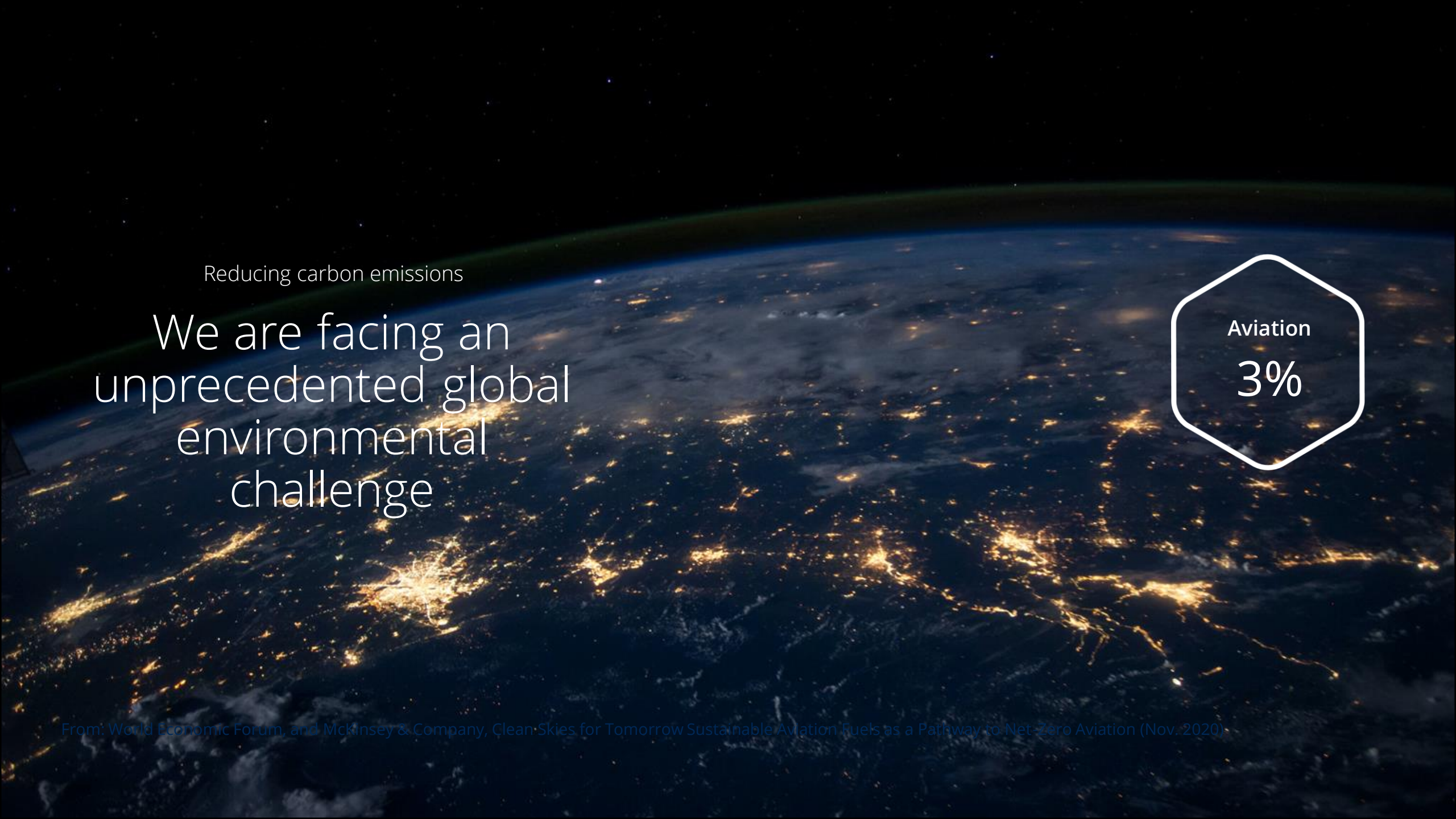
Er Power-to-X lige om hjørnet og klar til luftfarten

