

Alternative Aviation Fuels Assessing the BenefitsAddressing the Challenges



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Session 1: Setting the Scene
Montreal, Canada

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Assessing the Benefits, Addressing the Challenges

Assessing Benefits

To Operators

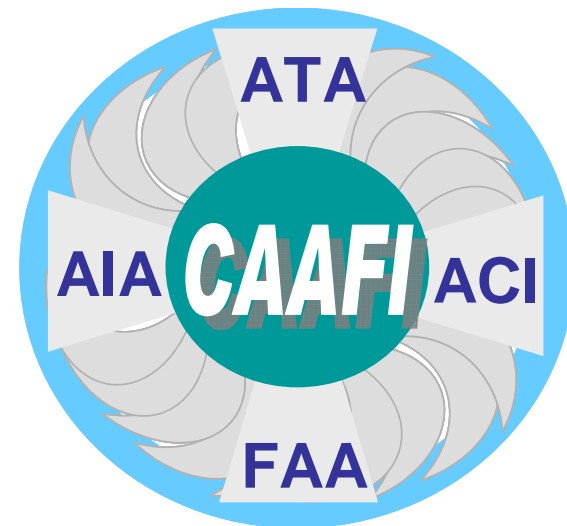
- *Environmental*
- *Economic*
- *Social*

To Suppliers

- *Customer Stability*
- *Global Environmental Focus*
- *Concentrated Distribution*
- *Certified Entry*

Addressing Challenges

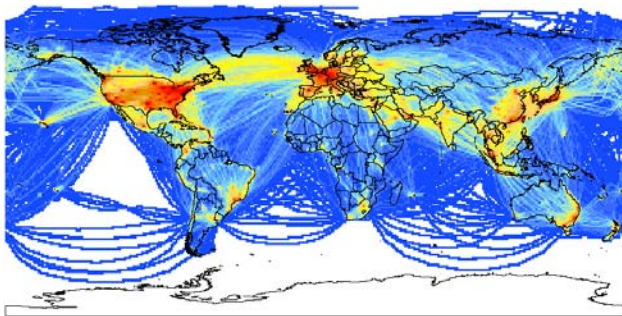
- *Timely Certification*
- *Certainty of Environmental Gain*
- *Speedy deployment*



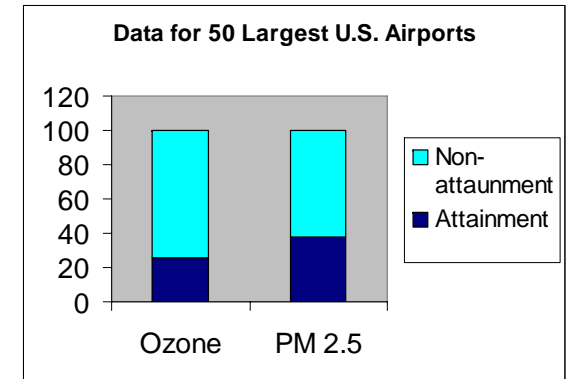
Environmental Needs and Opportunities for Alternatives



