Avio Aero Clean Aviation demonstrators: move innovation forward

Enrico Casale
Advanced Technology – EU Programs
enrico.Casale@avioaero.it

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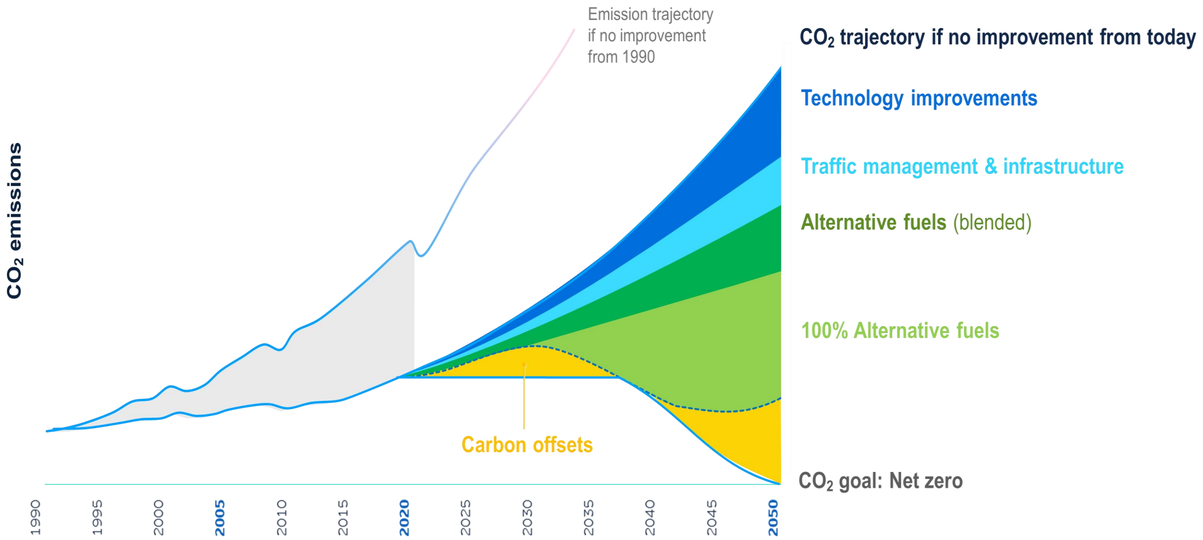
Industry goal to reach net zero CO2 emissions by 2050

2050 CO2 emission - Aviation Trajectory (*)



	2020	2025	2030	2035	2040	2045	2050
Commuter – 9-19 seats – <60 minute flights – <1% of industry CO_2	SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF
Regional – 50-100 seats – 30-90 minute flights – ~3% of industry CO_2	SAF	SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF	Electric or hydrogen fuel cell and/or SAF
Short haul – 100-150 seats – 45-120 minute flights – ~24% of industry CO_2	SAF	SAF	SAF	SAF Potentially some hydrogen	Hydrogen and/or SAF	Hydrogen and/or SAF	Hydrogen and/or SAF
Medium haul – 100-250 seats – 60-150 minute flights – ~43% of industry CO_2	SAF	SAF	SAF	SAF	SAF Potentially some hydrogen	SAF Potentially some hydrogen	SAF Potentially some hydrogen
Long haul – 250+ seats – 150 minute + flights – ~30% of industry CO_2	SAF	SAF	SAF	SAF	SAF	SAF	SAF

SOURCE: Collective Industry view from ATAG Waypoint 2050 report

(*) SOURCE: IATA, ATAG, GE marketing analysis

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AvioAero commitment to a more sustainable future of flight

Hybrid electric

MW-class hybrid electric propulsion system development … builds on GE's experience with motors, generators, power converters and power management systems

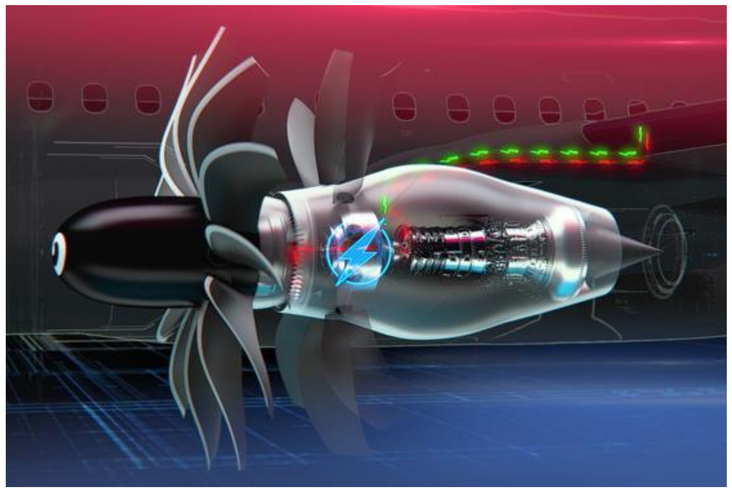
Hydrogen

CFM International* developing hydrogen combustion and fuel systems for Airbus ZEROe aircraft project … builds on 8M operating hours with hydrogen in GE land turbines

Image courtesy of Airbus

CFM RISE

GE and Safran Aircraft Engines program maturing advanced engine architectures like open fan, compact core and electric technologies for **>20%** better fuel efficiency vs. today's engines



Ground & flight tests designed to show technology readiness this decade for multigenerational upgrade by mid-2030s

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Clean Aviation OFELIA

Objectives

Enable RISE Open Fan architecture through distinctive capabilities on:

- High power density reduction gearbox
- High Speed low pressure turbine

100% SAF combustion testing

Ground test demo and flight test readiness

OFELIA

Demonstrate the propulsive efficiency of Open Fan architecture through Ground Test Demonstration paving the way for Flight Test Demonstration

