

Dr. Michael Enzinger
Airbus
Research & Technology



Airbus Multifunktionale Brennstoffzelle

High-Tech für die nächste Generation öko-effizienter Flugzeuge

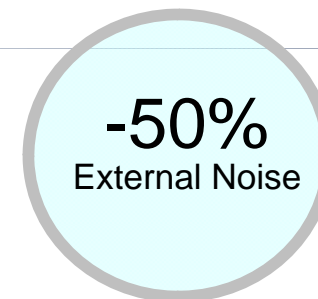
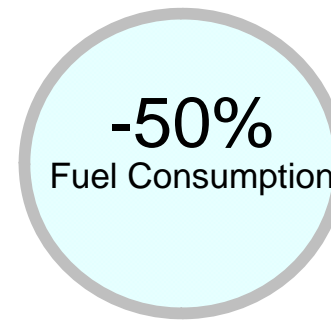
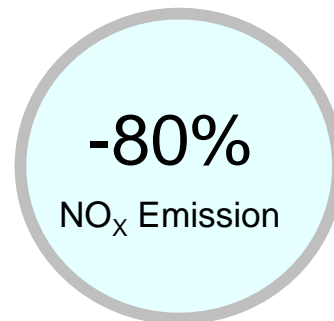
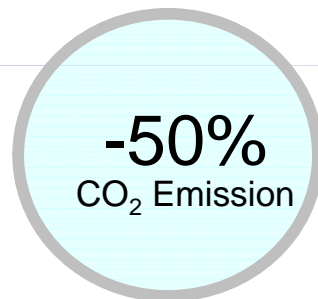


Airbus Vision 2020

“We want to make our aircraft even more efficient, cleaner and quieter. The eco-efficiency of our products will be a determinant benchmark to measure the success of our research.”

Dr. Thomas Enders

President and CEO of Airbus



Airbus is fully committed to the fuel cell technology as a key contributor to achieve the ACARE* 2020 goals

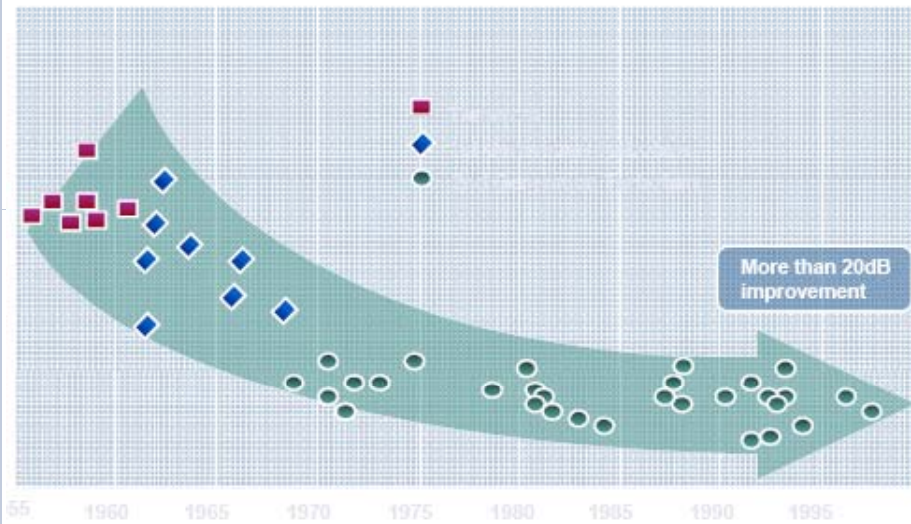
Content

- 1) Motivation
- 2) Scope
- 3) Current Status
- 4) Way forward

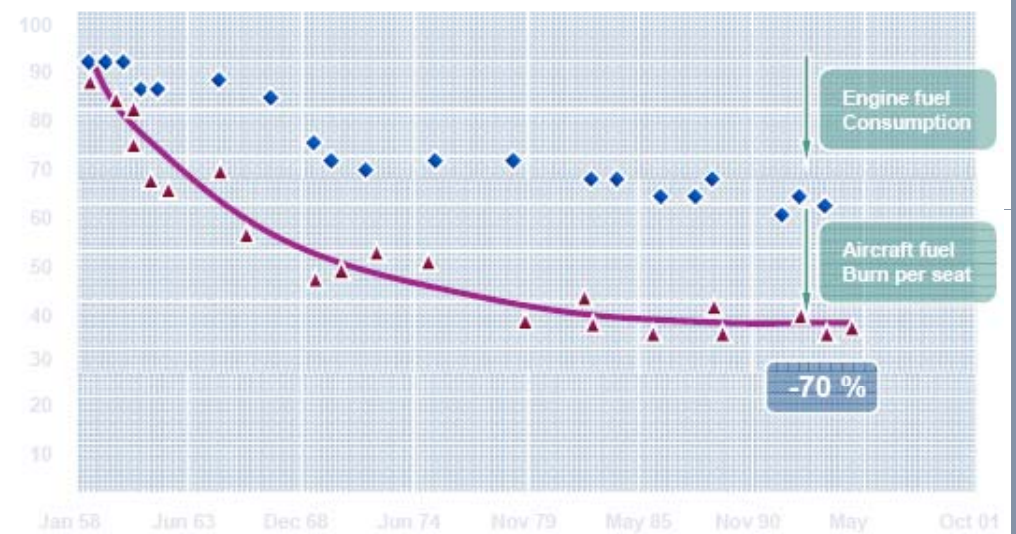
Aeronautical Industry has already achieved impressively

