Primi casi di “success stories” della cooperazione regione-CAJU nell’ambito di programmi di R&D regionali: PoliTO

Fabrizio Pirri

Politecnico di Torino

Politecnico di Torino
1859

INDICE

- La **progettualità CLEAN AVIATION** del Politecnico di Torino
- **HYDROLAB Project** Finanziato dal Fondo europeo di Sviluppo Regionale (FESR)
- Il nuovo **Centro Interdipartimentale** dedicato alla Areonautica e Spazio del Politecnico di Torino

The *Clean Aviation Joint Undertaking* (CAJU) is the EU leading research and innovation programme for transforming aviation towards a sustainable and climate neutral future.

CLEAN AVIATION

Clean Sky 2 CAJU

POLITO PARTECIPATION

HERA – Hybrid-Electric Regional Architecture

CLEAN AVIATION

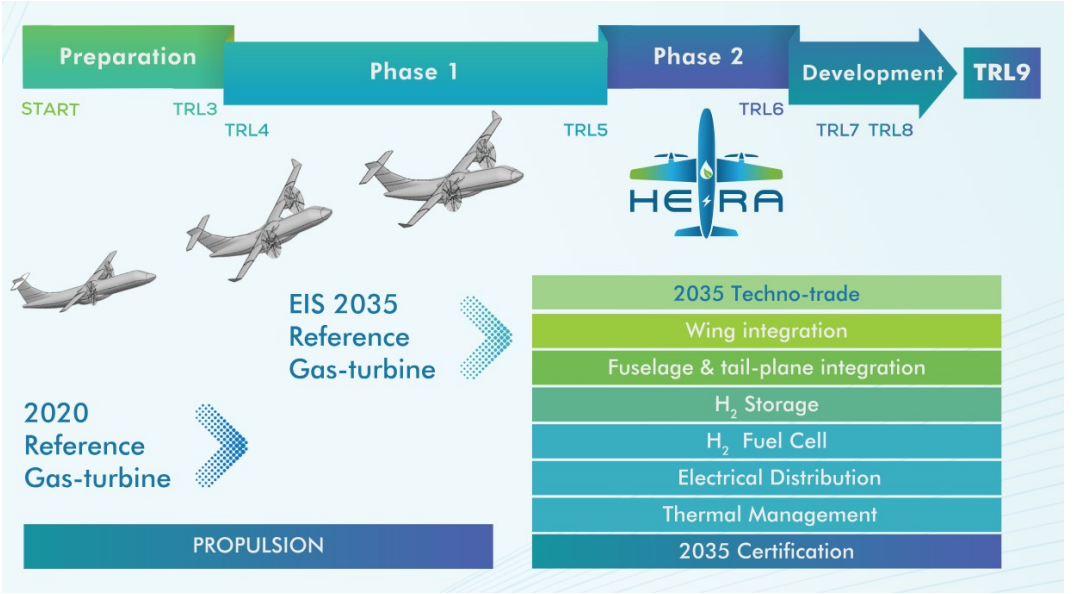
Project Coordinator: LEONARDO Aircraft Division
Duration: 48 months
Start date: 1st January 2023
Total budget: 55.7M€ (EU contribution 35M€)
N. Partners: 48

PoliTo EU budget: 1,055,150€
PoliTo IKAA: 899,250€

Main objective:

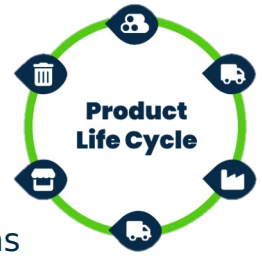
30%-50% fuel burn reduction compared to 2020 'state-of-the-art'.

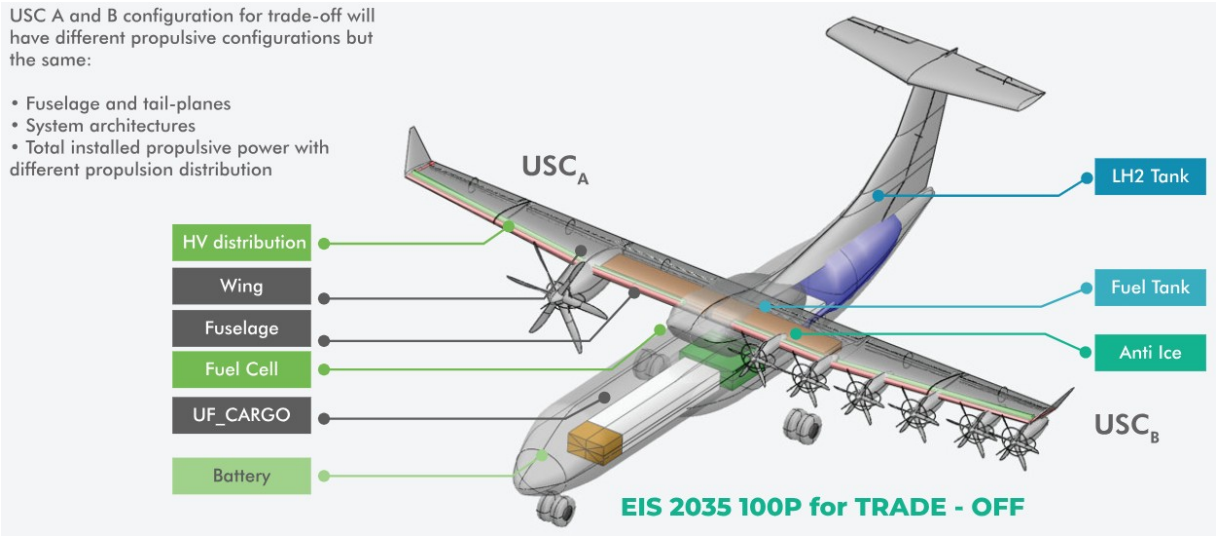
Hydrogen combustion, ***Hybrid solution***, ***highly efficient aircraft configuration*** for regional and short/medium range aircraft



PoliTo contributions:

