

UpNext



Cryogenics for the superconducting powertrain for aircraft applications: The ASCEND project

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- AIRBUS UpNext, Blagnac, France

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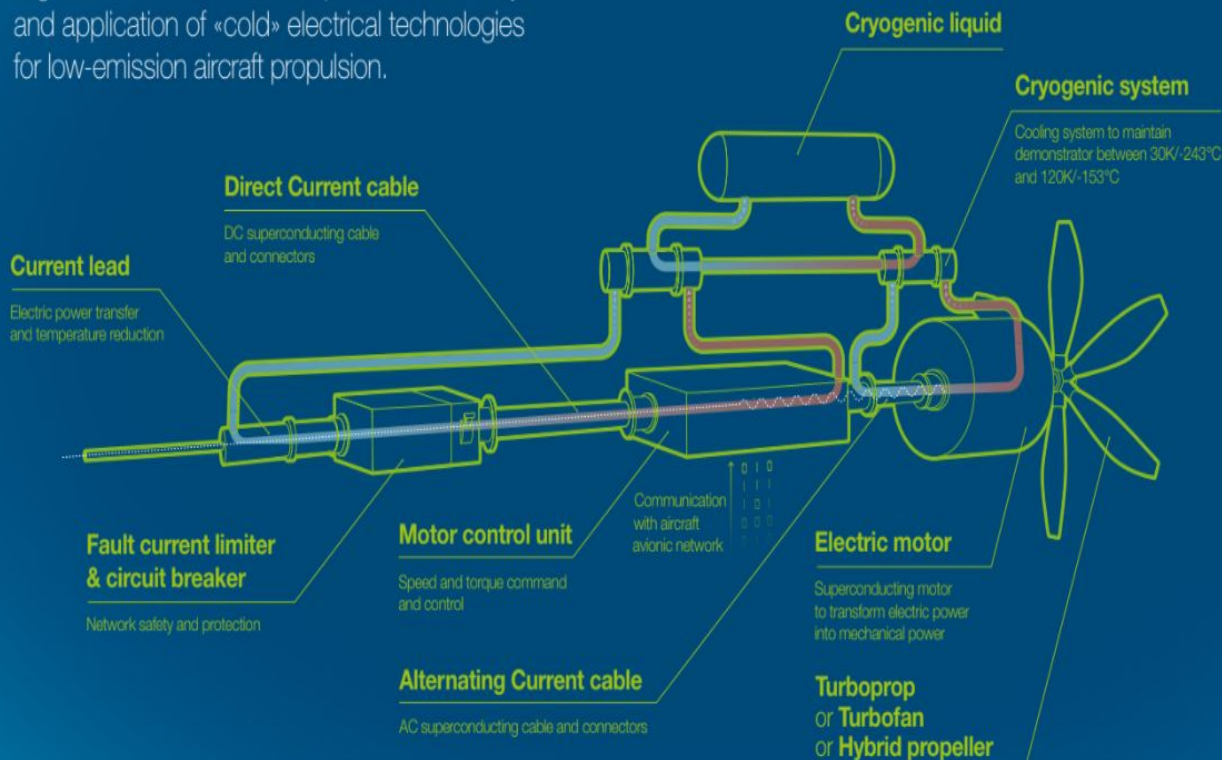
ASCEND intends to demonstrate the potential and feasibility of a cryogenic & superconducting powertrain to breakthrough aircraft electric propulsion performances.

Outline of the presentation

1. Introduction to the ASCEND project
2. Design and specifications of the cryogenic system for:
 - AC/DC superconducting cables
 - Motor control unit
 - Superconducting Motor
3. Current Status of ASCEND Demonstrator
4. Challenges for the future of ASCEND
5. Summary

UpNext

A ground demonstrator to explore the feasibility and application of «cold» electrical technologies for low-emission aircraft propulsion.



