GKN AEROSPACE

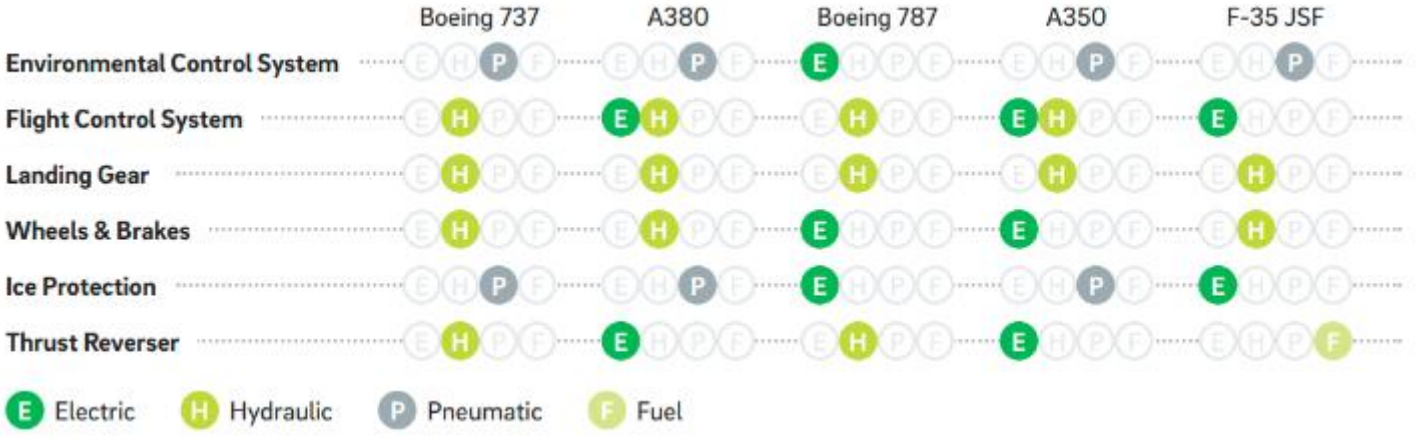
Developments in High Power wiring to support (hybrid) electric aviation