In the last 40 years...

75% Noise reduction



And 70% CO2 reduction

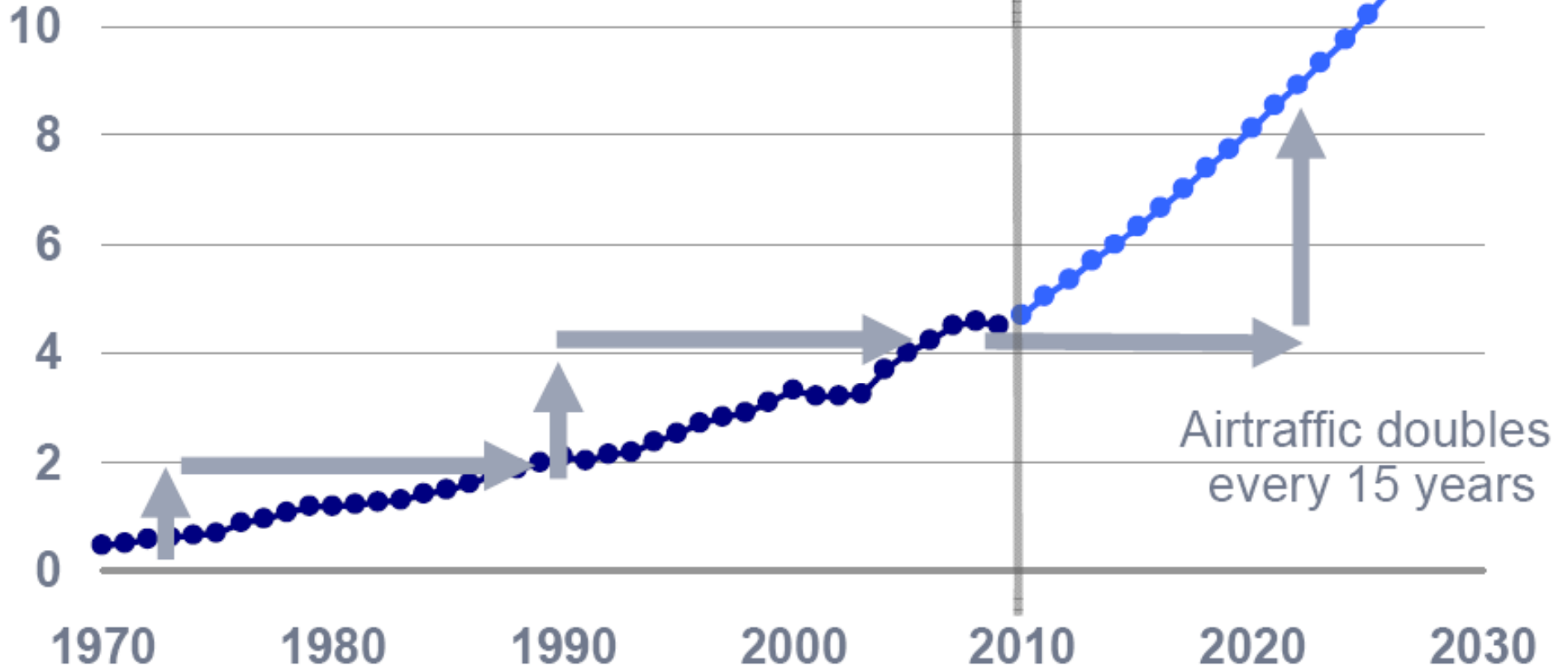


Aircraft Industry is a growth market

*Commercial A/C ≥ 100 seat; Freight A/C > 10 t payload

Pax-km

(10^{12})



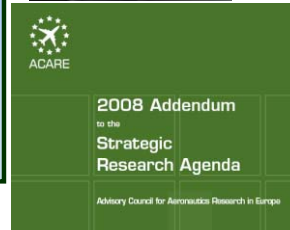
Environmental Targets



ACARE / EU- Vision 2020

Environmental Targets :

