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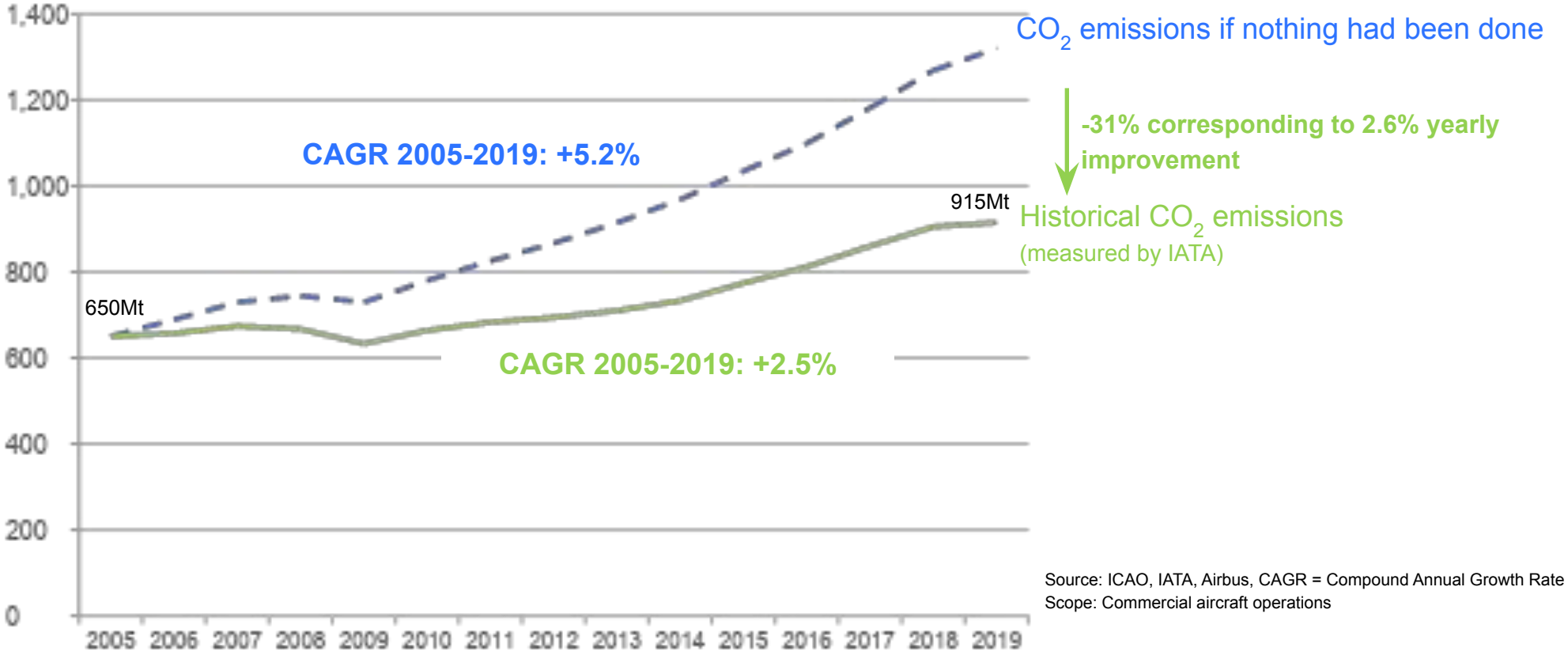
Laurent Boisson
Corporate Affairs

17 November 2022

Impressive 2005-2019 efficiency improvements

CO_2 emissions from operations (million tonnes)



Source: ICAO, IATA, Airbus, CAGR = Compound Annual Growth Rate
Scope: Commercial aircraft operations