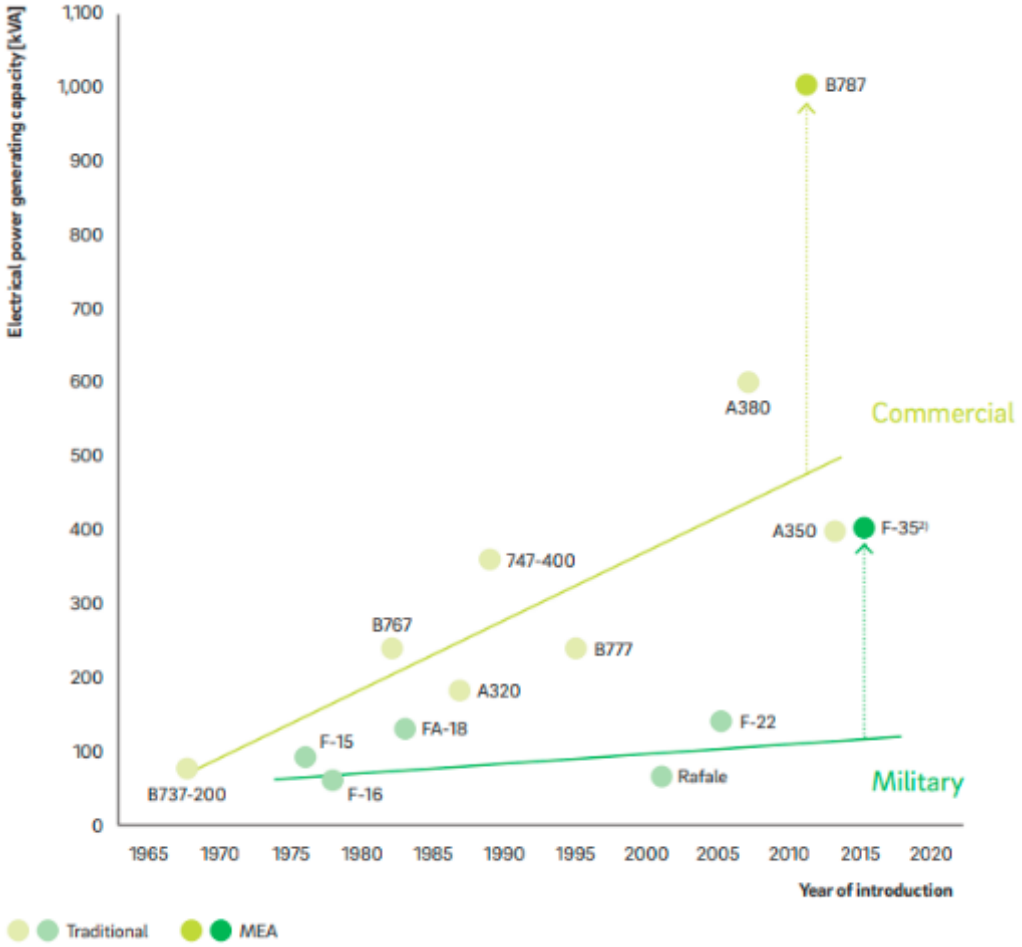
Johnny van Lugtenburg | GKN Fokker Elmo

MAKING THINGS FLY

More Electric Aircraft (MEA)

MEA trend has been ongoing for decades



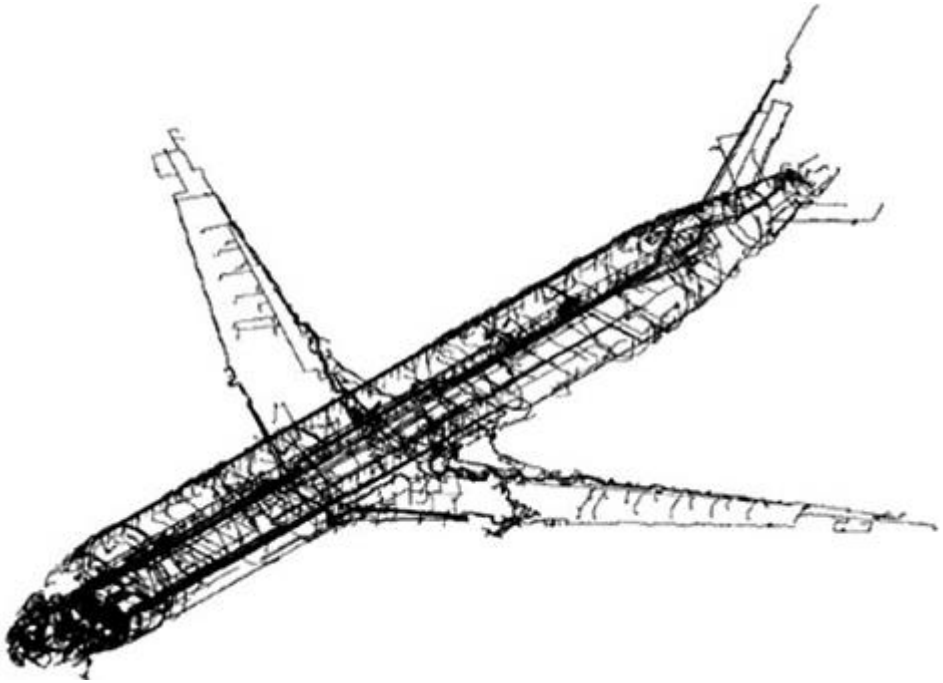


Source: Roland Berger Aircraft Electrical Propulsion (Public)