Reduction CO2 - 50%
Reduction NOx - 80 %
Reduction Noise - 10 dB



4 pillars strategy

Develop an efficient infrastructure
Optimise aircraft operation
Political instruments
Technology

Aircraft
manufacturers



Engine manufacturers



Operational aspects



Joining the efforts to achieve the targets

Fuel Cell Emergency Power System (FCEPS) Flight Test 2008

Airbus was the first aircraft manufacturer to

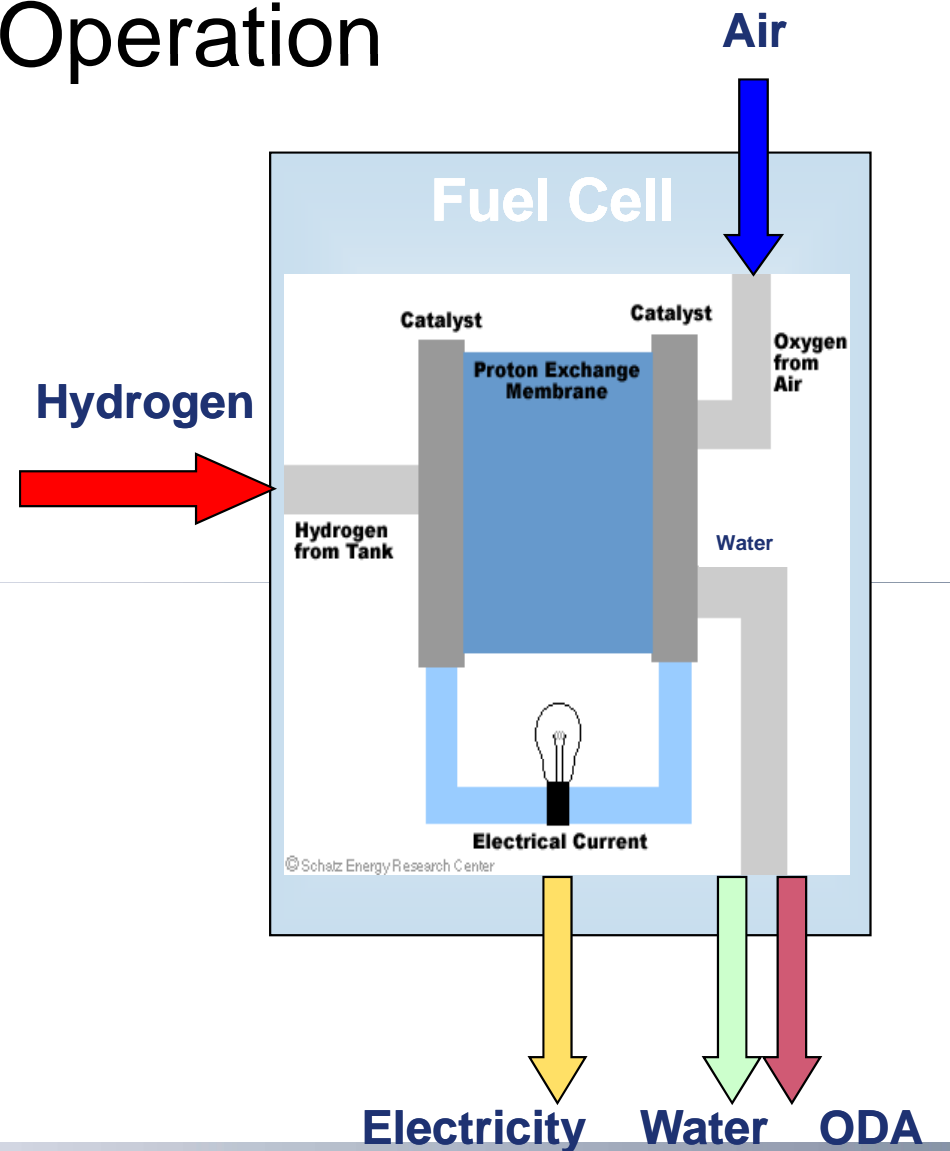
- Operate a hydrogen and oxygen supplied fuel cell system on board a civil aircraft.
- Perform flight tests and to power flight controls by a fuel cell in flight.
- Integrate a hydrogen supplied fuel cell system into an aircraft's electrical and hydraulic network.