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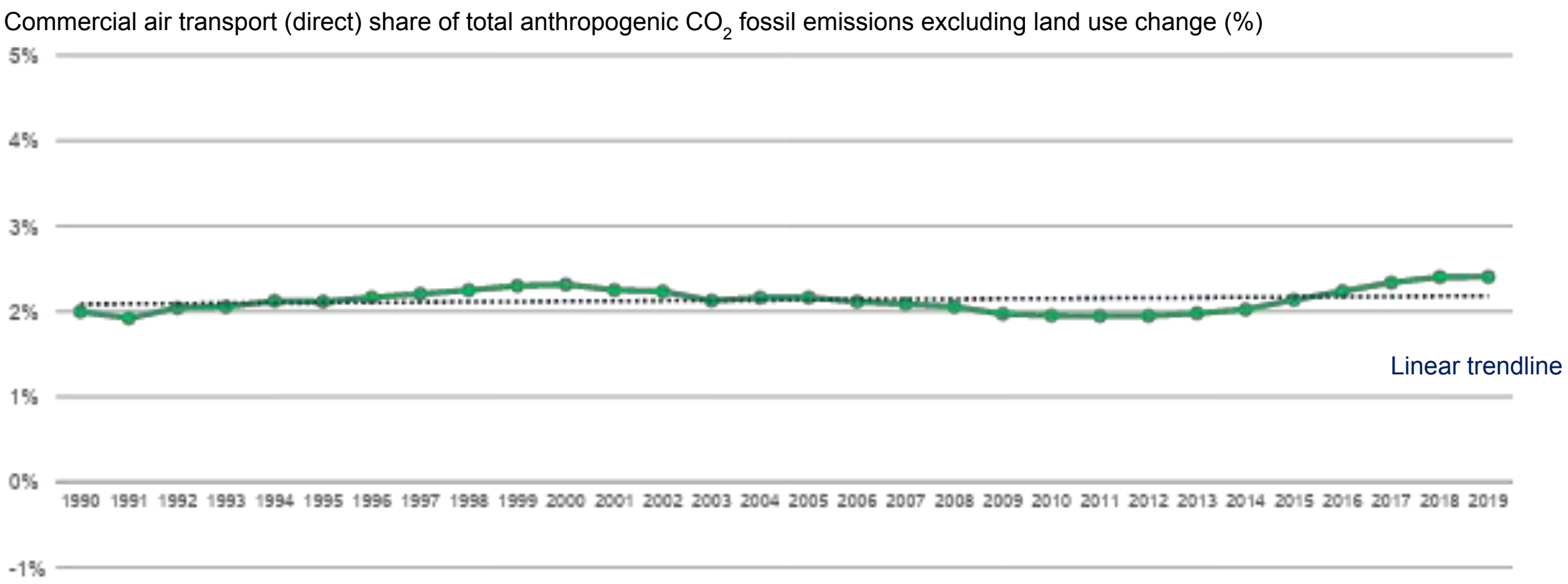
Commercial air transport direct share of total anthropogenic CO_2 fossil emissions has remained pretty stable over the last ~30 years



