

ZIEHL X 2026

Standortvorteil Supraleiter

CRYOPROP

Supraleitender Antriebsstrang für Flugzeuge

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Oswald Elektromotoren GmbH

www.oswald.de

Deutscher Mittelstand – Maschinenbau mit 200 Mitarbeiter

Standort: Miltenberg am Main

Elektromotorenbau seit über 100 Jahre

Familienunternehmen in 4. Generation



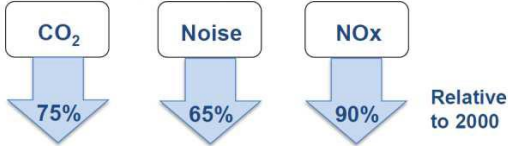
Kundenspezifische Direktantriebe:

- 5.000 kW
- 1.000.000 Nm
- 30.000 min⁻¹
- dynamisch-kompakt-wartungsarm



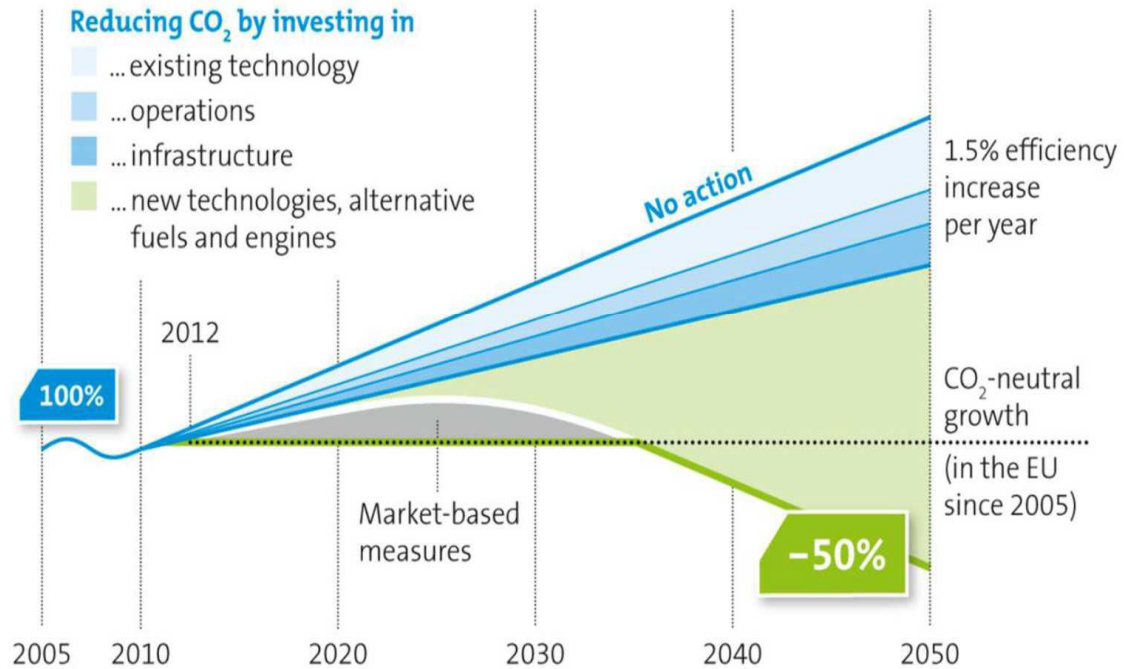
ACARE Flightpath 2050

By 2050, per passenger kilometre:



Optimise air operations and traffic management
Improve airport noise and air quality
Provide affordable and sustainable alternative fuels
Atmospheric Research

