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Executive Director

INNOVATION IN AVIATION
& SPACE FOR OPENING
NEW HORIZONS
Barcelona
19 OCTOBER 2022

Disruptive Technologies: the path to take European aviation to **climate neutrality**

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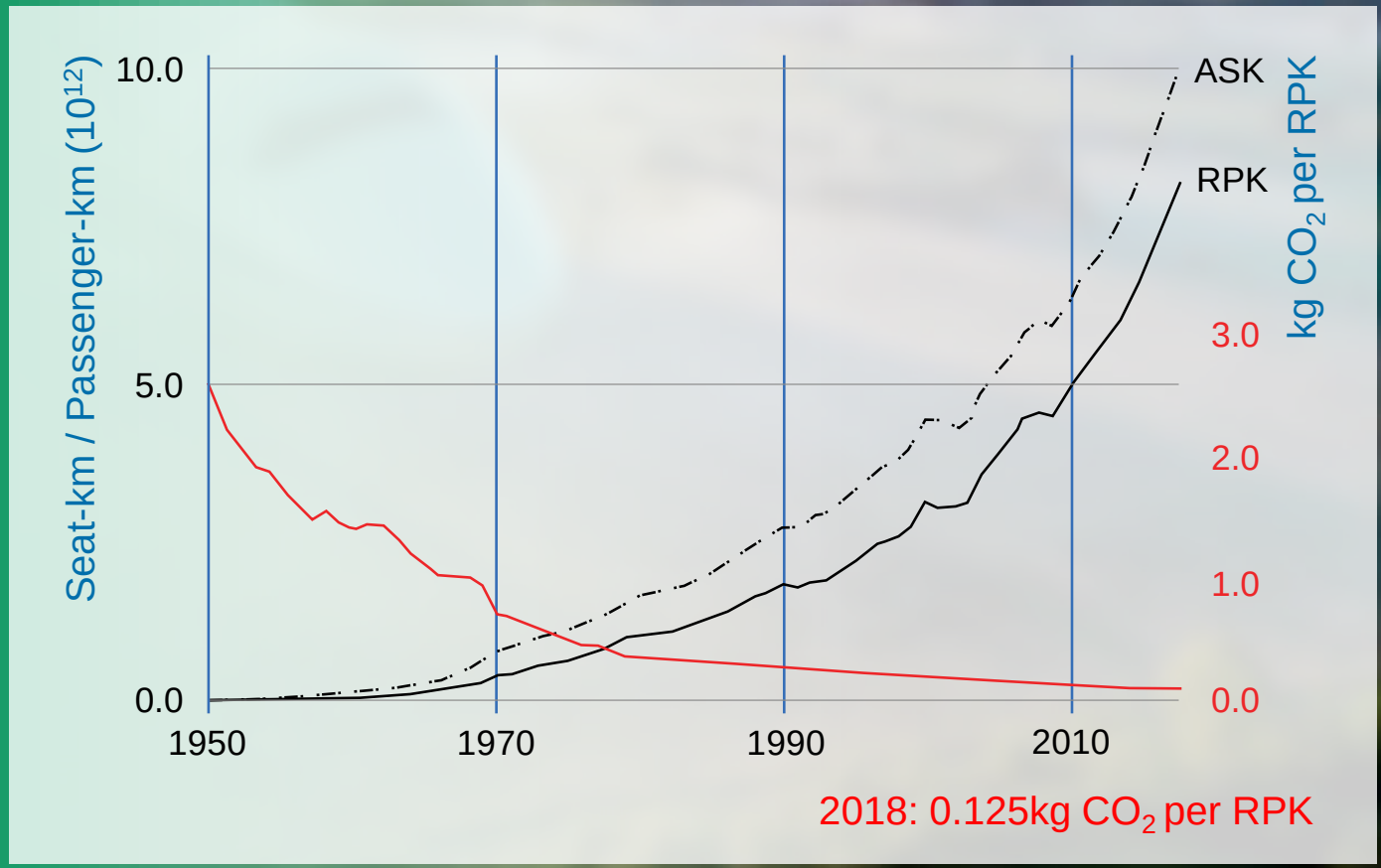
Why do we need Clean Aviation?

Aviation transport sector: **phenomenal progress** in efficiency… but **growth** consistently **outpaced these gains**.



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We area a European **Public Private Partnership**

- **Disruptive** aircraft **innovations by 2030**
- Reducing **net greenhouse gases:**
  -30% for Short-Medium Range Aircraft
  -50% for Regional Aircraft