Source: EDGAR CO_2 emissions, IATA, Airbus

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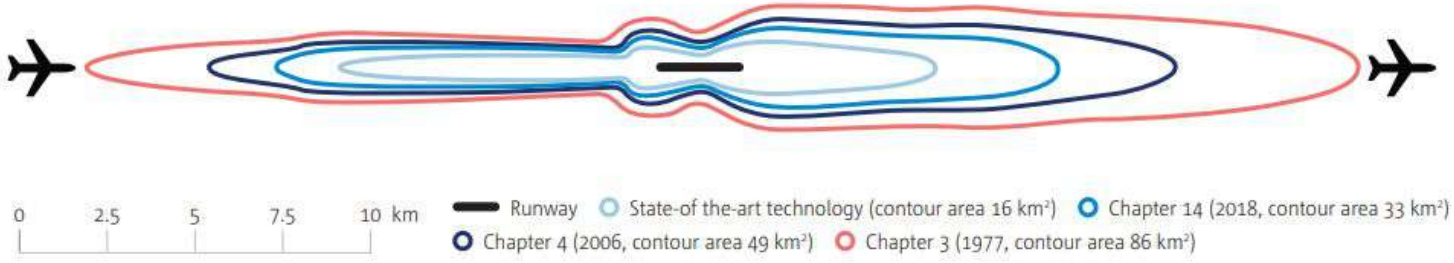
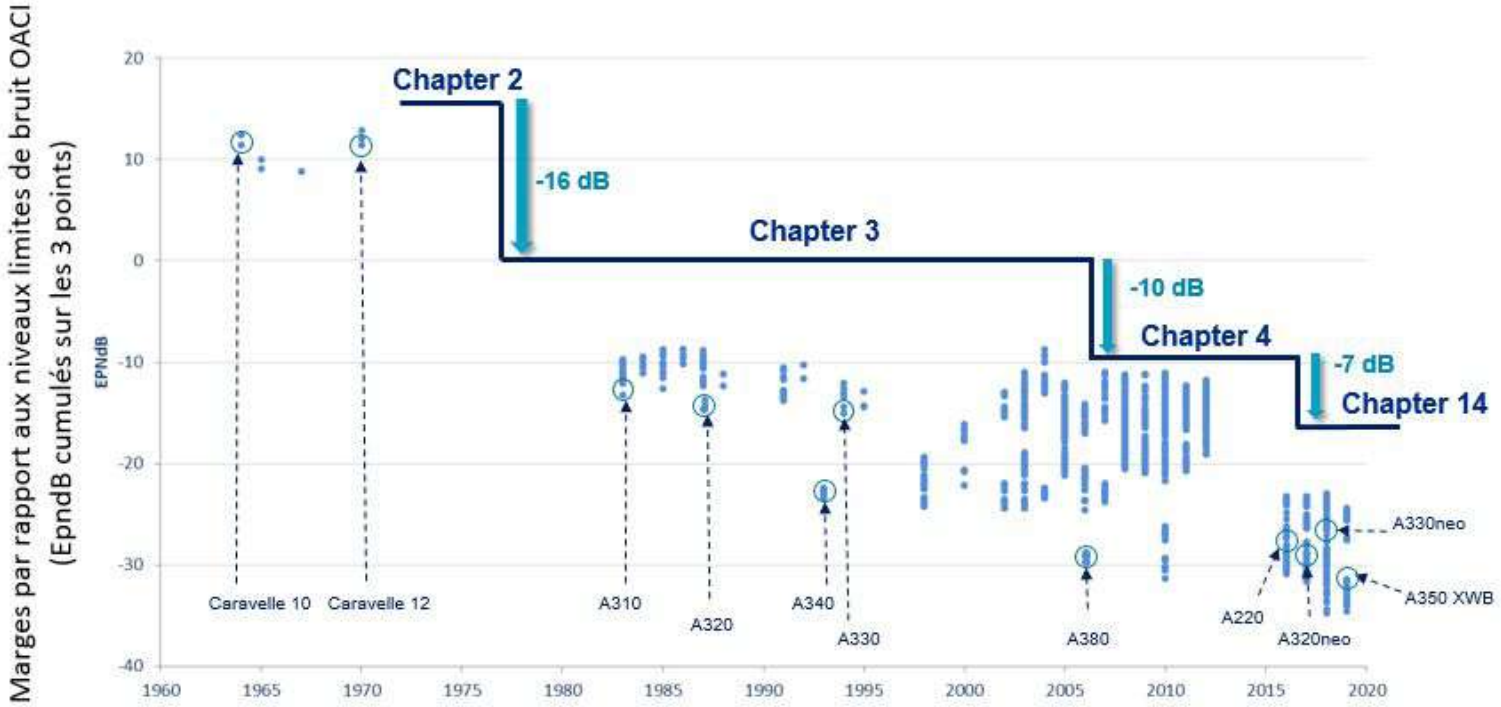
Figure 3.1 Single landing and take-off 80 dB noise contours for aircraft that just meet the noise limits of the Annex 16 Volume I chapters plus a state-of-the-art in-production aircraft





80% de réduction impact bruit sur populations*

Tous les Airbus de dernière génération respectent le dernier standard en vigueur (Chapitre 14)

* Depuis le chapitre 3 en 1977, EUROPEAN AVIATION ENVIRONMENTAL REPORT 2022

Les Assises Nationales pour la Qualité de l'Environnement Sonore, 2022 - **Feuille de route du transport aérien pour réduire son impact sur l'environnement**

