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Airlines & Aviation Alternative Fuels: Our Drive to Be Early Market Adopters

Bioenergy 2015

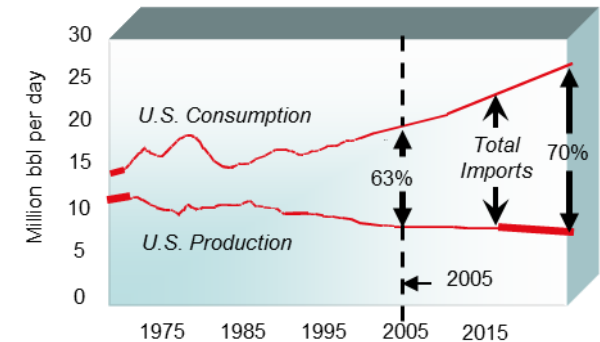
Nancy N. Young, VP-Environment; CAAFI Environment Team Co-Lead

June 23, 2015

Why Airlines Want Alternative Fuels

» New Supply Chain

- Energy Security/Supply Reliability
- Competitor to Petroleum-Based Fuels



» Environmental Benefit/Imperative

- Greenhouse Gas (Carbon) Emissions Benefits
- Reduce Emissions Affecting Local Air Quality
- Do Not Induce Other Environmental Problems

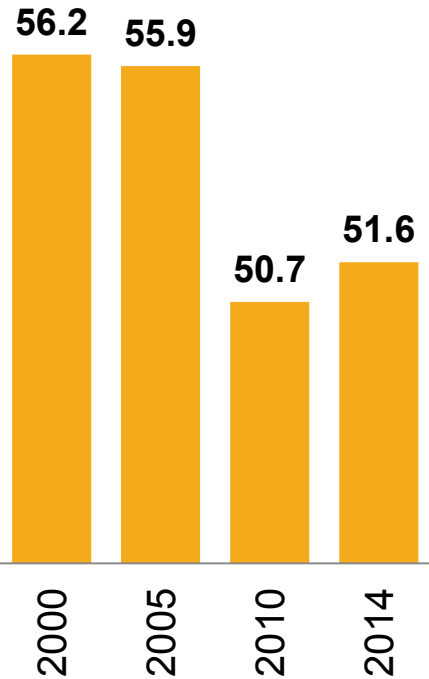


U.S. Airlines' Jet Fuel Costs Are High and Volatile

Average Price Paid Rose 255% in 2000-2014, Including 26% in 2010-2014

Using Less Fuel But ...

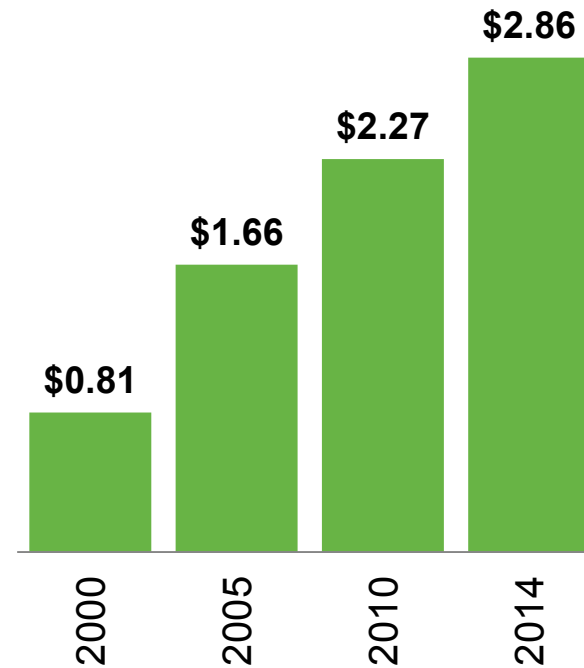
Million Gallons per Day



Source: BTS (T2: 921) for U.S. airlines

Due to Rising Prices ...