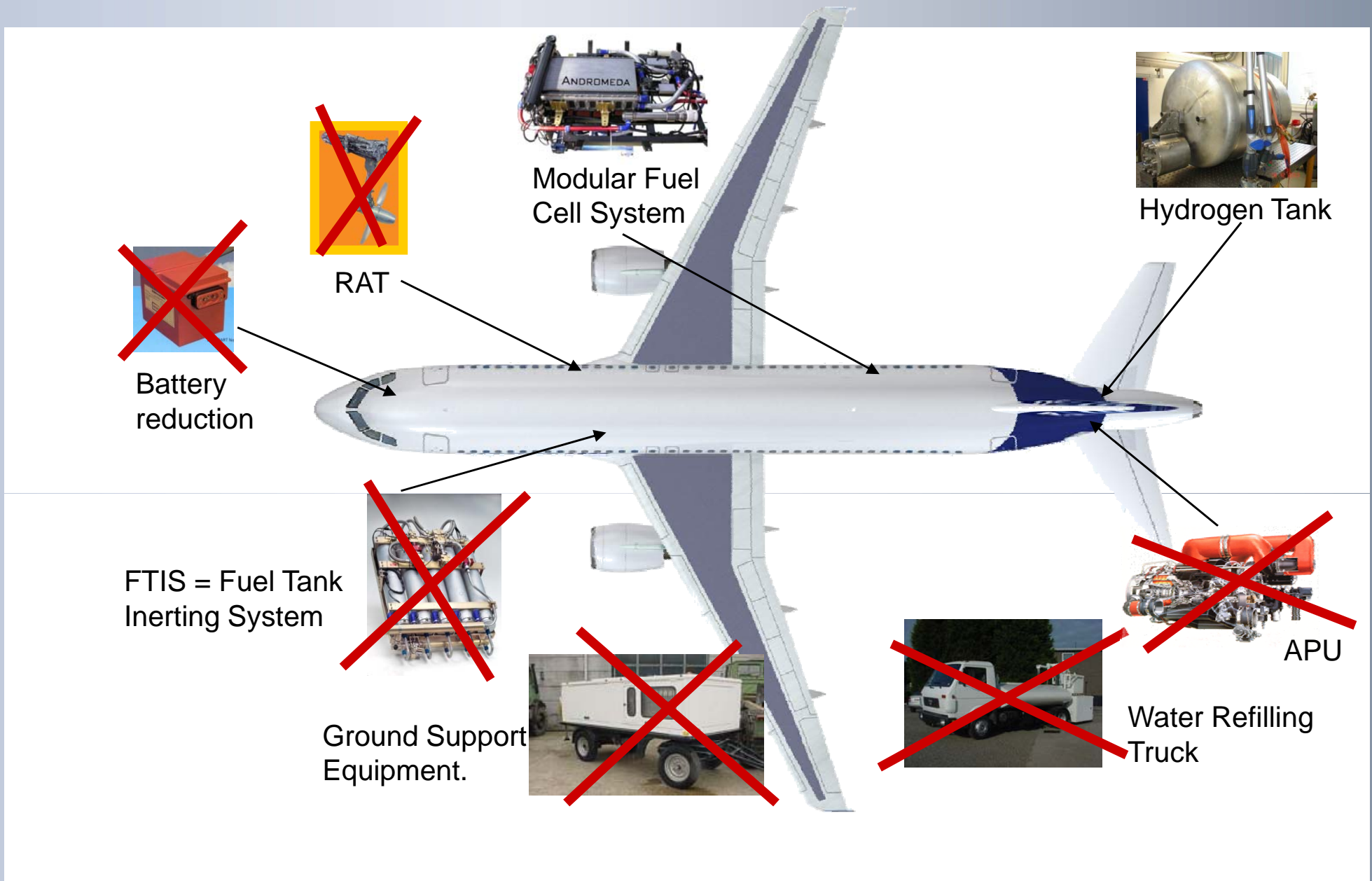
Fuel Cell Technology: Operation

Continuous change of chemical
energy
directly
to electrical energy and water
without
Combustion.

