Seminars on International Aviation and Environment, and State Action Plans

Mexico City, Mexico - April 1-4, 2014
Lima, Peru – April 7-10 2014

IDB Initiative on Biofuels for Aviation in Latin America & the Caribbean (LAC)

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- Introduction
- IDB experience in supporting aviation biofuels, and biofuels in general

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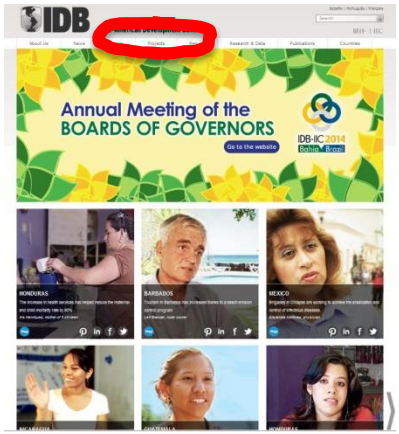
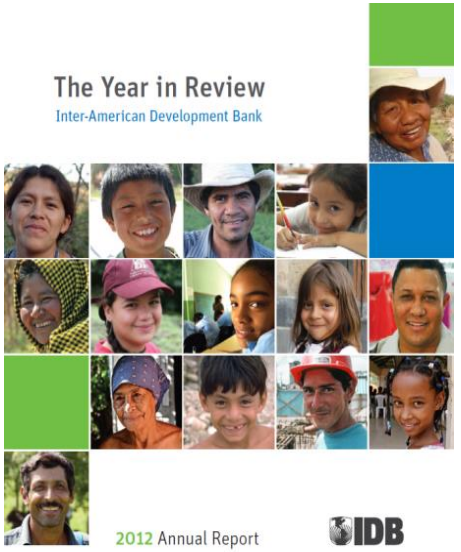
- **Oldest regional development bank (1959):** 48 member countries - 26 borrowers (with >50% votes in the Board); HQs in Washington, DC, offices in all borrowing countries; finances both private and public sector projects, with or without sovereign guarantees. The IDB Group encompasses 3 institutions: the Inter-American Development Bank, the Inter-American Investment Corporation – IIC and the Multilateral Investment Fund - MIF.
- **Main source for LAC* regional financing** (1961-2013)
  - ✓ Approved loans/guarantees since its creation: US$ 226 billion (US$12 billion/yr)
  - ✓ Overall leveraged investments (project costs): US$ 500+ billion
  - ✓ Non-reimbursable technical cooperation (grants): US$ 6 billion
- **Loans/guarantees to Energy Sector** (1961-2013)**:** US$ 31 billion
  - ✓ Now 25% of total portfolio (US$ 3 billion/yr) for clean energy/climate change



www.iadb.org



Note: * Latin America and the Caribbean

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Press Release

July 23, 2008

IDB lends $269 million for three Brazilian ethanol plants

The Inter-American Development Bank will lend $269 million for three new ethanol plants in south-central Brazil, in the **largest biofuel investment ever made by a development bank**. The Board of the Bank unanimously approved the financing today.

The three plants are being developed by Companhia Nacional de Açúcar e Álcool (CNAA), a joint venture formed by Brazilian sugar producer **Santelisa** Vale, U.S. private equity firms and **Global Foods**, a holding company registered in the Netherlands Antilles.

The **three new plants** are being built in the states of **Minas Gerais and Goiás**, far from the Amazon or any protected areas. Instead of purchasing land outright, CNAA will lease it from owners of medium to small-sized plots who decide they can earn a better return from sugar cane than they can from low-intensity pasture—the area's predominant land use at present.

The new plants will use **mechanized harvesting** for more than 90 percent of their acreage, and they will provide some 4500 high-quality permanent jobs. The plants will produce up to **420 million liters of ethanol** for the domestic market each year, and will generate their own electricity by burning bagasse (**56 MW each**).

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News Releases

December 15, 2009

Peru Biofuel project to receive US$25 million from the IDB

Combined ethanol refinery, sugar plantation and electricity plant will generate 500 permanent jobs for local communities in the Department of Piura, Peru.