An Electric propulsion System

- reduce voltage below 500V
- increase efficiency by 4 to 5%
- increase power density
- enable new architecture

in **3 years**

Cooling system for the AC/DC distribution

- 1kW at 67K
- Provided by a **Pulse tube Cryocooler** + a subcooled LN₂ Application closed loop

Cooling system for the Motor Control Unit (MCU)

- 6kW at 77K
- LN₂ open application loop with **subcooled** recirculation system

Cooling system for the Superconducting Motor

- 1kW at 20K
- Provided by Reverse Turbo-Brayton + a GHe application closed loop
- The Reverse Turbo-Brayton requires a LN₂ source in open loop

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ASCEND development so far



Motor

Connecting Device

DC Cable

AC Cable

Motor Control Unit

Detailed design in progress

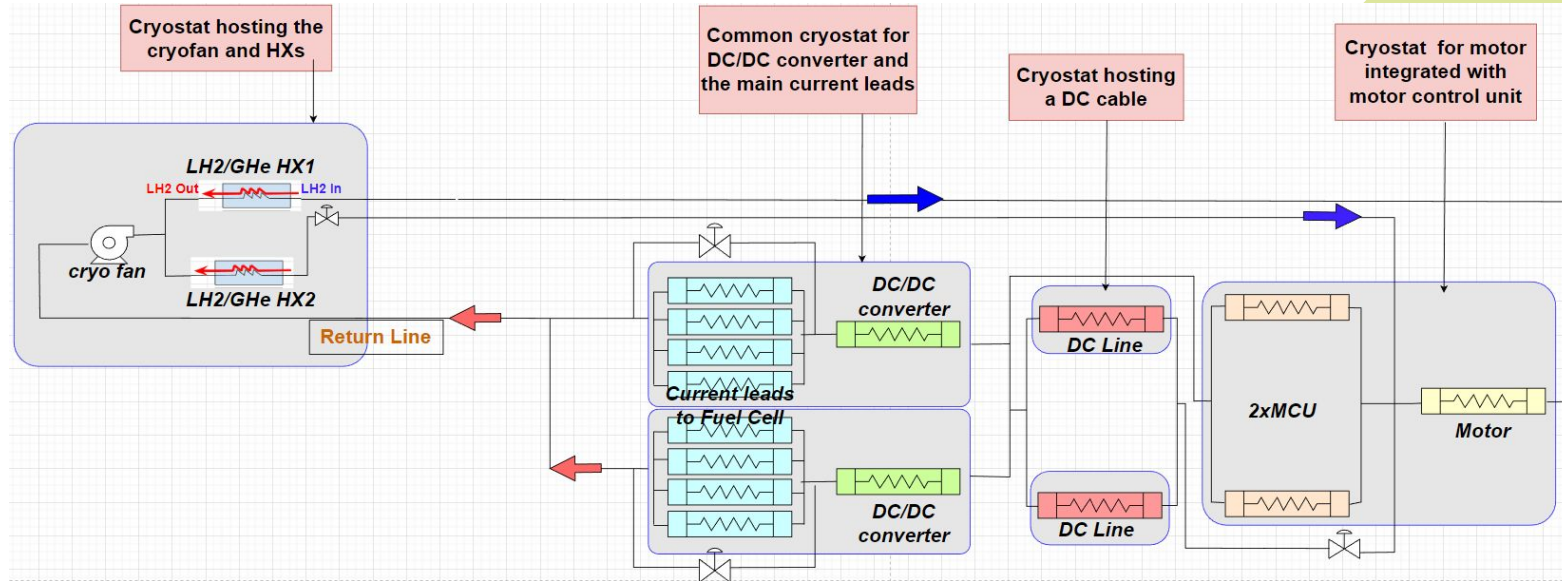


- No showstopper
- Electrical performances above expectations
- Enable new electrical architectures