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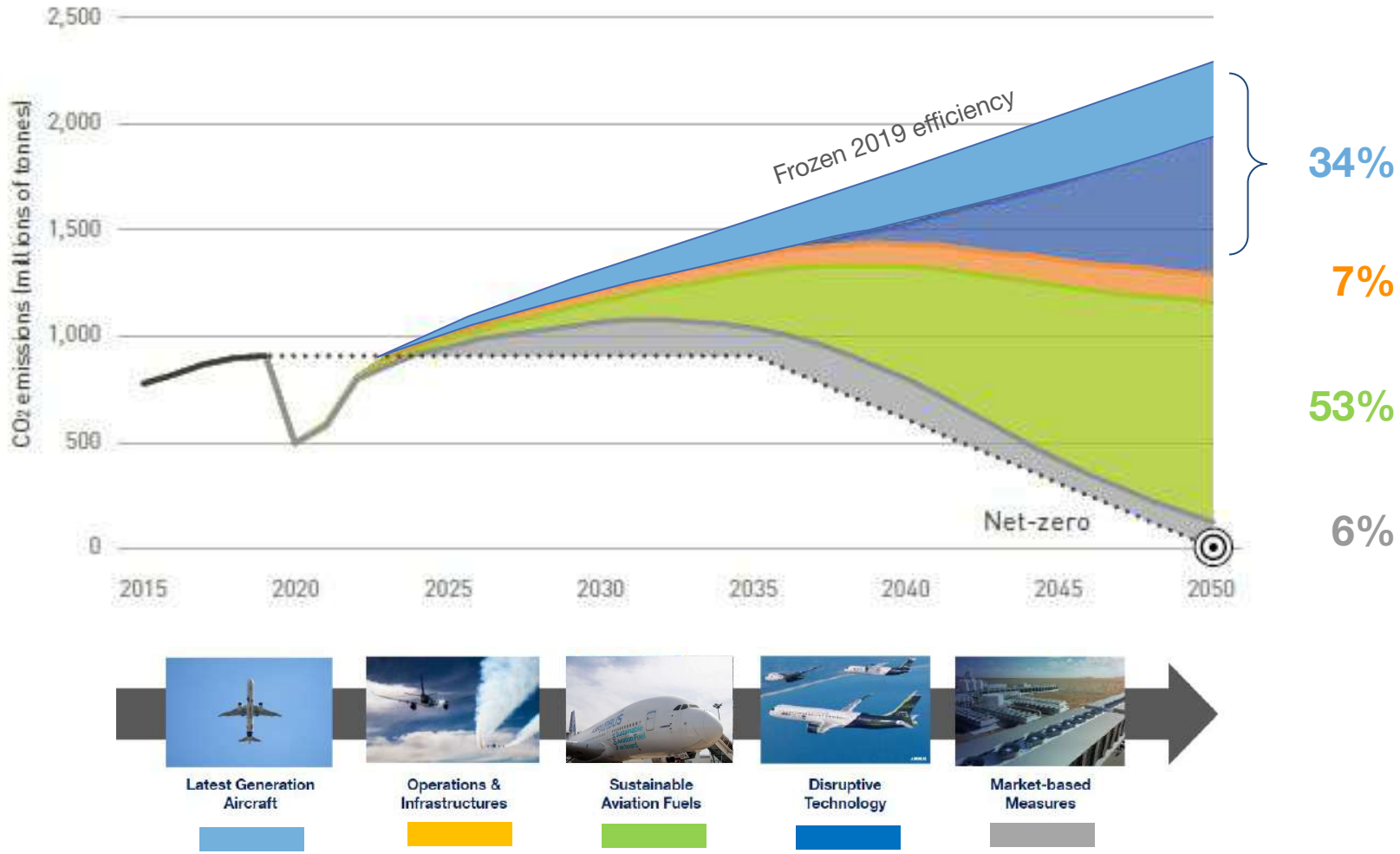
There is no single solution to decarbonise aviation

Airbus supports the ATAG most ambitious technology scenario



> ATAG CO_2 Roadmap based on most ambitious technology scenario & central traffic growth scenario: 3.1% CAGR 2019-2050)

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Latest generation aircraft

- **Fleet replacement could yield 20-30% CO2 savings**
- 80% of the current fleet is not to the latest standard of Airbus product line
- Continuous technology enhancements
  - Lightweight materials
  - Wing optimization
  - Engine efficiency
  - Electrification / hybridization

Operations & Infrastructures

- **Operational optimization solutions can save up to 10% CO2**
- Optimized flight trajectories
- Hybrid on-ground operations
- Air Traffic Management

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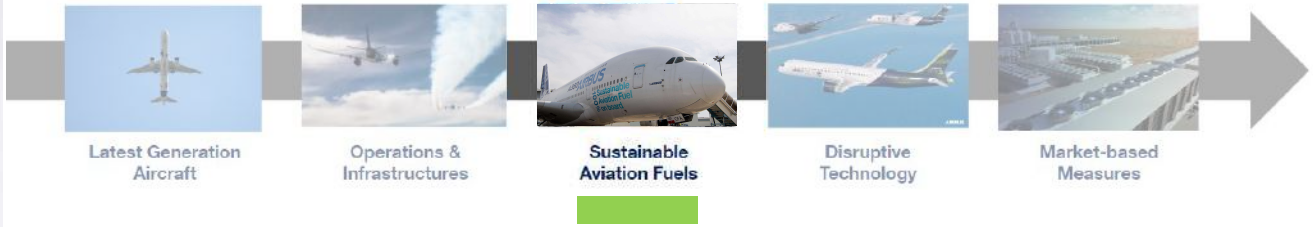