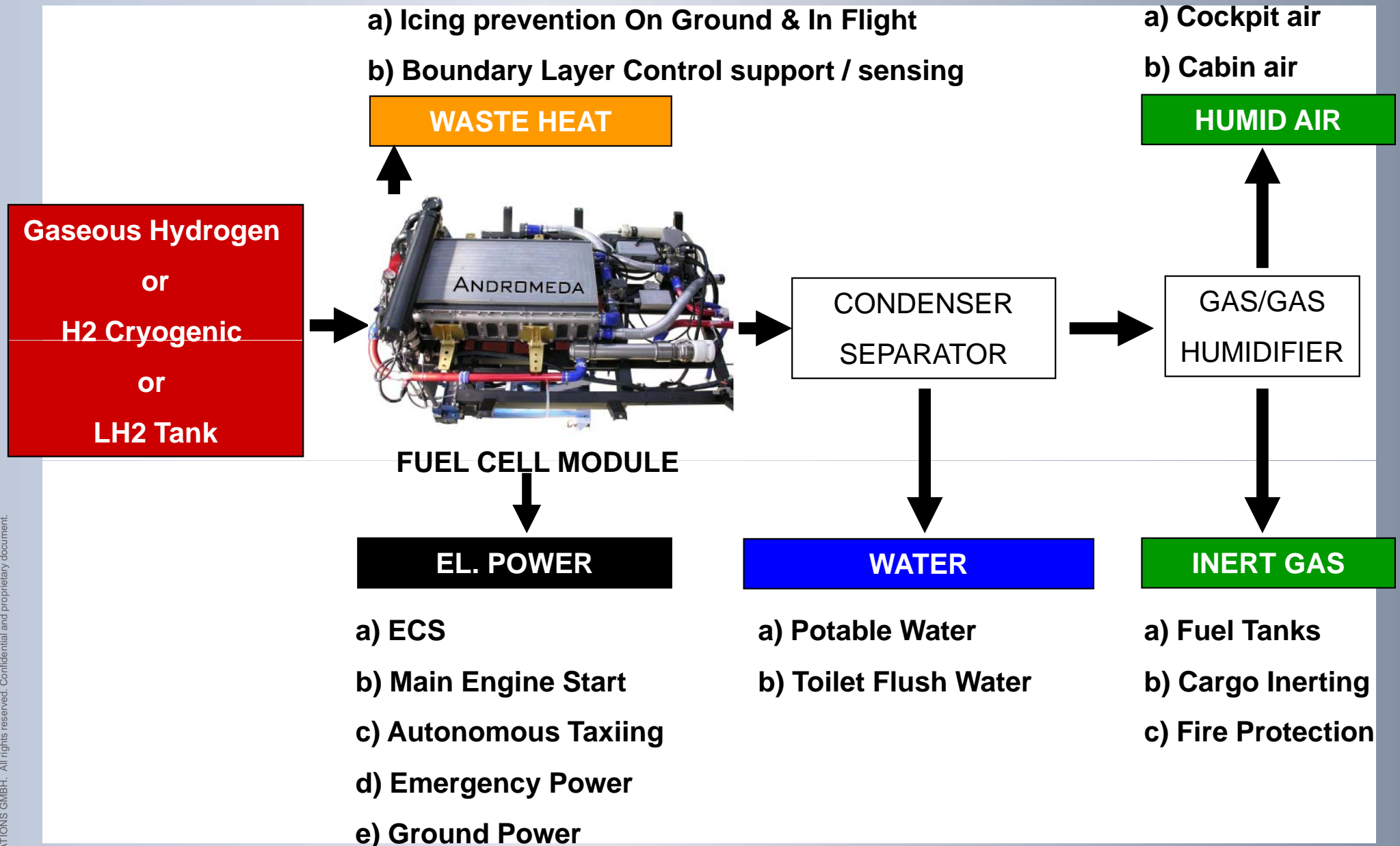
Fuel efficiency > 50%



Multifunctional Fuel Cell System on A/C – Systems overview



Multifunctional Fuel Cell System on A/C, Functional Overview



The Three Major Pillars of the Program

Fuel Cell Technology Integration

- FC system
- Power Mgmt
- Thermal Mgmt
- Ice Protection
- Power Electronics
- Inerting
- Hydrogen Storage
- Water generation



Aircraft Operations

- Value analysis
- DMC/RC/NRC/NPV
- Airport Operations
- Airline Operations
- Maintenance Concepts
- Hydrogen Infrastructure



Safety & Certification

- Risk analysis
- Safety Analysis
- Establishment of ATA Chapter 85
- Eurocae/SAE Standardization Working Group 80