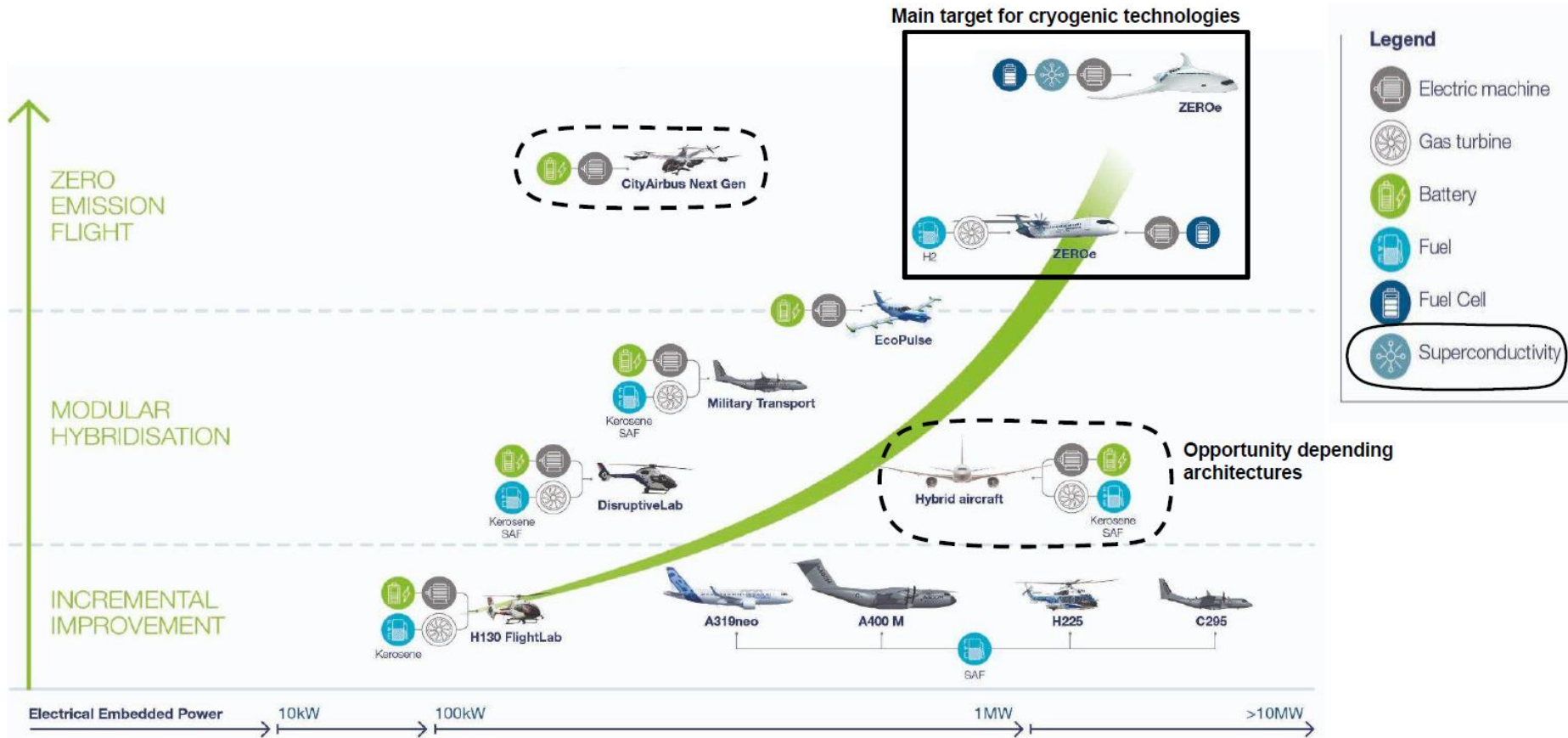
Measures to achieve CO₂-reduction targets



Source: BDL illustration based on industry strategy

www.bdl.aero

Konzepte und Strategien



A game-changer for electric propulsion on LH2 aircraft

Conventional

Lower potential

But

Less risky & more mature

Perfo



Regional

Short & medium range

Cryogenics

High potential

But

more risky and need to be matured

Conventional Technologies

Cryogenic technologies

Aircraft POWER

200 kW

5 MW

10 MW

20 MW

40 MW

Natural




Challenger

Enabler

UpNext

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	Conventional	Superconducting & Cryogenics
Material	 Conventional components	  YBCO, cryo-component
Typical Cooling needs	Glycol - Water/oil	Cryogenic < -200°C
Performance	REF	++
Maturity	REF	-
Advantages	<ul style="list-style-type: none"> Mature technology Available on shelf Strong supply chain 	<ul style="list-style-type: none"> FoM (no losses) New degree of freedom Scalability
Disadvantages	<ul style="list-style-type: none"> FoM at high power High losses No Scalable 	<ul style="list-style-type: none"> Maturity for A/C application No available product Cryogenic cooling

