BCA Perspective on Fuel Cell APUs

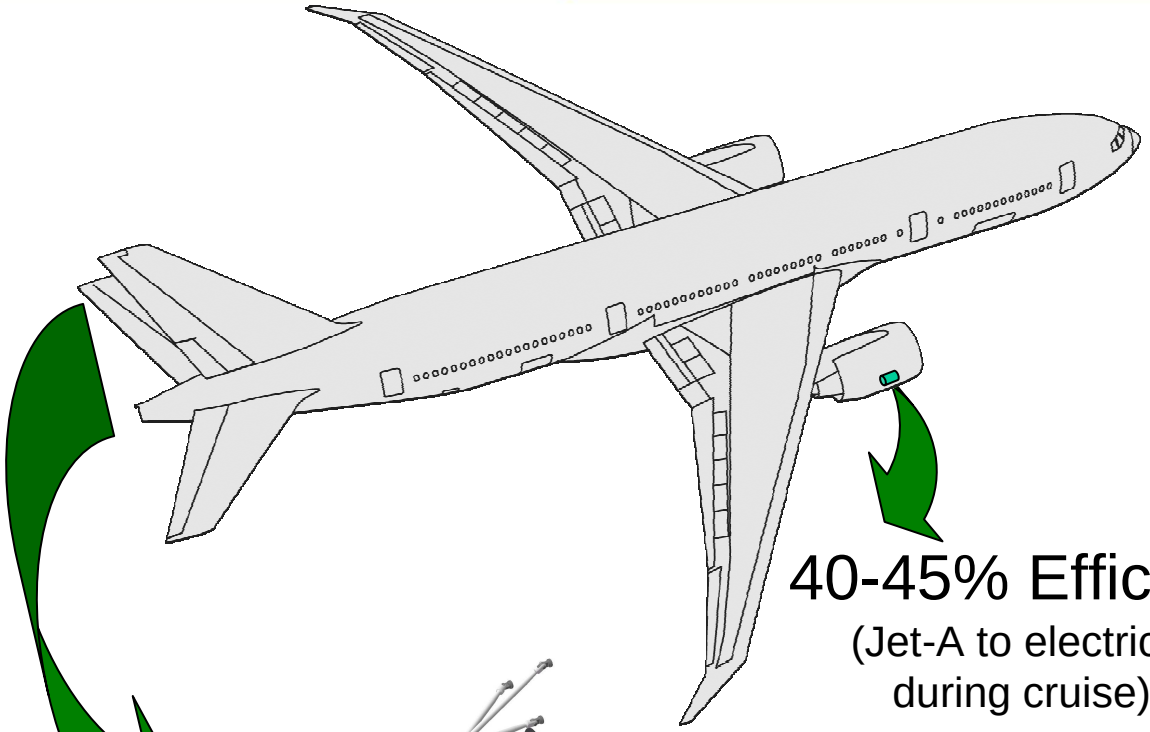
Joe Breit
Associate Technical Fellow
Boeing Commercial Airplanes

September 30, 2010

DOD-DOE Fuel Cell APU Workshop

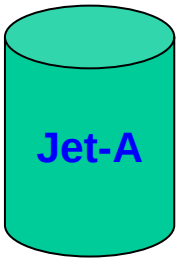
Commercial Airplanes

In-flight SFC* saving is ≈0.7%



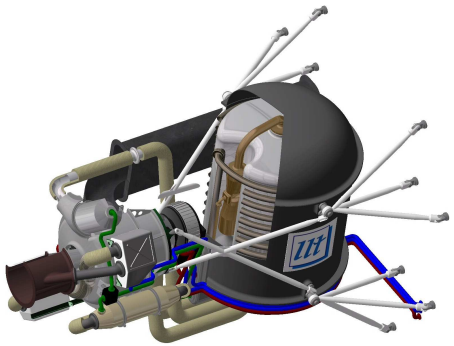
40-45% Efficient
(Jet-A to electrical during cruise)