Aircraft wiring

Facts & figures

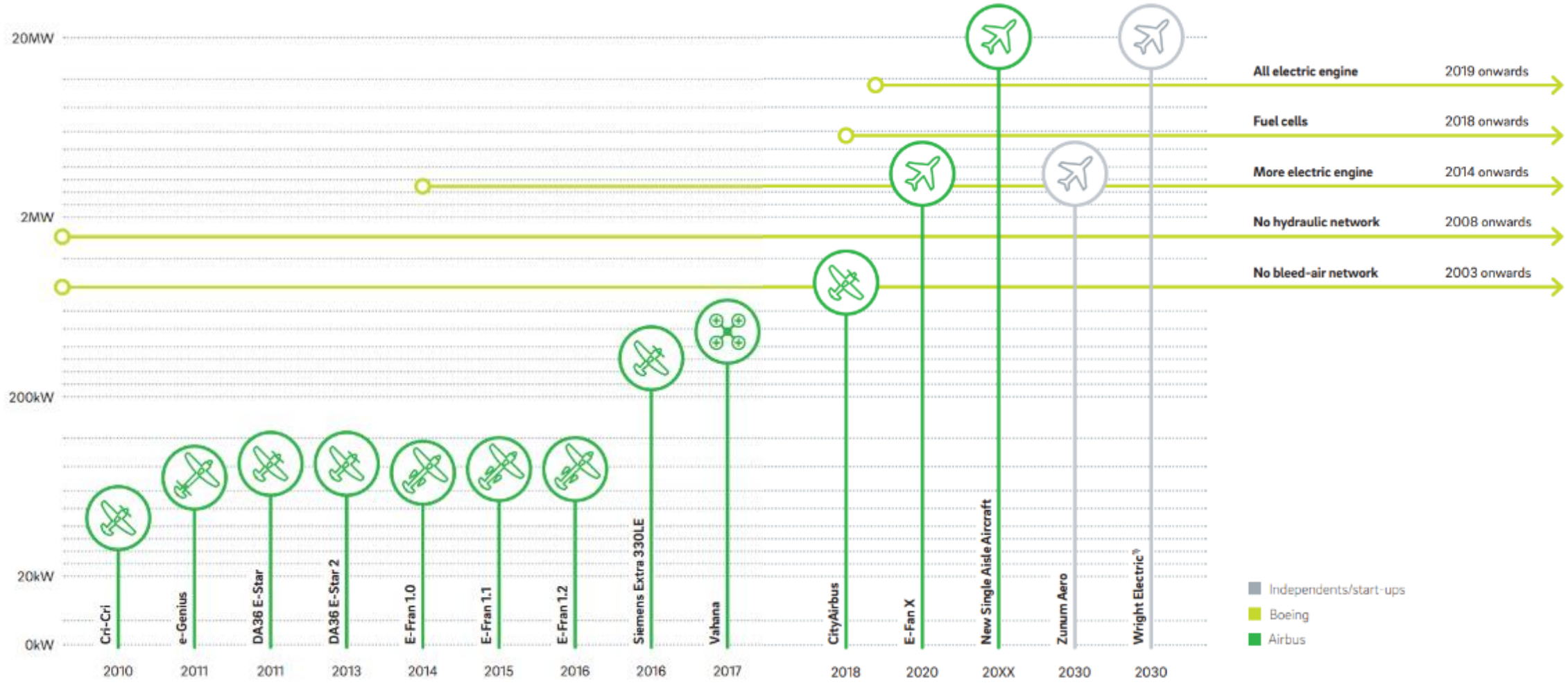
≈ 50 000 Connections
≈ 16 000 Cables
≈ 55 km Cable length
≈ 4 000 Endpoint / Connectors & Terminals



Complexity

- Multi-site, multi-company, multi-disciplinary concurrent Engineering environment
- Electrical, mechanical, thermal, geometrical and system functional reliability constraints
- Anticipating manufacturability, installability and maintainability
- Continuous changing data and configurations

Now moving into (Hybrid) Electric Propulsion



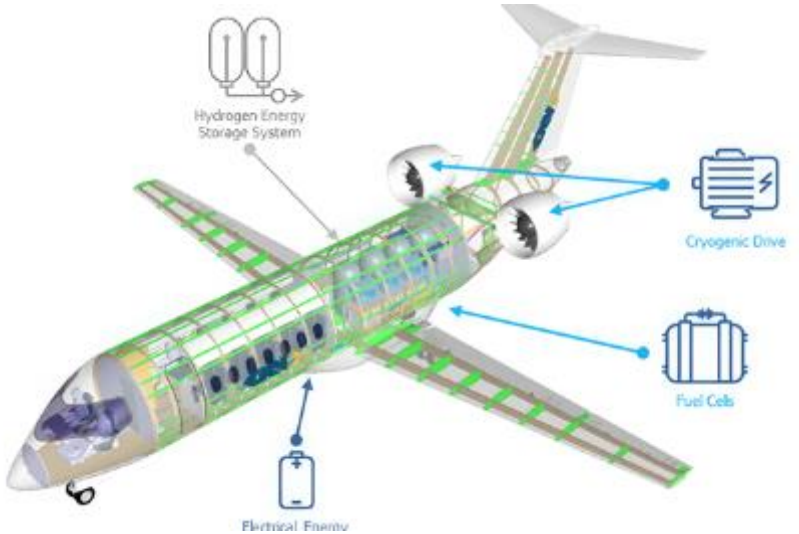
Source: Roland Berger Aircraft Electrical Propulsion (Public)

Different architectures & solutions

Battery Electric

Hybrid Electric

Hydrogen Electric



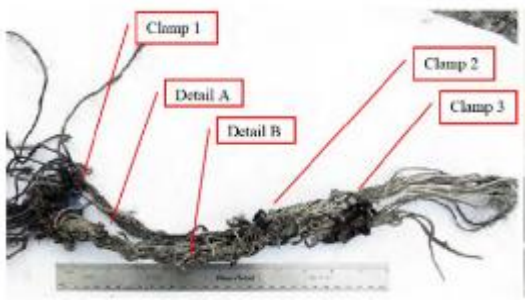
Commonality: Each needs technology to safety transport high electrical power throughout the aircraft (!)

