EMISSIONS INITIATIVES
Flightpath to Reduce Aviation Emissions

- Technology
- Operational Practices
- Infrastructure Improvements
- Positive Economic Measures

- “Drop in” Biojet Fuels
- Airframe, Engine and Systems Aircraft Improvements

Source: ATAG
Embraer EMB 202 Ipanema
The most employed agricultural aircraft in Brazil and the world's first ethanol-certified flying airplane (2004).

- Lower emissions
- 38% reduction in direct operating cost
- 80% aircraft sold and 40% fleet are ethanol powered
- Total fleet is 1200 aircraft;
**BUSINESS JETS FUEL GREEN: A STEP TOWARD SUSTAINABILITY**

**THURSDAY, JANUARY 17, 2019**
**VAN NUYS AIRPORT (VNY)**

**OUTSTANDING INDUSTRY ENGAGEMENT**

<table>
<thead>
<tr>
<th>SAJF Coalition:</th>
<th>GAMA, NATA, NBAA, IBAC, EBAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Suppliers:</td>
<td>AVFUEL, World Fuel Services</td>
</tr>
<tr>
<td>Fuel Producers:</td>
<td>World Energy, Gevo</td>
</tr>
<tr>
<td>FBOs:</td>
<td>Signature, JET AVIATION, Castle &amp; Cook, Clay Lacy Aviation</td>
</tr>
<tr>
<td>OEMs:</td>
<td>BOMBARDIER, Gulfstream, Embraer</td>
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</tbody>
</table>
HEFA Technology

Embraer E-170 Prototype Aircraft
Ground & Flight Tests – 2011
In partnership with GE Aviation

ecoDemonstrator 2016
Boeing & Embraer

Partnership on Aviation Biofuel

ITAKA
EU FP7 Project

Commercial flights Oslo Amsterdam
with HEFA Technology

1st Demo Flight of SIP Technology
June 19th, 2012
NOISE INITIATIVES
ICAO/CAEP - Balanced Approach to Aircraft Noise Management

ICAO’s Balanced Approach consists of identifying the noise problem at an airport and then analyzing the various measures available to reduce the noise, using four principal elements, namely:

1. Reduction of noise at source;
2. Land-use planning and management;
3. Noise abatement operational procedures; and
4. Operating restrictions.

Monitored and evaluated through Certification Noise Levels and New Technology Insertion;
Local Government policies and actions with inspection and control;
Best Takeoff and Approach Procedure for each Airport and for each Aircraft, relatively low cost improvement;
Actions that limits or reduces aircraft access to airports. Intended to be used as a last resort.
EXTERNAL SCENARIO ANALYSIS

- **Aircraft on development**
  - Lower External noise levels (30dB Cum Margin Stage IV);
  - Stricter Airport noise limits;

- **New Engines (higher BPR and larger diameter)**
  - Lower jet noise;
  - Installation effects of jet-pylon-flaps;
  - Lower relative area for engine acoustic treatment;
  - Fan noise source will be the most important;

- **Low Airframe Noise Solutions**
  - Increase of patents and inventions during last years
  - Higher importance of airframe noise (flaps, slats, landing gear)
  - Larger landing gear due to larger engines;

- **World Noise Projects Goals**
  - 32dB CUM Stage IV in 2015 (Ref: Single Aisle Configuration, TRL 4 a 6) – NASA ERA;
  - 42dB CUM Stage IV in 2020 (Ref: Large Twin Aisle Configuration, TRL 4 a 6) – NASA ERA;
  - 20dB CUM Reduction in 2020 – ACARE - X-Noise;
New Technologies have been produced significant noise reductions at noise source.
NEW ENGINES - TRENDS

Engine Diameter:
- EJETS – 1.6 m to 1.8 m;
- E2 – 2.0 m a 2.4 m;

- Engine Installation Effects
- Fan Noise
- Landing Gear Noise
AIRCRAFT NOISE TRENDS

- Engine Installation

Airframe Noise

Jet Noise

Airframe

Fan + Turbine + Compressor Noise

New Engines
(3 – 6 dB Quieter)

Airframe noise will be the dominant noise source in approach conditions.
“Brick by Brick” – Embraer Noise Road Map

2019

SILENCE

2015

Brazilian Silent Aircraft 2 & 3

2012

Brazilian Silent Aircraft

2008

External Noise 1 & 2

2003

- Excelence in Low Noise Development and Certification
- Propulsion Noise Models and Engine Installation Solutions
- Low Noise High Lift Design and Portfolio
- Flight Projection Techniques
- Propulsion Noise Studies
- High Lift Noise Studies
- Aeroacoustic Flight Tests
- Aeroacoustic WT Tests
- Basic CAA Development
- Development of Noise Tests
- Test Data Processing Tools
- Basic Noise Prediction Tools
- Integrated Analysis & Proof of Concepts
- Model Improvements and Solutions
- Aeroacoustic Simulations and Testing
- Engineering Basis and Certification
Low Cost Design Tools

Airframe Noise

Engine Installation Effects

Operational Noise

In-flight Engine Noise

CF34-10E

GasTurb Simulation
Fundamental Case Studies

Fan Cascade
Simplified Landing Gear
2D Airfoil/Highlift
Simple Jet
Silent Aircraft Initiative – FASE I

Silent Aircraft Initiative – FASE II

Intermediate Cases – Simplified Real Geometries

Complete Landing Gear
Fan Cascade
2D Jet
Silent Aircraft Initiative

Wind Tunnel x Flight
Intermediate Cases – Simplified Real Geometries

Real Geometry Case Studies
Wind Tunnel x Flight
Jet-Flap-Pylon Interaction

Jet-Flap-Pylon Interaction
Real Jet Installation Geometry

3D Simplified Landing Gear
‘Quiet’ Slat Cuts Noise In Boeing-Embraer E170 EcoDemonstrator

Guy Norris | Aviation Week & Space Technology

Jan 24, 2017
• Fan Rig development, construction and testing, for fan noise R&D
JET NOISE METHODOLOGIES

- Single cold jets
- Mach 0.4 - 0.9
- Dj 25 - 50 mm
- No flight stream
- Different nozzle configurations
JET NOISE INSTALLATION
AEROCOUSTIC WIND TUNNEL TESTS

External and Internal View of the Wind Tunnel Antenna

Microphone Clamp

800 Hz

FLAP = 0

FLAP = 13

FLAP = 24

1600 Hz
• Characterization and Development of Airframe Noise Improvements through Aeroacoustic Wind Tunnel and Flight Tests.
AEROACOUSTIC WIND TUNNEL TESTS

60 degrees array
Noise Source Identification Flight Tests
BEAMFORMING FLIGHT TESTS

FLIGHT TESTS AT EMBRAER – GPX TEST SITE
• On flight Beamforming testing methodology for source identification and quantification implemented and fully tested
Thank you!