Labor Conditions	(vi) Direct Land Use Changes
(vii) Human Health and Safety	(viii) Social and Environmental Impact Assessment
(ix) GHG emissions	(x) Rural and Social Development
(xi) Biodiversity and Ecosystems	(xii) Contractors and Suppliers
(xiii) Soil conservation	(xiv) Engagement and Communications with Stakeholders
(xv) Water use and contamination	(xvi) Economic Viability and Production and Processing Efficiency
(xvii) Air pollution	(xviii) Food Security

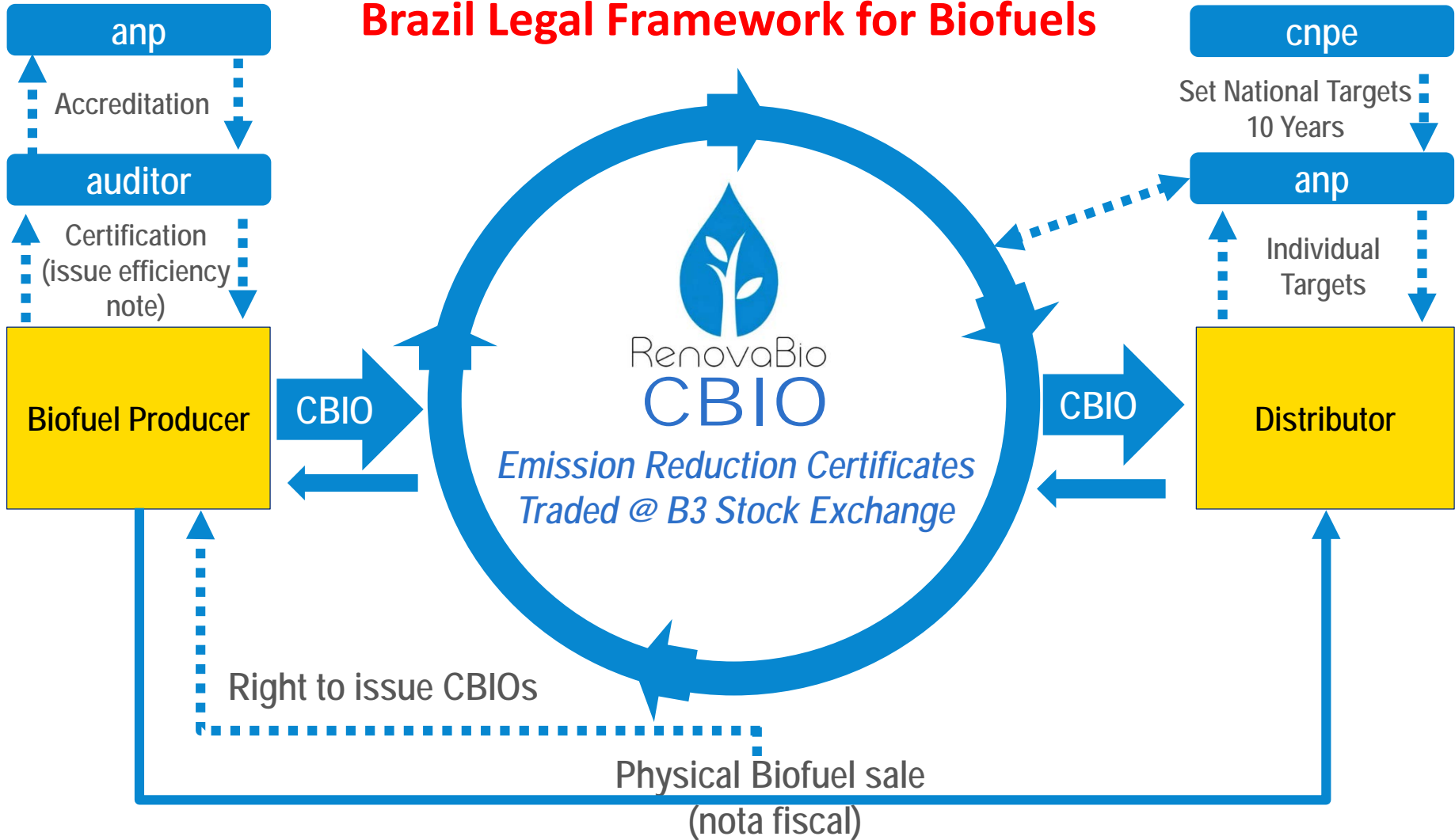




# SAF in Brazil

RenovaBio Concept

## Brazil Legal Framework for Biofuels

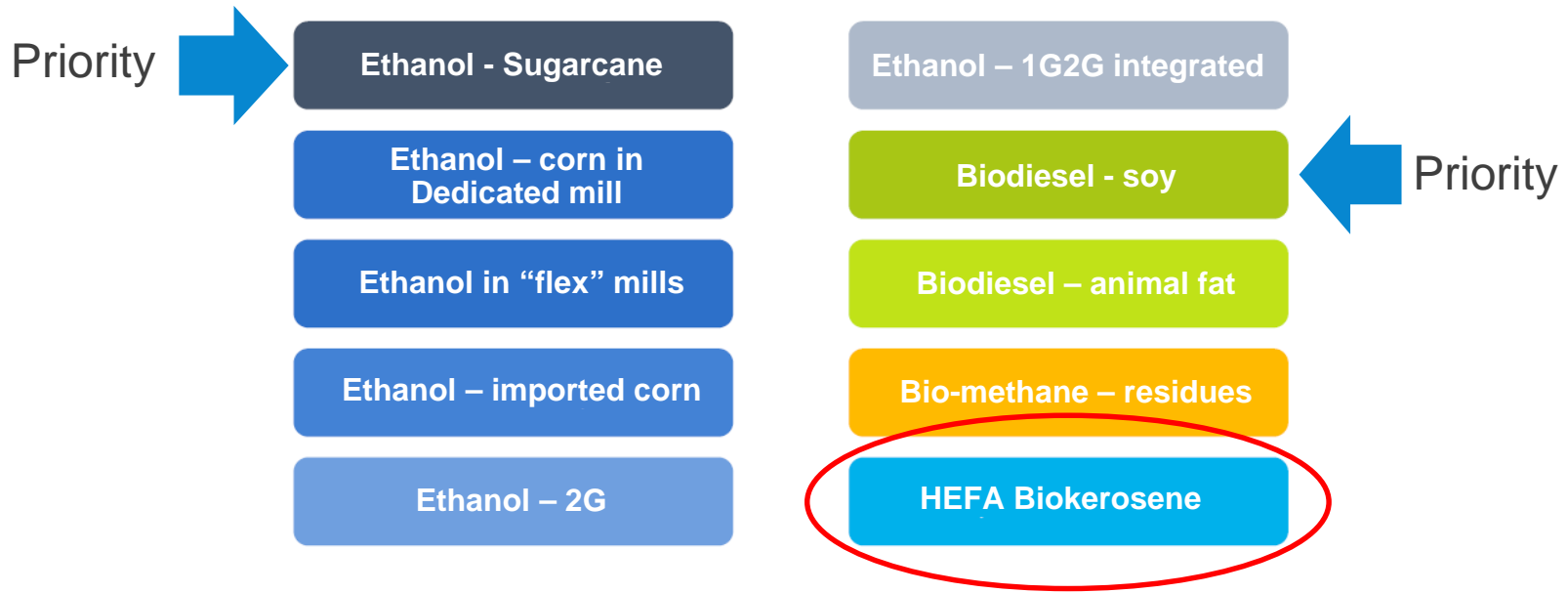


# SAF in Brazil

RenovaCalc – Calculation of Biofuel Carbon Intensity in g CO<sub>2</sub>eq/MJ



**Currently under construction**



# Aviation needs “drop-in” Biofuels

*Meets strict sustainability criteria, reduces lifecycle CO2 by 50 – 80%*



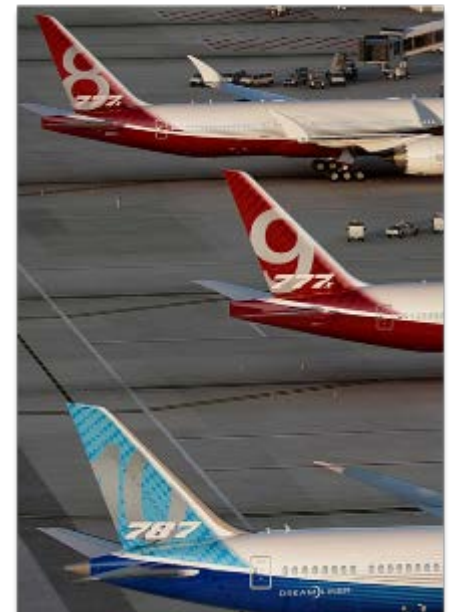
New ways to make the same fuel



Blend directly with conventional jet fuel



Meets or exceeds performance of petroleum



No change to airplanes, engines or fueling infrastructure

# Status of SAF industry

## ✔ Technically viable



ASTM and Def Stan approved

