

# UpNext



## **ASCEND – a first step towards cryogenic electric propulsion for aircraft?**

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

Ludovic Ybanez :  
Head of ASCEND demonstrator  
Managing Director of Airbus ExO Zero Emission SAS

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# Sustainable & efficient air transport

## Targets 2050

-75% CO<sub>2</sub>

-90% NO<sub>x</sub>

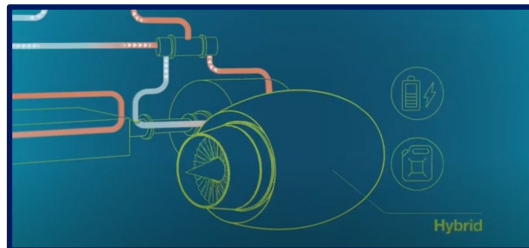
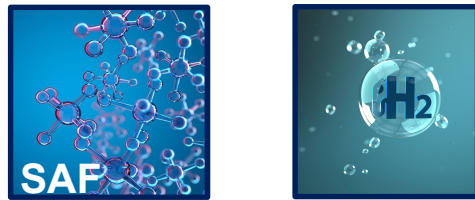
-65% noise



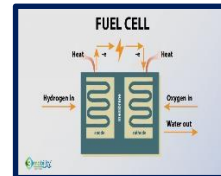
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# Reduce footprint of propulsion

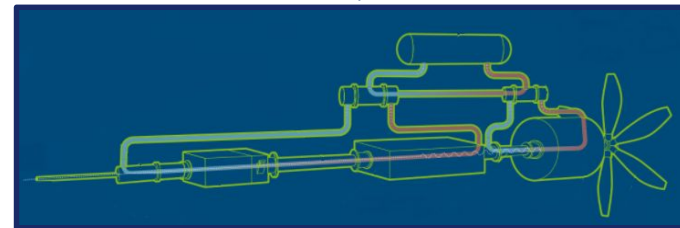
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Hybridization



Fuel cell

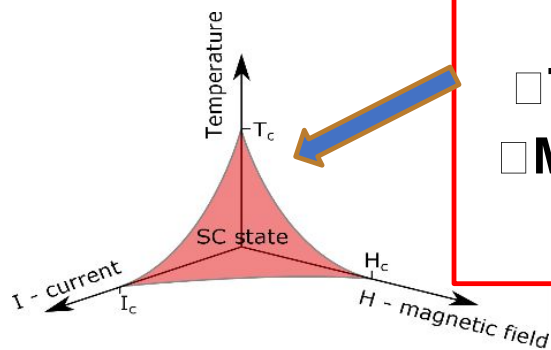


Electric Propulsion System

Superconducting  
&  
Cryogenic  
technologies?

# What is High Temperature Superconductivity?

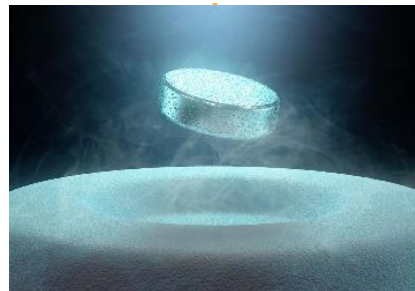
## Superconductivity?



- Below Critical:**
- Temperature ( $T_c$ ),
  - Magnetic field ( $H_c$ )
  - Current ( $J_c$ )

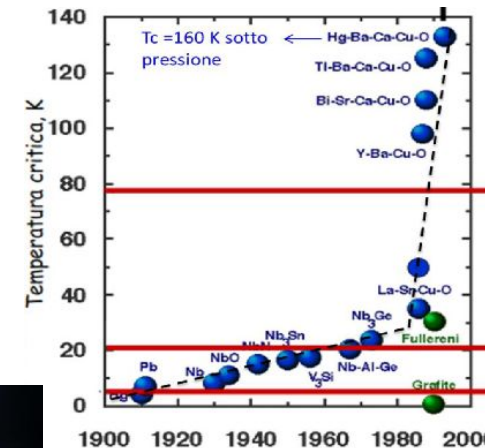
**1 No DC resistance: no losses**

**2 Meissner effect: perfect diamagnetism**



- HTS conductors can carry  $>100x$  the current per unit mass and cross section
- Breakthrough magnetic technologies : high magnetic fields, magnets ...