4.1 bn
Total Budget

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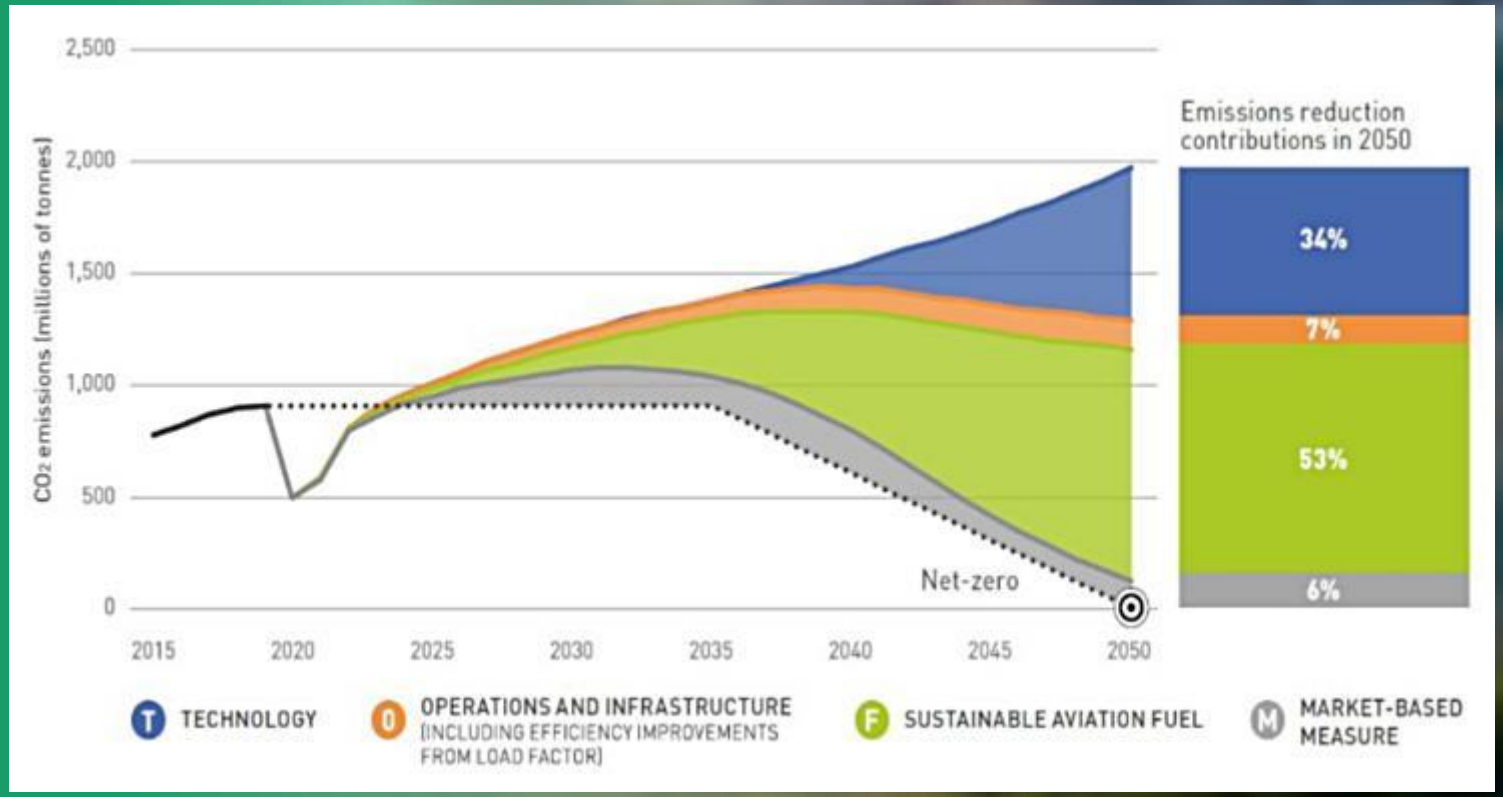
Disruptive Technology & Sustainable Aviation Fuel together will **drive the transformation**



Source: ATAG report 2021

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Clean Sky 2 – an open and inclusive PPP

An efficient and high performing **innovation eco-system**

Almost 1000
Total participants

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Clean Sky 2 Achievements (1 / 2)

Tech
Turboprop
Engine

Clean Sky 2
Test bed 2
Maiden flight

Racer
FRC

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Clean Sky 2 Achievements (2 / 2)