DGLR/RAeS/VDI Vortragsreihe Hamburg

WG80/AE-7AFC members are from the following companies



Prospects of Fuel Cell Technology

Airport Local Air Quality

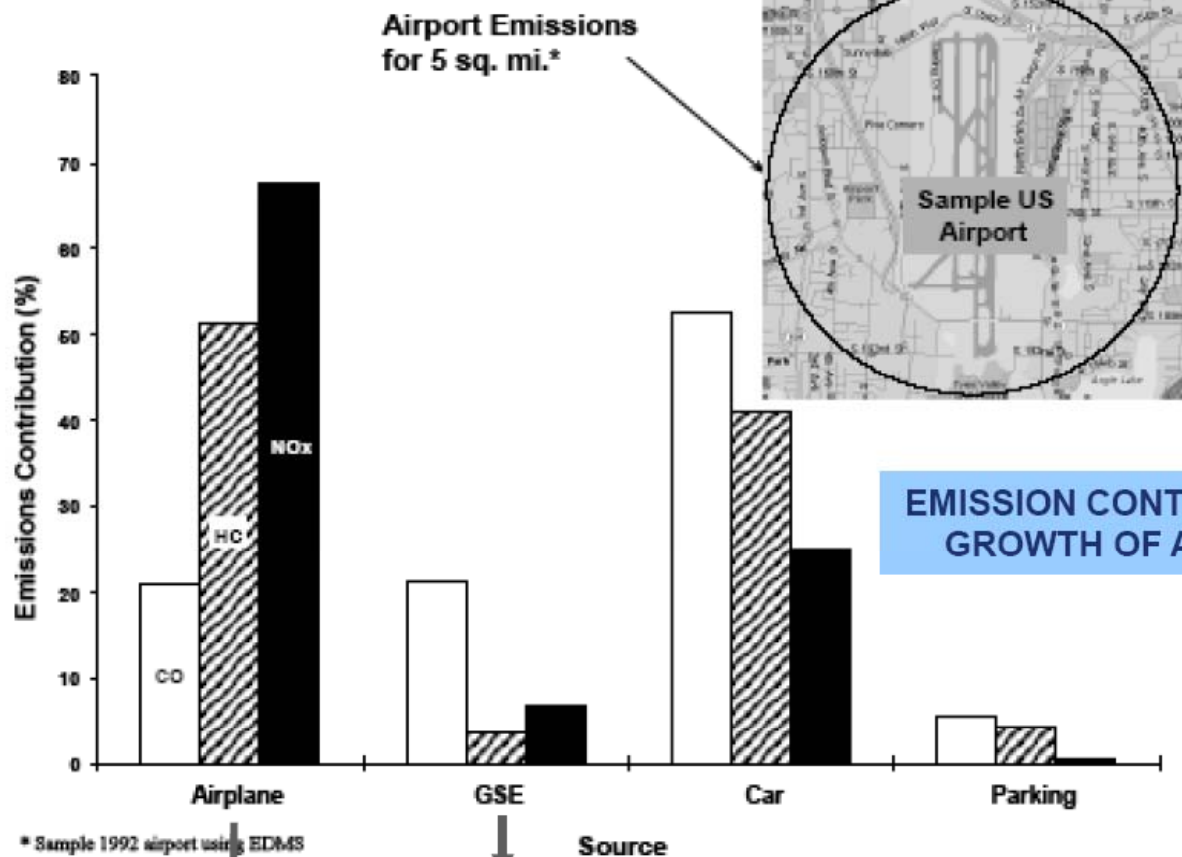


Fig. Source: „Water Misting and Injection of Commercial A/C Engines to Reduce Airport NOx“, NASA/CR –2004-212957

EMISSION CONTROL MAY ALLOW CONTINUED GROWTH OF AVIATION (Quote Regulation)

- # Improvement by Fuel Cell Power Unit deleting GSE
- # Improvement by Autonomous Taxiing with Engines stopped by Fuel Cell
- # Improvement by Water injection into Main Engine