## High Temperature?



**40 < High  $T^{\circ}$  < 135°K**  
high potential and start to be mature  
LN

**Low  $T^{\circ}$  < 20°K**  
Mature but  $T^{\circ}$  ...  
LH  
LHe

# High Temp Superconductivity - Maturity

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## INDUSTRIAL EXISTING APPLICATIONS

### DC and AC câbles

ITER, LHC, power distribution for over 20 years



### Fault current limiter

Ground electrical distribution all over the world



## RESEARCH & Technology

### Electric machines

Lot of prototypes for ground, naval & automotive applications, and one for A/C : ASUMED

### Cryogenic power electronics

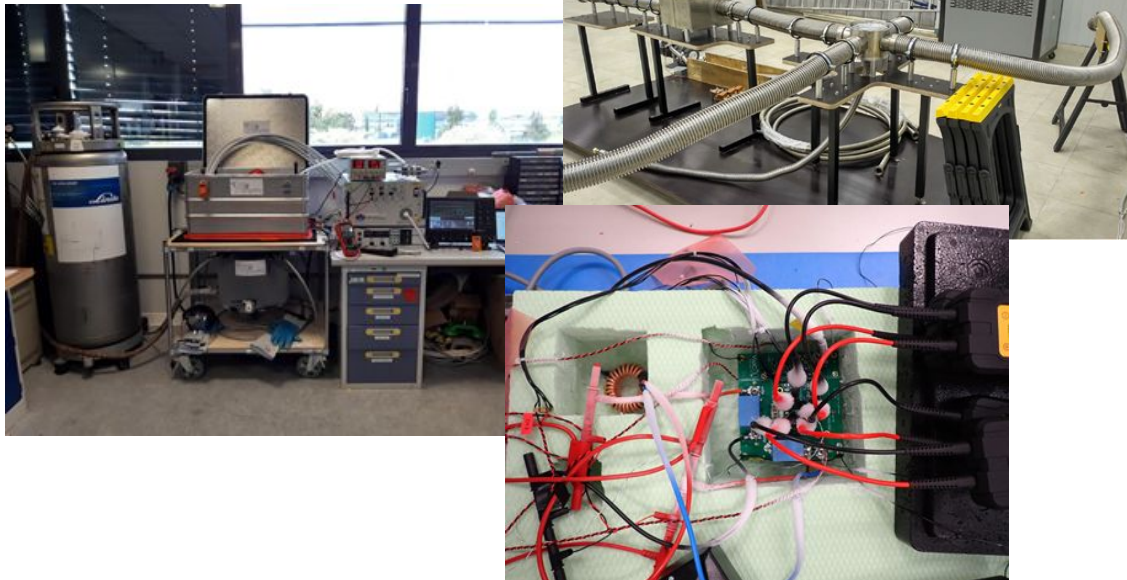
Active works in WW laboratories: US, UK, china

**HTS becomes mature on ground but needs adaptation for aeronautic usage**

# Potential of superconducting & cryogenic technologies

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- ① **Maturity of ground applications**
- ② **collaborative R&T projects**
- ③ **AIRBUS projects and assessments**



## **Mature on ground**

- Cables
- Current leads
- Fault current limiter
- Cryogenic systems

## **Lab. demonstrators**

- Superconducting electric motors
- Cold power electronics



**To mature and to adapt  
to aircraft requirements**

## Impact on electric system with LH2 on board

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### Higher Power density

→ increasing by 2 to 3



### Lower voltage

→ high current capabilities



### Improve energy efficiency

→ Powertrain efficiency >98%



### New technologies

→ Fault current limiter

## Cryogenic technologies & Superconducting

- significant benefit
- enable new aircraft configurations

(ex: distribution of low voltage + neutral cryogenic fluid)

# How to accelerate and demonstrate the potential at aircraft level?

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Not because a  
technology is incredible  
that a system is!

