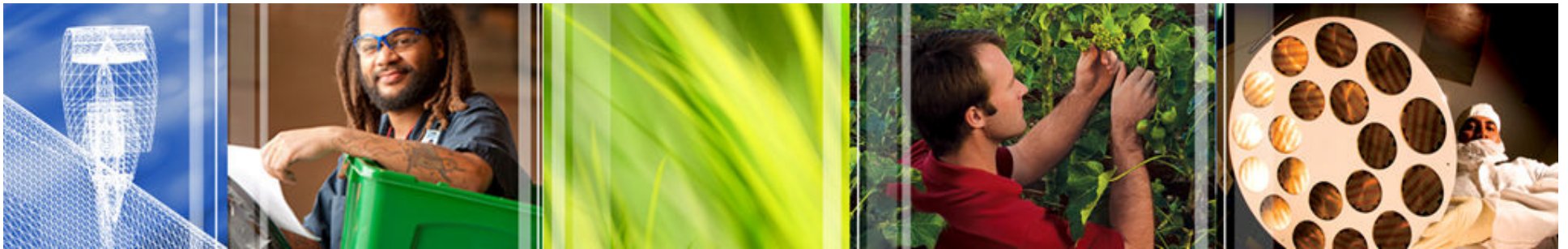




Commercial Airplanes

Aviation and Sustainable Biofuel



**Western Aviation Expo
Stephen Emmert – Boeing Commercial Airplanes**

May, 2013

A New Vision for Aviation

**Why Aviation
Biofuel?**



First industry steps



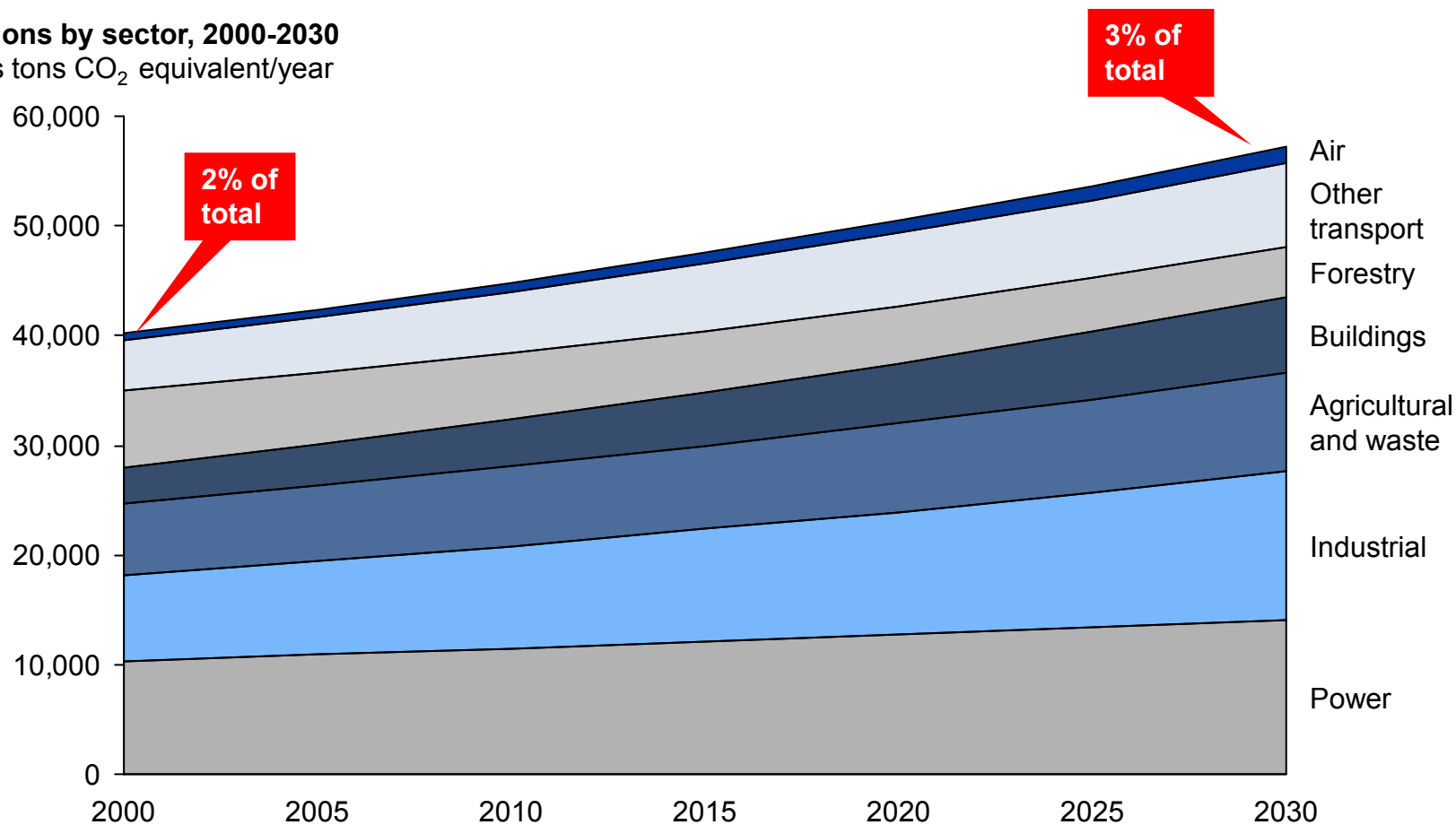
Boeing's Role



Global CO2 Emissions



Emissions by sector, 2000-2030
Millions tons CO₂ equivalent/year



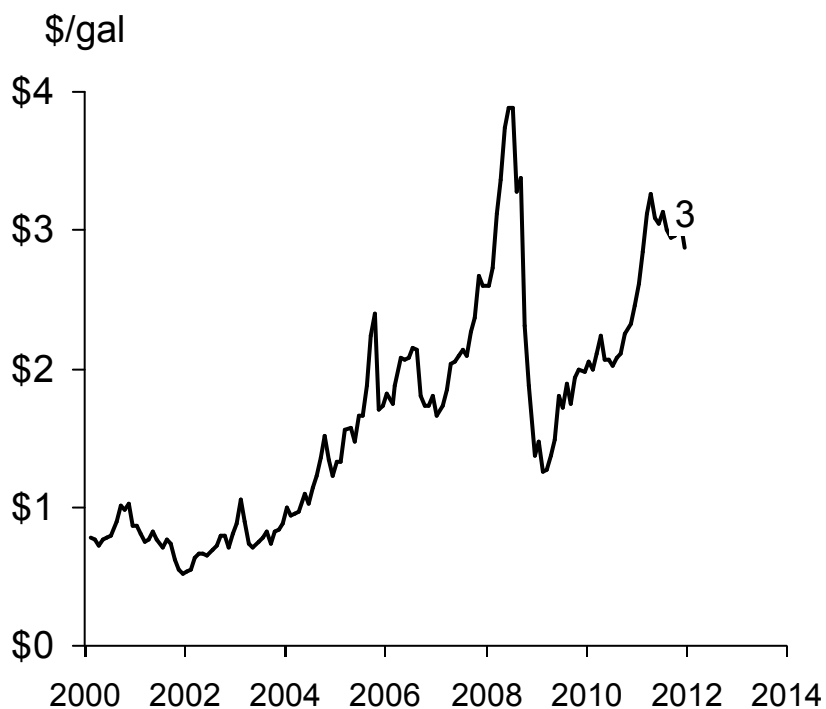
Small but growing share of emissions

Source: IPCC

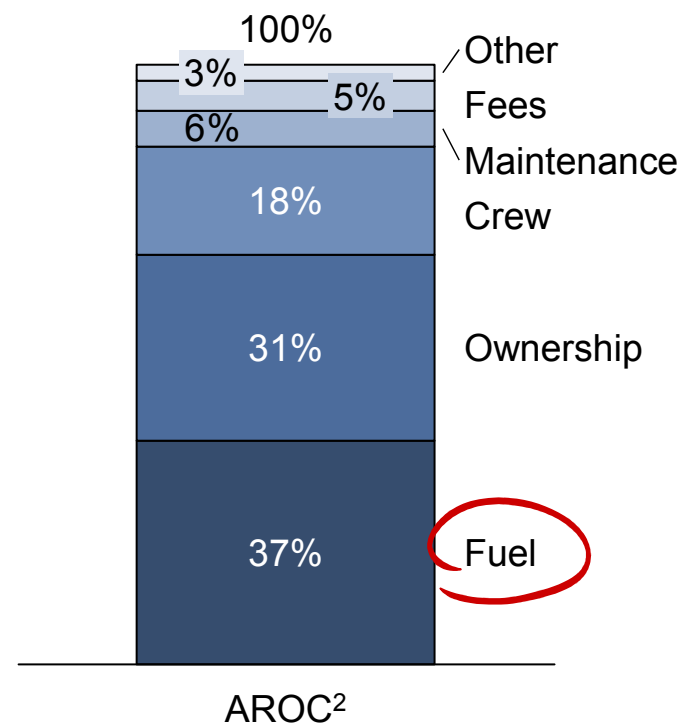