Kim Grøn Knudsen

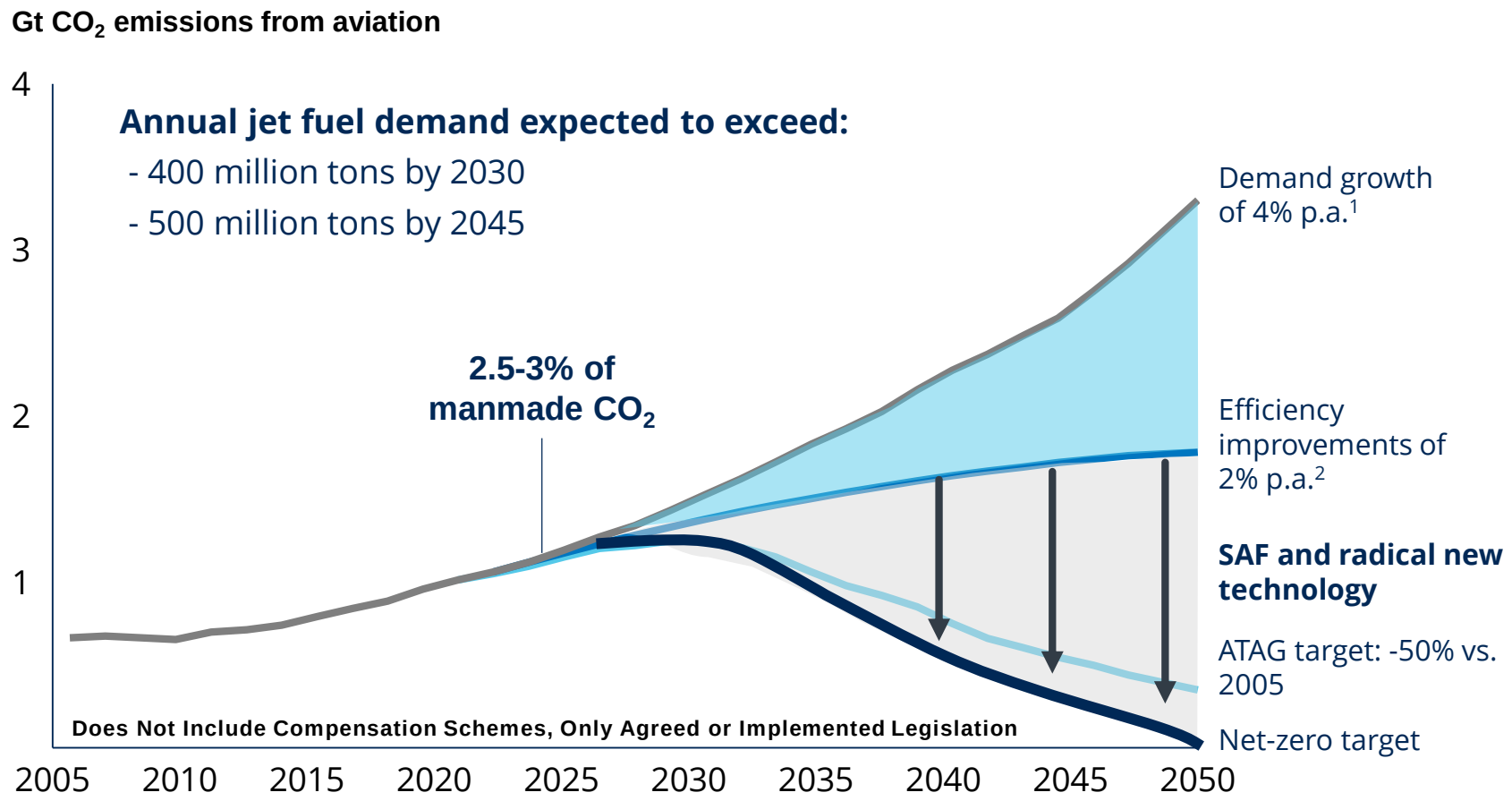
Reducing carbon emissions

We are facing an unprecedented global environmental challenge



From: World Economic Forum, and McKinsey & Company, Clean Skies for Tomorrow Sustainable Aviation Fuels as a Pathway to Net Zero Aviation (Nov. 2020)

In aviation, alternative fuels uptake expected to grow mainly post 2030 depending on emission scenarios



Challenges in decarbonizing aviation

High energy density required to carry load over long distances

Cross-border industry with airlines competing globally

Infrastructure build around fuels - any new energy source disrupts the supply chain

Long-lived airline assets - new aircraft could remain in business for 25+ years

Safety-focused industry - innovation requires certification

Source: ATAG, IATA, ICCT, WWF, UN, ICAO

1. Assumption: Annual kerosene demand expected to exceed 400 million tons by 2030 and 500 million tons by 2045sed on growth projections from ATAG, IATA, ICCT, WWF, UN
2. ICAO ambition incl. efficiency improvements in aircraft technology, operations and infrastructure – however highly ambitious compared to other sources (EASA)