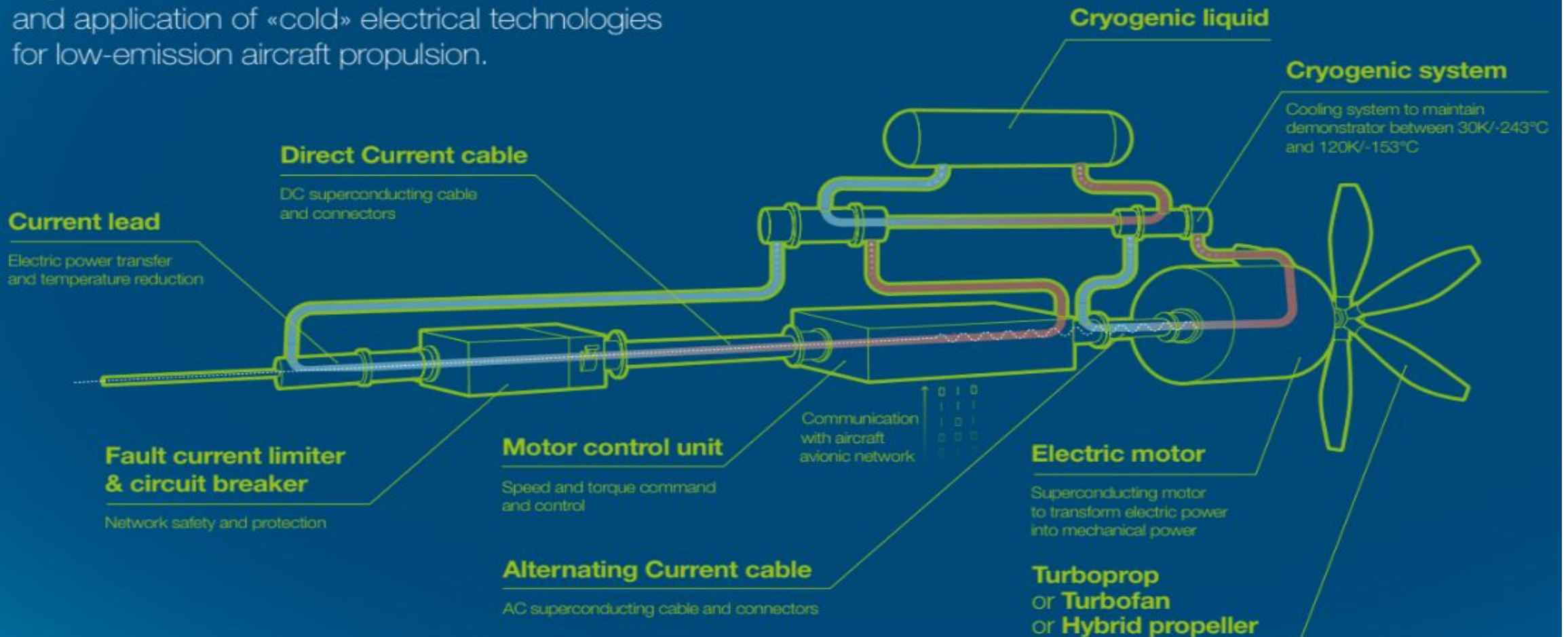
**Need a power train  
demonstrator to prove  
potential**