High quality standard, drop-in fuels

Six pathways approved

## ✔ In demand



Airlines support - 125,000+ commercial flights, ongoing

1 refinery, 4 airports

Airline offtake contracts signed – over 1.6B gallons

## 🟡 Sufficient supply



Limited but growing refinery capacity

Shrinking premium for approved fuels

Level playing field with ground transport needed

# First commercial scale refinery online

*AltAir Fuels in Paramount, CA*



- First dedicated US production facility for renewable diesel and jet fuels with ongoing production
- Repurposing of Alon refinery
- Tallow feedstock initially

- 40M gpy nameplate capacity in “Phase 1”
- Sustainable aviation fuel being delivered to airlines and suppliers
- United (LAX), World Fuels (Gulfstream), SkyNRG (KLM)
- Renewable Diesel being delivered to Navy under DLA FY’16 contract
- Ownership evaluating 5-7X expansion in next 2-3 years



# Online tool showing airplanes using SAF



- United Airlines and KLM flights departing from LAX
- Lufthansa, SAS and KLM / KLC flights departing from OSL
- SAS, KLM and Braathens flights departing from ARN

Source: <https://planefinder.net/custom/icao-fuel.php>

Boeing is committed to partnering for a better future



# We need truly sustainable Biofuels

*Strong demand by major airlines*

- ✓ Demonstrated life-cycle GHG reductions
- ✓ Measured and verified by objective third party standard
- ✓ No negative impact to food security, fresh water supplies or land-use
- ✓ Powers sustainable growth and economic development



# A history of strong environmental performance

*Sustainable aviation fuels are strategic to long term goals*

## GOAL 1

**1.5% AVERAGE ANNUAL FLEET FUEL EFFICIENCY IMPROVEMENT FROM 2009 TO 2020**

### PROGRESS

Currently tracking well above goal, although figure expected to normalize

### HOW IS INDUSTRY ACHIEVING THIS?

- New airplane and engine technologies
- More efficient operations by airlines
- Better use of air traffic management infrastructure

## GOAL 2

**STABILIZE NET AVIATION CO<sub>2</sub> EMISSIONS AT 2020 LEVELS THROUGH CARBON-NEUTRAL GROWTH**

### PROGRESS

Industry is actively supporting global actions at an intergovernmental level

### HOW IS INDUSTRY ACHIEVING THIS?

- All actions for Goal 1
- Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) at the International Civil Aviation Organization (ICAO)