=



1 litre

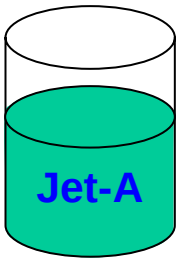
40% less fuel used



Future 2015 SOFC APU

≈75% Efficient
(Overall system at cruise)

=



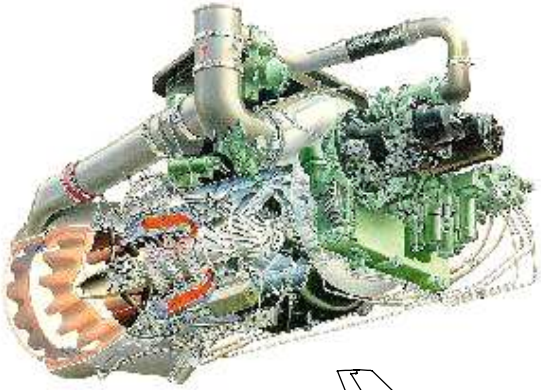
0.6 litre

* Specific Fuel Consumption

BOEING

Commercial Airplanes

Fuel saving opportunity on the ground is very attractive

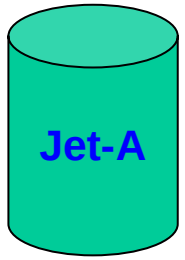


Typical Turbine-powered APU

15% Efficient

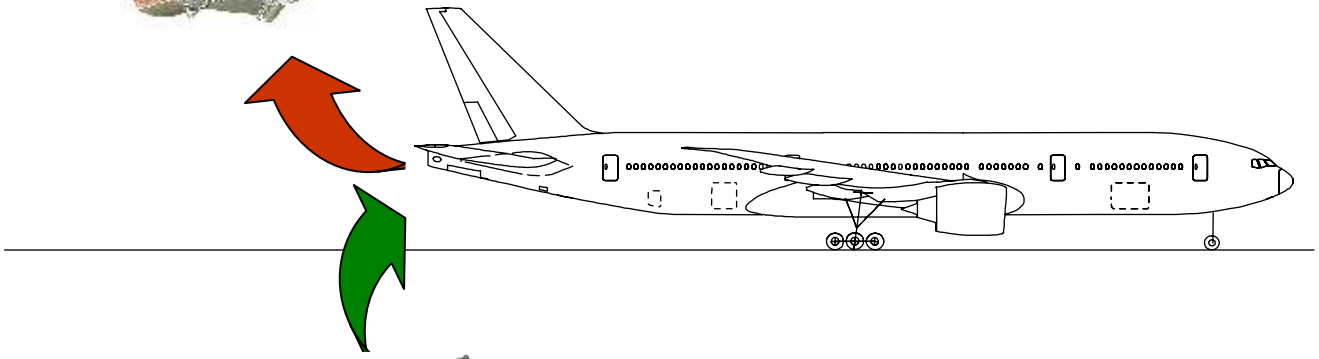
(over average operating cycle)