Ultra High Propulsive Efficiency

Multi Functional Fuselage Demonstrator

Ultra Fan Engine

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Huge **economic** impact

18.5 m

Jobs in Europe by 2020

Massive social & economic value to Europe

8.6 bn

Net economic value of CS2 innovations

Research & Technology: substantial **economic** benefits

320 bn

By 2050

Environmental benefits **value**

-60%

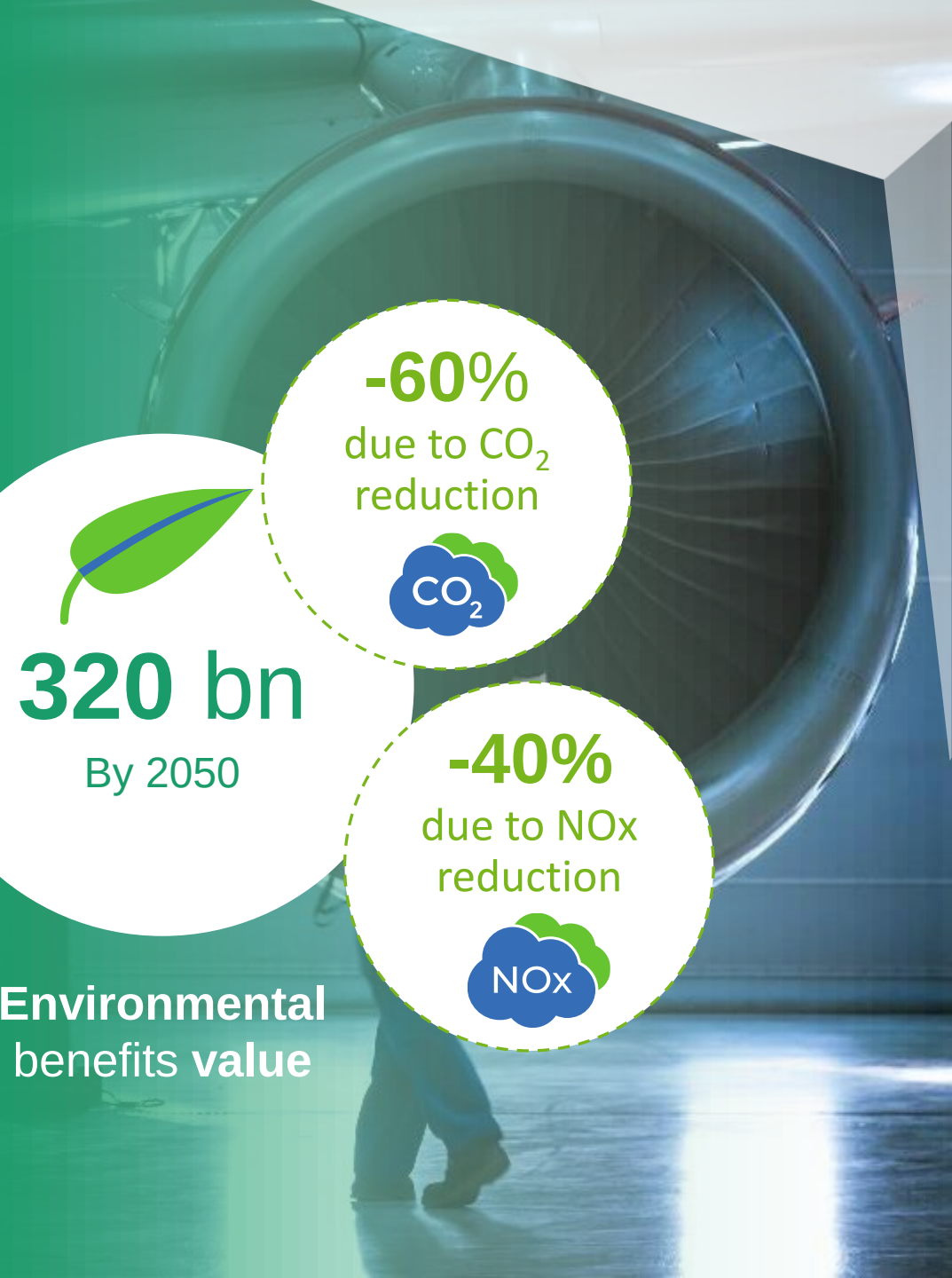
due to CO_2 reduction

CO_2

-40%

due to NOx reduction

NOx



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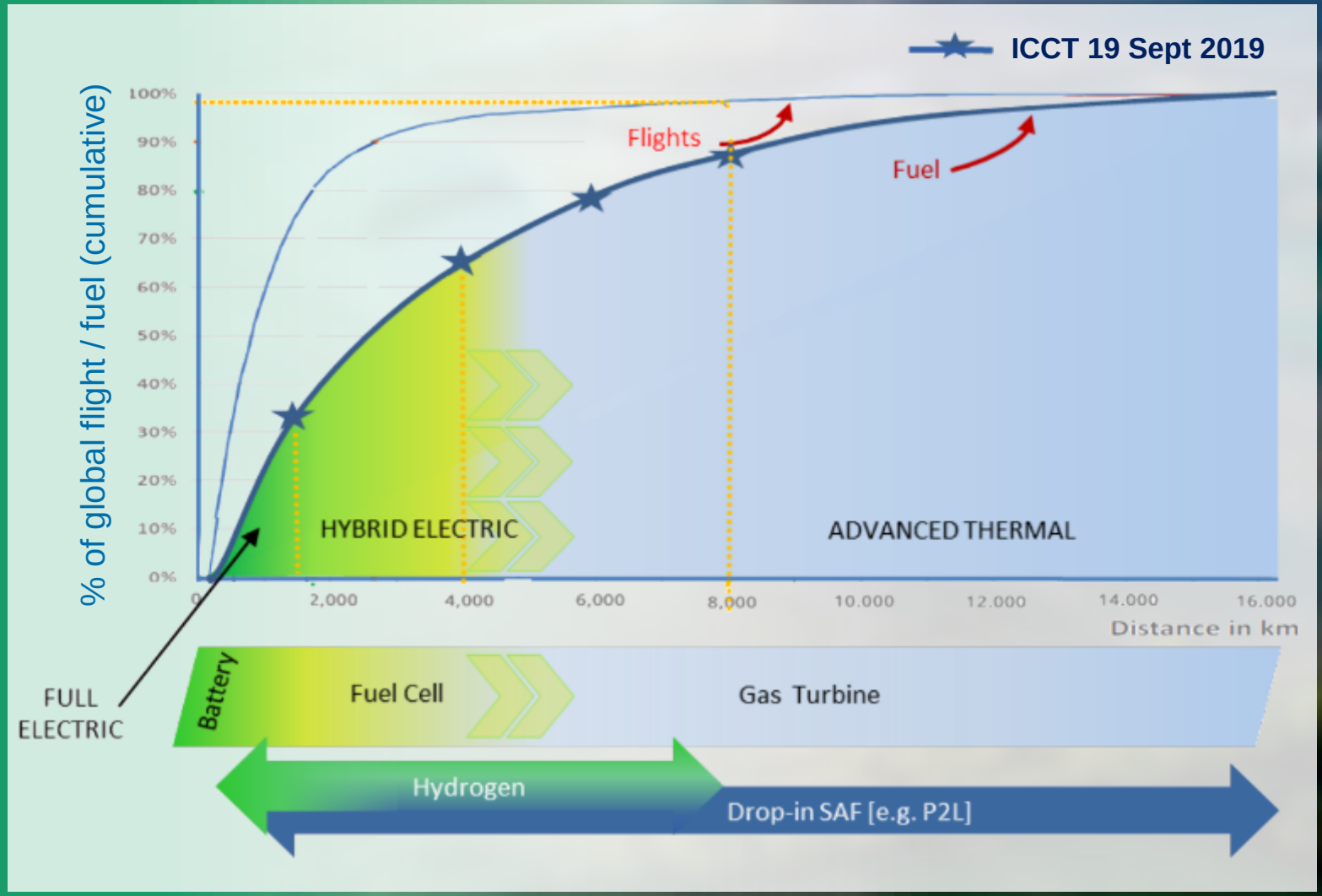
Differentiation will provide scope for **disruption**