Prospects of Fuel Cell Technology

Noise Reduction



APU



Excellent potential for a significant noise reduction

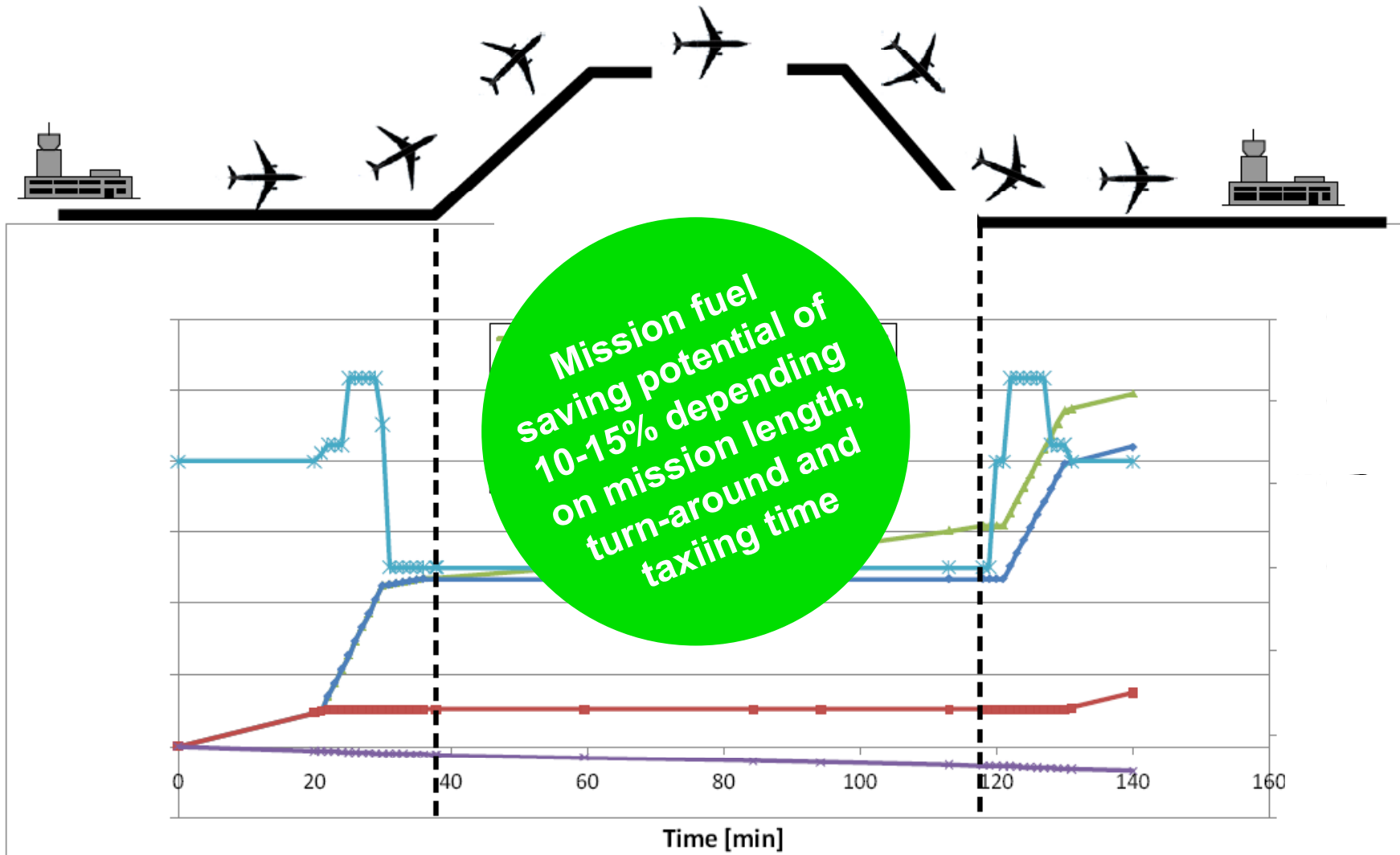


Fuel Cell

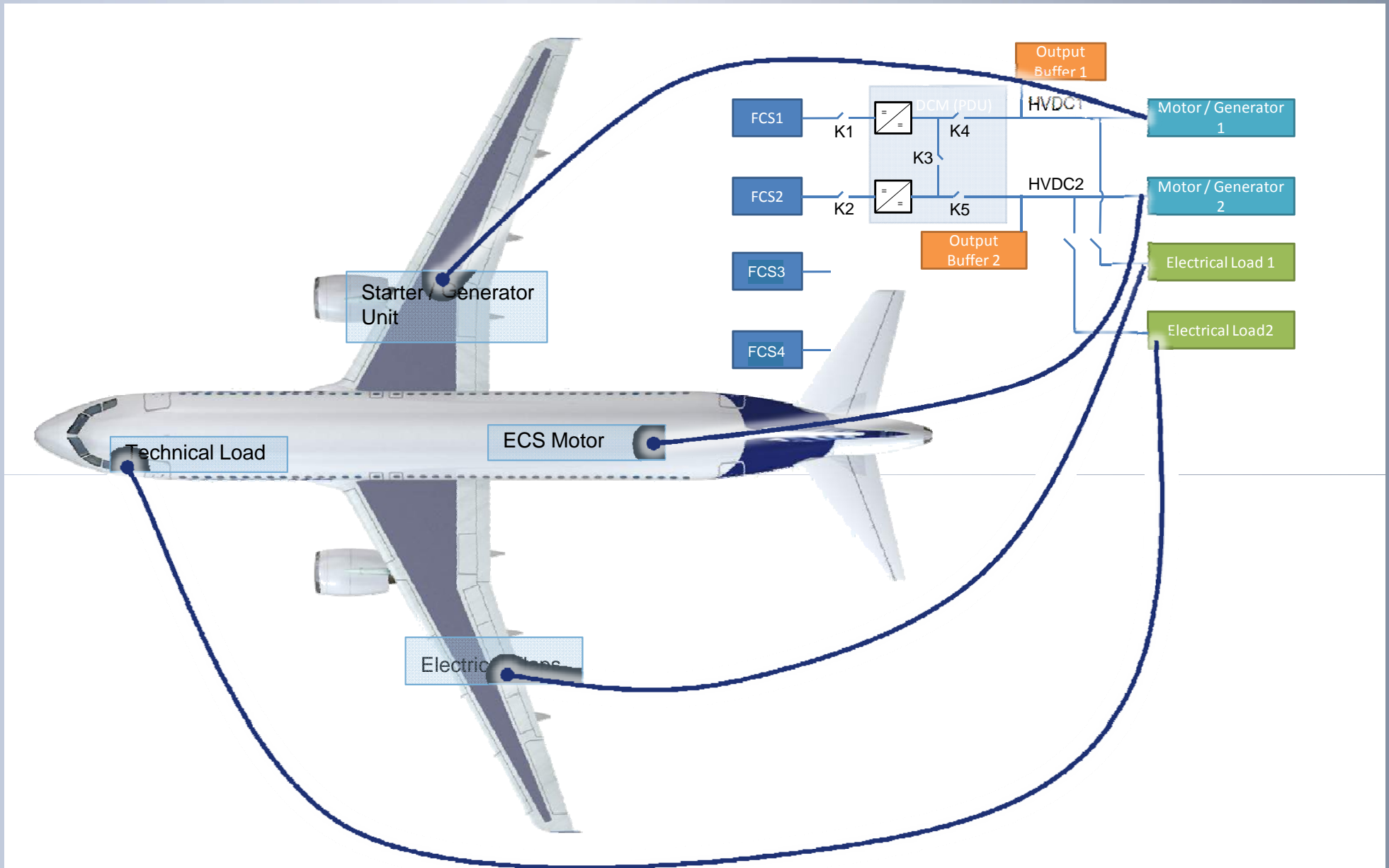


Fuel Savings Standard 500 nm Mission

Std. ICAO Mission



TRL 4 Power Management Review June 2011



Fuel Cell Test Center



Fuel Tank Inerting

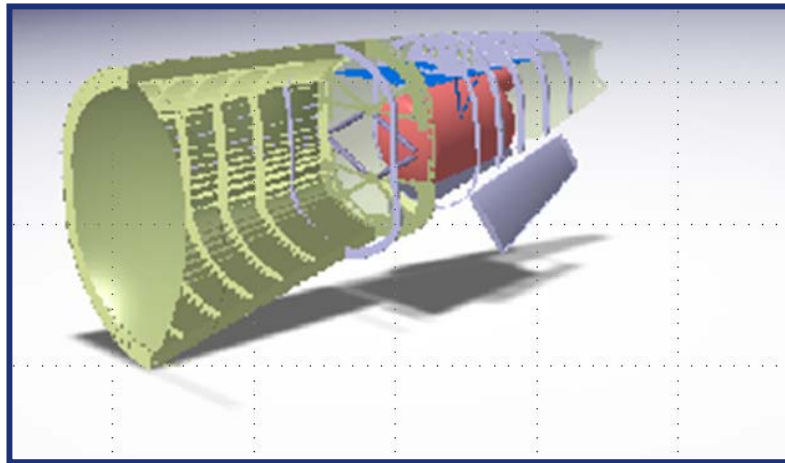