Sustainable Aviation Fuels

- **Flying with 100% SAF reduces the CO2 emissions by up to 85%**
- All Airbus aircraft is already certified to 50%, certification up to 100% by end of decade
- Industrial uptake needed to increase SAF's availability
- Coalitions and partnership signed to foster production of SAF

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Disruptive technologies

- **Our ambition is to bring to the market a zero emission aircraft by 2035**
- Hydrogen combustion generating thrust by burning liquid hydrogen
- Hydrogen fuel cells converting energy stored in H2 into electrical energy to power electric motors
- **Active on the H2 ecosystem: part of international organizations and coalitions and signing multiple partnerships**

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Introducing Airbus ZEROe

Turboprop

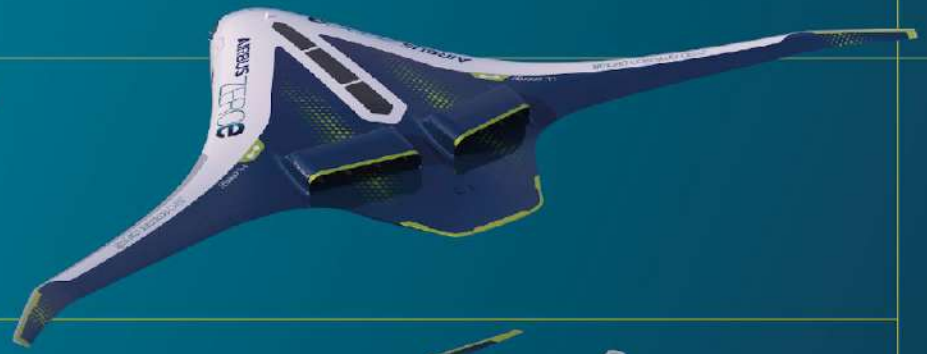
<200 Passengers

Hydrogen Hybrid Turboprop Engines (x 2)

1,000+nm Range

Liquid Hydrogen Storage & Distribution System

Blended-Wing Body



<200 Passengers

Hydrogen Hybrid Turbofan Engines (x 2)

2,000+nm Range

Liquid Hydrogen Storage & Distribution System

Turbofan

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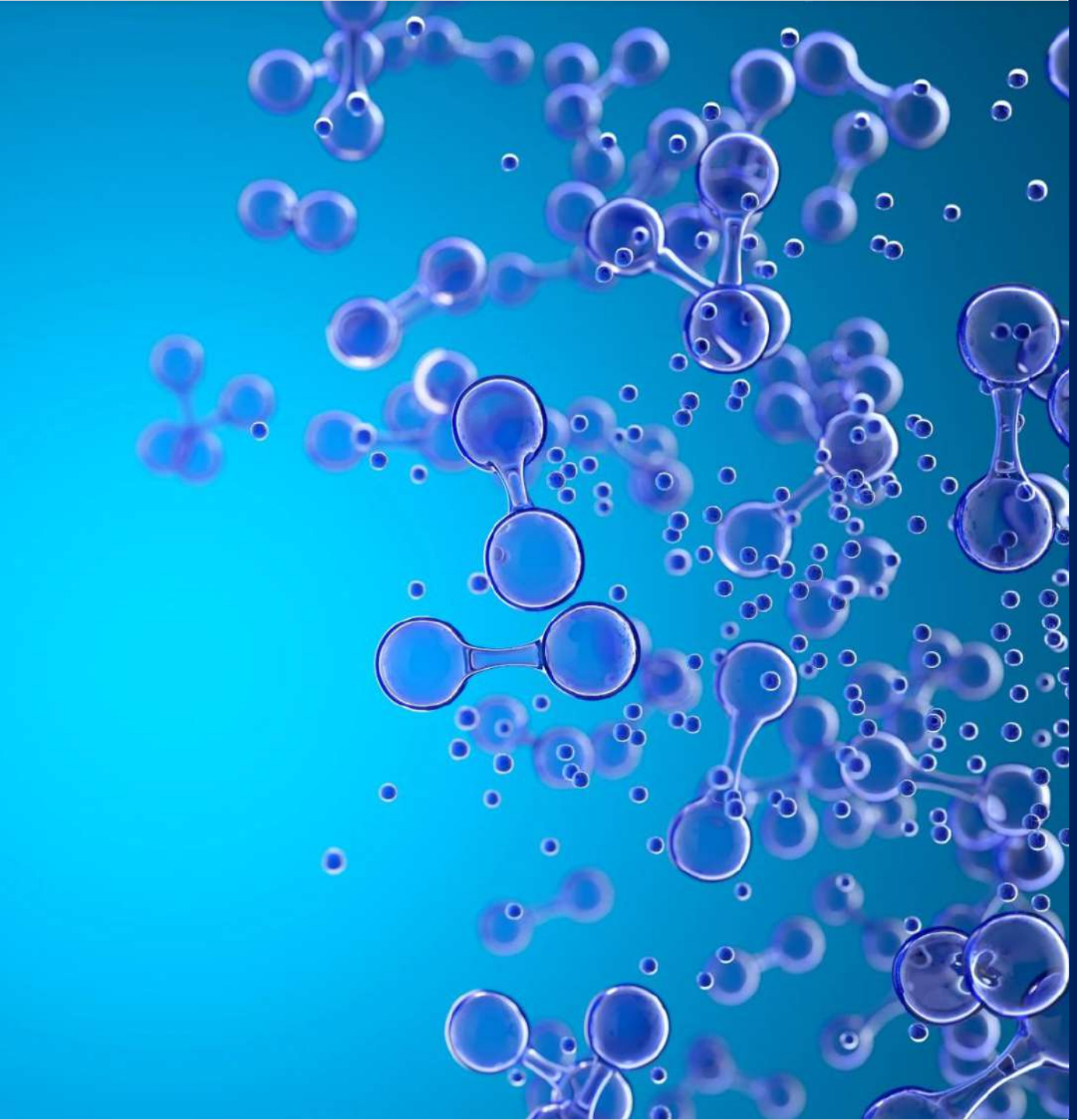