GBX Tech Mat

GBX Full scale test

LPT Tech Mat

Advanced design cold flow test

Combustor Tech Mat

100% SAF test

GBX & LPT for GTD

GTD validation

Ground and Flight Test Demos

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Clean Aviation AMBER

Objectives

Demonstrate integrated MW-class fuel cells within a hybrid propulsion system architecture

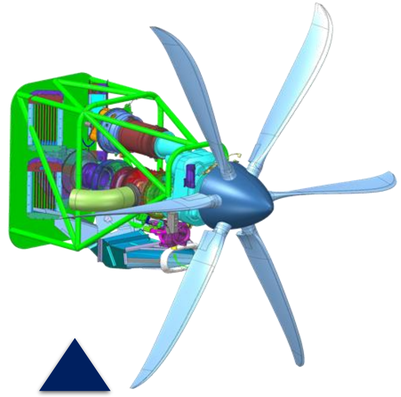
Evaluate performance entitlement and technology readiness

Execute rig demonstrations by mid-2020s to mature system and components

AMBER

Parallel hybrid-electric propulsion demonstrator integrating the advanced architecture of the Catalyst ™ thermal turboprop engine with an electric motor powered with hydrogen fuel cells

Mechanical Power Flow (MPF)		Subsystem / System Tests
Electrical System – Power Flow (EPF)		Subsystem / System Tests
Controls and Thermal Management		Dry Rig
Component and design technology		



Ground Test Demo

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Clean Aviation HYDEA

Objectives

De-risk, mature & integrate H2 combustion propulsion technologies

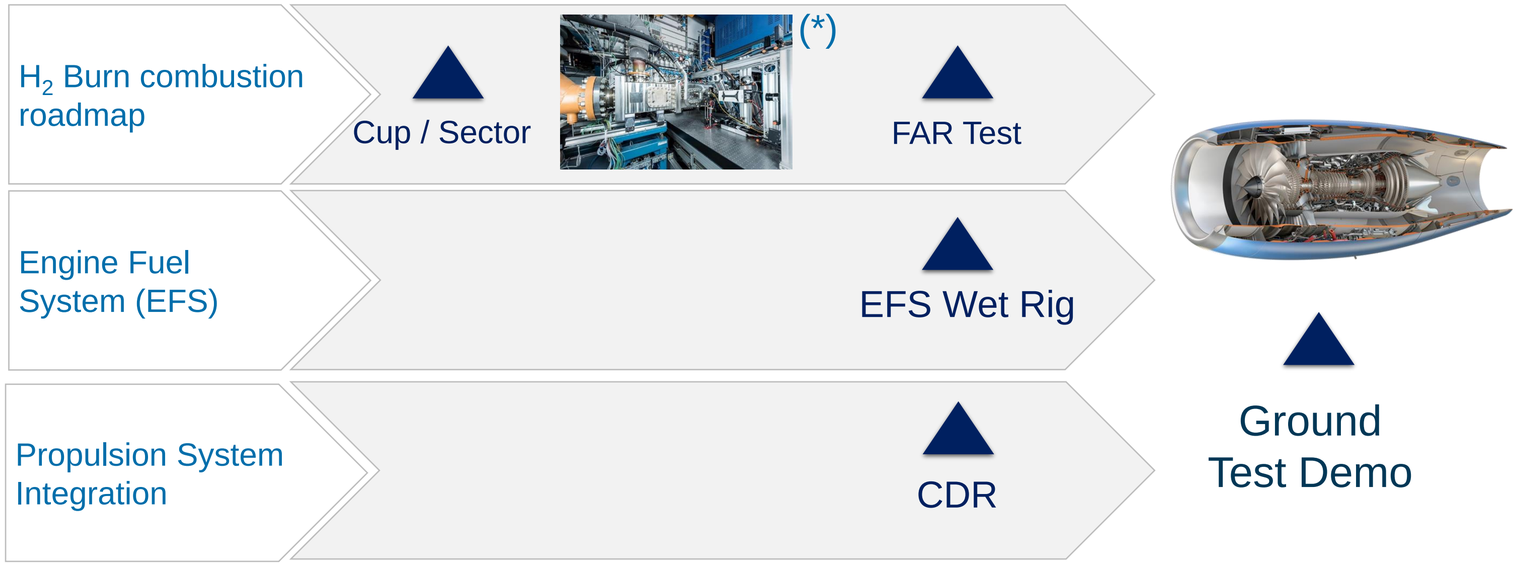
Design & develop an integrated H2 fuel system architecture

Perform product analysis, including technology and certification gaps through proactive engagement with

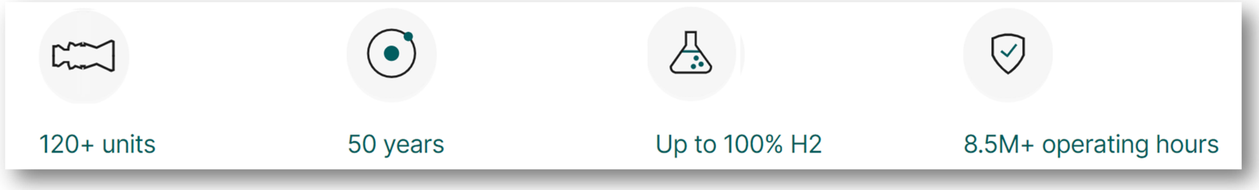
Aligning with EU's SRIA objectives to demonstrate the feasibility of H2 direct combustion in an aviation

HYDEA

Laying the foundations for future clean hydrogen combustion propulsion architectures, scalable for different aircraft sizes (regional, SMR)



Leveraging GE's demonstrated experience on hydrogen fueled gas turbines



* DLR's hydrogen combustion test rig, with the laser-optical measurement system right of center

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