Source: DLR/Sabre

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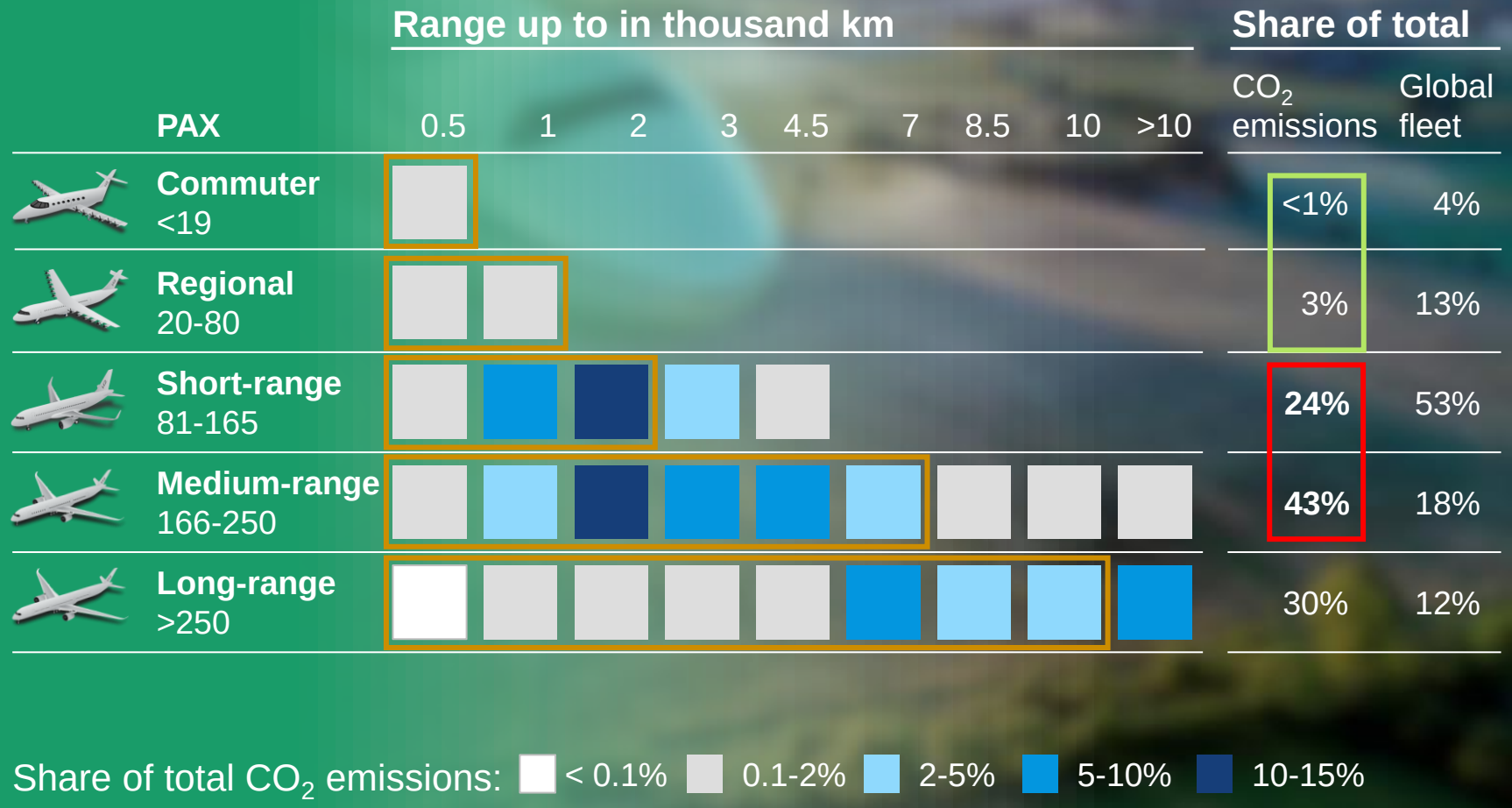
Mapping aviation's footprint