# ASCEND

## Advanced Superconducting & Cryogenic Experimental powertrain Demonstrator

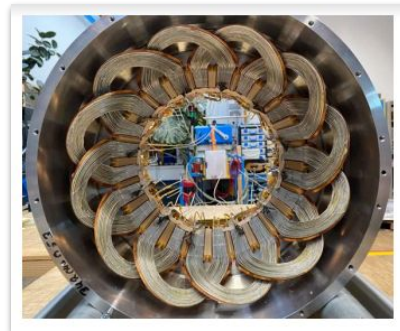
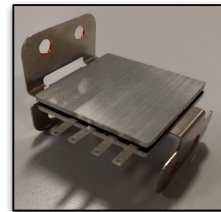
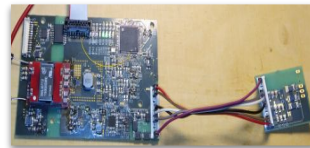
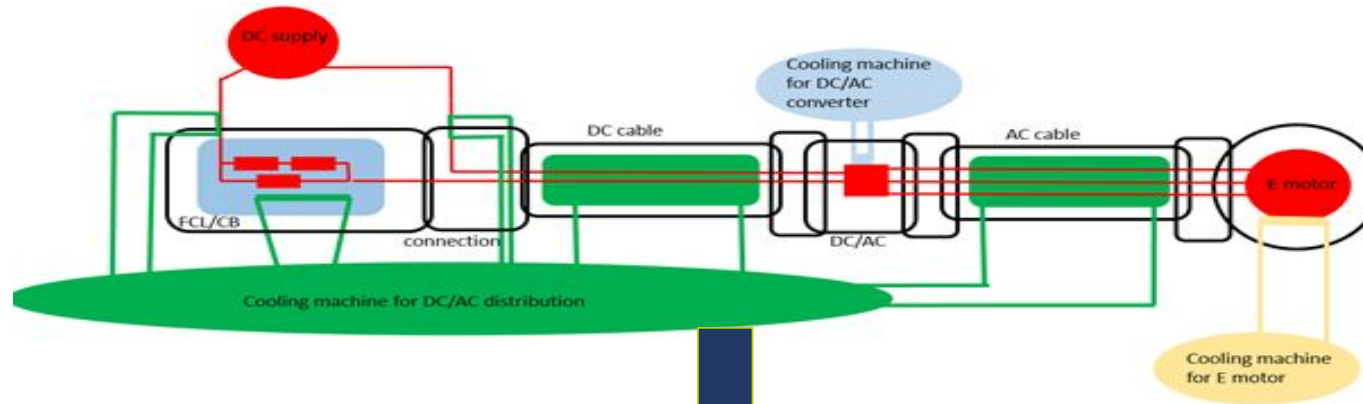
A ground demonstrator to explore the feasibility and application of «cold» electrical technologies for low-emission aircraft propulsion.



Zero Emission flying in CS3

# 1- A technological demonstrator

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**A 3 years demonstrator**

- Adapt ground technologies to aeronautic constraints
- Accelerate maturity
- Demonstrate feasibility