Fuel largest airline cost and rising

Rising fuel prices¹



Airline operating costs



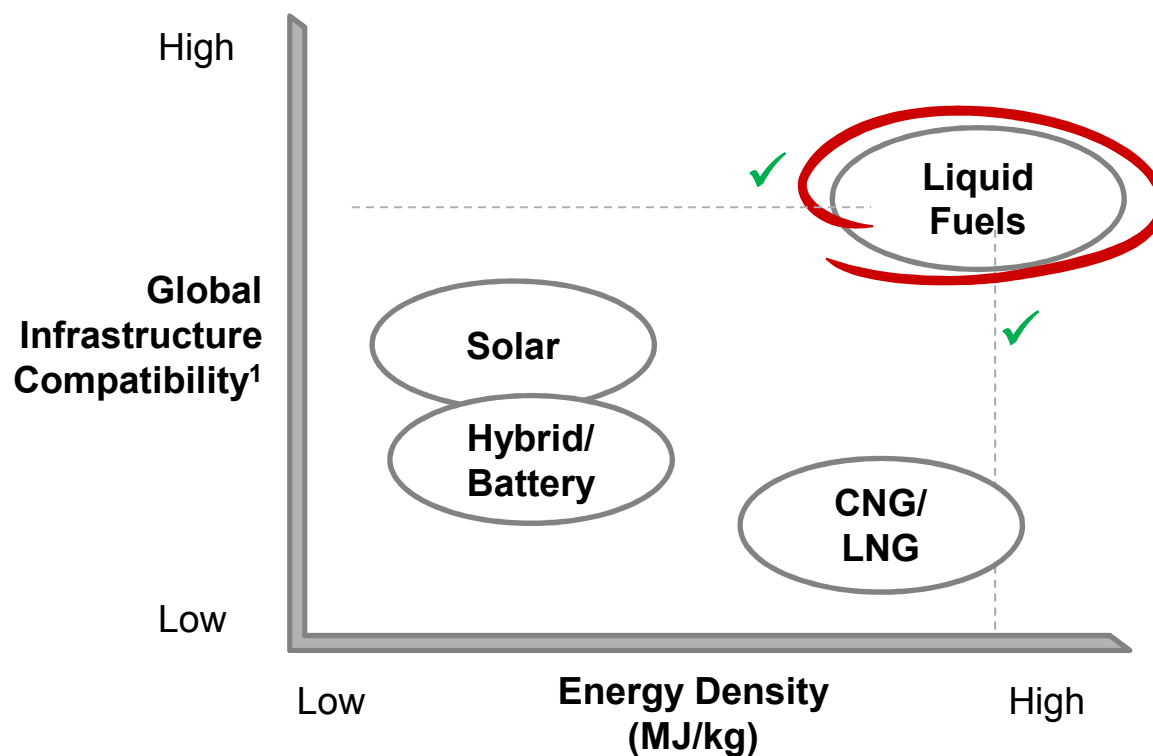
Sources: EIA

1. US Gulf Coast Jet 2. Airline Related Operating Costs based on US Majors 777-200ER fleet

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Energy Options for Aviation



Liquid Fuels Only Realistic Near Term Option

1. Defined as the combination of airport and airplane technology compatibility.
2. Sources (see appendix for detail): CNG/Liquid Fuels: C. Ronneau (2004), Energie, pollution de l'air et developement durable, Louvain-la-neuve: Presses Universitaires de Louvain.
Battery: Stanford University, Global Climate and Energy Project. *A Technical Assessment of High-Energy Batteries for Light-Duty Electric Vehicles*. GCEP Energy Assessment Analysis Fall 2006



Boeing Supports “Drop-In” Fuels

- Meets fuel performance requirements
- Requires NO change to airplanes or engines
- Requires NO change to infrastructure
- Can be mixed or alternated with today’s Jet-A fuel



A new way of making the same fuel

A Way Forward

Why Aviation
Biofuel?