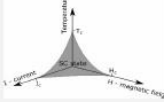

Cryogenic technology




- 8-10x less losses for Copper/Alu
- 5x less losses for GaN semiconductors

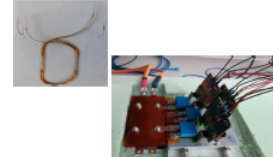
Superconductivity

below a Critical Temperature, Magnetic field and critical current

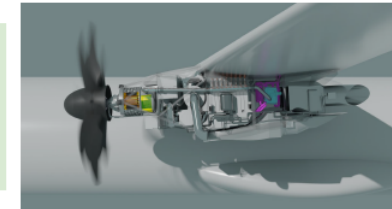
- No DC power losses
- > 100x more current density vs copper

LH2 Cryogenic temperature enables cryogenic electric technologies
(Superconductivity & low temperature components)



Significant increase in electric propulsion performance

→ high efficiency + new architecture + weight reduction



Significant fuel saving and aircraft weight reduction:

→ A game changer for low end of single aisle aircraft

→ An enabler for short and medium range

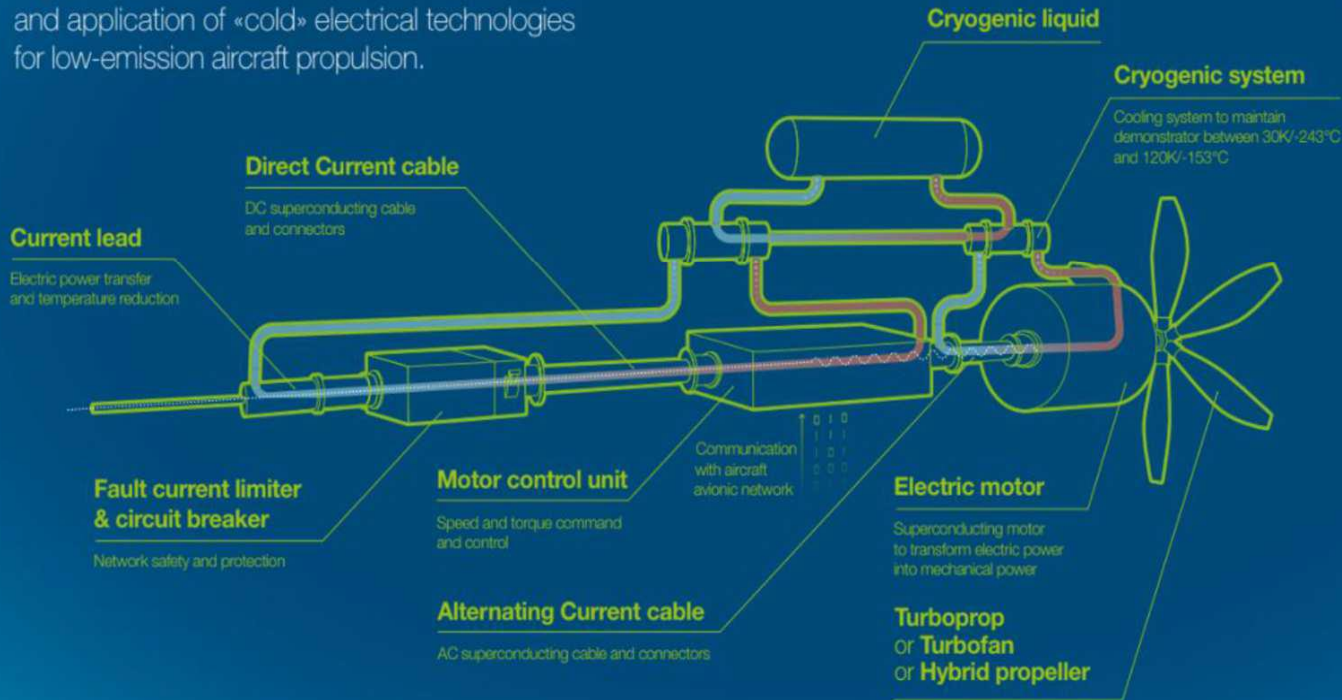


**ASCEND demonstrated end of 2023 the feasibility and a strong potential
CRYOPROP as a new step to demonstrate product maturity at the right time**

ASCEND

Advanced Superconducting & Cryogenic Experimental powertrain Demonstrator

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



Usage of superconducting and cryogenic technologies allows to*:



Halve weight of components



Reduce voltage to below 500V

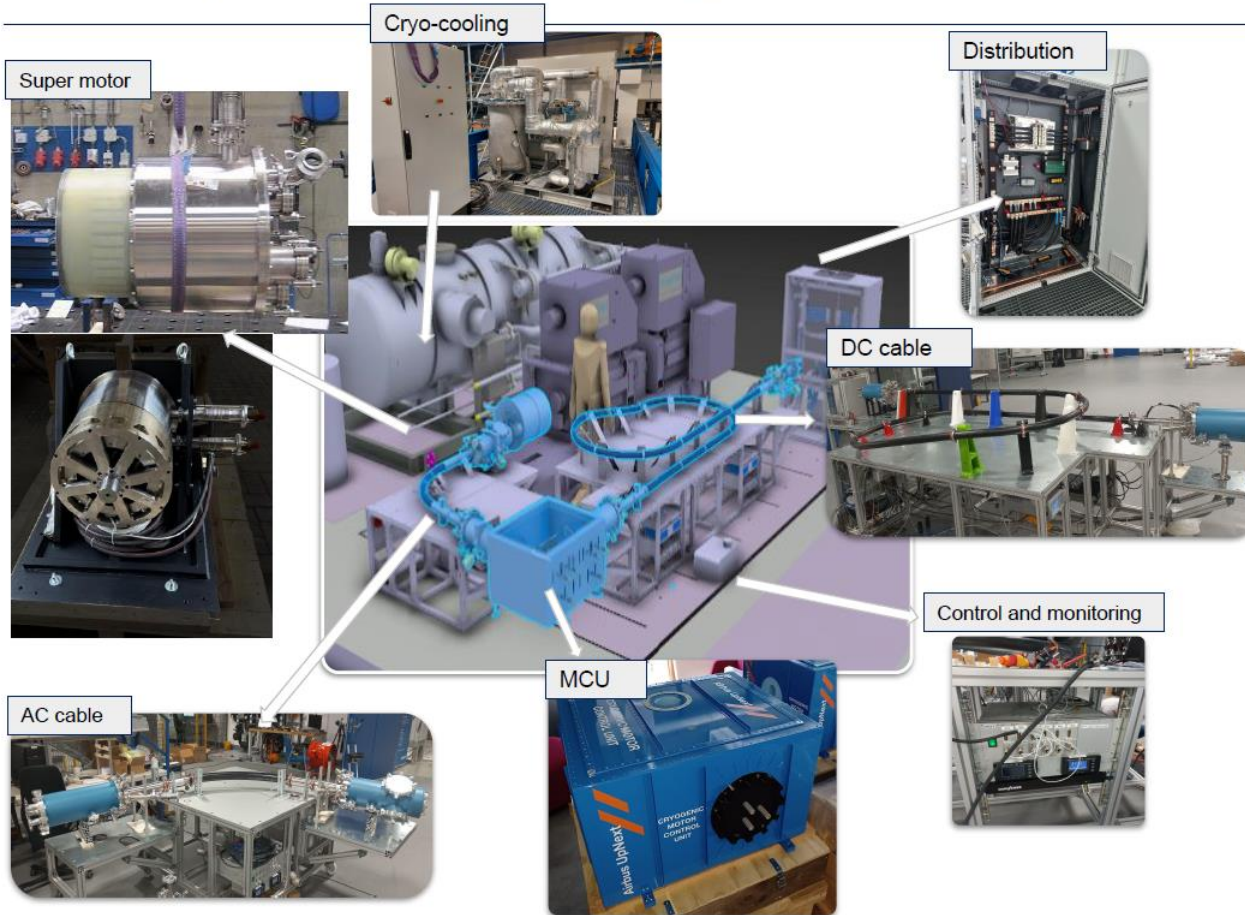


Halve electrical losses

*compared to conventional technologies

AIRBUS

<https://www.airbus.com/en/newsroom/stories/2023-12-ascending-to-new-heights-with-cryogenic-superconductivity>