- ✓ **On-Board systems design and modelling**
  - Architecture and electrification level definition. Systems vs. aircraft integration studies.
  - Systems modelling & Aircraft Digital Twin (Amesim / Simulink models)
  - RAMS analysis
- ✓ **Life Cycle Cost and Life Cycle Assessment estimation**
  - Aircraft life cycle (from cradle to cradle) total emissions in terms of GHG, PM, and other indicators
  - Development, production and operating cost of new technologies
- ✓ **Contribution to flight mechanics model**
- ✓ **Contribution to the airframe model**

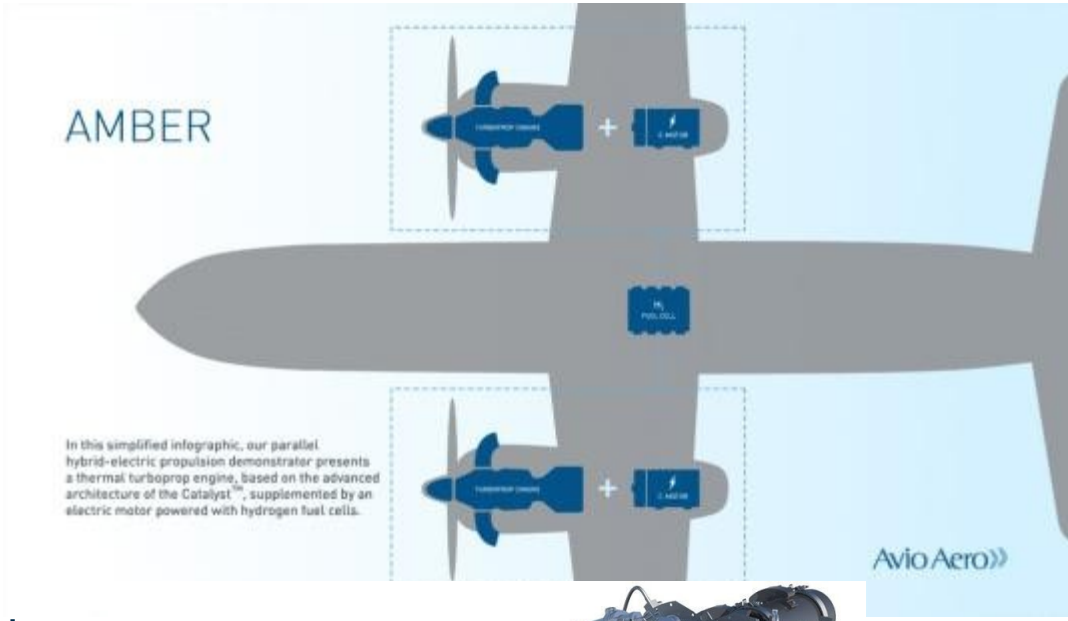




AMBER – InnovAtive DeMonstrator for hyBrid-Electric Regional Application

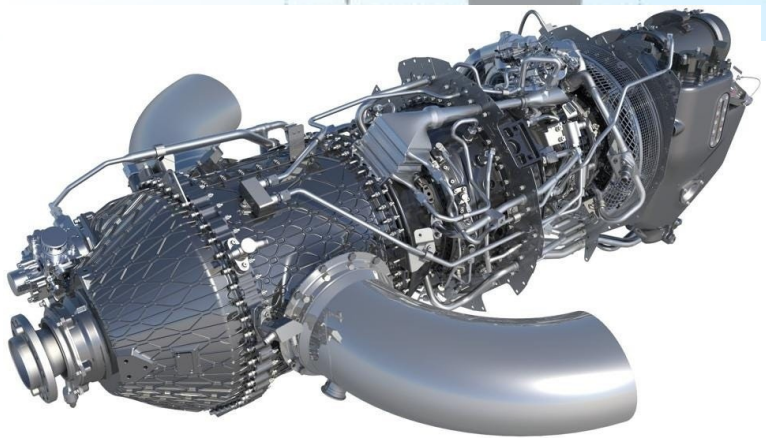
Project Coordinator: GE Avio srl
Duration: 39 months
Start date: 1st January 2023
Total budget: 43.5 M€ (EU contribution 33.8M€)
N. Partners: 19

PoliTo EU budget: 1,095,122€
PoliTo IKAA: 1.032.879€



PoliTo contributions:

- ✓ Effects of Top Level Aircraft Requirements and modules design in System configurations and demonstrators.
- ✓ Definition of preliminary overall propulsive system requirements for all the propulsive system modules
- ✓ Definition of the structural dynamic modeling of the hybrid thermal engine
- ✓ Design, calibration and validation of the optimized torque control of the propulsion electric motor
- ✓ LCA, Inventory datasets, environmental impact
- ✓ Interaction between different models created within AMBER capturing the overall propulsion system behavior



OFELIA – Open Fan for Environmental Low Impact of Aviatior

Project Coordinator: SAFRAN AIRCRAFT ENGINES
Duration: 37 months
Start date: 1st November 2022
Total budget: 139M€ (EU contribution 100M€)
N. Partners: 27