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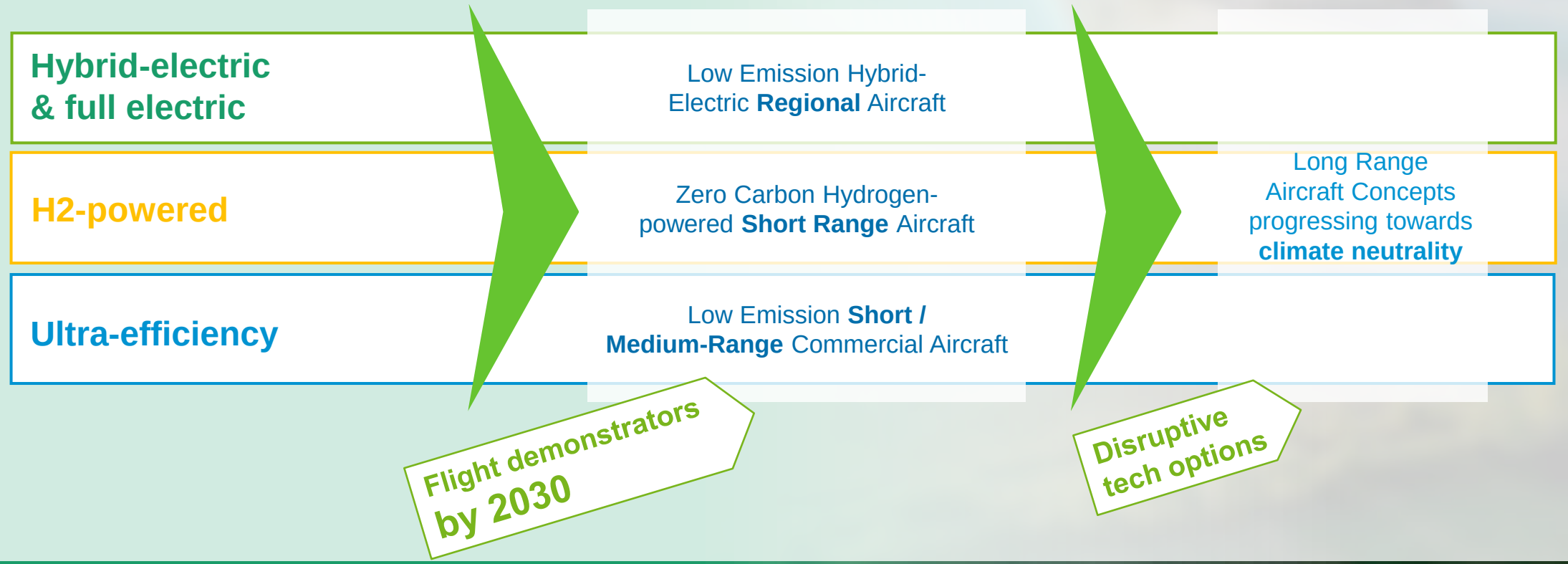
Linchpin in Europe's R&I for the transition



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Hybrid & full electric aircraft

-50%

Lower energy-fuel burn

-90%

CO_2

+ high-perf SAF

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Ultra-efficient **short & medium range** aircraft