Why hydrogen?

Zero emission: H_2 emits no CO_2* & has the potential to reduce non-CO_2 emissions (i.e. NOx) & persistent contrails
(*if generated from renewables via electrolysis)

Declining costs: the cost of producing H_2 is likely to decline over the next decades as it gets widely adopted by various industries. This will make zero-emission flying increasingly economical

Versatility: H_2 could be used as an ingredient of Sustainable Aviation Fuel* or directly on-board an aircraft through direct combustion or fuel cells
(*combined with captured CO_2 to produce Power-to-Liquid synthetic fuel)

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Hydrogen specificities

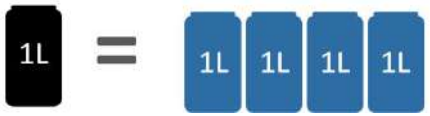
Kerosene vs H_2

for the same amount of energy

Weight

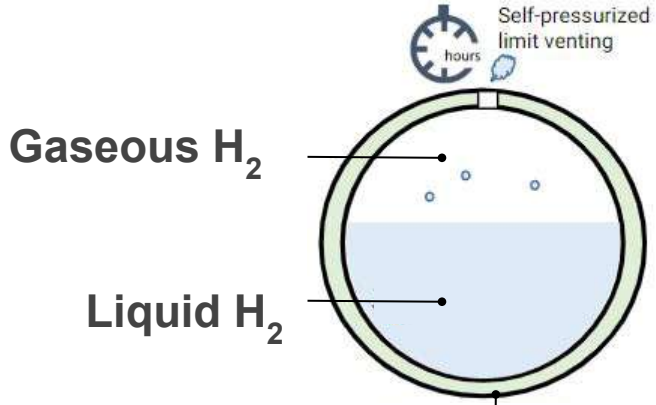
H_2 is 3 times lighter

Volume

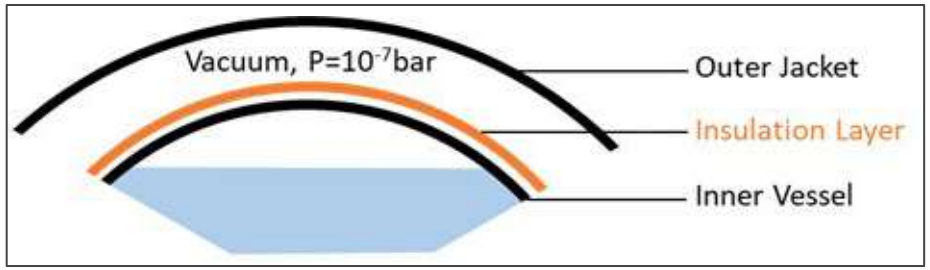


4L of Liquid Hydrogen

How to <u>store</u> H_2 in an aircraft ?