PoliTo budget: 243,850€
PoliTo IKAA: 330,144€

RISE open fan engine

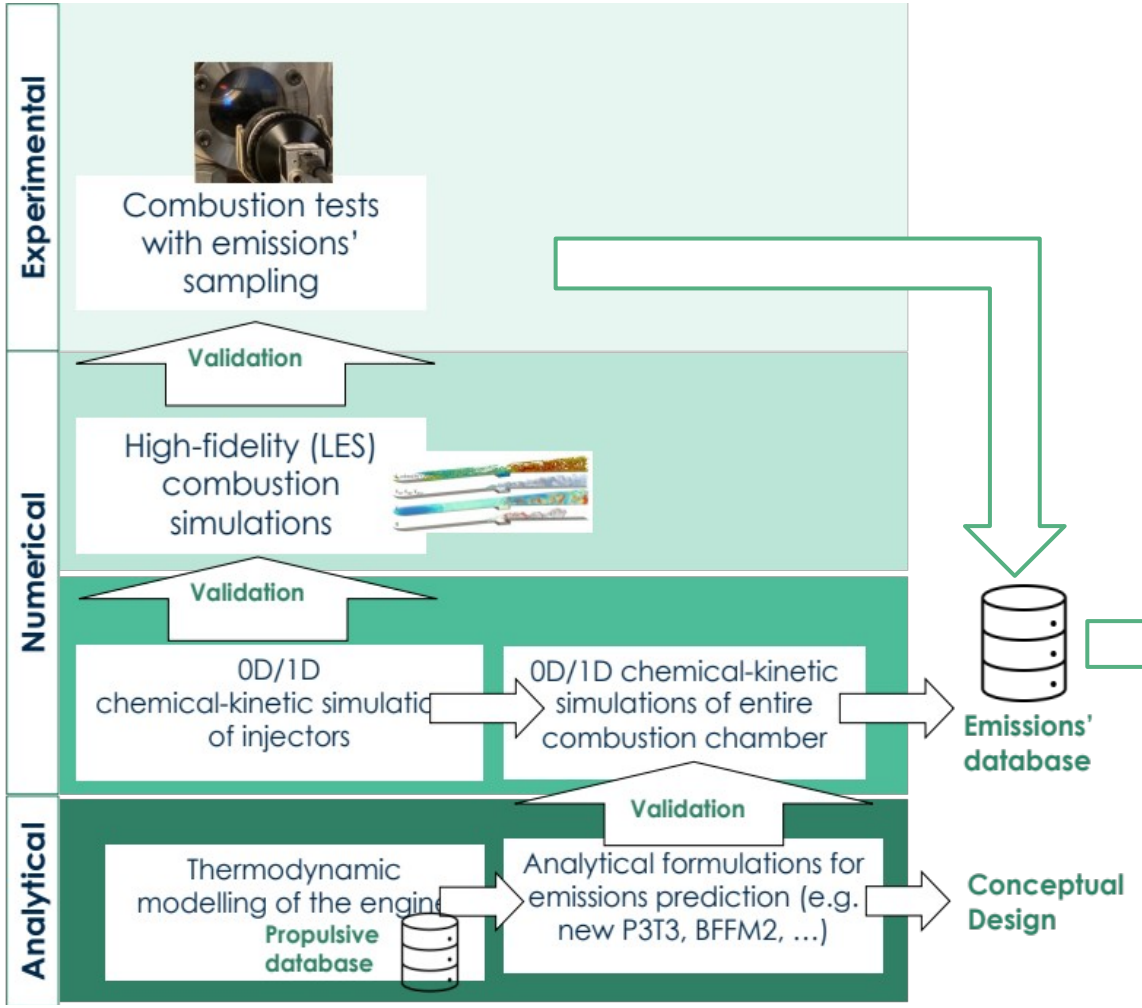
PoliTo contributions:

- ✓ Innovative SAF (pure SAFs and blends) characterization and comparison with fuel ASTM standard
- ✓ Estimation of the Green House Gasses savings (feedstock and production pathways)

MORE&LESS

MDO and REgulations for Low-boom and Environmentally Sustainable Supersonic Aviation

MDO and REgulations for Low boom and Environmentally Sustainable Supersonic aviation



Call: HORIZON-CL5-2022-D5-01-12 - Towards global environmental regulation of supersonic aviation

- Project Coordinator: POLITO
- Duration: 52 months
- Start date: 01/01/2021
- Total EU contribution: 5 M€
- N. Partners: 16
- PoliTo budget (EU Contribution): 261,337€

https://cordis.europa.eu/project/id/101006856/it

MORE&LESS aims at supporting Europe to shape global ***environmental regulations for future supersonic aviation****: recommendations are established on the basis of the outcomes of extensive high-fidelity modelling activities and test campaigns that merge into the multi-disciplinary optimization framework to assess the* ***holistic impact of supersonic aviation onto environment***

- ***[Lead]*** **Conceptual design of reference aircraft and mission**, with different fuels (biofuels and hydrogen) and Mach numbers ranging from 1.5 to 5
- **Integrated and validated multi-fidelity methodology to assess chemical emissions, noise emissions and sonic boom**

Definition of optimal LTO procedures

[Lead] Definition of the **architecture of the holistic framework and integration** of the platform.

[Lead] **Science-based support to policy and decision makers**, including regulatory entities (ICAO/CAEP, EASA, ENAC, Eurocontrol, etc...)

PoliTO Contribution

Medium-range h**Y**brid low-pollu**T**ion flexi-fuel/**H**ydr**O**gen **S**ustainable engine

Call: HORIZON-CL5-2022-D5-01-12 - Towards a silent and ultra-low local air pollution aircraft

- Project Coordinator: Ruhr-Universitaet Bochum
- Duration: 48 months
- Start date: 1st January 2023
- Total budget: 3.1 M€
- N. Partners: 5
- PoliTo budget (EU Contribution): 347,443€

MYTHOS proposes to develop a demonstrated innovative and disruptive ***design methodology*** *for future short/medium range civil engines capable of using a wide range of liquid and gaseous fuels including SAFs and, ultimately, pure hydrogen.*

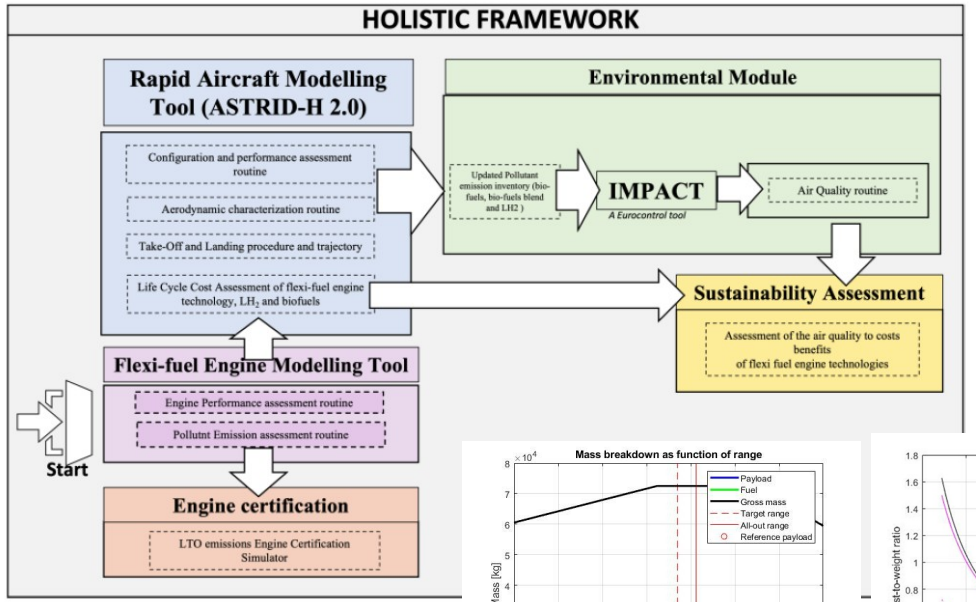
To achieve these, the MYTHOS consortium develops and adopts ***a multidisciplinary multi-fidelity modelling approach*** *for the characterization of the relevant engine components to advance data-driven* ***reduced models, which will be embedded in a holistic tool for the prediction of the environmental footprint of flexi fuel aircraft in early design stages.***