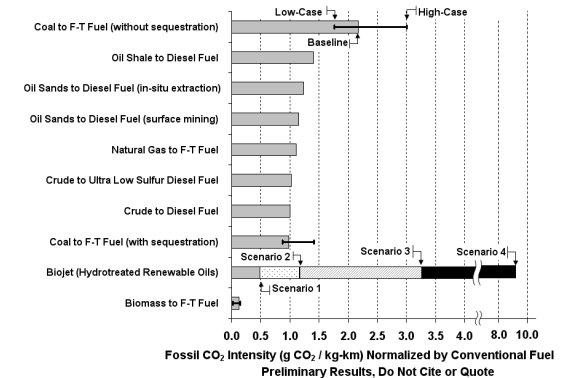
Air Quality



Global Climate



Reduce PM 2.5*



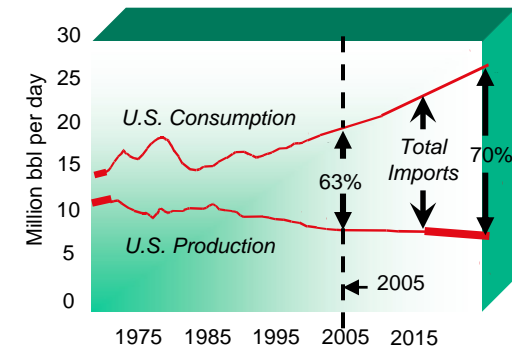
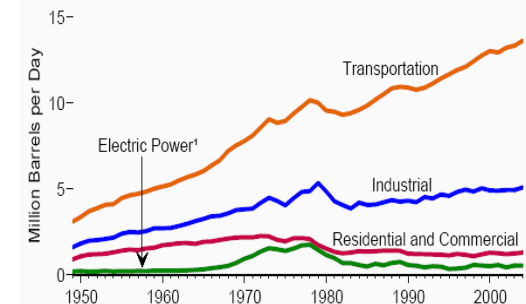
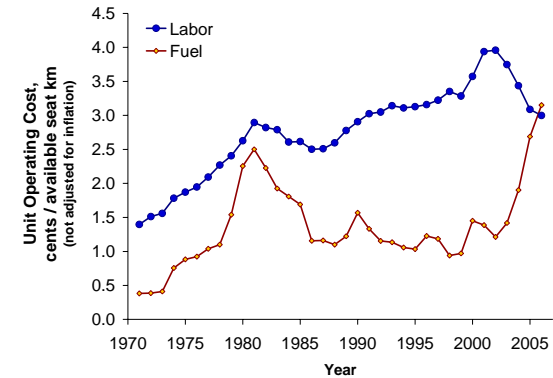
Limit CO₂ LCA**

*US EPA NAAQS for PM2.5

**PARTNER COE, Hileman et al.

Economic Needs and Benefits of Alternatives

- Diverse supply options
- Accommodate Growth Without CO2 economic penalties
- Supply Stability with local options



Proactive Aviation = Socially Responsible Aviation



Photos from 7-Jan-09 Continental Flight demonstrator with Boeing, CFMI, UOP, Terrasol, Sapphire



Aviation Strengths Benefit Energy Suppliers

- Aviation is dependent on Hydrocarbon based liquid fuels
- Concentrated Airport Distribution for rapid deployment, 35 airports – 80% of fuel supply in U.S.
- Single regulatory framework enables a global market
- Accelerated Safety certification efforts target –
 - Fischer Tropsch Biomass blend approvals by mid-year 2009
 - Hydrotreated Renewable Jet (HRJ) blend approvals by 2010
- Globally accepted air quality models implemented via FAA/MIT environmental Center of Excellence
- Aviation systems engineering experience in R&D
- Most Sustainable Transport User Business Model
- Highest Visibility for Technical Success

***CAAFI, IATA, ICAO Positioning Aviation to Lead
Creation of an Alternative Fuels Future!***

Addressing Alternatives Challenge - Priorities

- **Eliminate Certification as Time Critical Path For Deployment**
 - *Focus on multiple process targets*
 - *Myriad of Development Teams Globally*
- **Execute impartial, fully inclusive “best practices” GHG LCA and Air Quality assessments**
 - *Multiple independent GHG LCA assessment*
 - *Air Quality via globally accepted process*
- **Ensure Earliest Supplier / Customer Engagement**
 - *DOC facilitated 9/8, 9 business workshop*
 - *26 producer Co's./ 20 buyer Cos. present*
- **Engage All Relevant Government Functions**
 - *All departments, agencies engaged in U.S.*
 - *Outstanding Interagency Cooperation throughout*