Emission reduction targets – many are committed

Selected aviation key players

Aircraft producers

Net zero emission by 2050

BOMBARDIER AEROSPACE

50% reduction in emission by 2050

AIRBUS · EMBRAER · SAFRAN · BOEING · GE Aviation

Commercial airplanes flying on 100% sustainable fuels

BOEING 2030

AIRBUS 2035

Airlines operators

Net zero emission by 2050

IATA

- 290 member airlines
- 82% of *pre*-covid global air traffic
- October 4th, 2021

Clean Skies for Tomorrow Coalition

WORLD ECONOMIC FORUM

- 10% Sustainable Aviation Fuel by 2030
- Supported by 60 companies
- Airlines, airports, fuel suppliers, *etc.*

Supported by policies
EU and US driven

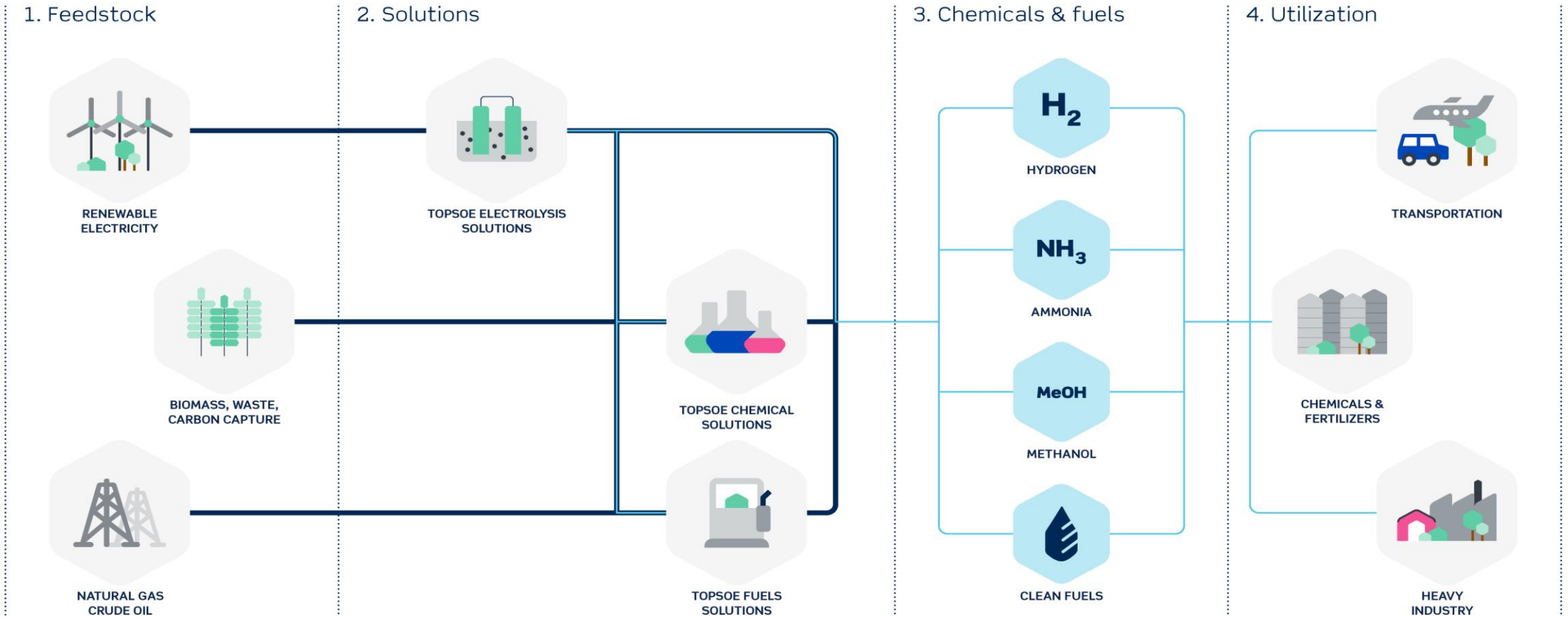
	2025	2030	2035	2040	2045	2050
SAF	2%	5%	20%	32%	38%	63%
Minimum e-jet	-	0.7%	5%	8%	11%	28%

- EU ReFuelEU Aviation proposal SAF blending mandate
- Various European countries have announced ambitious SAF mandates