Aircraft safety

“Aircraft wiring can no longer be thought of as a collection of single wires. It must be considered as an Integrated System, whose failure has an aircraft level effect”
(ATSRAC committee, FAA, following TWA 800 and Swissair 111 events)

> Part 25, Subpart H,

F-22 crash



A brief arcing event (due to improper installation) was sufficient to breach the titanium hydraulic line and ignite a fire.

Trans World Airlines Flight 800


Recovered TWA 800 wreckage

Explosion of the fuel/air mixture in the Centre Wing Tank (CWT) due to short circuit of wiring outside the CWT, but entering through wiring of the Fuel Quantity Indication System.

Swissair Flight 111

Aircraft certification standards for material flammability were inadequate in that they allowed the use of materials that could be ignited and sustain, or propagate fire

Challenges

High Voltage

- Components & constructions
  - Partial discharge
  - Higher temperatures
- Modelling & simulation
  - Thermal models
  - EMI / EMC
  - Arc fault models
- Certification support
  - Lifecycle / reliability (aging)
  - Design rules (Thermal/EMI)

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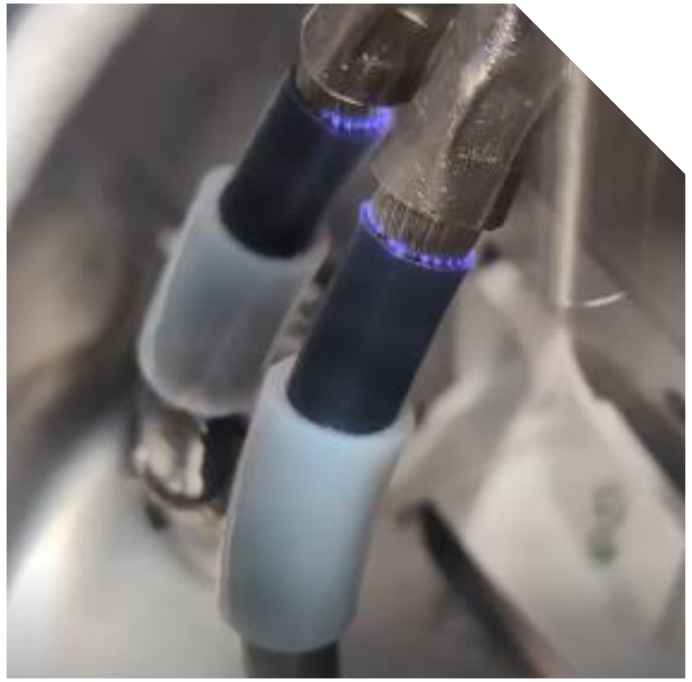

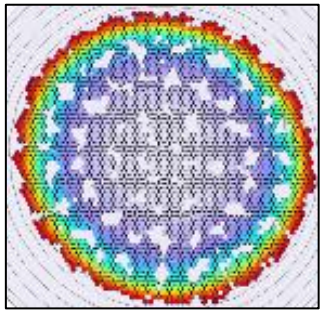

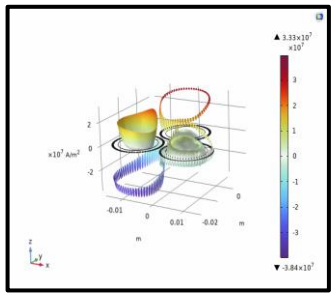

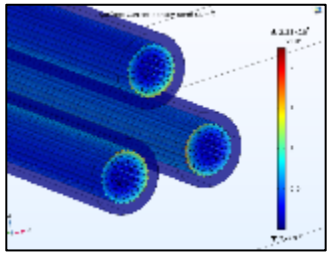

Conclusion

Summary

- More Electric Aircraft trend is ongoing for decades
- Technologies for (Hybrid) Electric Propulsion needed to decarbonize aviation
- Wiring solutions needed to safety transport (very) high electrical power throughout the aircraft
- The aircraft will be more designed around the electrical propulsion system