First industry steps



Boeing's Role



State of Aviation Biofuel Industry



✓ Technically viable



ASTM and Def Stan approved

High quality standard

✓ In demand



Airline support

In commercial use

US Military Support

✗ Sufficient supply



Refinery capacity small

Price premium

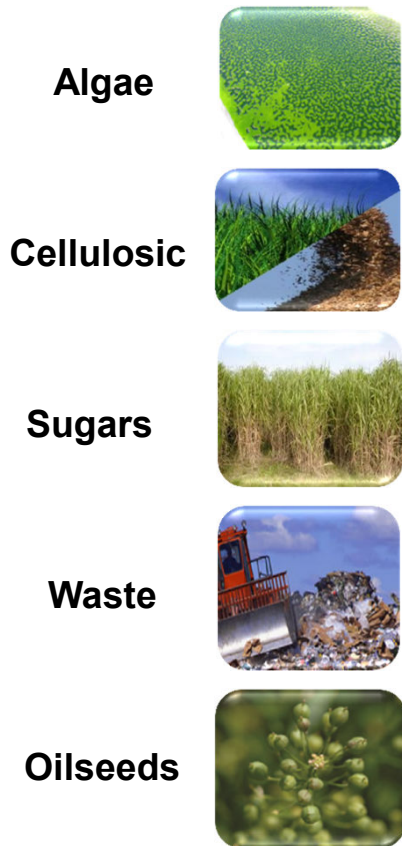
Limited sustainable feedstock

Supply is the main challenge

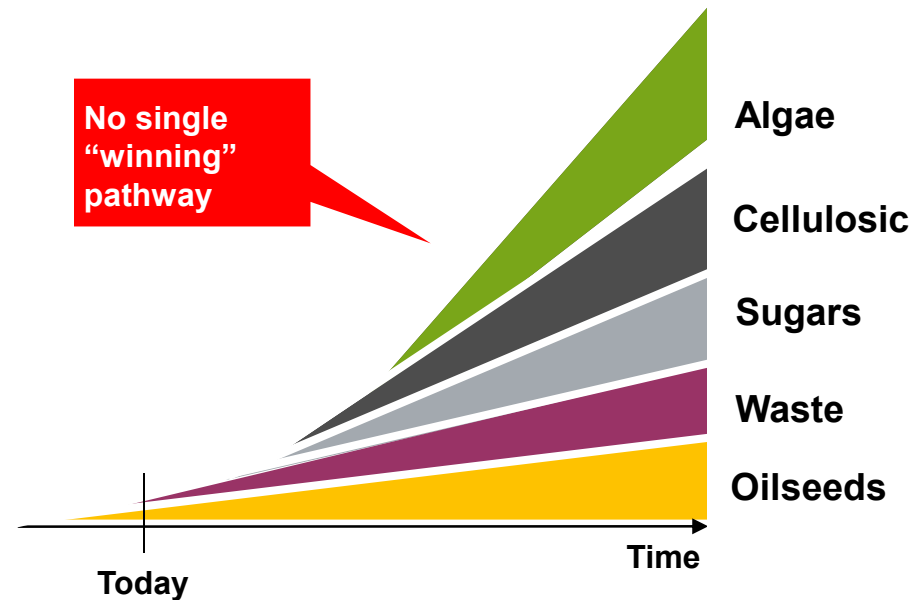


Sources for Aviation Biofuel

Sources of Fuel



Expected Availability



Marketplace will determine future mix of fuel sources

Sustainability is Critical to Success



Key Sustainability Requirements¹



Doesn't contribute to indirect impacts



Positive GHG impact



3rd party standards and audits²

Benefits



Assurance of environmental benefit



Socio-economic



Moral license



Credit opportunity³

1. Other requirements include land use changes, water use, land rights, labor rights 2. Examples include RSB, FSC, etc. 3. Examples include EU ETS avoidance and US RINs
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Boeing's Role in Making Biofuel a Reality

Why Aviation
Biofuel?