- Sustainable Skies Act
- Incentives for SAF production
- US target production of 11 million m^3 in 2030 and 132 million m^3 in 2050

KIK

Topsoe solutions accelerate the energy transition



HALDOR TOPSOE

How to reach the targets

Potential Sustainable Aviation Fuel (SAF) pathways

	HEFA	Alcohol-to-jet[i]	Gasification/FT	Power-to-liquid
Opportunity description	Safe, proven, and scalable technology		Potential in the mid-term, however significant techno-economical uncertainty	Proof of concept 2025+, primarily where cheap high-volume electricity is available
Technology maturity	Mature		Commercial pilot	In development
Feedstock	Waste and residue lipids, purposely grown oil energy plants[ii] Transportable and with existing supply chains Potential to cover 5%-10% of total jet fuel demand		Agricultural and forestry residues, municipal solid waste[iv], purposely grown cellulosic energy crops[v] High availability of cheap feedstock, but fragmented collection	CO_2 and green electricity Unlimited potential via direct air capture Point source capture as bridging technology

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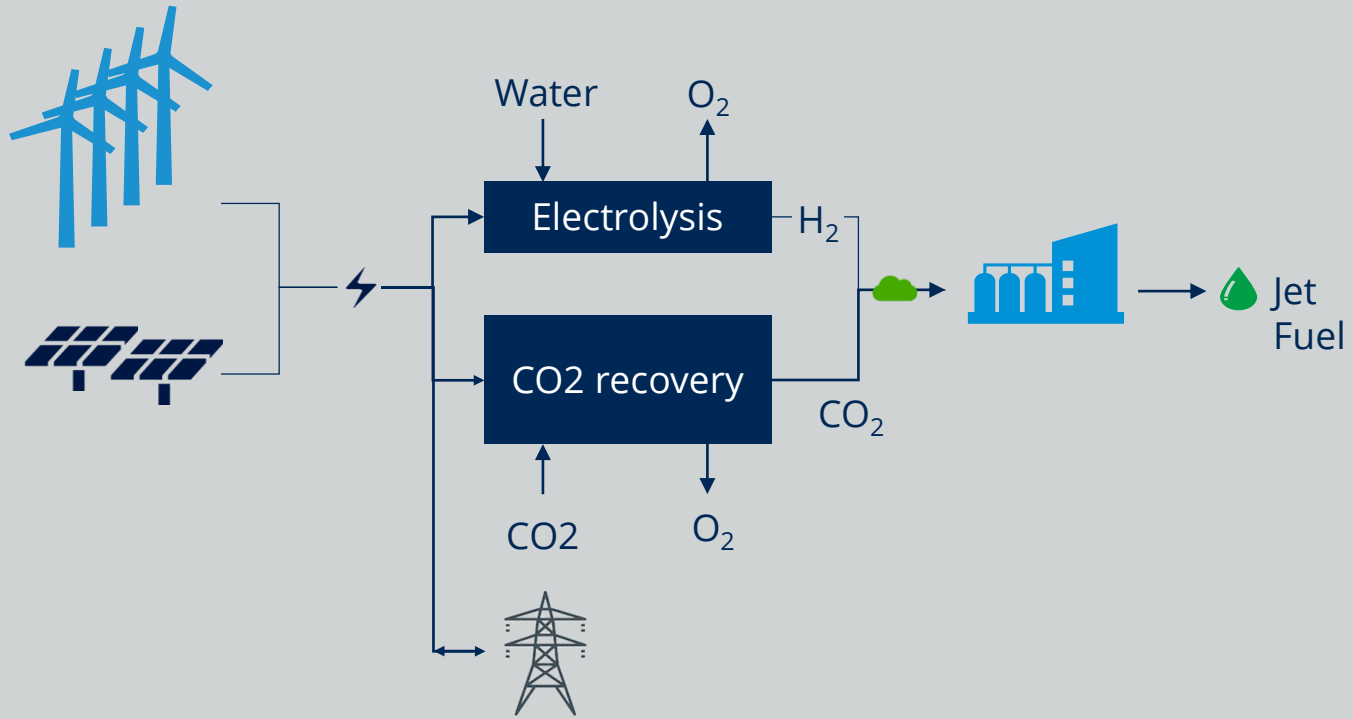
Power-to-Jet fuel