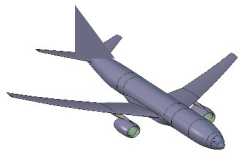
https://cordis.europa.eu/project/id/101096286

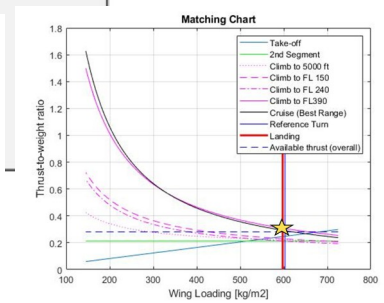
https://mythos.ruhr-uni-bochum.de/

PoliTO Contribution

- **Conceptual design of reference aircraft and mission**, considering the impact of flexi-fuel sustainable engine;
- ***[Lead]*** **Analysis of operational procedures** in Landing and Take Off cycle (LTO);
- ***[Lead]*** **Life-cycle analysis** aimed at the determination of **air quality-to-costs assessment of flexi-fuel technologies**
- ***[Lead]*** Definition of the **architecture of the holistic framework and integration** of the platform.
- *[in partnership with Wroclaw Univ]* Pollutant distribution and **toxicity** analysis at airport level
- ***[Lead]*** **Science-based support to policy and decision makers**, including regulatory entities (ICAO/CAEP, EASA, ENAC, Eurocontrol, etc…)







eVTOL mUlti-fideliTy hybrid desIgn and Optimization for low Noise and high aerodynamic performance

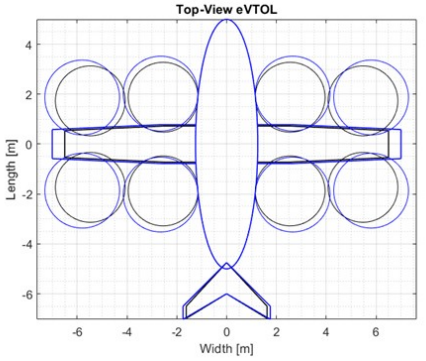
Call: HORIZON-CL5-2023-D5-01-09 - Competitiveness and digital transformation in aviation – advancing further capabilities, digital approach to design

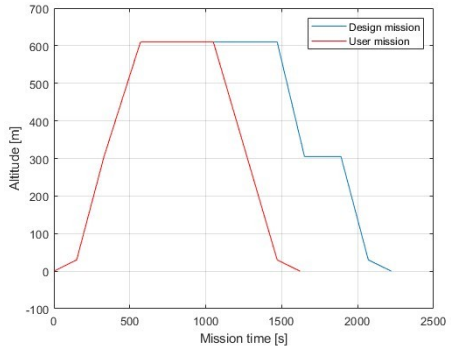
- Project Coordinator: Technische Universiteit Delft
- Duration: 48 months
- Start date: 1st January 2024
- Total budget: 3.5 M€
- N. Partners: 12
- PoliTo budget (EU Contribution): 570,000€

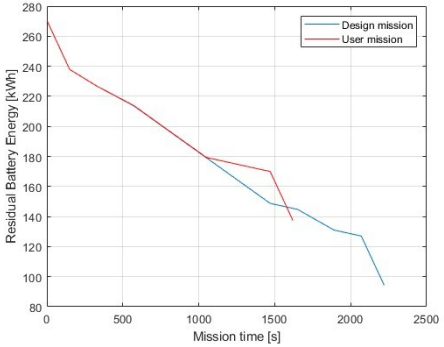
https://cordis.europa.eu/project/id/101138209
https://evtolution.eu/

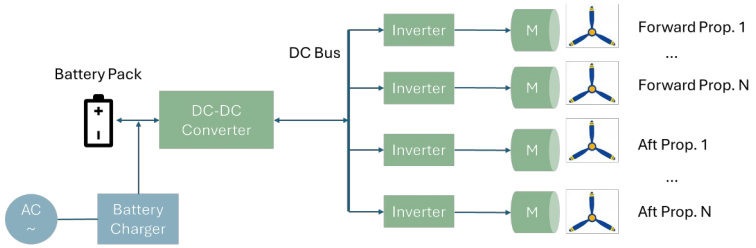
*eVTOLUTION is designed as a low-to-mid-TRL enabler project meant to **develop the knowledge, data, tools, methods and tests** that are necessary to understand, model, and optimize aerodynamic performance and noise emissions of **eVTOL**.*

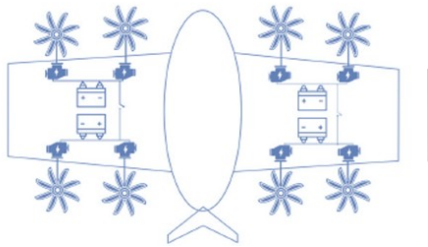
*eVTOLUTION aims at **developing a multi-disciplinary and multi-fidelity simulation and optimization platform tailored to the specific issues encountered in eVTOL** aircraft design regarding aerodynamic efficiency and **noise emissions**, enabling, at the same time, the **identification of energy efficient strategies for sustainable flight**. The design exercise is focused on the **case study provided by a AAM Manufacturer**.*