=

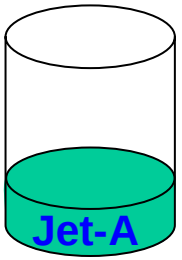


1 litre

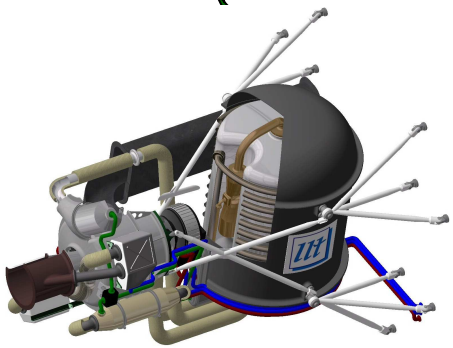
75% less fuel used



=



0.25 litre



Future 2015 SOFC APU

60% Efficient

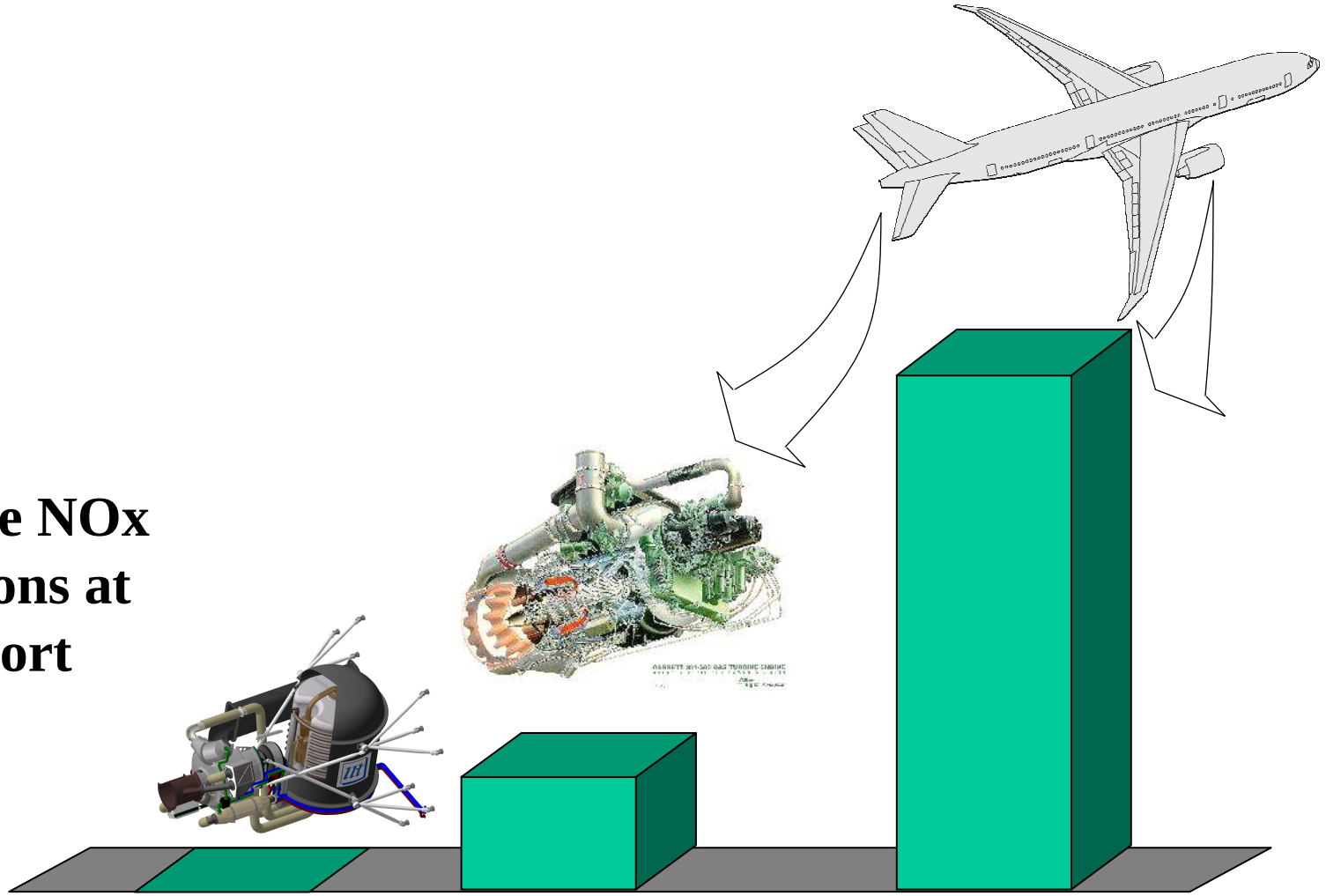
(at std. sea-level conditions)

