Special Session on

Cryogenic Electric Machines

Organized and co-chaired by:

- **Reda Abdouh**, Airbus UpNext, reda.abdouh@airbus.com
- **Emelie Nilsson**, Airbus UpNext, emelie.nilsson@airbus.com

Abstract

Cryogenic electric motors, with windings made of High-Temperature Superconductors (HTS) and/or hyperconducting materials, are emerging as a critical technology required to achieve net-zero emissions goals for large-scale commercial aviation. The fundamental challenge facing aviation electrification is the power density gap. Commercial aircraft require multi-megawatt (MW) propulsion systems that demand significantly higher power-to-weight ratios to be viable.

Superconducting electric machines (SCMs) overcome this limitation, with projections showing they can reach power densities exceeding.

This breakthrough is enabled by the physics of superconductivity: when HTS materials are cooled to cryogenic temperatures, they exhibit zero electrical resistance. This allows the motor windings to carry vastly higher currents than a conductor would at ambient temperature, generating intensely powerful magnetic fields that dramatically reduce the overall motor volume and weight.

The principal engineering challenge resides in the cooling of the fully superconducting system, especially the stator, which produces substantial thermal loads. The availability of liquid hydrogen on an electric aircraft—to be used as fuel in fuel cells—provides a heat sink at a temperature of about 20 K to efficiently cool the motor components. This dual use of LH2 is a potential game-changer for multi-megawatt class electric propulsion systems. This interdependence makes cryogenically cooled motors an essential component for future zero-emission LH2-fueled aircraft.

Global research efforts are actively pushing the Technology Readiness Level (TRL) forward. Critically, industry collaboration is accelerating in aviation. NASA's High-Efficiency Megawatt Motor (HEMM) project is developing a 1.4 MW motor. Airbus UpNext tested its superconducting 500 kW ASCEND motor in 2023. This important milestone is followed in CRYOPROP with a 2 MW design, targeting TRL4 on component level by the end of 2026. Critically, industry collaboration is accelerating:

Airbus and Toshiba announced a joint research initiative in 2024 to apply Toshiba's 2 MW superconducting prototype to next-generation hydrogen aircraft. Raytheon Technologies (RTX) is also developing a 2.5 MW motor. Beyond aviation, the technology is being adapted for maritime use, such as Kawasaki's 3 MW motor designed for vessels including LH2 carriers. Component validation (TRL 6) is anticipated by 2030, paving the way for 10 MW systems in the mid-2030s.

Topics of interest include, but are not limited to:

- Cryogenically cooled electric motors (superconducting or copper/aluminum windings) for aviation, wind turbines, maritime use or other applications.
- Coil design and manufacturing.
- Cooling systems, thermal management systems.
- Manufacturing of cryogenic motors.
- Design and modelling of electric motors.
- AC loss optimization.
- Electric and cryogenic system and architectures.
- Reliability aspects of cryogenic electric machines.

Important dates

- Full Paper Submission: February 1, 2026
- Full Paper Notification: May 1, 2026
- Final Paper Upload: June 1, 2026

Submission of papers

Paper submission follows the rules of regular papers. All the instructions for paper submission are included in the conference website:
https://icem2026.ubi.pt/submission.html