Multiple Teams Addressing Development in Flight

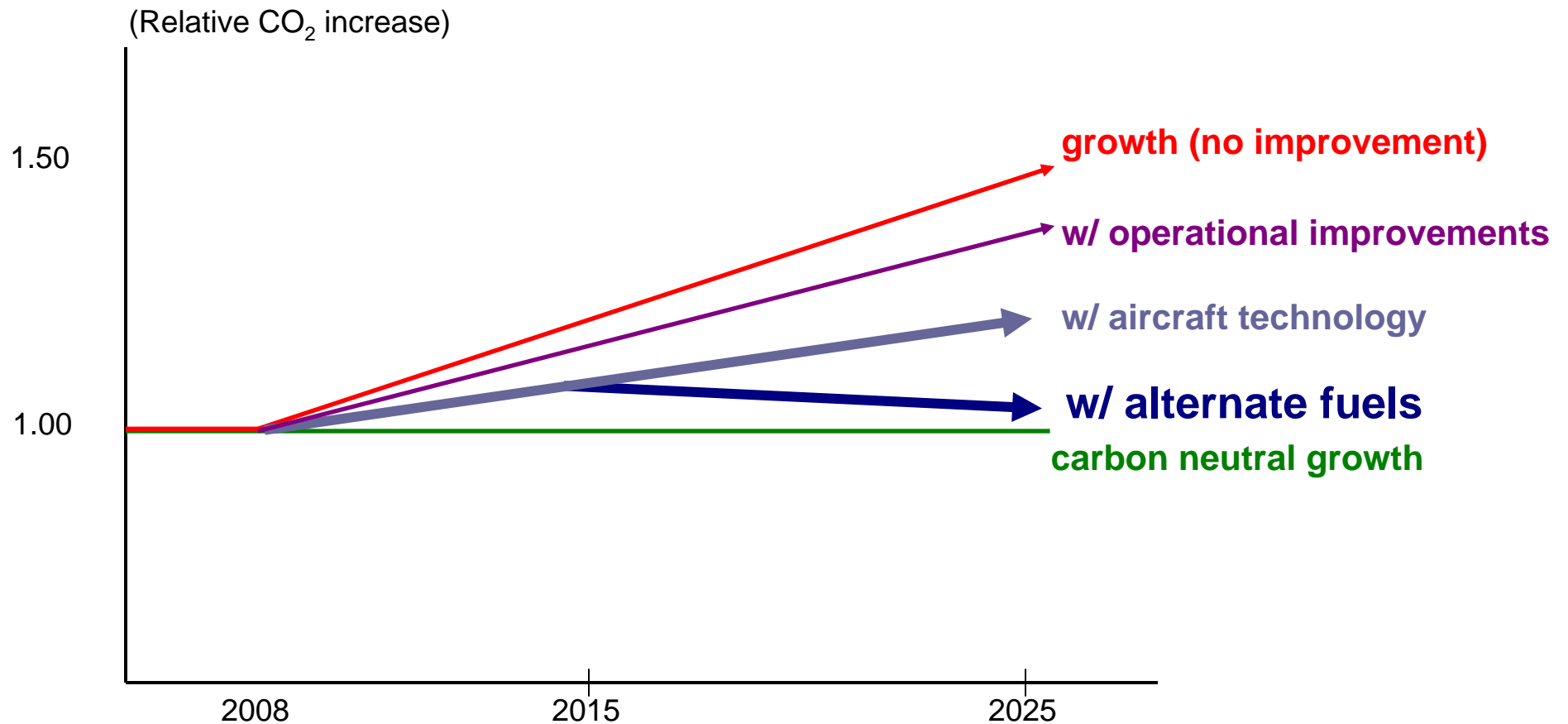
<u>Team</u>	<u>Fuel Type</u>	<u>Timing</u>
<ul style="list-style-type: none"> South African Airways, All Engine OEM's 	Coal to Liquid (CTL – 100% Sasol)	05' – 08' 04/08 Defstan Certification
<ul style="list-style-type: none"> Airbus, Shell, Rolls Royce (A380) 	Gas to Liquid (GTL)	01/08 Flight
<ul style="list-style-type: none"> Boeing Flight programs – <ul style="list-style-type: none"> - Virgin/ GE - New Zealand / RR - Continental / CFMI - Japan Airlines / P&W 	Biojet (various types)	02/08' – 02/09' flights
<ul style="list-style-type: none"> UOP/ Jet Blue / Airbus / IAE 	Algae	Formed Mid – 08'
<ul style="list-style-type: none"> RR / British Airways 	Biojet (various types)	Formed Mid – 08'

ASTM Approvals – CAAFI Targeted* Certification Timing

<u>YEAR</u>	<u>FUEL TYPE</u>	<u>STATUS</u>
<ul style="list-style-type: none"> • 2008,9 	<ul style="list-style-type: none"> - 50% FT Synjet blends including biomass/ coal / gas 	<ul style="list-style-type: none"> - ASTM approval targeted by June 09' - Rapid Adjudication process with producers/ OEM's / USAF
<ul style="list-style-type: none"> • 2010 	<ul style="list-style-type: none"> - 100% FT Synjet including biomass - 50% HRJ Synjet Blend 	<ul style="list-style-type: none"> - Supporting low sulfur cost/benefit starting 4/08 - Working with ASTM, FAA and engine/aircraft OEMS
<ul style="list-style-type: none"> • 2013 	<ul style="list-style-type: none"> - Pure HRJ Synjet including Algae - Other Biofuel processes 	<ul style="list-style-type: none"> - DARPA program complete. Fuels available for FFP tests - DARPA Algae program sourcing imminent.