An initiative of Maple Energy Plc, an energy company that has focused solely on Peru since 1994, listed on the London Stock Exchange's Alternative Investment Market and on the Lima Stock Exchange. The project is known as Maple Etanol, requires **a total investment of $245.5 million** and will receive assistance from Netherlands development agency SNV, with extensive experience in developing inclusive businesses.

The project includes construction of a **130 million liters per year** sugarcane ethanol destilery. It includes 7,800 hectares of sugarcane on a 14,000-hectare property that Maple Energy purchased from the government of Piura and private individuals. The land comprises desert and/or arid areas that Maple Etanol will convert into highly productive land.

Mechanization, along with the use of efficient drip irrigation, will enable Maple Etanol to achieve yields of up to 153 tons of sugarcane per hectare. The project will also include **a 37MW cogeneration plant** selling excess electricity to Peru's interconnected power system. In addition to the $25 million from the IDB, Maple Etanol will receive cofinancing from other multilateral agencies and a private commercial bank. The Andean Development Corporation (CAF) will finance $65 million, the Entrepreneurial Development Bank of the Netherlands (FMO) will finance $25 million and Interbank $25 million. The IDB loan will **have a term of 12.5 years with a 2.5-year grace period**.

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IDB Scorecard for Sustainable Biofuels

ENVIRONMENTAL

General

Yield (liters oil/ethanol per ha)
above 6000
above 4500
between 1500 and 4500
below 1500

Yield (GJ per hectare per year)
above 100
between 50 and 100
below 50

Cultivation

Former land use
No land area (algae and waste)
Degraded land
Under-utilized land or husbandry
Marginal land
Displaced cultivation or husbandry
Rainforest, primary forest
Peat land
Wetland
Ecological sensitive/protected area - Biological corridors

Crop Lifecycle
Replant greater than 3 years
Replant every year, no-till
Replant every year, low till
Replant, 1-3 years
Replant every year

Crop rotation/Crop mix
Nitrogen fixing crops used in rotation
Inter-cropping
No crop rotation

www.iadb.org/biofuelsscorecard

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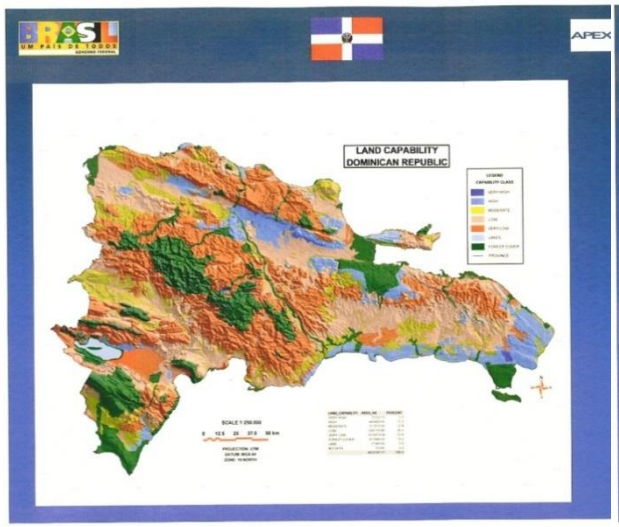
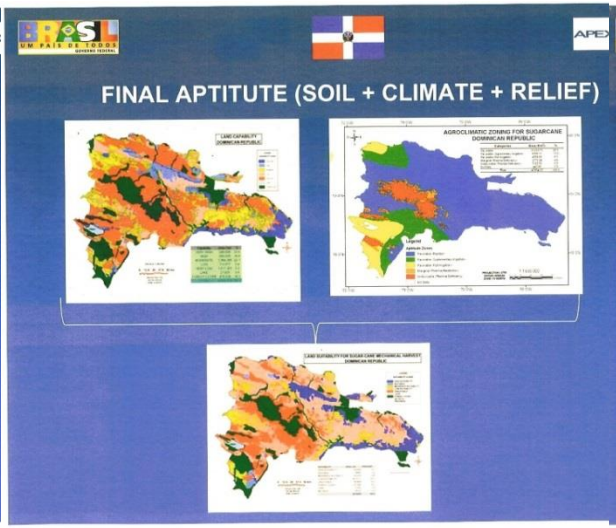
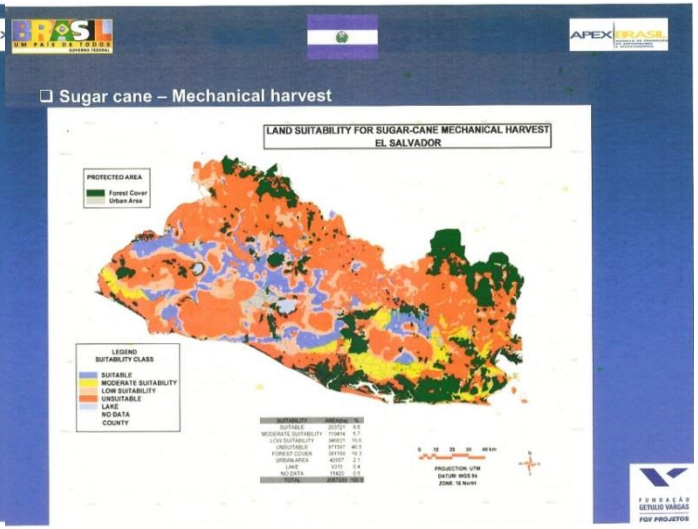
Support to BR-US MOU on biofuels