**Tested in EAS facility
end of 2023**





- No showstopper
- Electric performance validated

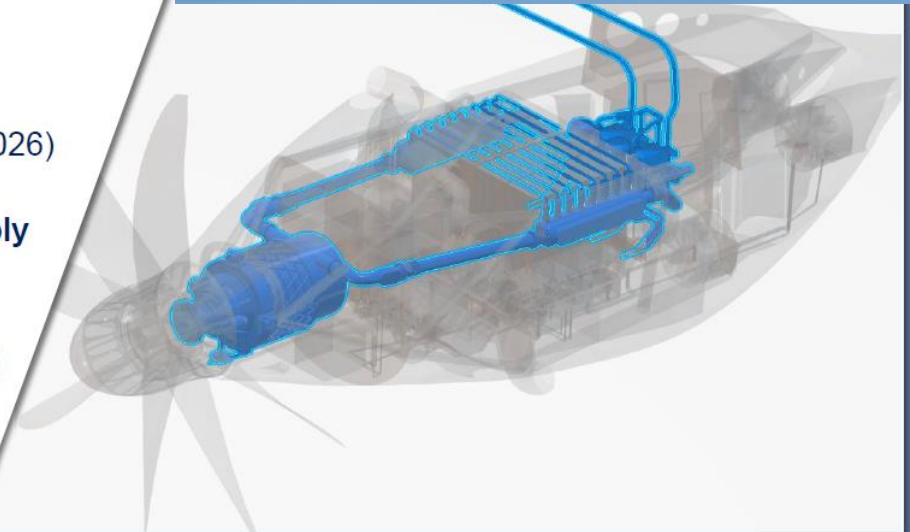
But challenges

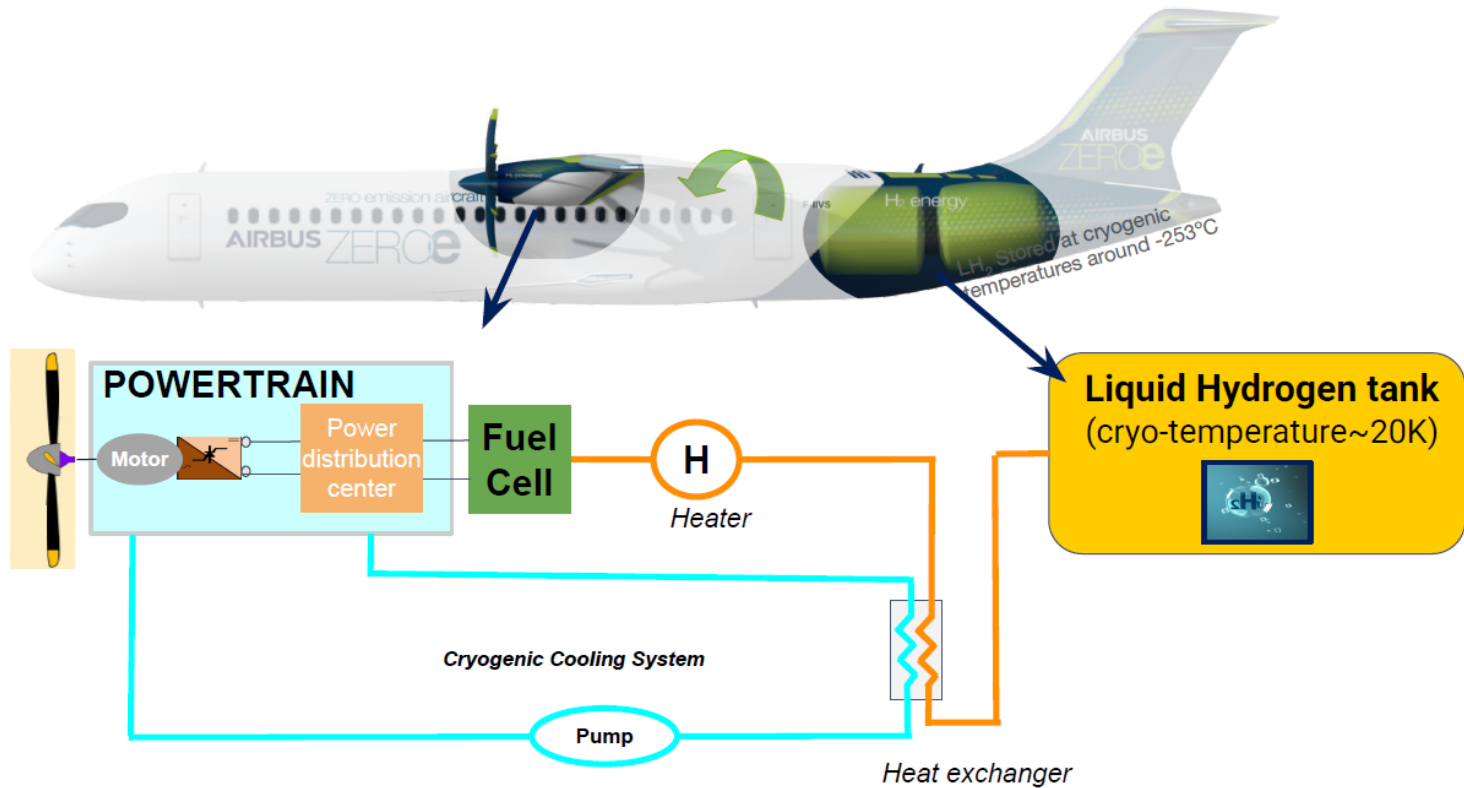
- Cryo-technologies not at aeronautic standards
- Integration
- Reliability