BOEING

Commercial Airplanes

Fuel cell APU can cut airplane NOx emissions at the airport

Airplane NOx Emissions at Airport



BOEING

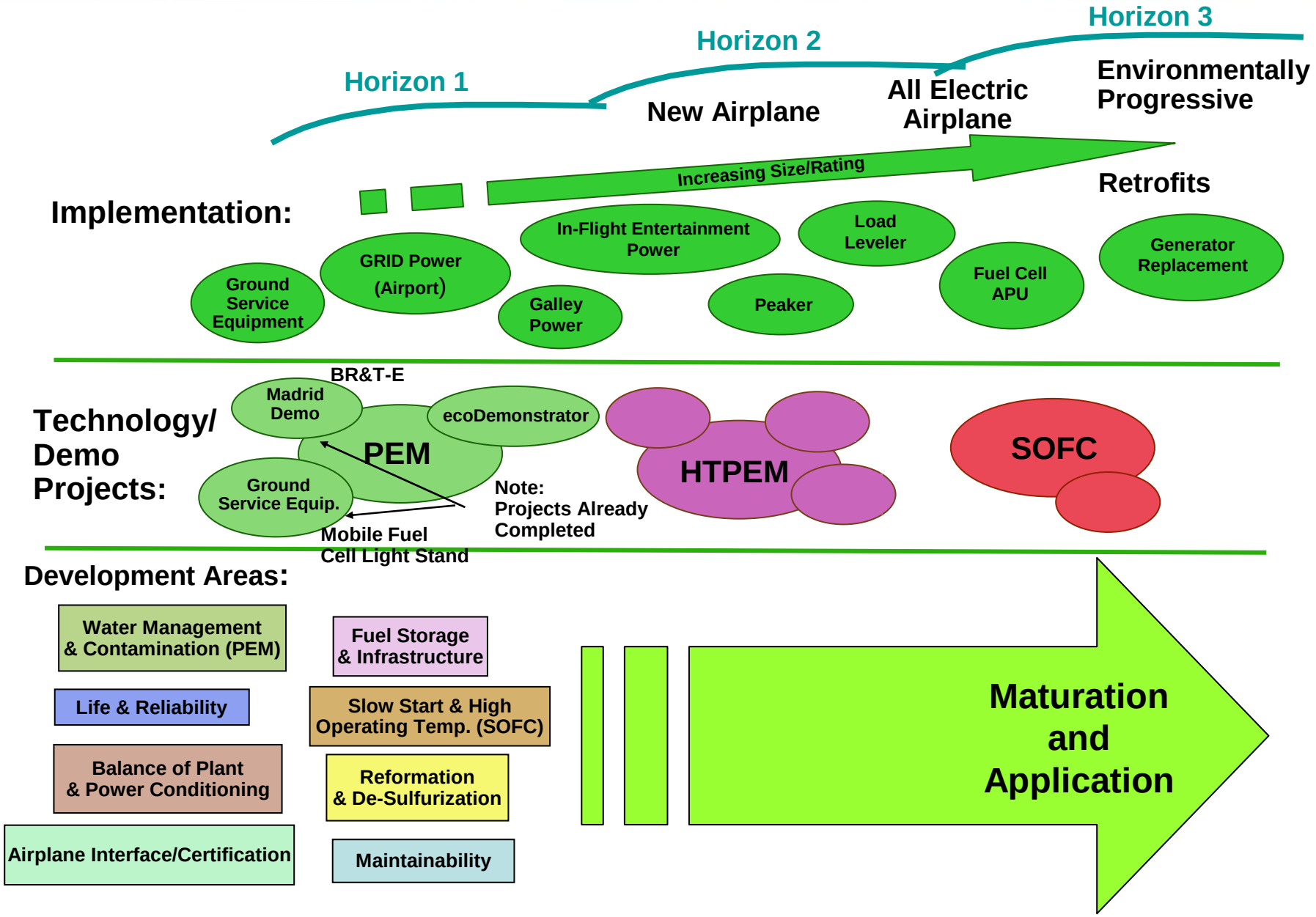
More Electric Airplane (MEA) Background

- **Efficiency changes in 787 due to:**
  - **Composite airframe**
  - **Efficient no-bleed engines**
- **Transition in power sources in the MEA**
  - **Increase in electric power to ~1.5 MW**

