The Future of More Electrical Aircraft

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Air Transportation Merits

- Air Transportation is a catalyst to economic growth
  - Contributes to 8% of World GDP
  - Transports 40% of goods between regions
  - Represents more than 30 Millions jobs worldwide

- Air Transportation makes continents closer
  - It enhances understanding between the different nations and cultures
Air travel remains a growth market

- Air traffic has doubled every 15 years
- Air traffic will double in the next 15 years
- 20-year world annual traffic growth ~5%

Source: ICAO, Airbus

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Air transportation has improved a lot...

Over 20 dB aircraft noise reduction

...but we want to go further

- 70% Fuel Burn
- 70% CO₂ Emissions
Flight Path 2050 Goals

- **Meeting Societal and Market needs**
  Mobility, travel time, robust schedules, capable ATM, coherent infrastructure

- **Environment and Energy Supply**
  75% CO$_2$ reduction vs 2000
  90% NO$_x$ reduction vs 2000
  65% Noise reduction vs 2000
  Zero Emissions-taxiing
  Recyclability
  
  ...

- **Safety and Security**
  Safety Improvement, Mitigation of weather & other hazards, min. impact of security checks, seamless operating air transportation system (manned & unmanned), A/C inherent potential against threats, EU air transportation system with fully secured data network
Disruptive technologies are needed
Some imagine solutions…
Identifying current limitations...

Can we expand / change the design space?
Towards Electrical Aircraft: Opportunities & Challenges

• Key Opportunities
  – Lower fuel burn, emissions, noise
  – Configuration

• Key Challenges
  – Energy storage & power density
  – Energy transmission
  – Power electronics
  – Certification

• Use of demonstrators
  – E.g. Diamond DA40 E-Star2
  – Electric Motor from Siemens
    • 80 kW Max Take-off, 13 kg
  – MOU signed at Le Bourget 2013 to investigate Certification aspects
Small full electric aircraft are already feasible

- **E-Fan Pilot Training aircraft**
  - About 600 kg MTOW, 10m span
  - 2 x 60 kW electrical engines
  - Currently using Lithium Polimer cells for energy storage
  - Aircraft designed around electrical concept
Energy Storage

- Current batteries offer power densities of up to a couple hundred Wh/kg.
- Power densities meeting or exceeding 1000 Wh/kg could be offered within the next 2 decades e.g. with Lithium-Air batteries.
• By the end of next decade, electrical motors with power around 500 kW should be available
  • Big APU’s, Hybrid helicopters
A potential future for More Electrical Aircraft…
Mission Profile

**Take-off & Climb**
Power comes from both turbine engine and energy storage unit

**Cruise**
Power comes from energy storage unit

**Initial descent**
Power comes from energy storage unit
Turbine engine switched off
Fans windmill and fill energy storage unit

**Approach & Landing**
Power comes from energy storage unit
Turbine engine switched on

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It is not the strongest of the species who survives, not the most intelligent, but the one most responsive to change.

Charles Darwin
Thank you for your attention!