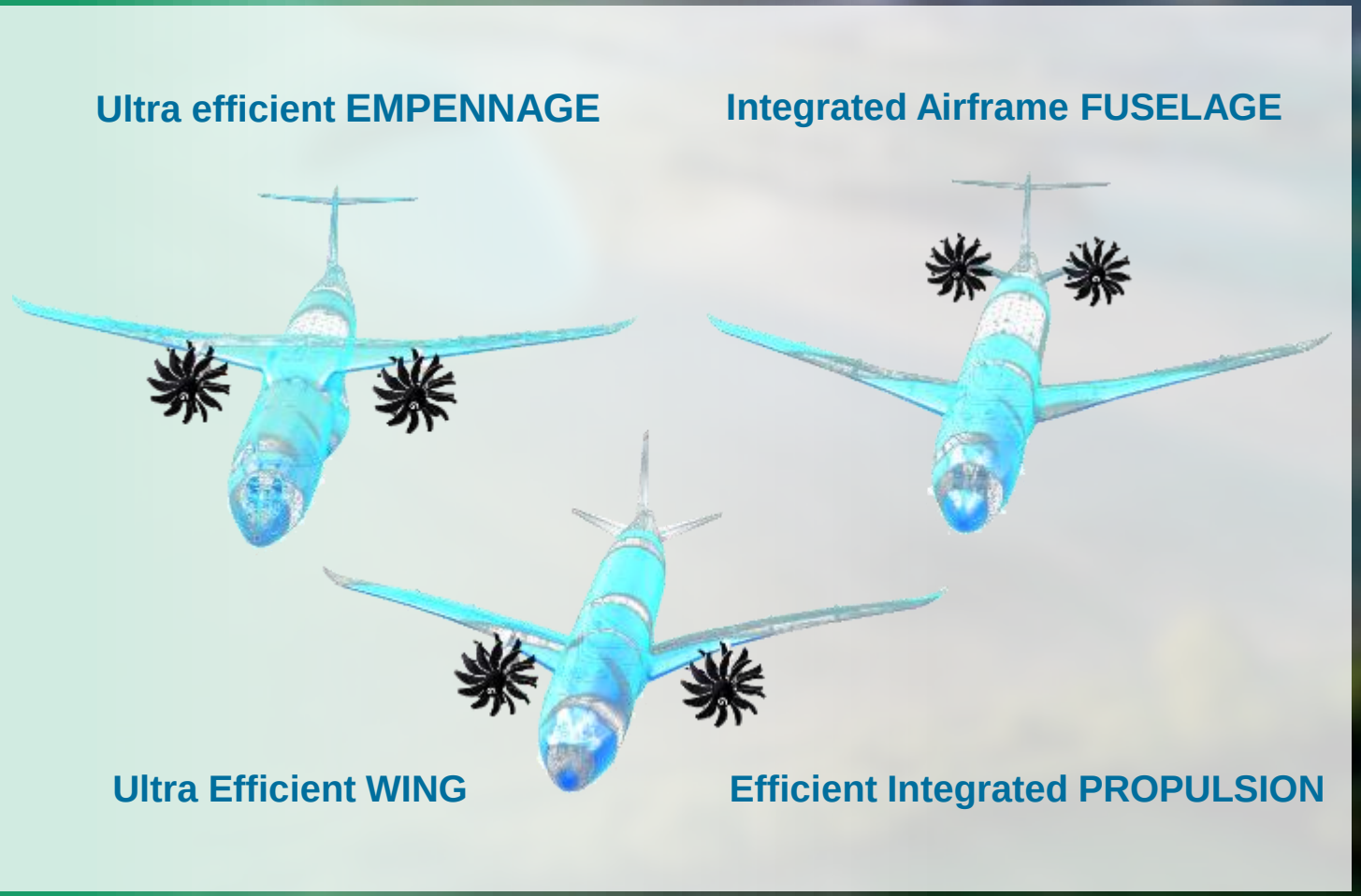
-30%

Lower energy-fuel burn

-85%

CO_2

+ high-perf SAF



Images courtesy CFM International, GE and Safran

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Hydrogen-powered short range aircraft

DIRECT COMBUSTION
OF HYDROGEN

MULTI MW FUEL CELL PROPULSION
FOR HYDROGEN POWERED AIRCRAFT

LARGE SCALE LIGHTWEIGHT
LIQUID H2
INTEGRAL STORAGE

NEAR TERM DISRUPTIVE TECH
FOR HYDROGEN POWERED AIRCRAFT

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H2 is promising, but not without challenges

	Direct CO_2	NO_x	Water vapor	Contrails + cirrus	Climate impact reduction potential
E-fuel / PTL	↓	=	=	↓	-30 -60%
H2 **direct burn**	↓	?	↑	↓	-50 -75%
H2 **fuel cell**	↓	↓	↑	↓	-75 -90%

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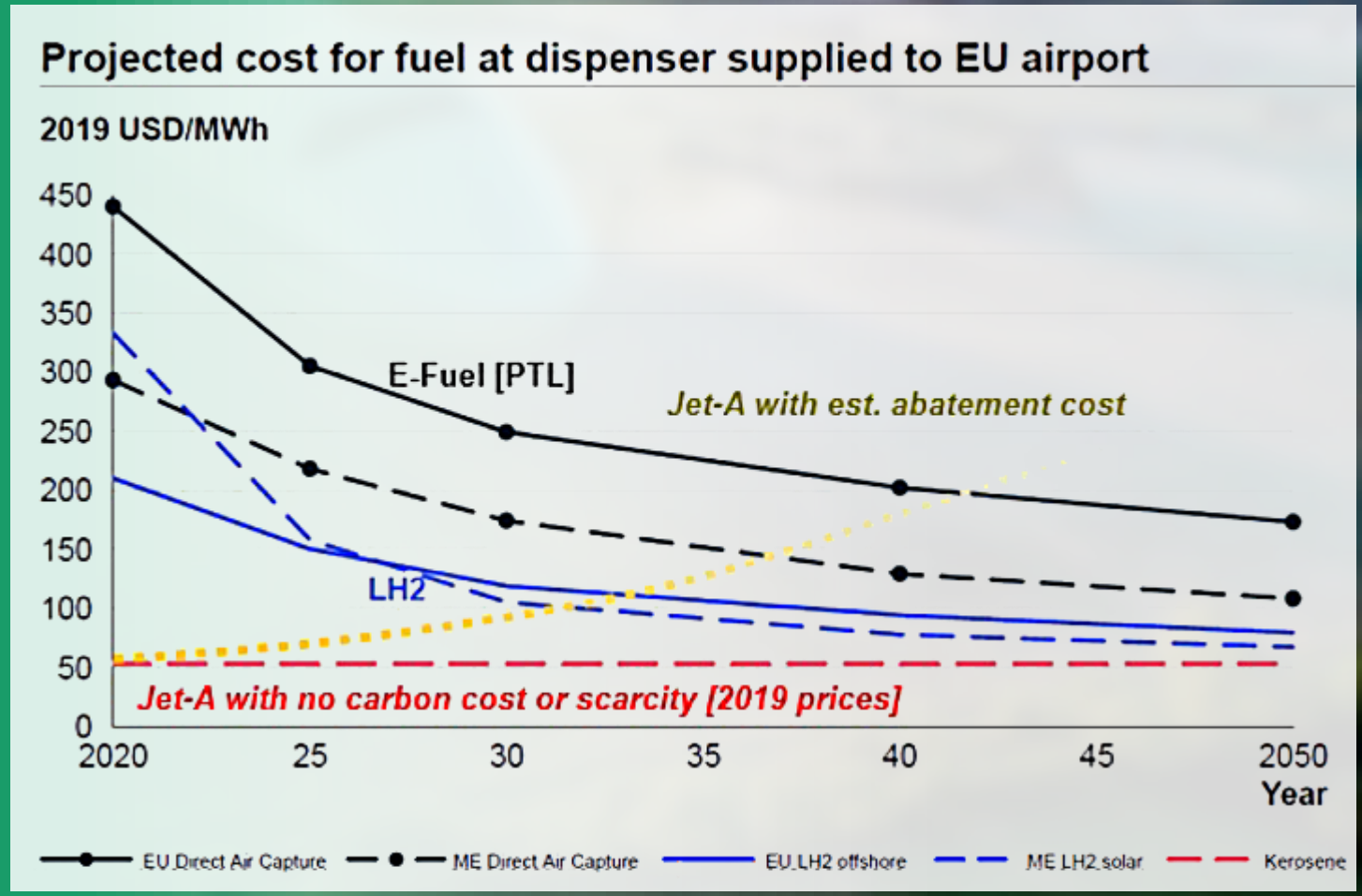
LH2 Costs **decrease** significantly over years