but

- Challenges on cryogenic components

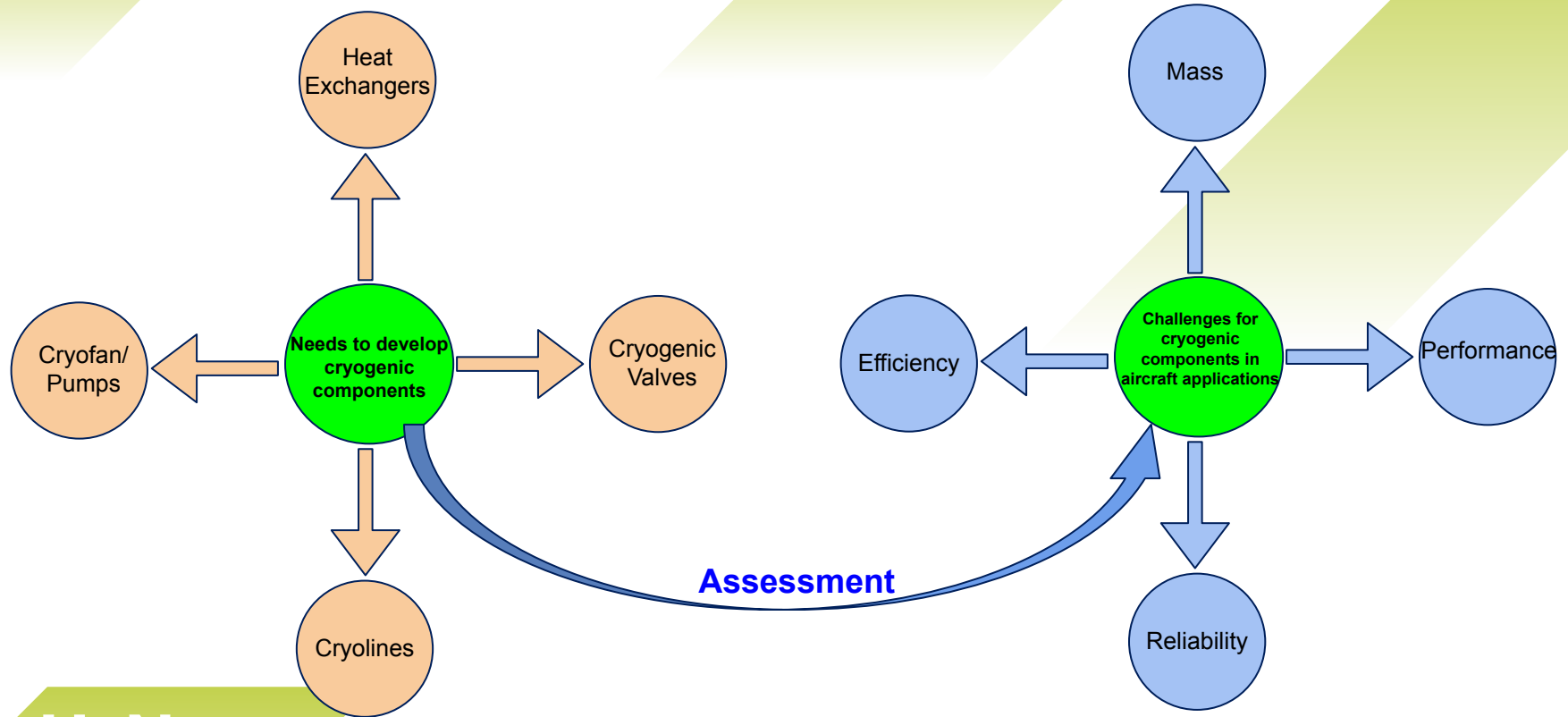
New cryogenic architecture for ASCEND (Phase - II)



*Note: Patent pending

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Challenges for the new cooling architecture of ASCEND



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Summary



- ASCEND ground demonstrator on track and no showstopper identified.
- Delivery of components started and integration to be started soon in Airbus, Ottobrunn, Germany.
 - PCU and AC/DC cables installation already started
 - Step by step testing & integration of each component
 - full powertrain tests of the superconducting powertrain by Sep 2023.
- New cooling architecture for the ASCEND (Phase - II) is defined using LH_2 on board.
- Needs to develop cryogenic components suitable for aviation applications.

UpNext

8



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keep moving

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