Duplex Fuel Cell System

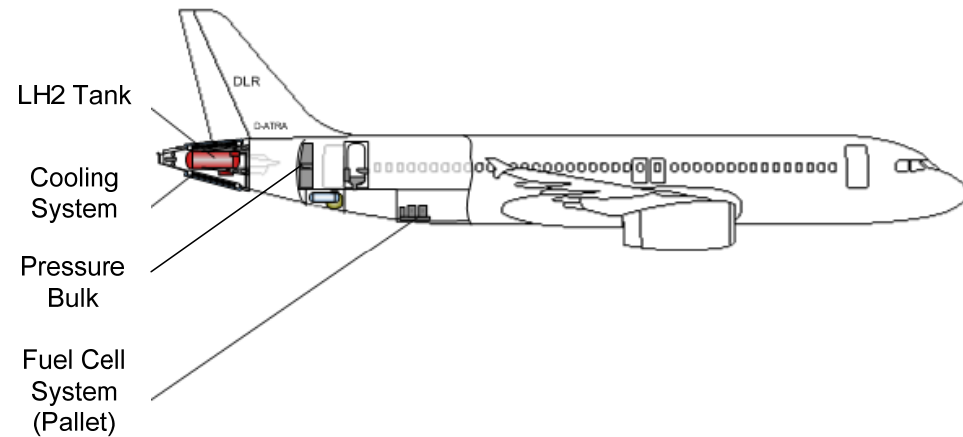


Inert Gas Conditioning System

TOP MFFCI Flight Test Demonstration



Structural Integration of the H2 Tank and cooling system into the A320 tailcone



Overall F/T concept: combination of structural and functional integration



Functional integration of a fuel cell system



F/T A/C A320

Thank you!



AIRBUS
AN EADS COMPANY