Efficient No-Bleed Engines

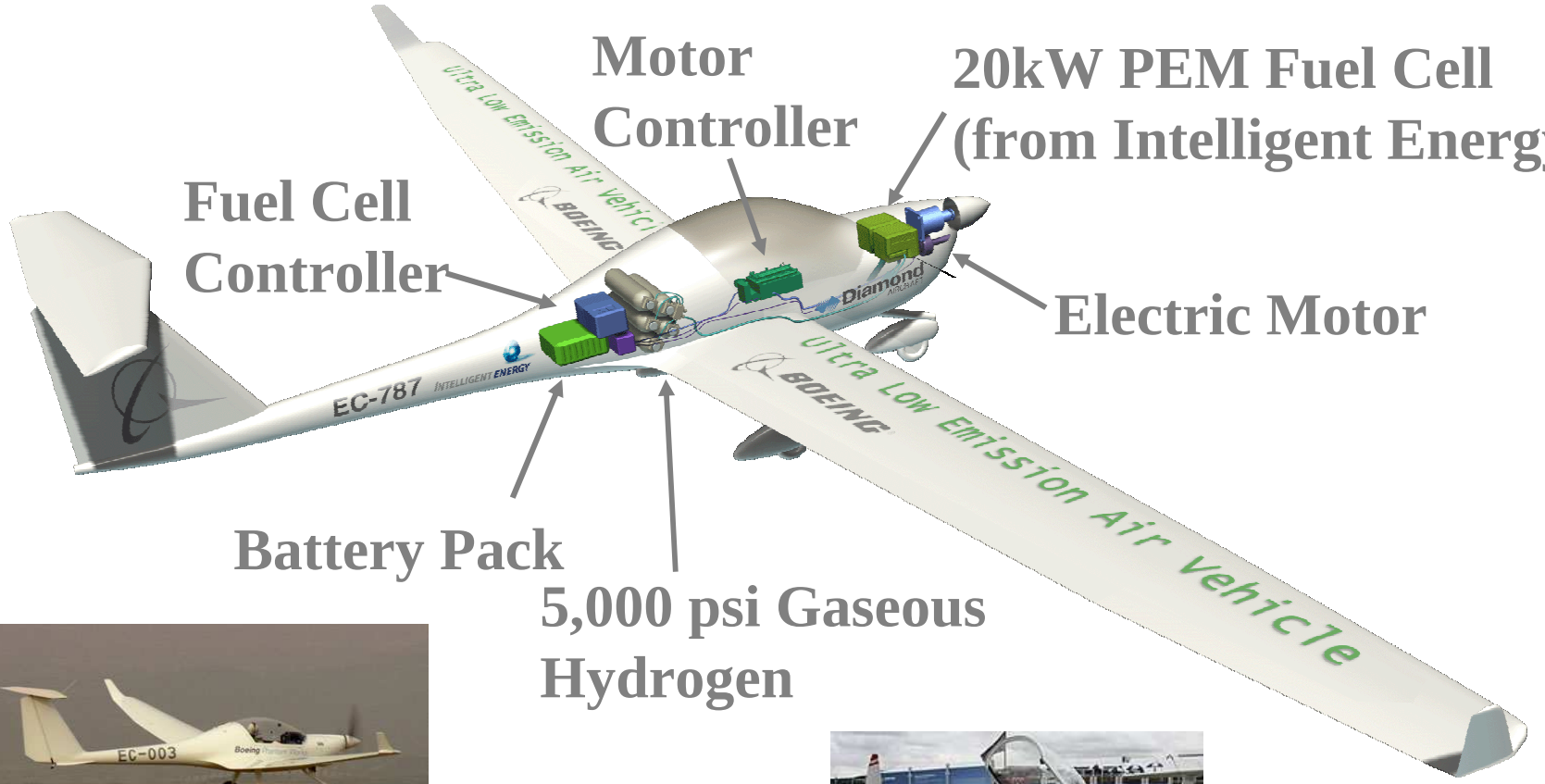
Power Source	Bleed	No Bleed + MEA
Electrical	Cabin Lighting Avionics, Fuel Pumps, etc.	Engine start, De-Ice ECS & Pressurization, Cabin Lighting, Avionics, Fuel Pumps, Brakes, Flight Controls, etc.
Hydraulic	Brakes, Flight Controls, Landing Gear, etc.	Flight Controls, Landing Gear
Pneumatic	Engine start, De-Ice ECS & Pressurization	Cowl De-Ice