CRYOPROP

Mature & develop a supply chain for a Cryogenic propulsion system

-  **Develop a MW-class cryogenic powertrain demonstrator** with LH2 / GHe cryo-cooling system, sMotor, Cryo-MCU, DC cables, PCMS
-  **Maturity for ZEROe Program needs** (TRL4 at Component & TRL3 at System level by 2026)
-  **Develop a Cryogenics & Superconducting supply chain**
-  **Foster skills on Cryogenics & Superconducting technologies**





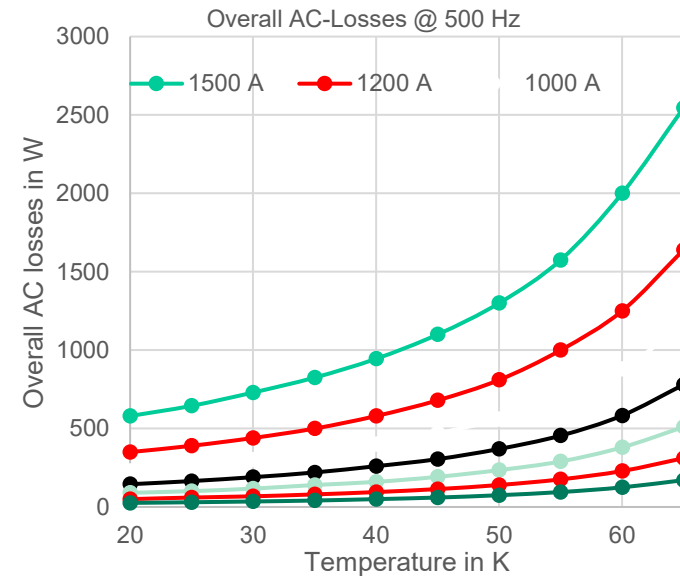
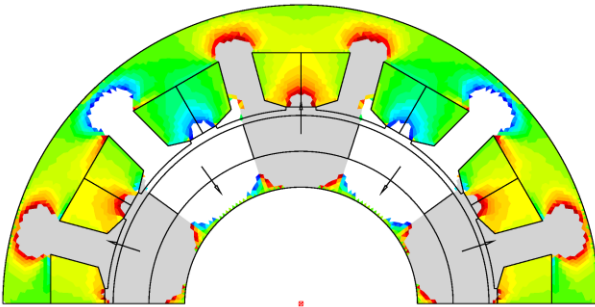
Liquid hydrogen (at -250°C) as a coolant to increase performance of electric propulsion

Drehstromanwendung

- Hohe Betriebsfrequenzen ($f = n \cdot p$)
- Hohe magnetische Felder \hat{B}, \bar{B}
- Transiente Vorgänge

Verluste im Supraleiter

- Stromtransportverluste
- Koppelverluste
- Hystereseverluste



- Steigender Flugverkehr in Zukunft absehbar
- Reduzierung von Emissionen notwendig

- Wasserstoff als Energieträger in zukünftigen Flugzeugen
- Hohe Synergieeffekte mit Supraleitung
- Supraleitung bietet hohes Potential für Antriebsstrang

- Komponenten des Antriebsstrangs sind bekannt und vorhanden
- Weiterentwicklung und Integration notwendig

Vielen Dank für Ihre Aufmerksamkeit!

Acknowledgements to AIRBUS UpNext for sharing information and slides used in this presentation