Energy Challenges of Commercial Aviation

Dr. Rhett Jefferies
CLEEN Program Manager,
Office of Environment and Energy
Federal Aviation Administration

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Aviation’s Contribution to Society

• > $1.2 trillion each year to the U.S. economy
• Supplies more than 1 million jobs
• Global transport of people and products — quickly and safely
• Better quality of life — allowing us to visit friends and relatives, to travel, to experience new places, to connect the regions of the world
But …. There associated environmental challenges

- Aviation impacts community noise footprints, air quality, water quality, energy usage and availability, and the global climate.
- Trends show environmental impacts from aircraft noise and emissions will be a critical constraint on mobility.
- Fundamental changes ongoing from economic downturn, fuel costs, and financial turmoil.
Demand and fuel cost continues to increase as the need for aviation grows

Note: Value in parentheses below year is average price paid per gallon excluding taxes, into-plane fees, pipeline tariffs and hedging costs

Sources: ATA, Energy Information Administration, Department of Transportation

Chart courtesy of John Heimlich, ATA
GREENING U.S. AVIATION

SIMPLIFIED VIEW OF AVIATION IMPACTS

CO2: 71%
Water: 28%

CO, HC, NOx, SOx, Primary PM2.5: < 1%

Atmospheric Chemistry and Physics

Primary PM2.5
Secondary PM2.5
Ozone

Population Exposure and Health Impacts

Global Climate Change

Cooling Effects
Warming Effects

Combustion Emissions

SOx
NOx
CO
H2O
CH4

Emissions from Fuel Production

CH4, N2O, CO2

Land and Water Usage

Aircraft Noise
The Solution - U.S. five-pillar approach

- Advance Scientific Understanding & Improve Analysis Capability
- Accelerate Transition of New Aircraft Technology
- **Develop Alternative Fuels**
- Accelerate Operational Changes
- Examine Policies, Standards and Market Based Measures

Our Plans

- Absolute reductions in significant noise and air quality impacts
- Aggressive efficiency improvements of at least 2% per year
- Carbon neutral growth by 2020, absolute reductions by 2050
- Aircraft and engine CO₂ and other emissions standards
FAA Alternative Aviation Fuel Activities

• Commercial Aviation Alternative Fuels Initiative (CAAFI)
• Continuous Lower Energy, Emissions and Noise (CLEEN) program
  • Assess impact of alt fuels on aircraft fuel system
  • Alt fuel engine tests and flight demos
• Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence www.partner.aero
  • Life cycle analysis of green house gas emissions
  • Modeling and assessment
• Airport Cooperative Research Program www.trb.org/ACRP/Public/ACRP.aspx
  • Resources for integrating alt fuels at airports
  • Cost/benefit analyses of alt fuels at airports
WHAT HAVE WE ACHIEVED RECENTLY?

- Approval of a new synthetic jet fuel specification (ASTM D7566) —
  - Fisher-Tropsch alternative blends now approved
  - Hydroprocessed renewable jet (HRJ) expected soon
- Multiple flights on these fuels
- Research & Development roadmaps
- Development of a Fuel Readiness Level (FRL) scale
- Formed coalition of airlines, aircraft and engine manufacturers, energy producers, researchers and U.S. government agencies
- Facilitated links between energy companies, airline fuel buyers and investors in support of early commercial deployment;
- Established CLEEN program
CURRENT ALTERNATIVE JET FUEL PROCESSING

Petroleum

Fischer-Tropsch (FT)
- Coal
- Natural Gas
- Biomass
  - Syn Gas (CO, H₂)
  - Gasify
  - FT Process

Conventional Refinery Processes
- Crude Oil
- Syn-Crude
- Bio-Crude
- Hydroprocessing
- Jet Fuel

Hydroprocessed Renewable Jet (HRJ) from Bio-Oils
- Plant/Algae Oils
- Oil Extraction
Synthetic Jet Fuels in R&D Phase

Advanced Fermentation (FRJ)
- Genetically Engineered Microbes

Alcohol Oligomerization (CRJ)
- Fermentation
- Dehydration
- Olefins

Pyrolysis (PRJ)
- Pyrolysis
- Bio-Crude

Conventional Refinery Processes
- Polymerization

Jet Fuel

Sources of Lignocellulose:
- Sugarcane
- Switchgrass
- Corn stover
- Forest waste

Processes:
- Silicon
- Fermentation
- Dehydration
- Olefins
- Sugar Fermentation
- Alcohol Oligomerization
- Pyrolysis
- Olefins
- Polymerization
- Bio-Crude
- Hydroprocessing
- Conventional Refinery Processes
- Jet Fuel
CERTIFICATION / QUALIFICATION PLANS & TARGETS

- D7566 Issued Sept 1 2009
- HRJ Research Rpt – in Review
- Future Fuels Testing
  - HRJ 50% Blend in D7566 2011
  - Additional Testing 2010
- FRJ, PRJ, CRJ Approvals TBD
- FRJ Flight Test 2013
• Commercial aviation growth & capacity constrained by environmental impacts
• We are actively addressing energy challenges of commercial aviation
  • Improving scientific understanding
  • Accelerating technology transition
  • Developing aviation alternative fuels
• Aviation alternative fuels show great promise for reducing environmental impacts and enhancing energy security
• Commercial Aviation Alternative Fuels Initiative (www.caafi.org)
• CLEEN (http://www.faa.gov/about/office_org/headquarters_offices/aep/research/cleen/)
• Partnership for AiR Transportation Noise and Emissions Reduction (www.partner.aero)
• Airport Cooperative Research Program (www.trb.org/ACRP/Public/ACRP.aspx)