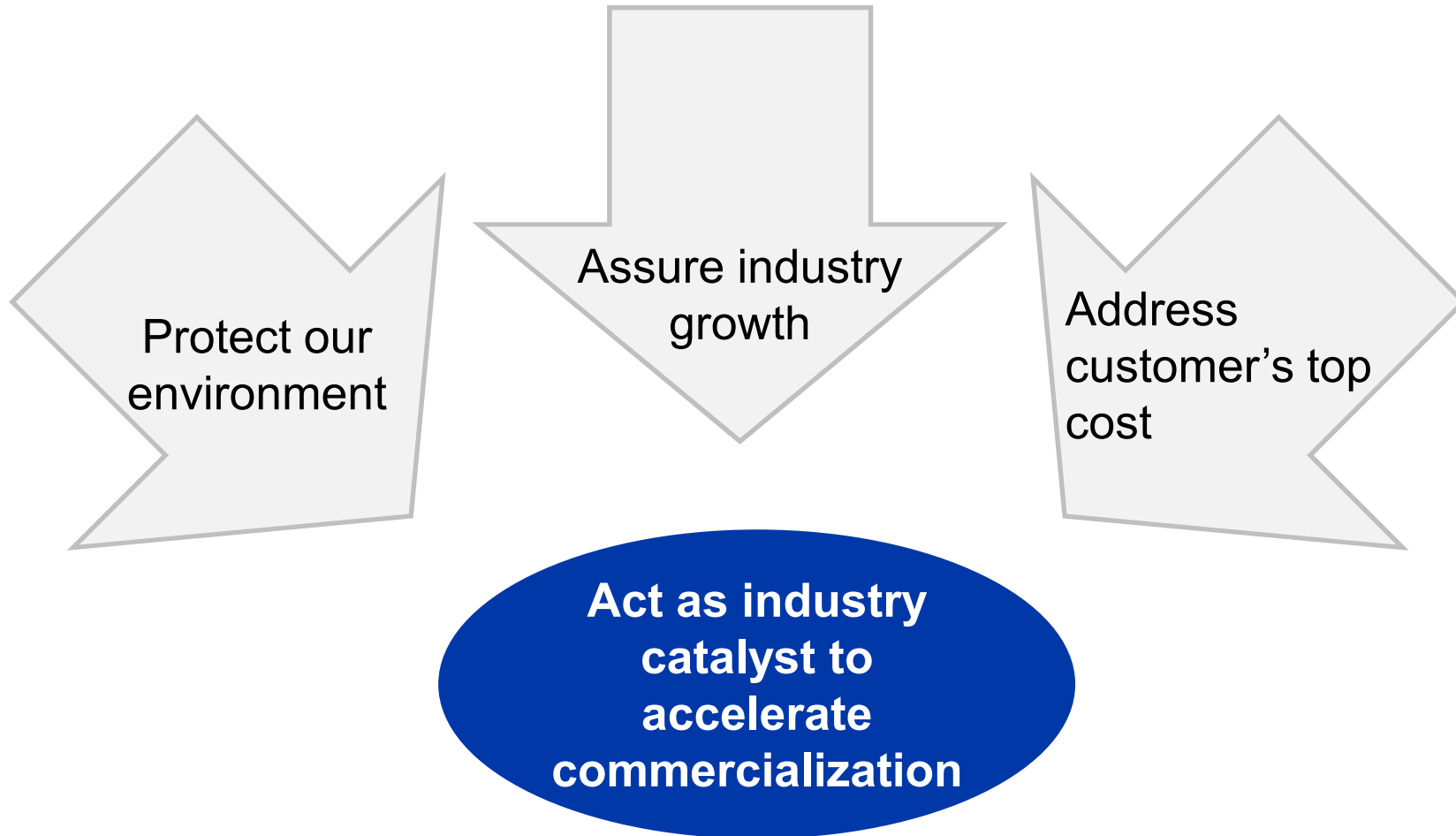
First industry steps



The Boeing Role



Boeing Role





Boeing Global Biofuel Engagements

Recent and Active Biofuel Projects

Outcomes



- ASTM & DEF STAN approval
- SAFUG¹ growing
- Commercial flights from 2011
- Focused regional research projects
- Biofuel roadmaps published

1. Sustainable Aviation Fuel Users Group

Moving From Dreams to Reality



Aviation Biofuel Progress

- ASTM approval for commercial use
- Regional assessments
- Favorable policy developments
- Commercial flights continue

Next Steps

- Continued emphasis on sustainability
- ASTM approval for Alcohols-to-Jet
- Research - expanded feedstocks/pathways
- Commercial production scale-up

Great progress. Superior fuel. Early in the journey.