Technical assistance (US$1,500,000 SECCI funds) to implement studies and evaluations to support National Biofuels Programs in:

- **El Salvador (APEX-funded)**
- **Dominican Republic - DR (APEX-funded)**
- **Haiti, Guatemala and Honduras (IDB-funded)**
- **DR Phase II required to evaluate specific projects (IDB)**







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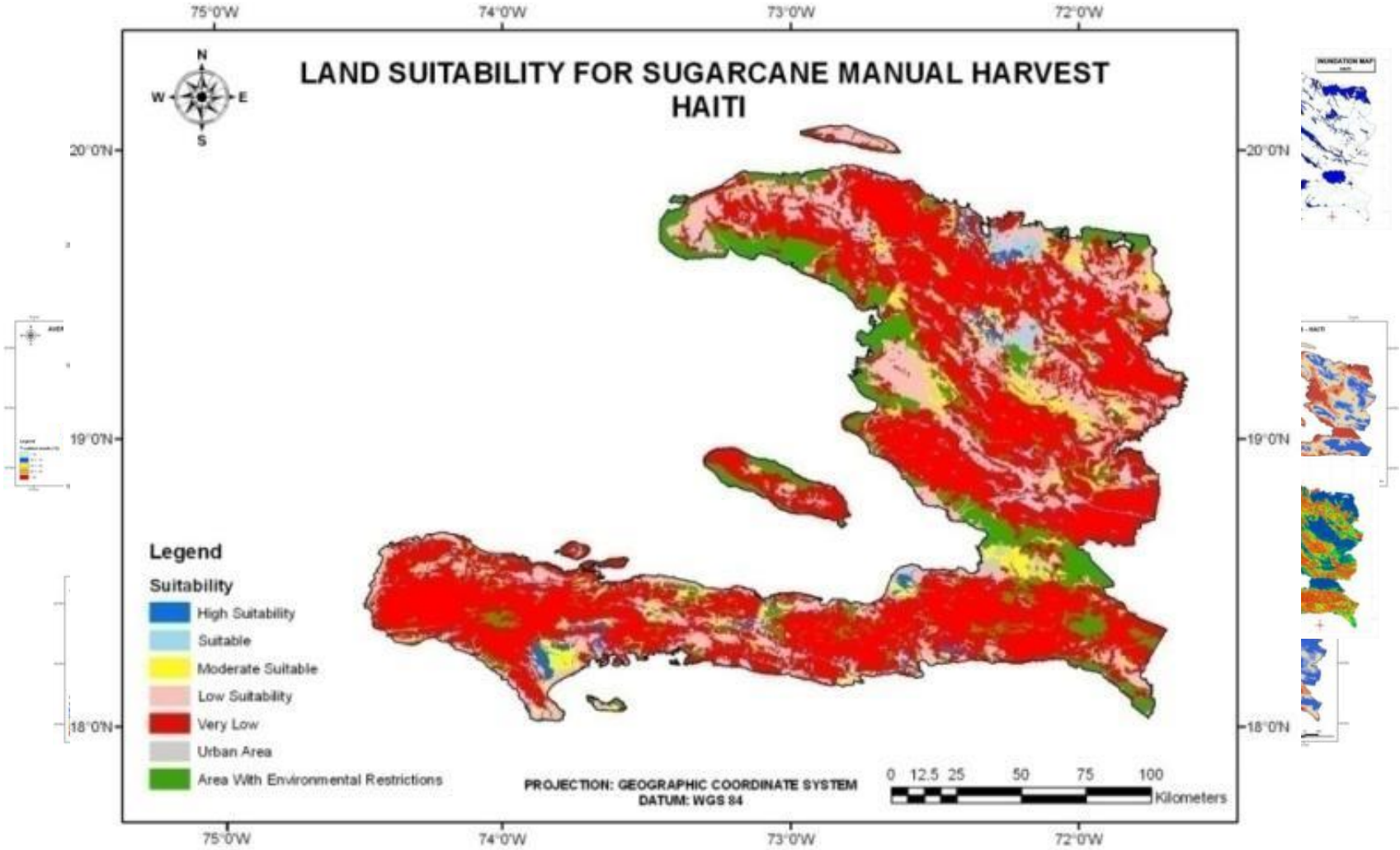
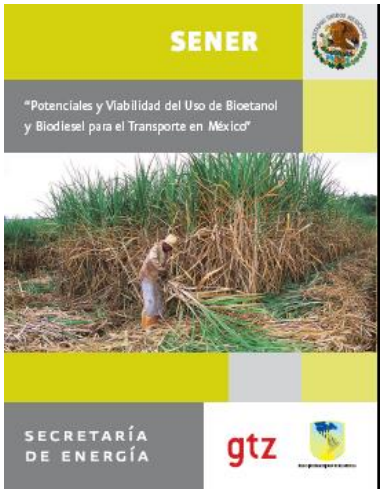

LAND SUITABILITY FOR SUGARCANE MANUAL HARVEST
HAITI
75°0'W
74°0'W
73°0'W
72°0'W
20°0'N
19°0'N
18°0'N
N
S
W
E
Legend
Suitability
High Suitability
Suitable
Moderate Suitable
Low Suitability
Very Low
Urban Area
Area With Environmental Restrictions
PROJECTION: GEOGRAPHIC COORDINATE SYSTEM
DATUM: WGS 84
0 12.5 25 50 75 100
Kilometers

Case of Mexico

A technical assistance project* to SENER funded by HSET/USDOE and GTZ to evaluate the feasibility of the production, distribution and utilization of ethanol and biodiesel as fuel for transportation:

- Technical, economical, social and environmental impacts from the introduction of biofuels under alternative scenarios for market penetration & oil prices



- Several technologies were evaluated for different raw materials and the utilization of biofuels – fixed/variable blends, hydrated ethanol, flex fuel vehicles, ETBE; increased cogeneration
- Some of the results: US$160 million would be required for replacing MTBE/TAME in major cities, without the need for expansion of sugarcane plantation; replacing 10% of gasoline nationwide requires additional 800,000 ha (twice the sugarcane area then), US$2 billion in 45 new distilleries and 400,000 new jobs; sugarcane most competitive solution

http://www.energia.gob.mx/webSener/res/169/Biocombustibles_en_Mexixo_Estudio_Completo.pdf

Note: * Project ME-T1007

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Case of Brazil

("renovAção" Program for requalification of sugarcane cutters)