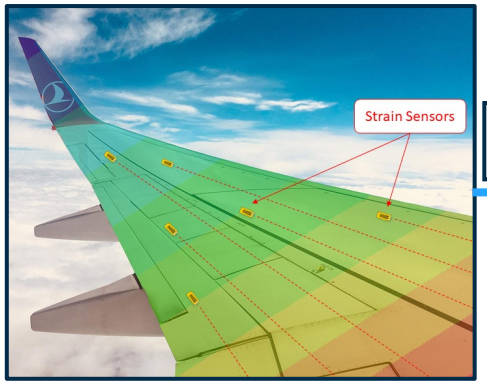
PoliTo contributions:

- ***[Lead]*** **Mission profile** definition, **aircraft requirements** and constraints;
- ***[Lead]*** On-board **energy management and cooling system**;
- Contribution to the aircraft optimization framework through **development of tools capable of evaluating design points for minimum energy consumption in flight**;
- Analysis of **mission fulfilment and compliance with initial requirements.**

DIMOSS

DIsplacement MOnitoring using Strain Sensors

PoC Transition
Funded by Fondazione Compagnia di San Paolo
Scient. Resp.: Eng. Marco Esposito (DIMEAS)

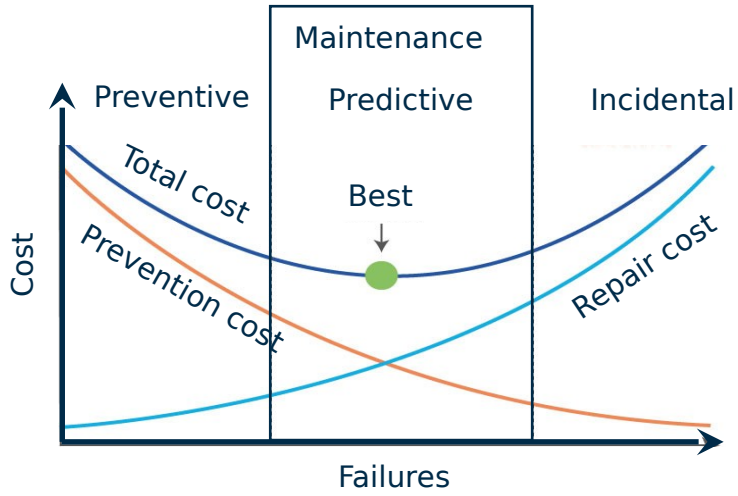


STRAIN

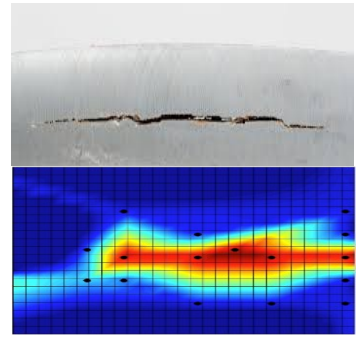
Integrated software – sensors approach
Independent of material and loads
Real time capabilities
Compatible with existing commercial FEM softwares

DIMOSS

DISPLACEMENTS
STRESSES

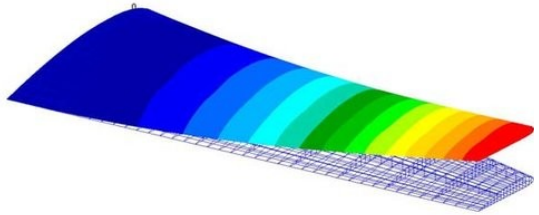


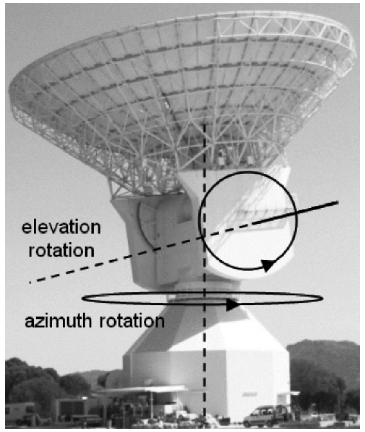
Damage monitoring



Structural Health Monitoring

Smart Structures





HYDROLAB PROJECT

Aimed at Implementing In Piedmont:

Aerospace Liquid Hydrogen Distribution System Technology

Finalizzato all'attuazione in Piemonte:

Tecnologia aerospaziale dei sistemi di distribuzione dell'idrogeno liquido

Funded by European Regional Development Fund

Finanziato da Fondo europeo di Sviluppo Regionale

HYDROLAB PROJECT

FESR: supporting research, development and exploitation of innovation (R&D&I) activities

Project category 1. b – "Strategic Big-challenges", development and/or significant scientific and technological advancement in the Regional Smart Specialization Strategy 2021 -2027 of the Piedmont Region;

FESR: supportare le attività di ricerca, sviluppo e valorizzazione dell'innovazione (RSI) Categoria progettuale 1. b – “Big-challenges strategiche”, sviluppo e/o l’avanzamento scientifico e tecnologico di rilievo

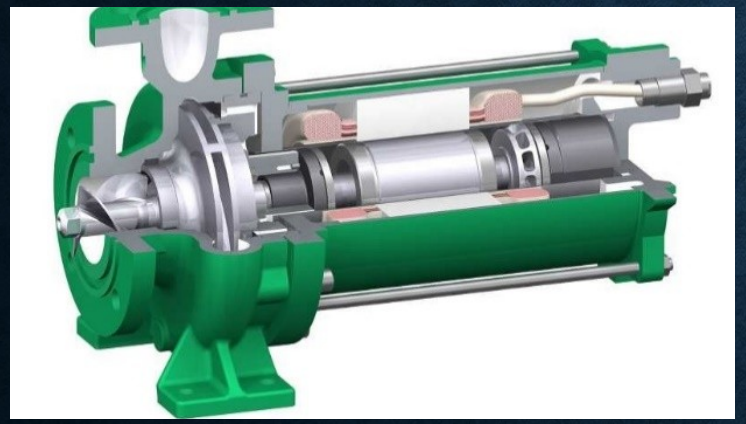
nella Strategia Regionale di Specializzazione Intelligente 2021 -2027 della Regione Piemonte;