From renewable energy to electrolysis to jet fuel



Power-to-jet fuel

- Green fuels solution
- Proven technologies
- Industrialisation of electrolysis
- Cheap power to be competitive

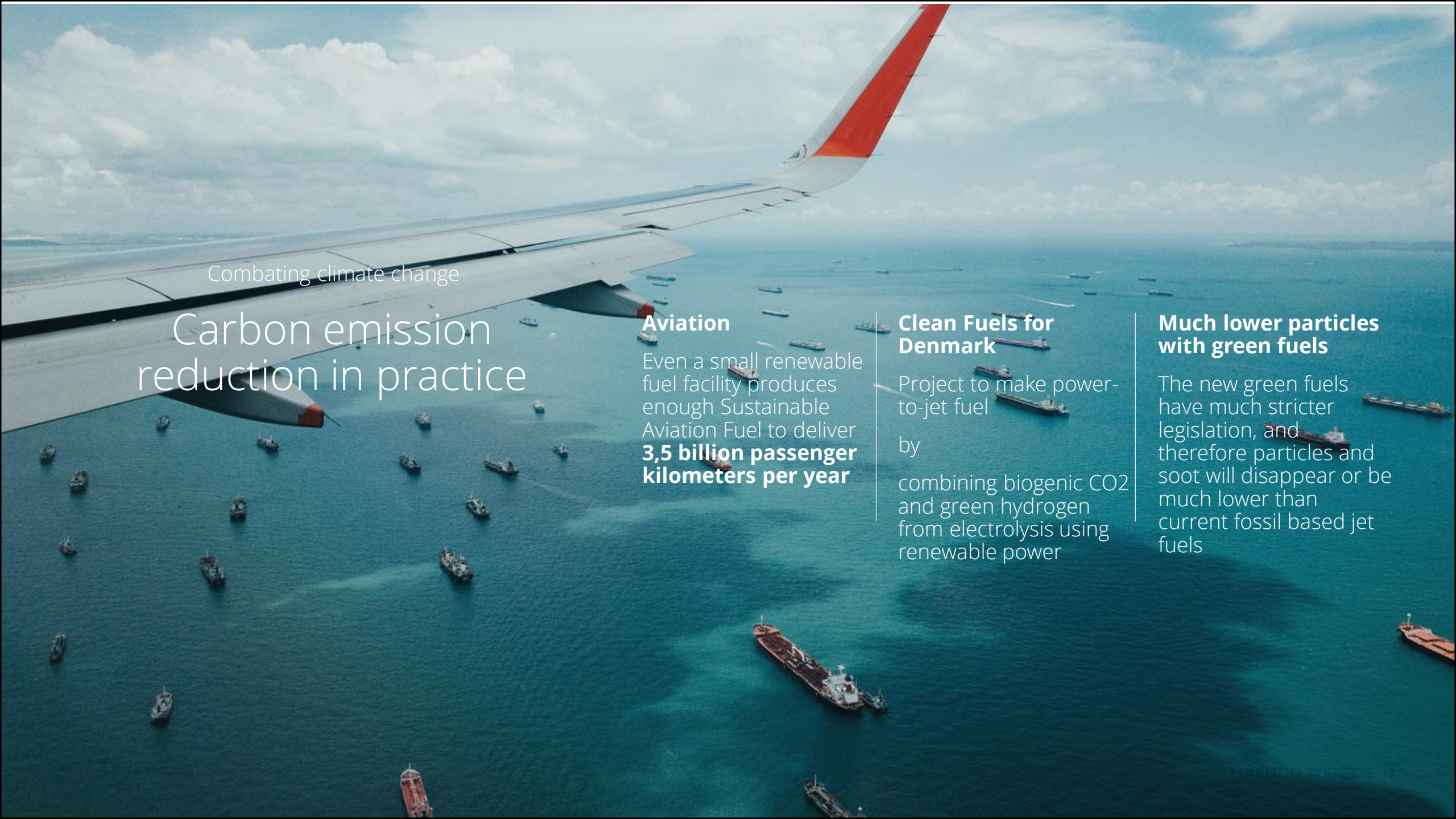
A proven and popular technology to produce renewable fuels

HydroFlex™

We have 6 running licenses up to date producing renewable fuels from a wide range of feedstocks

We have won more than 90% of all renewable fuel projects for SAF and HVO production in the US

9 more HydroFlex™ plants will start in 2022 producing SAF and HVO



Combating climate change

Carbon emission reduction in practice

Aviation

Even a small renewable fuel facility produces enough Sustainable Aviation Fuel to deliver **3,5 billion passenger kilometers per year**