A US$500k SECCI Technical Assistance Operation for UNICA (Sugar Cane Industry Association) the major sugar and ethanol organization in Brazil with 119 sugar mills, responsible for aprox. 60% of the ethanol and sugar produced in Brazil:

- **Full harvesting mechanization is expected by 2014 for all major sugar cane areas with <12% slope, and by 2017 in all other areas.**
- **During next 3 years about 26,500 sugar cane cutters will be displaced.**
- **Project target is requalify 7,000 workers/year: 3,000 through professional training for the sector and 4,000 for other sectors.**

UNICA
UNIÃO DA INDÚSTRIA DE CANA-DE-AÇÚCAR
ETANOL • AÇÚCAR • ENERGIA SÃO PAULO • BRASIL

JOHN DEERE

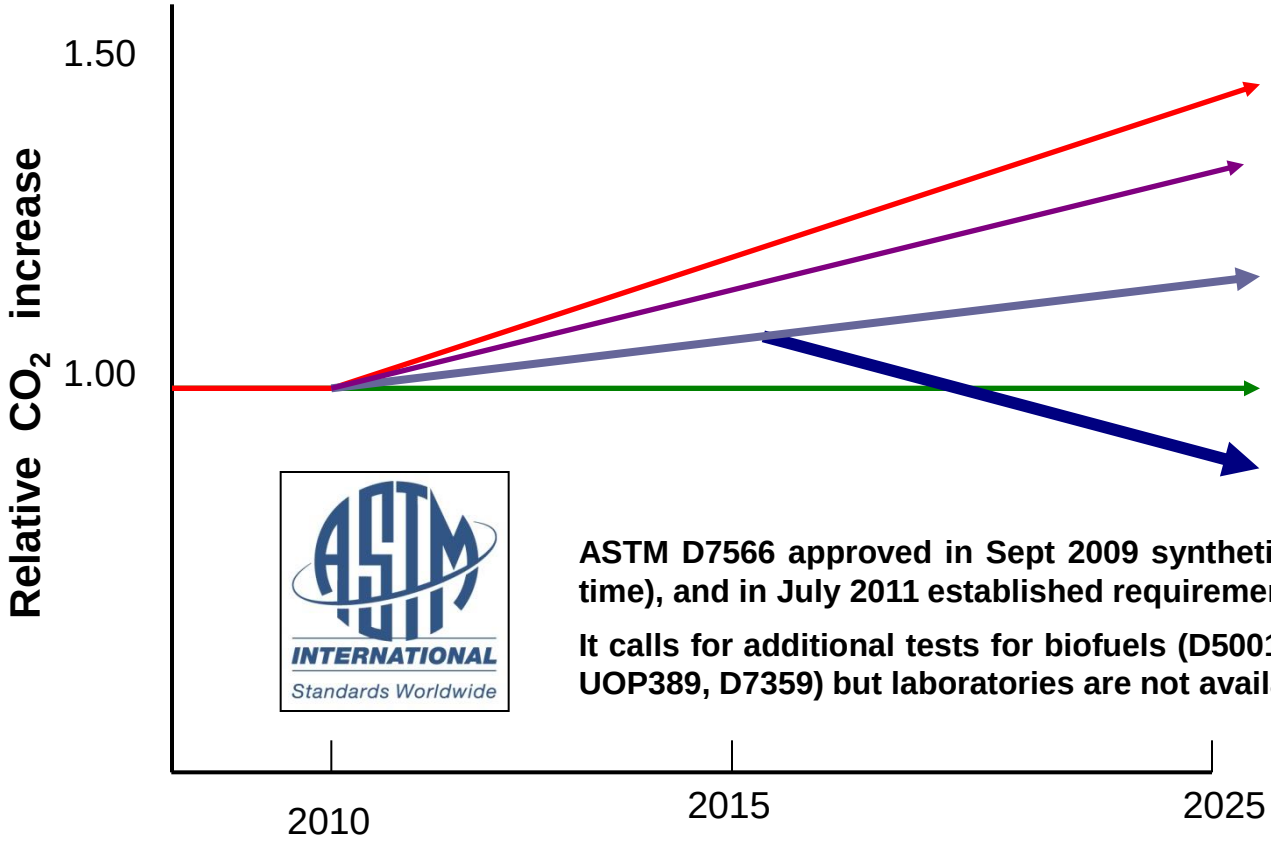
syngenta

CASE IH AGRICULTURE

renovAção

IDB

Aviation committed to carbon-neutral growth



ASTM D7566 approved in Sept 2009 synthetic fuels for aviation (for the 1st time), and in July 2011 established requirements for renewable sources.