Proposed Path to Fuel Cell Technology for Aviation

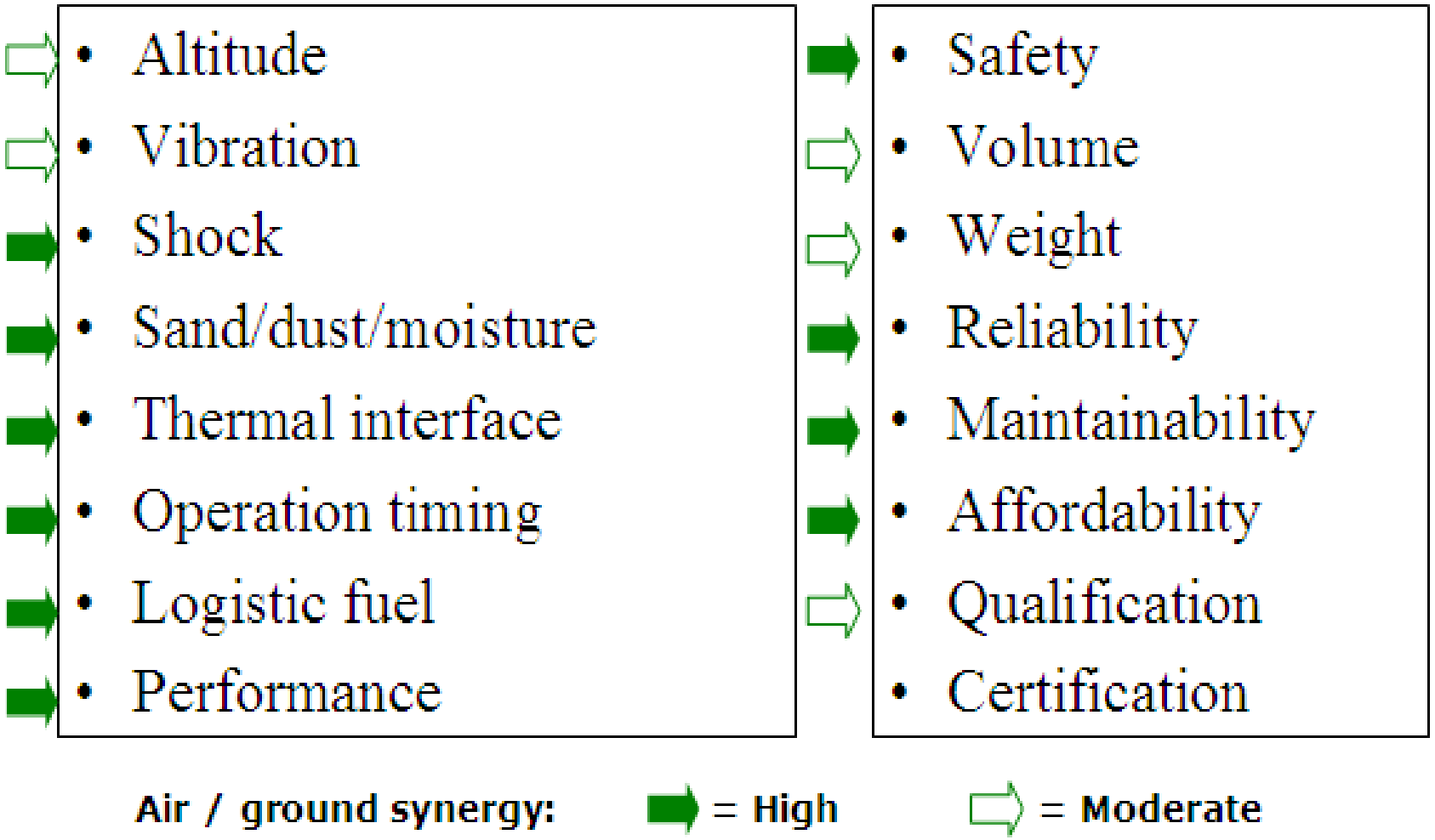


Demonstrators are a means to get familiar with integration and operational issues

