Europe-Japan Symposium
Electrical Technologies for the Aviation of the Future

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Hybrid Electric Propulsion
Content

• Airbus civil aircraft

• Fully Electric Propulsion

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• Conclusion
Aviation drives our global economy

- Air traffic doubles every 15 years
- 3 billion Passengers
- 50 million Tonnes of freight
- $2.4 trillion Global GDP annually
- 58 million Jobs supported

Source: ATAG 2014
Airbus aircraft families are covering a capacity range from 100 to 500+ passenger seats
Fully Electric Propulsion
Fully Electric Propulsion
Historical Development of Electric Flight

More development activities resulted in higher power levels
What are the limits of fully electric propulsion

We want both high power and high voltage

LiIon/LiPo commercially available

First Flight Date

motor power [kW]
Fully Electric Propulsion
Key Challenge for Commercial Aviation

A319: 800 nm / 140 PAX

Conventional Kerosene

- 30 kg Kerosene per PAX

Fully Electric

- 1000 kg Battery per PAX

With current battery technologies, fully electric propulsion is impossible for commercial aviation.
Fully Electric Propulsion
Key Question for Today’s Conference

How to build a bridge between small fully electric a/c and large hybrid electric a/c
Hybrid Electric Propulsion
Hybrid Electric Propulsion

Nothing New for Other Markets

The huge challenge is to transfer this technology into the commercial aviation market.
Hybrid Electric Propulsion Technology Target Setting

Significant performance improvements on system component level are essential.

Long term target for electric machines:
10 to 15 kW/kg at system level

Long term target for batteries:
500 to 700 Wh/kg at system level
Hybrid Electric Propulsion
Overall Energy Balance

High efficiency of electric sub architecture to boost overall efficiency of hybrid system architecture
Parallel system architecture to provide additional drive power for specific flight phases

1: Battery Management System
Serial system architecture to separate power generation from thrust generation

1: Battery Management System
Energy management over mission profile is key to boost efficiency
There is a potential for hybrid electric propulsion – Initially for regional range a/c.

Block Energy:
- Used on a block mission
- Stored both in fuel and in batteries

Block Energy Benefit < Block Fuel Benefit
Hybrid Electric Propulsion
Potential Efficiency Benefit

For big commercial a/c hybrid electric propulsion is the key enabler for further technology bricks.
Synergies between technology bricks will open the design space for overall aircraft design.
Hybrid Electric Propulsion
Expected and unexpected benefits

✓ Fuel savings
✓ Reduction of emission CO2, Nox
✓ Significant noise reduction
✓ Lower manufacturing costs
✓ Easier maintenance, better aircraft reliability
✓ Better pax comfort

Breakthrough aircraft architecture will lead to unexpected benefits
Hybrid Electric Propulsion
Hybrid Ground and Flight Demonstrators

Technology demonstrators to validate basic assumptions and to drive technology maturations
Hybrid Electric Propulsion
Hybrid Ground and Flight Demonstrators

Airbus Group is already in the air: eGenius, CriCri, Hybrid Dimona and E-Fan 1.0

http://wemakeitfly.airbus-group.com/
Conclusion

- We need to multiply by 6 the energy density storage capability of batteries
- We need to multiply by 4 the electrical machine power density
- Hybrid architecture will require and enable new aircraft configuration
- Energy management system is key to boost efficiency
- Hybrid electric propulsion is the key enabler
  - For further technology bricks
  - Towards world targets for energy saving
- Unexpected benefits of hybrid architecture will come on top of fuel savings
  - Pax comfort
  - Lower costs for OEM and airlines

The challenges we see will only be met on a joint world Research Platform
Thank you,