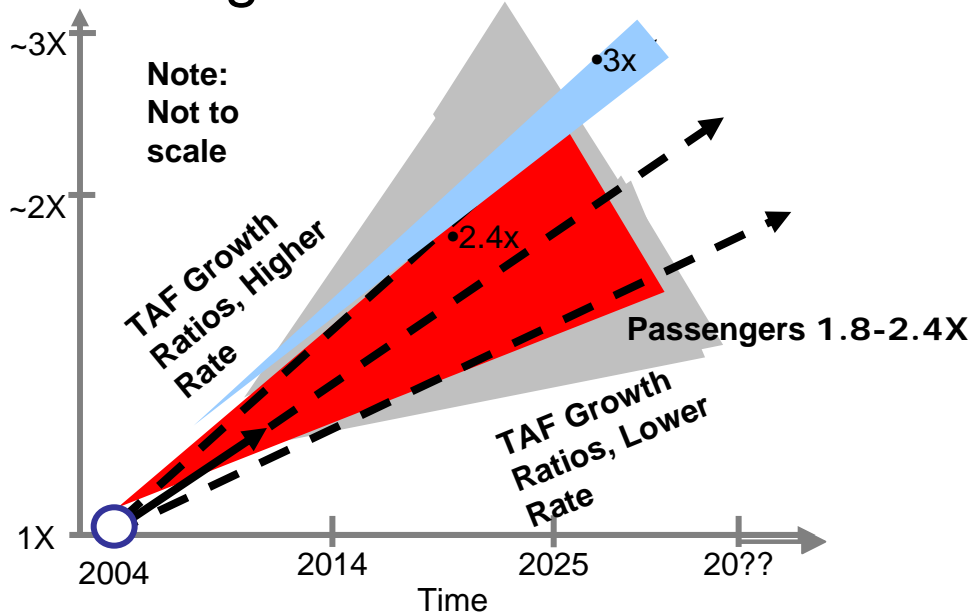
* Generic Targets based upon outcomes to date anticipated fuel availability for tests

Challenge: Reduce Aviation Environmental Footprint



Challenge: Air Quality (PM2.5) Gains Needed

Growing demand ...



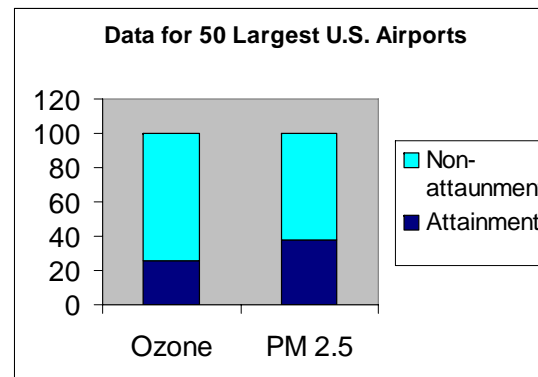
Preliminary Analyses of Emissions Growth for NexGen Scenarios

... a growing footprint

	2X Change
HC	+ 75%
CO	+ 70%
NOx	+ 90%
SOx	+ 85%

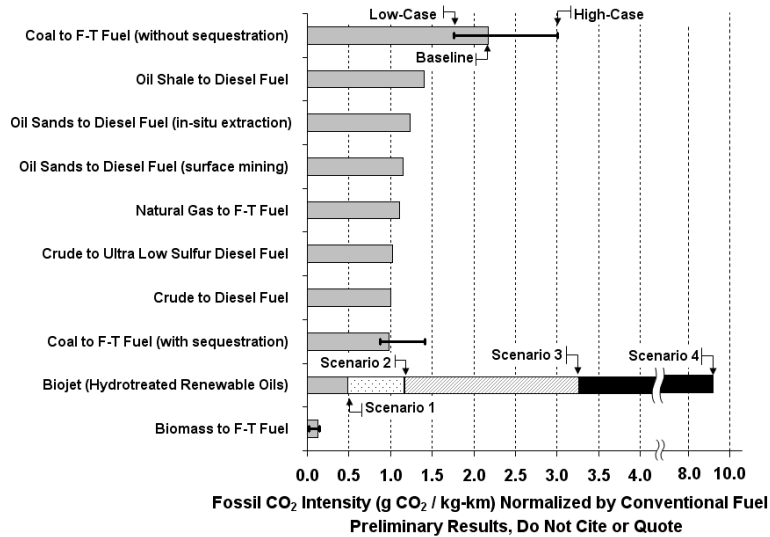
...sulfur is precursor to PM 2.5 driven capacity constraints