HYDROLAB: 5 FOCUS

HYDROLAB 5 FOCUS

1&2 END USER & Il mercato e stato dell'arte della disciplina
END USER & The market and the state of the art of the discipline

3 MATERIALS MATERIALI
Quali e Come testare / Which and how to test

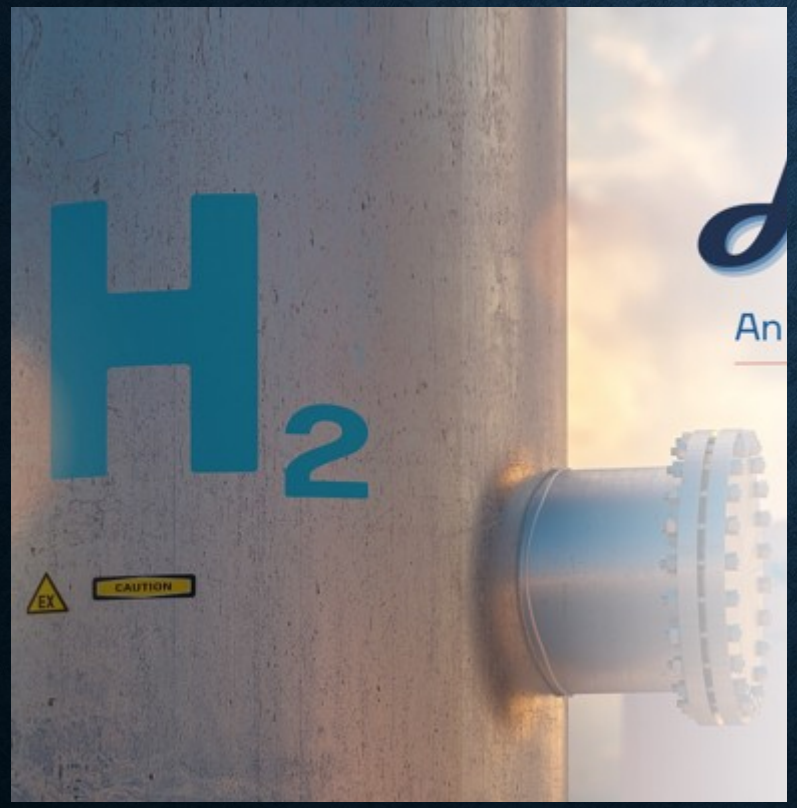


4 Electrical embedded pump

Pompa sommersa a mottore elettrico

5 Design of test bench
Test bench design

WHO? CHI?
WHAT? COSA?



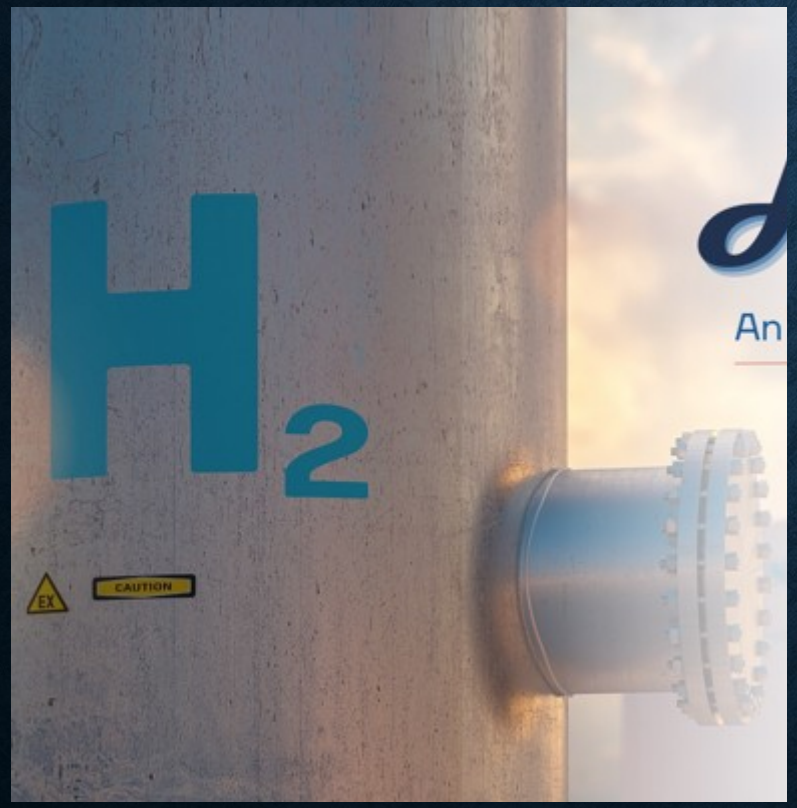
- 6 PMI
  - REACTIS ITALIA : gestione-digitalizzazione (database, bench)
  - MICROCHANNEL SrL: Meccanica idrogeno - testing
  - SDM Tooling: drafting
  - Inpraise Sro (CZ): design tecnologia cuscinetti
  - Noaeka SrL (Padova): design impiantistica criogenica
  - FINISTERRAE srl design e progettazione

- 1 END USER : SAGAT TORINO: driver/certificazione/impianti di terra

- 1 POLITO (HYDROGEN LAB): testing+ supporto+motori elettrici
- Two consulting: CAP GEMINI (TOULOUSE); INNOVIA (University of Bordeaux)

ENABLERS / ABILITATORI

CONCLUSION
CONCLUSIONE



- Piedmont / Italy has the potential to become a leader on this technology
- Il Piemonte/Italia ha il potenziale per diventare leader in questa tecnologia

A new Center: Integrated Digital and Experimental Aerospace for Sustainability - IDEAS

La missione del Centro Interdipartimentale per l'Aerospazio, **IDEAS** - **Integrated Digital and Experimental Aerospace for Sustainability**, è quella di sviluppare soluzioni tecniche e conoscenze scientifiche che supportino lo sviluppo sostenibile delle future missioni, sistemi e tecnologie aeronautiche e spaziali. I risultati dell'attività del Centro saranno fondamentali per implementare nuovi concetti al servizio della nostra società, per proteggere i cittadini e il pianeta già a breve termine, e per supportare la ricerca aerospaziale di frontiera e l'esplorazione spaziale nel medio e lungo termine.