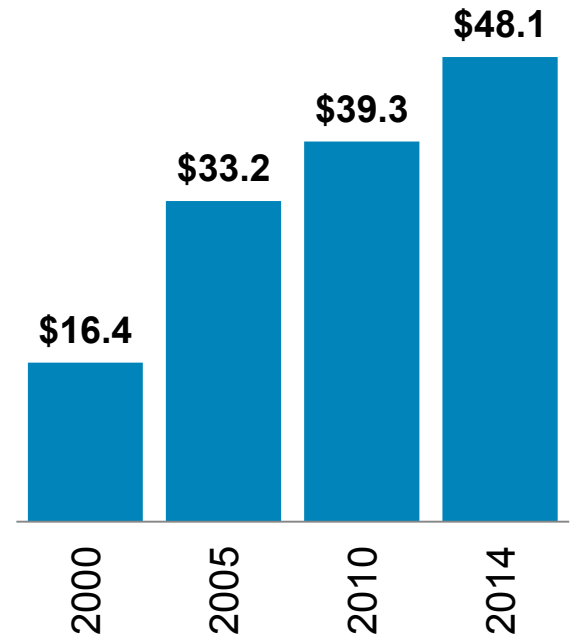
Avg. Price Paid per Gallon Systemwide



Source: BTS (Form 41 P-12(a) for U.S. airlines)

... Incurring Higher Costs

Billion USD per Year



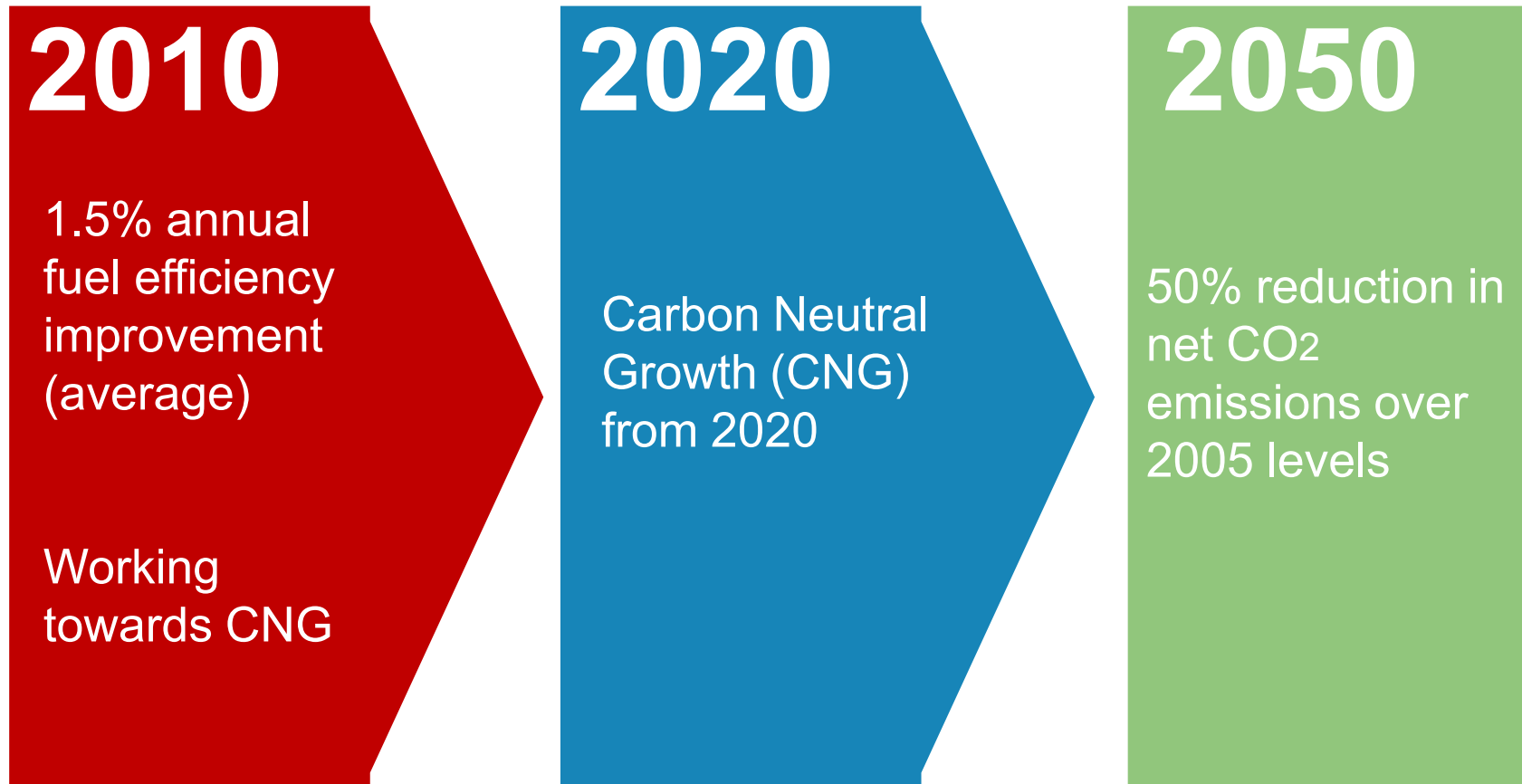
Source: BTS (Form 41 P-12(a) for U.S. airlines)