...controllable with alternative fuels



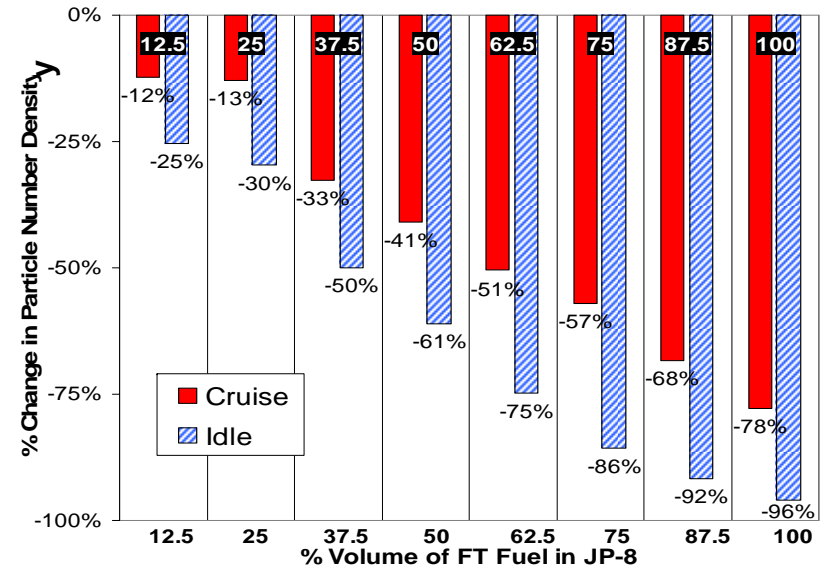
CAAFI Approach to Environmental Challenges

For GreenHouse Gas LCA



- **EPA/DOE/USAF “Rules & Tools” Roundtable**
- **FAA Aircraft Emissions Algorithms**
- **8+ Process Specific Case Studies form bounds**
- **Fully Peer Reviewed**

For PM 2.5 Formation



- **USAF and FAA Particle Measurements**
- **FAA/CRC low sulfur studies**
- **TRB / ACRP Cost/Benefit Handbook for Airports**
- **FAA EDMS Tools**

Challenge: Deployment Business Team 09/08 Meeting

Addressed Deployment

- 20 end users
- 26 Energy suppliers
- Aviation specific production and distribution roadmaps
 - Fisher Tropsch economics
 - USAF/CAAFI Biofuels advisory process



F-T fuel plant
(CO₂ capture and use with biomass)

50%-100%



Future bio-jet fuel process

0%-50%
(Increasing % over time)



* Graphics, David L. Daggett, the Boeing Company, 09/07

Government Participation in Aviation Alternatives

*28 Representatives / 14 Agencies at 08 Sept.
2008 CAAFI Business team*

Air Force Petroleum Agency

Air Force Research Lab (AFRL)

Commerce Department

DARPA / Army (ARO)

Defense Energy Support Center (DESC)

Defense Department

Energy Department - Energy Efficiency and Renewable Energy (EERE)

Energy Department - National Energy Technology Lab

FAA - Environment and Energy

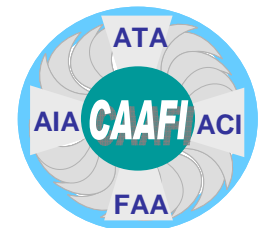
FAA - Airworthiness

NASA Glenn Research Center

Office of Management and Budget (OMB)

Office of Science and Technology Policy (OSTP)

USDA Rural Development



***“Each day brings further evidence
that the ways we use energy
strengthen our adversaries and
threaten our planet.”***

....Barack Obama Inaugural
Address - 1/20/09

Assessing the Benefits / Addressing the Challenges

2009 is Key Year :

- Certification to Plan
- GHG assessments to produce accepted gains
- Build airline consumer / energy supplier dialogue.
- Leverage global reach with IATA and new EU / ICAO Initiatives
- Focus & Align R&D plans between government and industry globally
- Strengthen/extend US partnerships to speed deployment.



(The) U.S. aviation industry is eager for an entirely new fuel dynamic and will be an enthusiastic purchaser of environmentally friendly alternative fuels
*.....Letter dated 1/16/09 to President Elect Obama from aviation fuel users / suppliers**

* Full letter text available at CAAFI website