**and prepare the step after**

- Evaluate more risky options

## 2- Tests and integration

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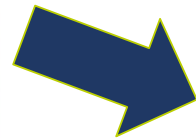
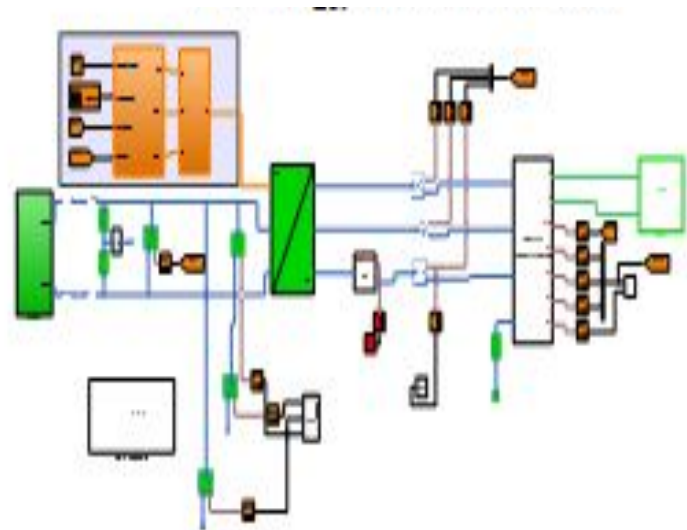
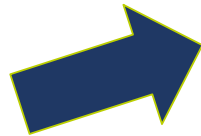
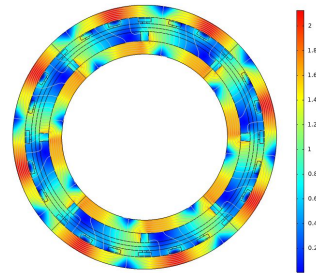
**Integrate  
demonstrator in EAS  
(E-Aircraft System  
House) in Ottobrunn**