- **Scale** effect and **learning** rate
- **Middle East** synfuel and LH2 production: lowest costs
- **Shipping costs**:
  - neglectable for Kerosene/synfuels
  - LH2: competitive by 2025+



Source: Joint CS2 JU FCH JU study 2019

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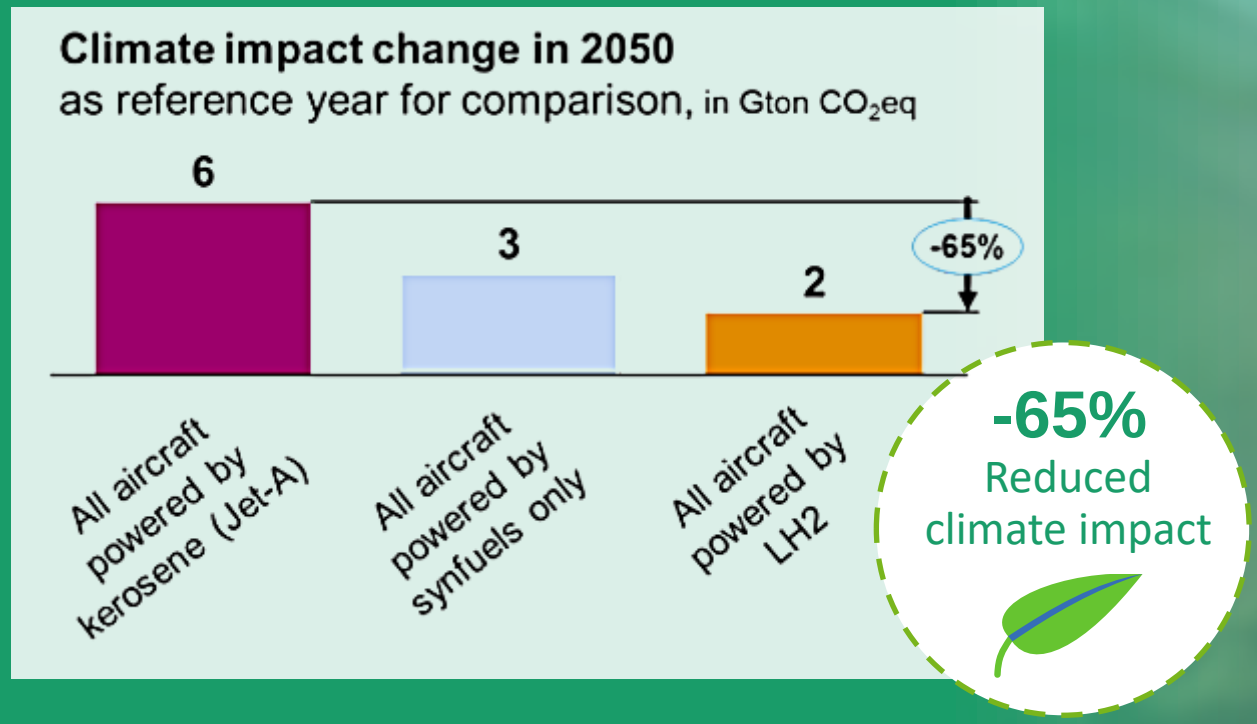
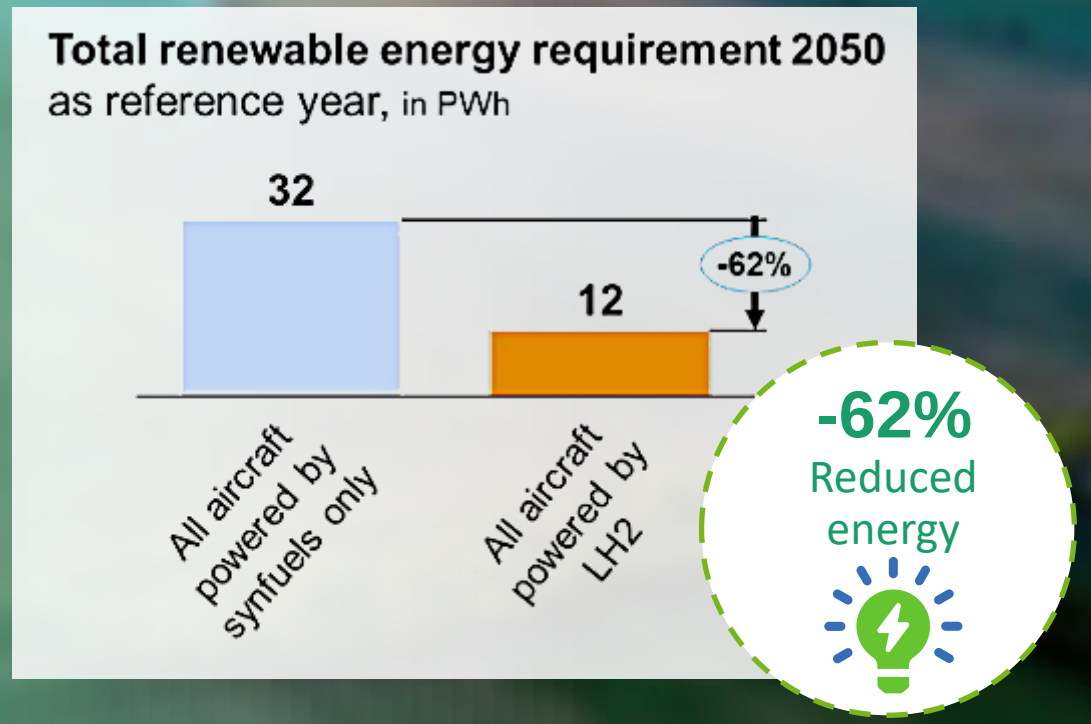
Full system-wide replacement with H2 aircraft