It calls for additional tests for biofuels (D5001, D2445, D5291, D4629, D6304, UOP389, D7359) but laboratories are not available everywhere.

Main aspects of biofuels for aviation x passenger cars

- Key decision by aviation stakeholders: **“drop-in”** fuel, i.e., no need for any modification in turbines or storage/distribution systems (as opposed to ethanol for passenger cars that require flex-fuel cars or converted engines).

•Technical standards, fuel specifications and safety/quality control norms are **uniform worldwide** (non-existent in the ethanol/biodiesel markets):

  - ✓ Smaller number of consumer points (# airports vs. # gasoline stations)
  - ✓ Jet fuel less exposed to subsidies/tariff distortions

- Stakeholders **consensus**: airlines, aircraft/turbine manufacturers, fuel producers, government agencies, all joining efforts (not seen in the ethanol/biodiesel market).
- No **mandate** yet for biojet fuel blending, as seen for ethanol and biodiesel

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IDB Initiative for Sustainable Aviation Biofuels

- Aviation biofuels will be an important driver of sustainable socioeconomic development in LAC (land, water, climate, labor, etc)
  - ✓ **1st activity:** Life cycle assessment of the production of biojet fuel from sugar cane (DSHC), co-financed with Boeing and Embraer: **> 82%** carbon emissions reduction

EMBRAER

BOEING

IDB





LAC biojet fuel flights (2010-2013)

Date	Airline/sponsors (country)	Aircraft	Turbine manufacturer	Biofuel producer	Feedstock	Technology
Nov 2010	TAM (Brazil)	A320	CFMI	UOP	Jatropha	HEFA*
Apr 2011	InterJet (Mexico)	A320	CFMI	UOP	Jatropha	HEFA
Aug 2011	Aeromexico (Mexico-Madrid)	B777-200	GE	UOP	Jatropha	HEFA
Sept 2011	Embraer (Brazil)	EMB 170	GE	N/A	Camelina	HEFA
Sept 2011	Aeromexico 29 flights (Mexico-Costa Rica)	B737-800	CFMI	UOP	Camelina	HEFA
Oct 2011	Iberia (Spain-Mexico)	A320	CFMI	UOP	Camelina	HEFA
[illegible] 2012	LAN (Chile)	A320	CFMI	Air BP Copec	Used cooking oil	HEFA
Jun 2012	GOL/IDB/others (Brazil)	B737-800	CFMI	UOP	Used cooking oil, non-edible corn	HEFA
Jun 2012	Azul/Amyris/GE/ Embraer/IDB/others (Brazil)	EMB 170	GE	Amyris	Sugar cane	DSHC**
Jun 2012	Aeromexico (Mexico-Brazil)	B777-200	GE	UOP/SkyNRG	Used cooking oil, jatropha, camelina	HEFA
Aug 2013	LAN (Colombia)	A320	CFMI	Air BP Copec	Used cooking oil	HEFA
Oct 2013	GOL/IDB/Boeing/others	B737-800	CFMI	UOP	Used cooking oil, non-edible corn	HEFA

Notes: * Hydro processed Esters and Fatty Acids ; also known as Bio-Synthetic Paraffinic Kerosene (SPK) or Hydrotreated Renewable Jet (HRJ)
** Direct Sugar to Hydrocarbons

IDB

- ✓ Support demonstration flights with Azul (1st ever with DSHC) and GOL (as part of ICAO Flightpath) during Rio+20 using different feed stocks.