Clean Fuels for Denmark

Project to make power-to-jet fuel

by

combining biogenic CO2 and green hydrogen from electrolysis using renewable power

Much lower particles with green fuels

The new green fuels have much stricter legislation, and therefore particles and soot will disappear or be much lower than current fossil based jet fuels

OUR VISION

To be recognized as the global leader in carbon emission reduction technologies by 2024

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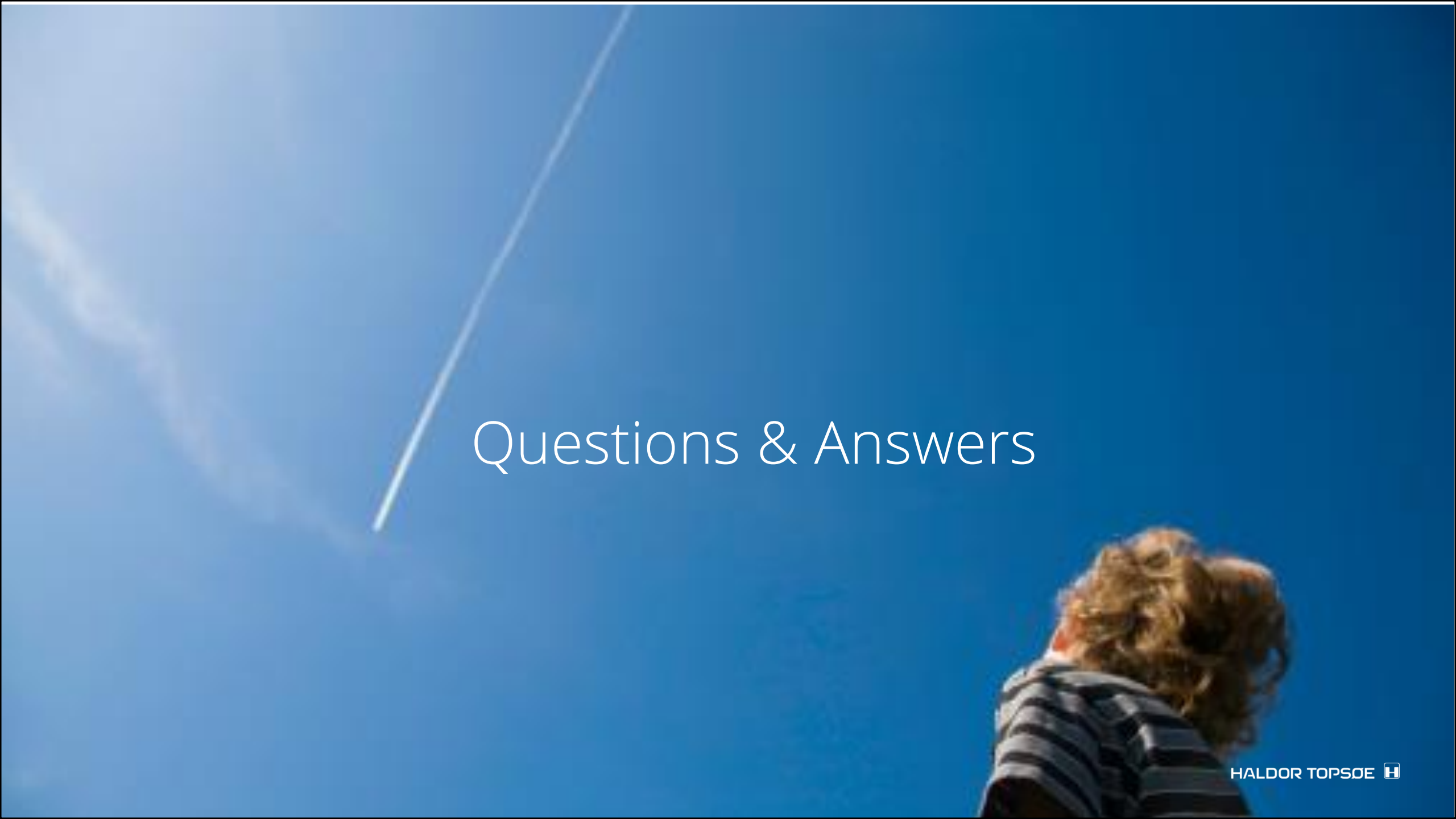
Questions & Answers



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