## GOAL 3

**REDUCE AVIATION NET CO<sub>2</sub> EMISSIONS TO 50% OF WHAT THEY WERE IN 2005, BY 2050**

### PROGRESS

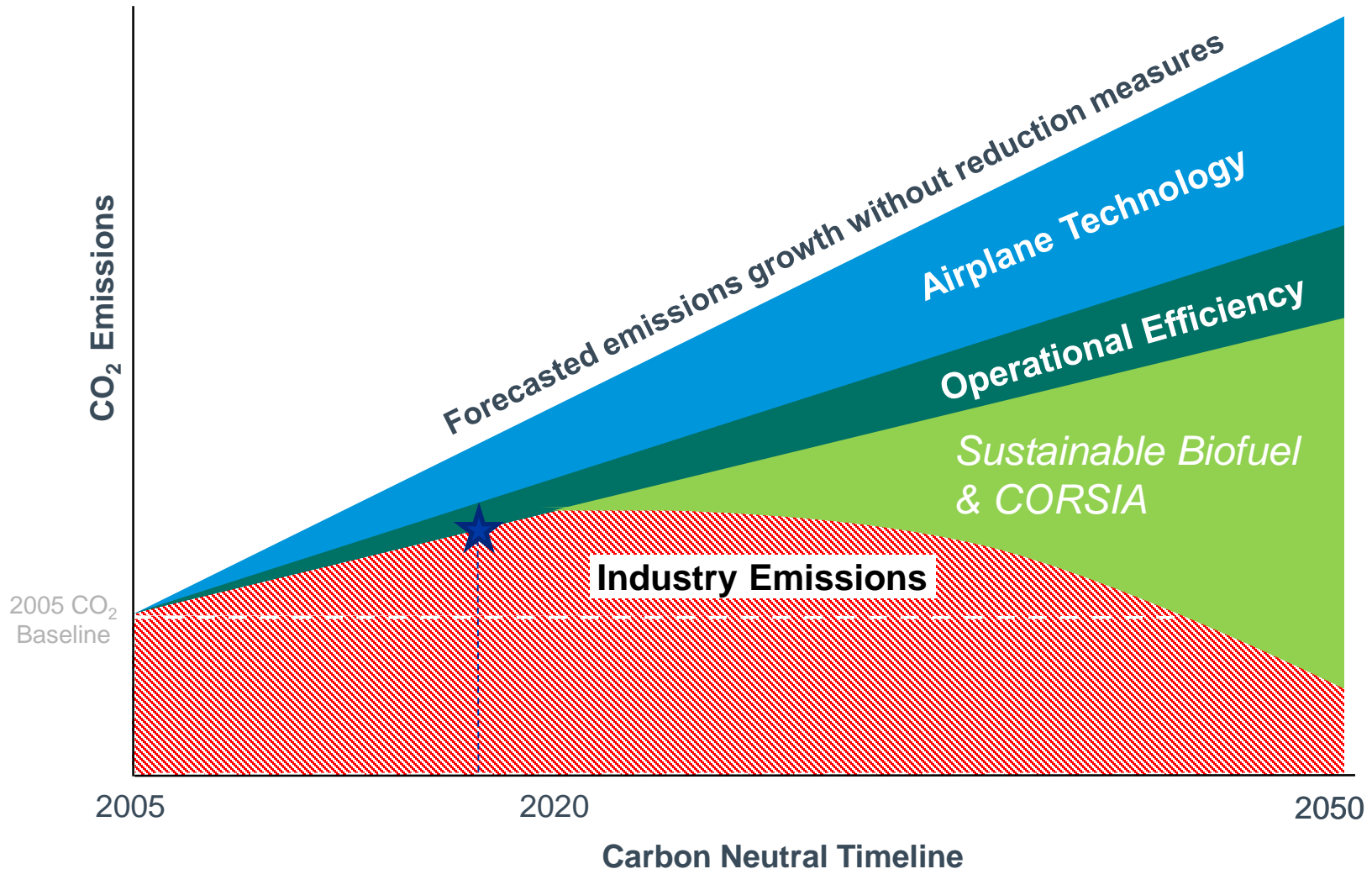
Significant research and innovation efforts underway