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Starting in 2022 Clean Aviation's **daring** new projects

	PROJECT TITLE	PROJECT COORDINATOR	PROJECT TOPIC*
HYBRID ELECTRIC POWERED AIRCRAFT	HE-ART	ROLLS-ROYCE DEUTSCHLAND LTD & CO KG	Multi-MW Hybrid-Electric Propulsion System
	AMBER	GE AVIO SRL	
	TheMa4HERA	HONEYWELL INTERNATIONAL SRO	Thermal Management Solutions
	HECATE	COLLINS AEROSPACE IRELAND, LIMITED	Electrical Distribution Solutions
	HERWINGT	AIRBUS DEFENCE AND SPACE SA	Innovative Wing Design
HYDROGEN POWERED AIRCRAFT	CAVENDISH	ROLLS-ROYCE PLC	Direct Combustion of Hydrogen in Aero-engines
	HYDEA	GE AVIO SRL	
	NEWBORN	HONEYWELL INTERNATIONAL SRO	Multi-MW Fuel Cell Propulsion System
	H2ELIOS	ACITURRI ENGINEERING SL	Large Scale Lightweight Liquid Hydrogen Integral Storage Solutions
	fLHYing tank	PIPISTREL VERTICAL SOLUTIONS DOO PODJETJE ZA NAPREDNE LETALSKE RESITVE	Near Term Disruptive Technologies
	HyPoTraDe	PIPISTREL VERTICAL SOLUTIONS DOO PODJETJE ZA NAPREDNE LETALSKE RESITVE	
ULTRA EFFICIENT SHORT & MEDIUM RANGE AIRCRAFT	OFELIA	SAFRAN AIRCRAFT ENGINES	Ultra Efficient Propulsion Systems
	SWITCH	MTU AERO ENGINES AG	
	HEAVEN	ROLLS-ROYCE PLC	
	UP Wing	AIRBUS OPERATIONS GMBH	Ultra Performance Wing
	FASTER-H2	AIRBUS OPERATIONS GMBH	Advanced Low Weight Integrated Fuselage and Empennage
TRANSVERSAL AREAS	HERA	LEONARDO - SOCIETA PER AZIONI	Aircraft concepts enabling 30 to 50% reduction in emissions
	SMR ACAP	AIRBUS OPERATIONS GMBH	
	CONCERTO	DASSAULT AVIATION	Novel Certification Methods and Means of Compliance for Disruptive Technologies
	ECARE	AEROSPACE VALLEY	Developing a European Clean Aviation Regional Ecosystem (ECARE)

* Official launch of projects is still subject to legal redress and to successful completion of grant preparation

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Skip-a-Generation technology leap

- **Keep pushing the envelope >** ‘traditional’ aeronautical sciences
- Non-traditional sciences > **key enablers**
- **Replacing ~75% of the global** fleet by 2050
- **Simulation, digital twin** and **innovative certification**
- **Life-cycle aspects** and recyclability

The **MOST EXCITING TECHNOLOGICAL DECADE** for AERONAUTICS **IS BEGINNING**

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Our recommended 6 key actions for further transformation

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Thank you!

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