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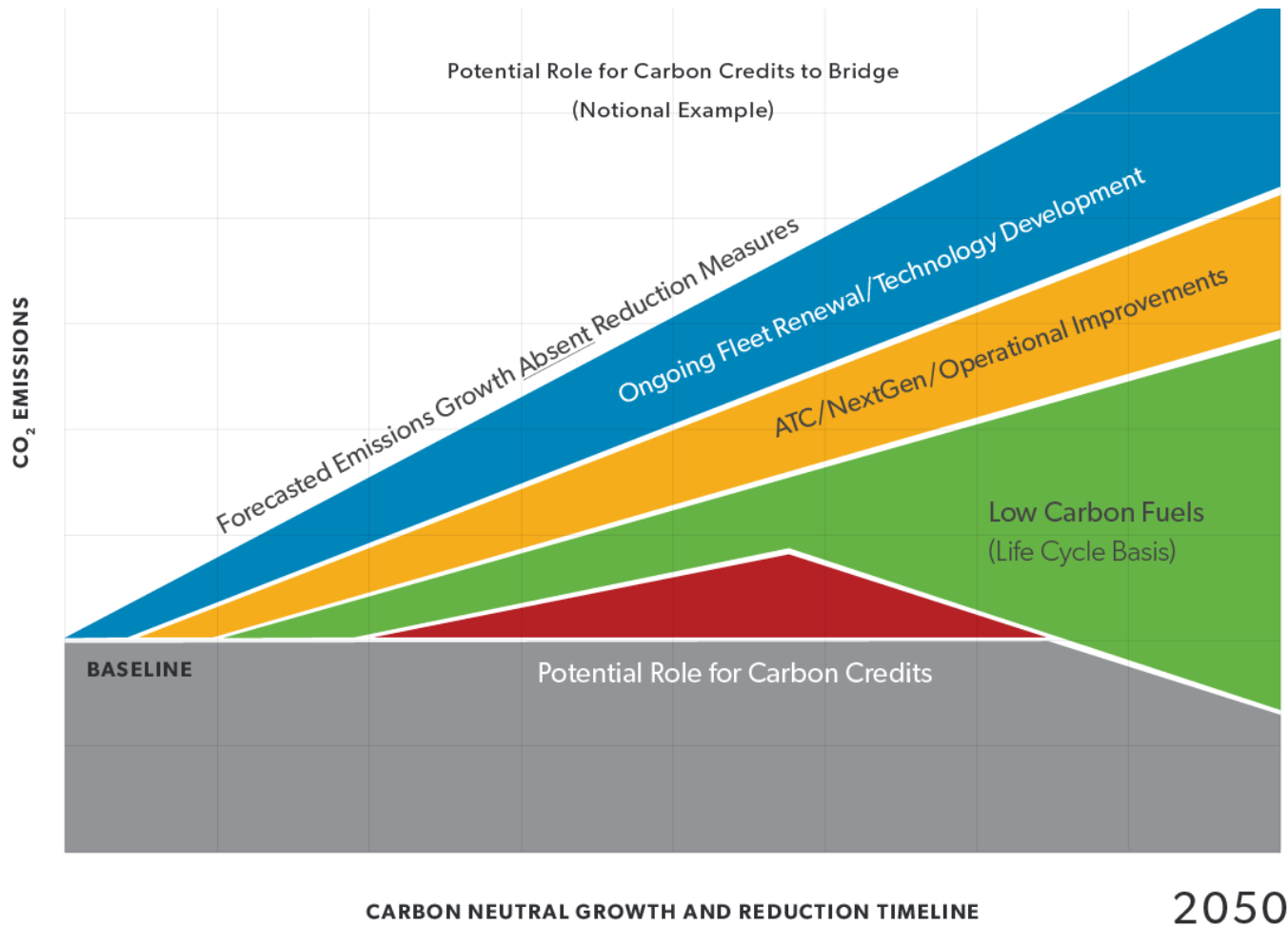
Global Aviation Has Aggressive Carbon Targets

CNG from 2020 Agreed at United Nations Body (ICAO*)



How Do We Meet Our Targets?