IDEAS si articola su cinque aree scientifiche:

- due laboratori per lo spazio nel segmento up-stream:

  HUMANS – Humans-in-the-loop Moon and Mars Analog for Sustainability

  STELLAR - Space Technology & Engineering Lab for Learning and Research

- uno per il segmento down-stream:

  DIGITAL PLANET - Pioneering Leading Advancements in Networked Environmental Tech

- due per l'aeronautica:

  ADVANCED AIR MOBILITY

  SUSTAINABLE AVIATION

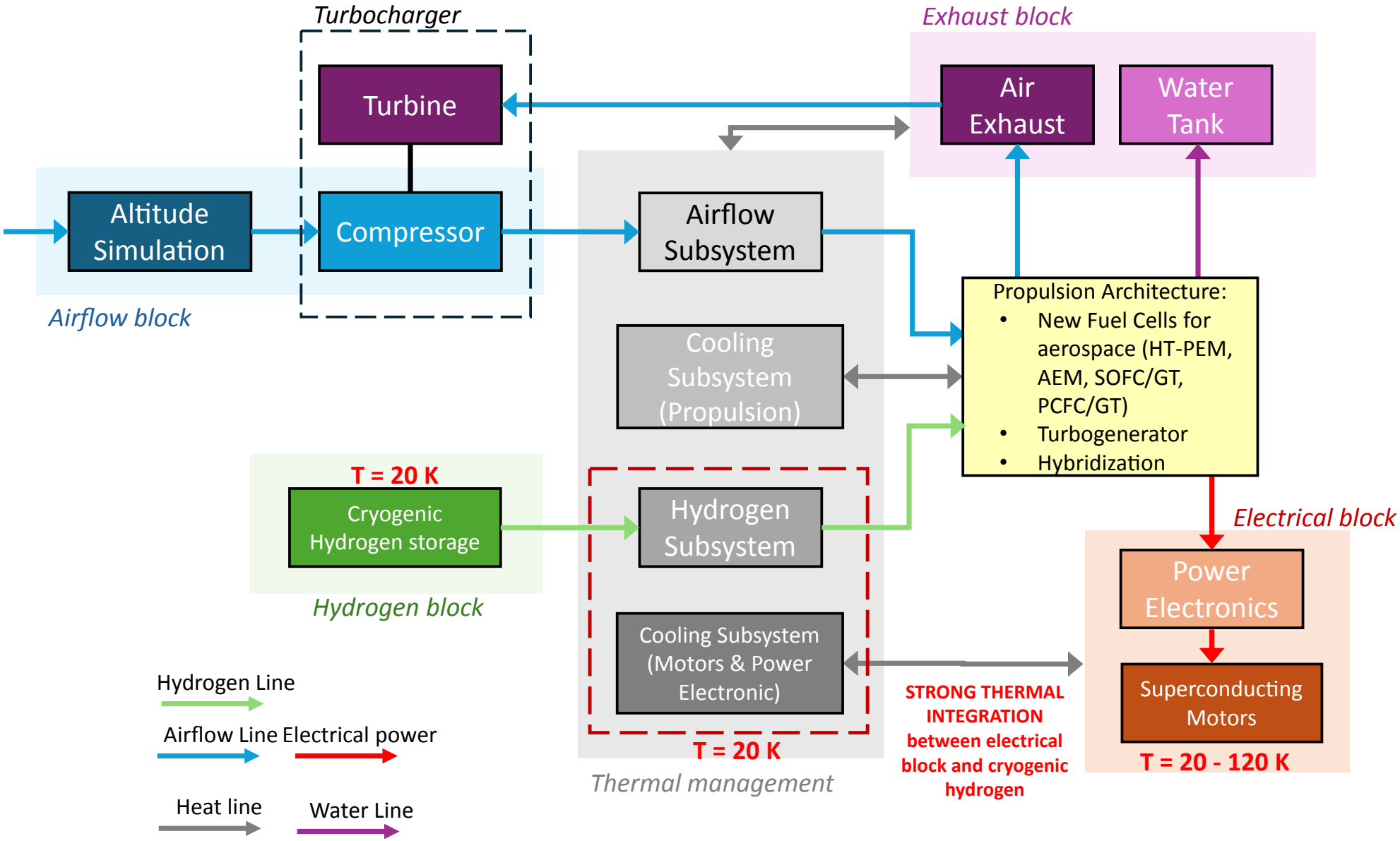
Ogni laboratorio si articola su tre pilastri, ossia la digitalizzazione dei processi di progettazione e simulazione, lo sviluppo di tecnologie (hardware e software) innovative, e la sperimentazione funzionale e ambientale delle stesse in ambiente controllato e/o rilevante. I laboratori possono essere implementati presso il Politecnico di Torino o in siti diversi (aziende, centri di ricerca, agenzie, università) in collaborazione con Polito.

L'ambizione di IDEAS è quella di valorizzare al meglio le competenze spaziali e aeronautiche del territorio a beneficio di una comunità più ampia. Per raggiungere questo ambizioso obiettivo, il Centro Aerospaziale: (i) intraprende ricerche di frontiera a livello mondiale; ii) sostiene l'innovazione e la competitività; (iii) offre competenze e istruzione; (iv) è aperto alla società tutta per migliorare l'impatto sui cittadini. -