RIO+20
Conferência das Nações Unidas
sobre Desenvolvimento Sustentável

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- ✓ Brazil's first commercial biojet fuel flight, CGH-BSB on October 24th, 2013

- ✓ Feasibility study of the first LAC biojet fuel production plant for ASA of **Mexico**

Aeropuertos y Servicios Auxiliares

BIO turbosina
Aeropuertos y Servicios Auxiliares

UOP
A Honeywell Company

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- ✓ Study on Camelina in **Argentina**: feasibility of cultivation in marginal areas in south of the country, includes analysis of economic, social and environmental issues.

CAAFI
FUELING SOLUTIONS FOR SECURE & SUSTAINABLE AVIATION

Biennial General Meeting
28 January, 2014
Washington, DC

FAA AIA CAAFI ATA ACI-NA

CAAFI General Meeting 2011
November 30 – December 1, 2011
Georgetown University Hotel and Conference Center, Washington, DC
www.caafimeeting.com

olade
Organización Latinoamericana de Energía

OBSA

AIRBUS
AN EADS COMPANY

SENASA

CBPPM
II Congresso Brasileiro de Pesquisa em Pinhão-manso
"Pinhão-manso: focando em soluções sustentáveis para produção de biocombustíveis"
29 a 30 de nc 1- Centro d entos da CNTC, Brasília-DF

PROCITROPICOS

IICA

Patrocinador Prata: UBYFOL
Transportadora Oficial: GOL
Apoio: BID, CAPES, Ministério da Educação

Promoção e realização: ABPPM, Embrapa, Ministério da Agricultura, Pecuária e Abastecimento, Governo Federal Brasil País rico é país sem pobreza

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- ✓ Brazil Action Plan for **FIFA World Cup 2014** and **Rio 2016 Olympics**: to reduce/offset carbon footprint of international and domestic flights through use of biojet fuel in cooperation with the Brazilian Platform

1st activity:

support effort led by Embraer to prepare a certification compliance plan to make possible commercial flights in Brazil (STC process) with E-jets aircrafts during the games

Azul+Verde Renewable jet fuel

Azul EMBRAER

IDB



PROJECT "AZUL+VERDE" PHASE II

Motivation

Ongoing DSHC Task Force at ASTM

AMYRIS
TOTAL

Specification Properties	Fit-For-Purpose Properties	Component/Rig/ APU Testing	Engine Testing	ASTM Balloting and Approval process
	Q1 '13	Q1-Q2 '13	Q1-Q3 '13	Q4 '13

Tech data feeding into the ASTM process

AZUL+VERDE Phase II : Focus on FIFA World Cup 2014

Azul
AMYRIS
EMBRAER

Azul E190/195 commercial flight using DSHC fuel blend with regular fossil jet fuel

EMBRAER AMYRIS Azul
Parker
Pratt & Whitney
anp
ANAC

Brasil 2014
Commercial flights during FIFA World Cup

EMBRAER

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SUSTAINABLE ENERGY FOR ALL | LATIN AMERICA AND THE CARIBBEAN

Next activities:

✓Support to **UN SE4ALL** Initiative (doubling renewables worldwide pillar): HIO on biofuels for LAC with Novozymes and FAO: events, studies, investment projects promotion - 1st activity expected to be in Mexico

✓ Support to **ANAC** (Brazilian Agência Nacional de Aviação Civil): development of a software/algorithm within the FAA's Aviation Environmental Design Tool 2a (AEDT 2a) to compute GHG emissions related to flights using biojet fuels, particularly those based on sugarcane

✓ Studies on **value chains** for the following technologies:

- Direct Sugar to Hydrocarbon (DSHC) - Sugarcane; enzymes
- Hydroprocessing of Esters and Fatty Acids (HEFA) - Camelina, Jatropha, sugarcane, Hydro-cracking and microalgae
- Alcohol oligomerization to jet-fuel (TKA) - Ethanol from sugarcane; Hydrolysis

EMBRAER BOEING AMYRIS

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THANK YOU

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