**Demonstrate  
performances**

### 3- Modeling and aircraft applications

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#### ❖ Generalize results

from 100 kW to 10MW  
for different aircraft  
architectures

#### ❖ Failure mode and analysis



evaluate potential for  
all airbus portfolio  
with or without LH2

Zero Emission flying in CS3

# ASCEND Roadmap & Public Funding Framework

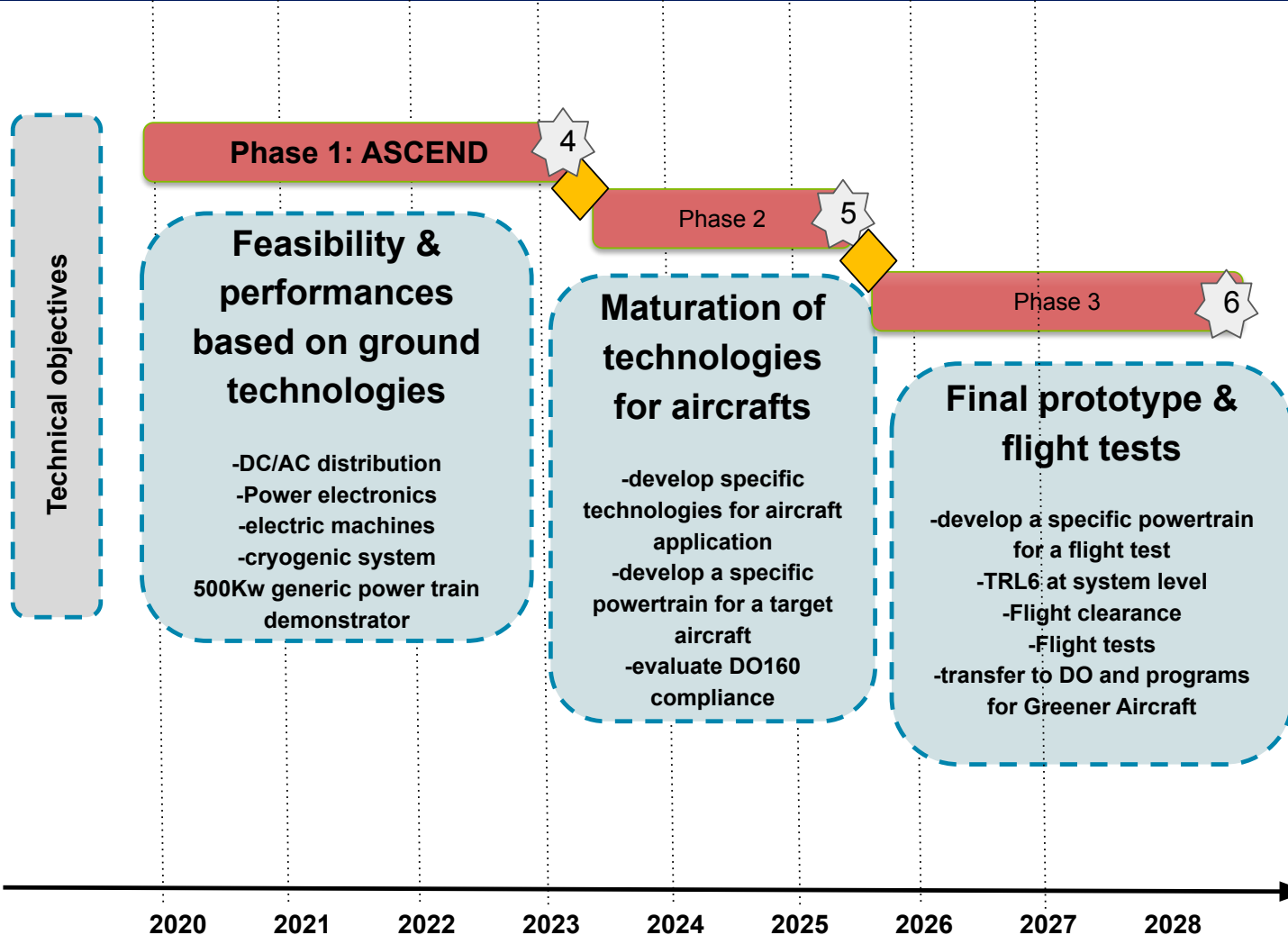


TRL "system"



Go/noGO

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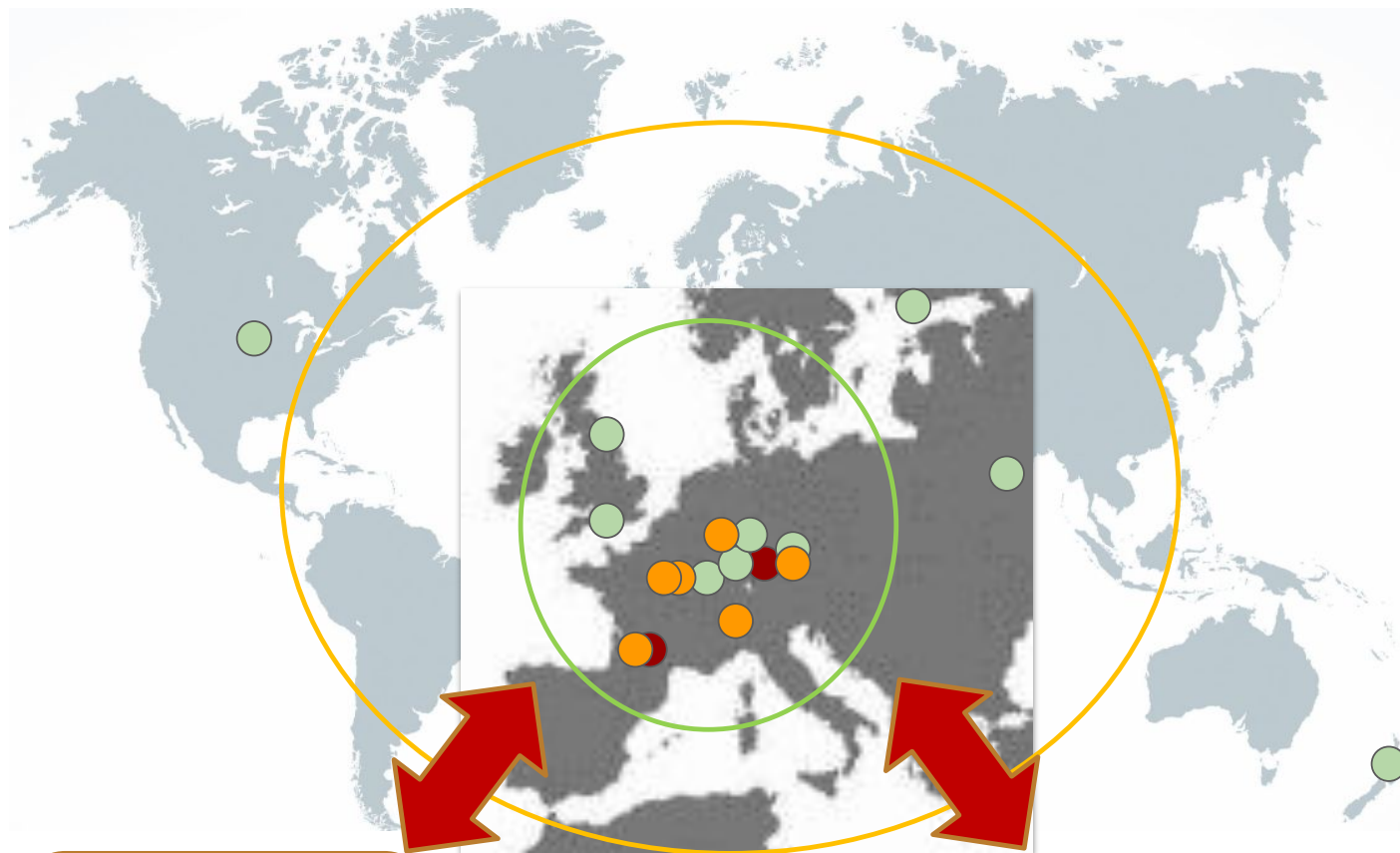
## Acceleration phase for a long term view