### HOW IS INDUSTRY ACHIEVING THIS?

- All actions for Goal 1 & 2
- Development of sustainable alternative aviation fuels
- Research into future design concepts by airplane and engine manufacturers

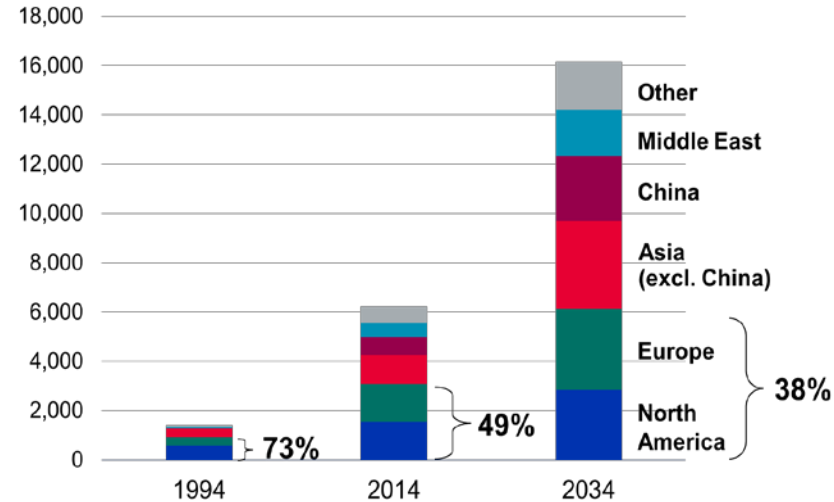
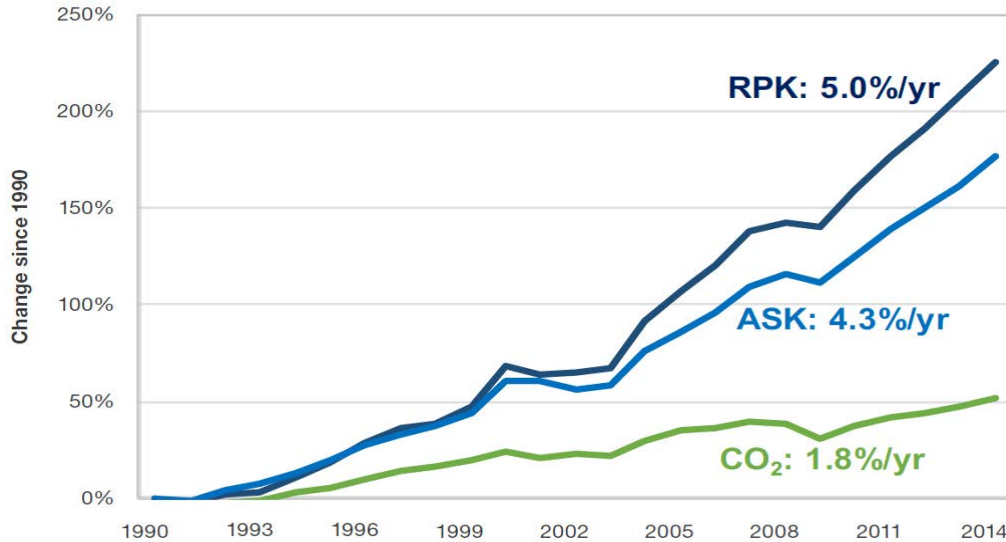
# A history of strong environmental performance

*Sustainable aviation fuels are strategic to long term goals*





# Aviation CO2 emissions are growing, but slower than traffic growth



**Within 20 years: global fleet x 2** due to strong demand in air travel sustained by Asia and Middle East.

Source: Boeing 2015 Current Market Outlook; Passenger traffic (RPKs) billions