Boeing Fuel Cell Airplane Demonstrator – BR&T (Boeing Research and Technology) Europe



Ground System Applications can Mitigate Aircraft Integration Challenges



Mobile Fuel Cell Light Stand

Quiet Operation, Large Illuminated Area

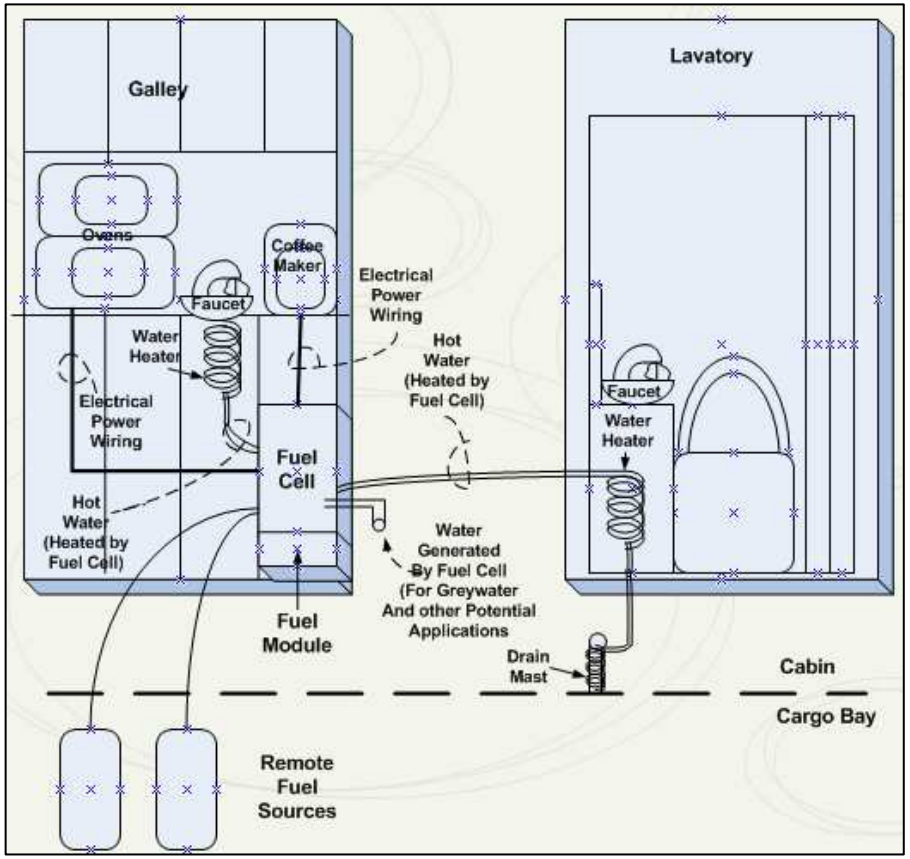
Caltrans Director, Randy Iwasaki (C)

Alpha System shown in technology show at AASHTO meeting on 10/25/09 →

AASHTO = American Association of State Highway Transportation Officials

Courtesy of Sandia Labs

Fuel Cells for Non-Essential Loads



- Fuel cells can remove these loads from the power system
- Fuel cells can be used to power non-critical loads like galleys and In-Flight Entertainment
- Can use waste heat and waste water improving overall efficiency
- Decreases the size of generating system
- Decreases the engine power extraction
- Improved operational efficiency for airlines
  - Design to provide power for specific airline configuration (i.e. galleys and IFE) - not penalized operationally beyond need
- Micro-grid approach provides increased flexibility as to configuration
  - Changes do not require update to airplane electrical power system

Summary

- Fuel Cell APUs have the potential to benefit airplane efficiency and decrease airplane emissions
- Ground applications and testing can be used to develop the technology and infrastructure
- Demonstrators can be used to understand the application and identify technology gaps
- Application on non-essential loads can be used to gradually introduce this technology to in-service operation
- R&D specific to the application can help to advance the technology of fuel cells for airplanes

BOEING

Questions?