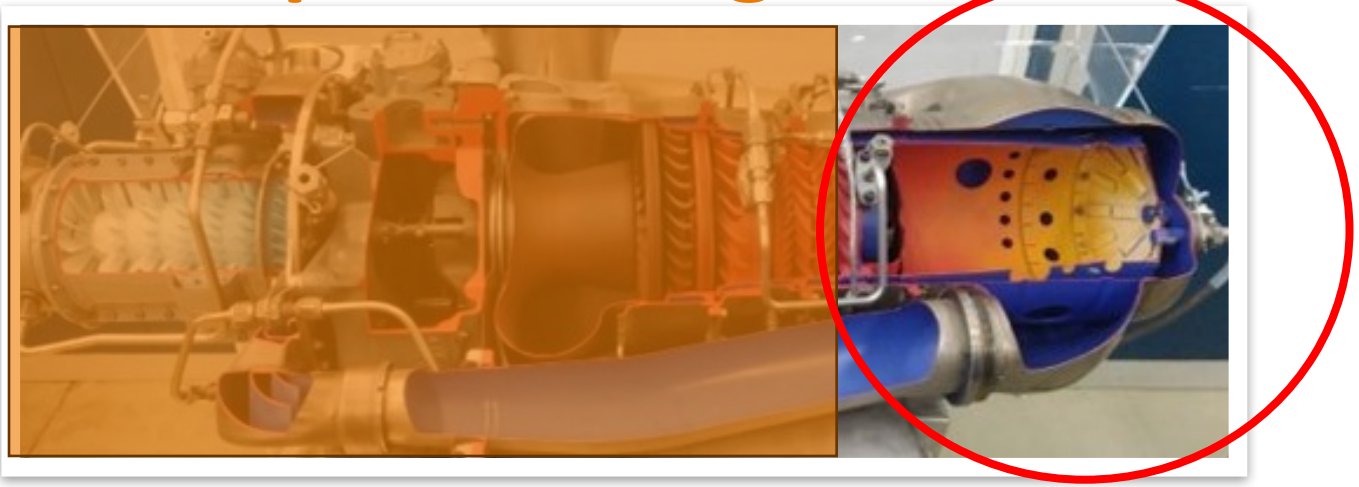
Sustainable Aviation

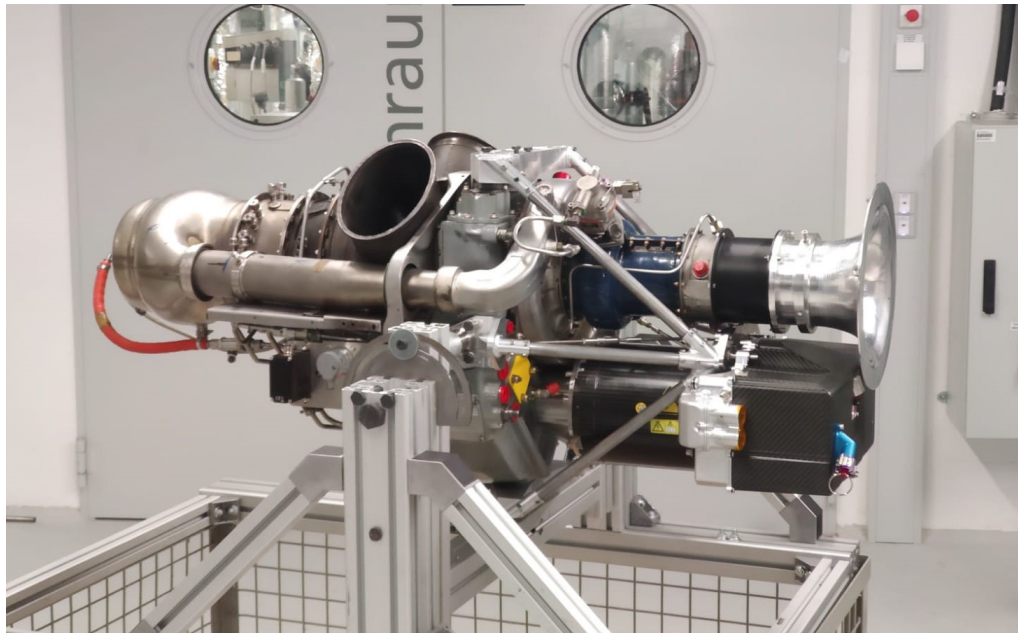
- *Description*
- **Main features of first step Technology Lab (Clean Powertrain):**

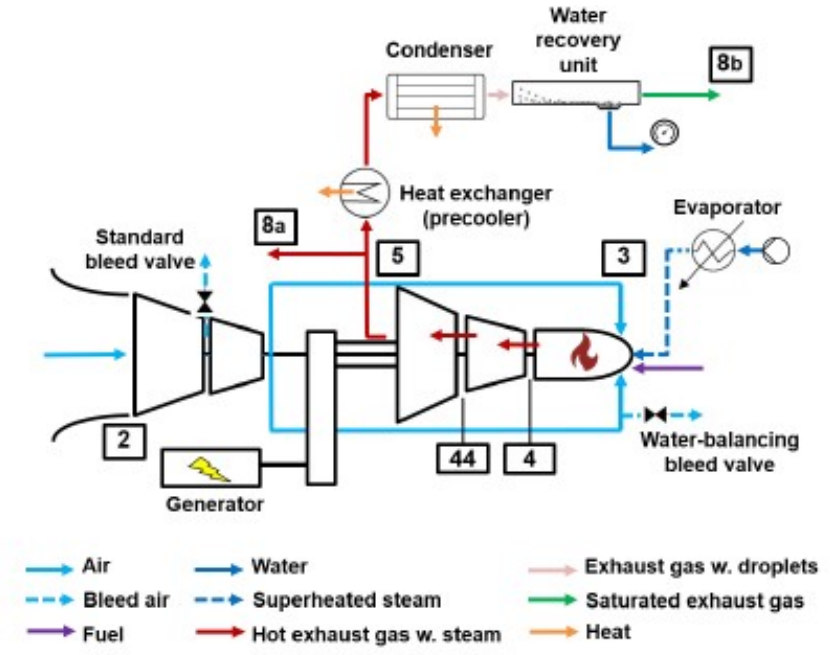
- Effective cooling of power electronics and motors based on superconducting materials (superconducting motors) through the integration of the liquid/cryogenic hydrogen storage/distribution system
- Fuel cells for aerospace products: HT-PEM, AEM, SOFC/GT, PCFC/GT



….toward scale up and integrated combustor







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都灵理工大学

Thank you

Politecnico di Torino