Cryogenic temperature - 253°C



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ZERO e Hydrogen combustion demonstrator

A380 multimodal test platform
with its capacity to store large hydrogen tanks

Hydrogen combustion engine
located along the rear fuselage

4 liquid hydrogen tanks
stored in a caudal position

Liquid hydrogen distribution system

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ZEROe Ecosystem partnerships - Public announcements

May 2019

Airbus and **SAS Scandinavian Airlines** sign hybrid and electric aircraft research agreement

November 2019

easyJet and Airbus sign a Memorandum of Understanding related to joint research project on hybrid and electric aircraft

September 2020

Airbus reveals three new zero-emission concept aircraft

September 2021

Air New Zealand and Airbus to research future of hydrogen-powered aircraft

February 2022

MoU with Air Liquide, Incheon Airport and Korean Air

MoU with CAAS, Changi airport and Linde

MoU with SNAM and SAVE

MoU with Milan Airports

2019 | 2020 | 2021 | 2022

June 2021

Air Liquide, Airbus and **Groupe ADP** partner to prepare hydrogen infrastructures deployment at airports

September 2021

Airbus, **Air Liquide** and **VINCI Airports** announce a partnership to promote early use of hydrogen at airport and accelerate the decarbonization of aviation sector

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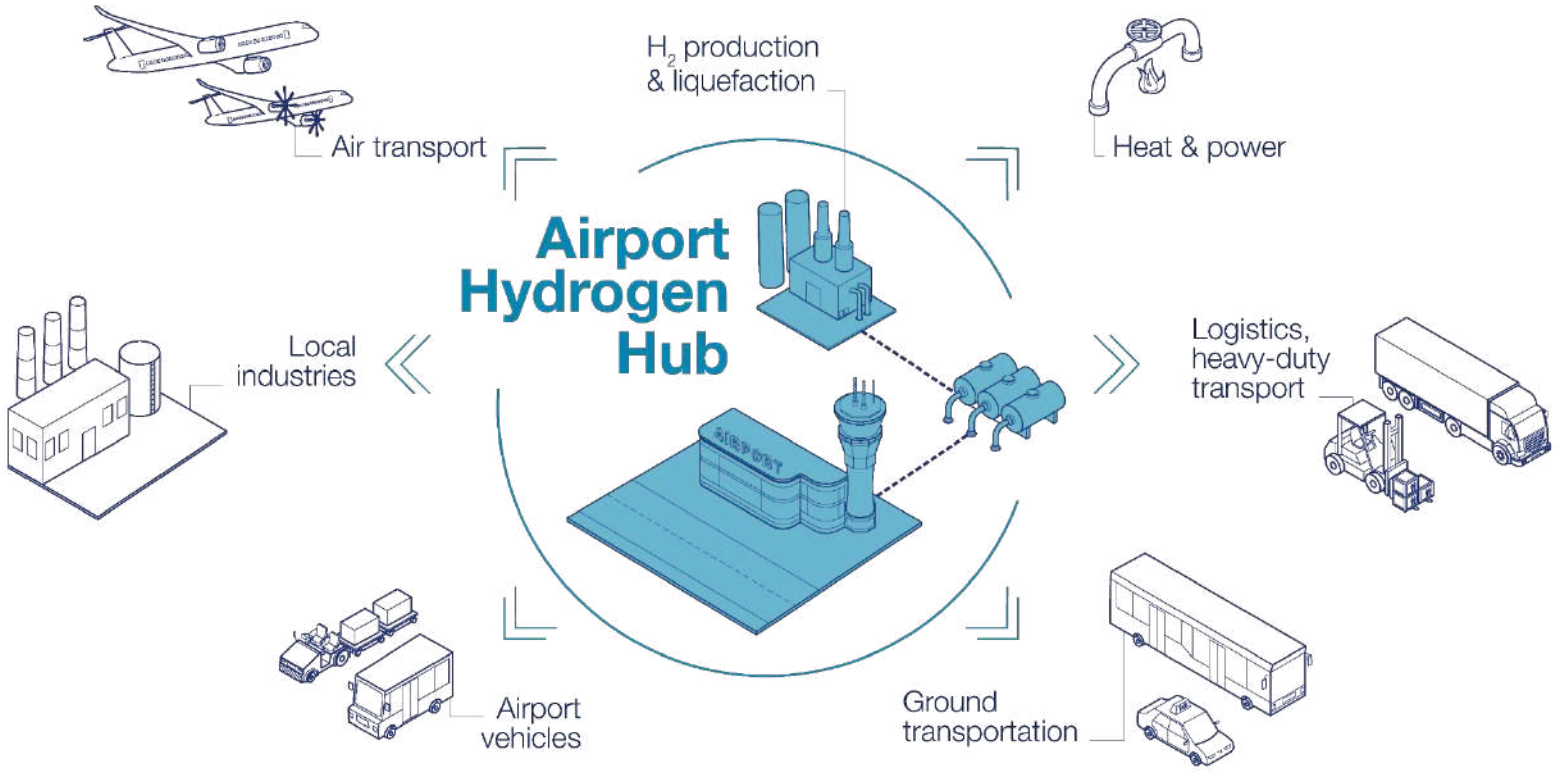
Hydrogen Hubs at airports