- 3 demonstrators to increase step by step maturity
- recommendations and architectures at aircraft level
- increase skills and competencies in cryogenics
- go/no-go milestones

# An Airbus team & partners

● Airbus ● Academics/Institutes ● Companies

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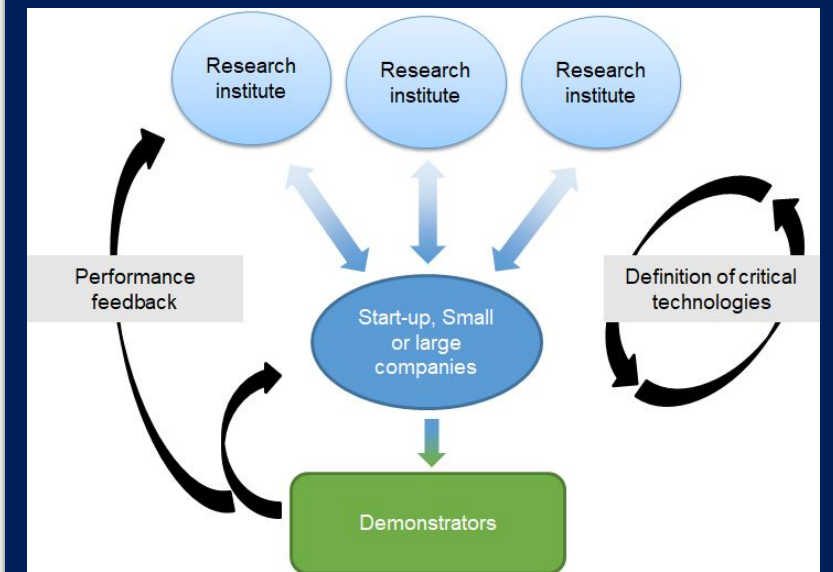


**Airbus UpNext & CRT**  
Distribution, cryogenic,  
Electric motors, tests (UpNext & CRT)

**AIRBUS UpNext, CRT & EAS**  
Power electronics (UpNext & CRT)  
Tests & Modeling (UpNext & CRT & EAS)

## World wide partners

- Labs and Institutes
- SMEs
- large groups





ELECTRIFICATION

## Electric flight

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-  A driver for sustainable growth in aviation
-  Reduced environmental footprint
-  Cleaner, quieter travel compared to existing technologies
-  Improved mobility

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thank you &  
keep moving

# UpNext

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