Technology & Alternative Fuels, Operations & Infrastructure



What an Airline Needs to Deploy Sustainable Alternative Jet Fuels

1) Safety

- This is addressed through
 - (a) The jet fuel specification; and
 - (b) Application of procedures to assure fuel quality is maintained

} We know how to do this

2) Environmental Benefit

- This is being addressed through
 - (a) Lifecycle greenhouse gas emissions; and
 - (b) Sustainability review

} Covered in U.S. & EU; working on global acceptance

3) Commercial Viability

- Need cost competitiveness &
- Supply reliability

} Making significant progress

A4A & Sustainable Alternative Aviation Fuels

Working Within Coalitions to Achieve Success

» Co-Founded and Co-Lead the Commercial Aviation Alternative Fuels Initiative[®] (CAAFI)

- Co-Leads: A4A, FAA, ACI-NA (airports) and AIA (airframe & engine manufacturers)
- Four Teams Aimed at Addressing Key Questions – Over 300 Participants
 - Certification/Qualification (e.g., jet fuel specs)
 - Research and Development (e.g., suitable fuels)
 - Environment (e.g., methodologies and case studies)
 - Business/Economics (e.g., finance/commercial terms)



Drive to “Drop-In” through Jet Fuel Specs

Safety/Quality – But Also Important to Supply & Cost

» ASTM International: New Jet Fuel Spec (D7566) for Alternative Jet Fuels

- Fischer-Tropsch-Derived (FT) Jet Fuel – 2009
- Hydrotreated Esters & Fatty Acids (HEFA) – 2011
- Synthesized Iso-Paraffinic (SIP) – 2014
- Working on Alcohol-to-Jet (expected 2015); others

» Drop-In Allows Use of Same Infrastructure

- Working up fuel quality protocols specific to alternative fuel (already have for traditional jet fuel)
-

Jet Fuel Spec Enables Commercial Flights

Over 1600 Commercial Flights!



Getting to Full Commercial Viability

What Is Needed

- » **Market Signals from Fuel Purchasers (Beyond Demo Flights to Full Off-Take Agreements)**
 - » **Consistent Energy/Biofuels Policy from Governments**
 - » **Scale-up Capability and “Positive” Economics (Relative to Petroleum-Based)**
 - Feedstock costs and availability are particularly critical
-



Airline Off-Take Agreements (Full Scale)

Starting with Millions of Gallons; Key Step to Scale-Up



5 M gpy
from 2014



Supply
2018



RED ROCK BIOFUELS



3 M gpy



370M usg



180M usg
over 11
years



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Other Airlines' Purchase Agreements

- » **KLM (The Netherlands) – SkyNRG**
- » **Lufthansa (Germany) – Neste & GEVO Project**
- » **GOL (Brazil) – Amyris**
- » **Alaska Airlines – GEVO (for commercial demo flight +)**



Commercial Viability: What A4A Is Doing

» Public-Private Coalitions to Marshal Resources

- CAAFI[®]; Strategic Alliance with the U.S. Military (Defense Logistics Agency); Farm to Fly with USDA, DOE, FAA, CAAFI, Boeing and other partners; Regional initiatives: e.g., Pacific Northwest & Midwest; Defense Production Act

» Achieved Eligibility for RFS/RIN Credit

» Developed Key Guidance for Doing Deals

- “Guidance for Selling Alternative Fuels to Airlines”

[http://www.caafi.org/files/CAAFI Business Team Guidance Paper 060413.pdf](http://www.caafi.org/files/CAAFI_Business_Team_Guidance_Paper_060413.pdf)

» Advocating Appropriate Government Policy



A Moment on *Farm to Fly* & the Defense Production Act Initiatives

» Farm to Fly – Critical to Enabling Biojet Eligibility for Existing Biofuel Programs

- Programs such as biorefinery and biomass crop assistance, which have focused almost entirely on ground-based fuels
- Crop insurance for proven energy crops
- Demonstrating and implementing a sustainable supply chain

» Defense Production Act Project

- Helping to “kick-start” the industry through demonstrated supply chains
- It is critical that Congress allow this project to continue



If You Want to Feel Good About the Future, Look Up!



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