Why Airports as Hydrogen Hubs?

- Airports are heavy goods transport hubs (machinery, buses, trucks, ….and aircraft)
- Heavy transport requires hydrogen for decarbonisation
- Airports hydrogen hubs which will also prepare for zero emission aviation

Airport hydrogen hubs will:

- Prepare regulations and standards for the handling of hydrogen at airports
- Ensure that a large number of airports worldwide are supplied with LH_2 by 2035
- Foster efficiency improvements and cost reductions in hydrogen liquefaction, storage and distribution



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ZEROe airport partnerships | LYS study

VINCI AIRPORTS Air Liquide

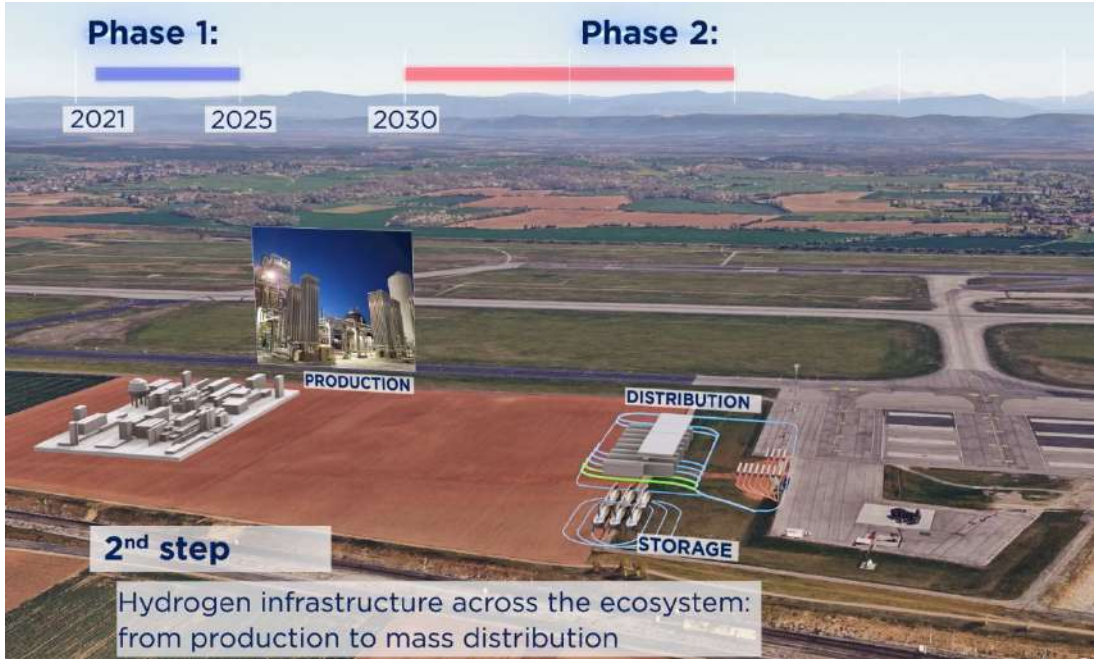
3-party partnership unveiled in September 2021

Scope: case study on Lyon St-Exupéry airport

- Study of possible non-aeronautical hydrogen applications
- Study of future hydrogen needs for aviation
- Definition of a progressive H_2 infrastructure build-up plan

Infrastructure roadmap at LYS:

- Phase 1: gaseous hydrogen refuelling station with on-site electrolysis and back-up LH2 storage supplied by trucks (target 2025/26)
- Phase 2: on-site electrolysis, liquefaction and storage for non-aviation and aviation (>2030)



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ZEROe

Zero emission concept aircraft powered by Hydrogen | Any questions?

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