Addressing the complexity of the future SAF landscape :

Operational constraints, technical challenges and key innovations

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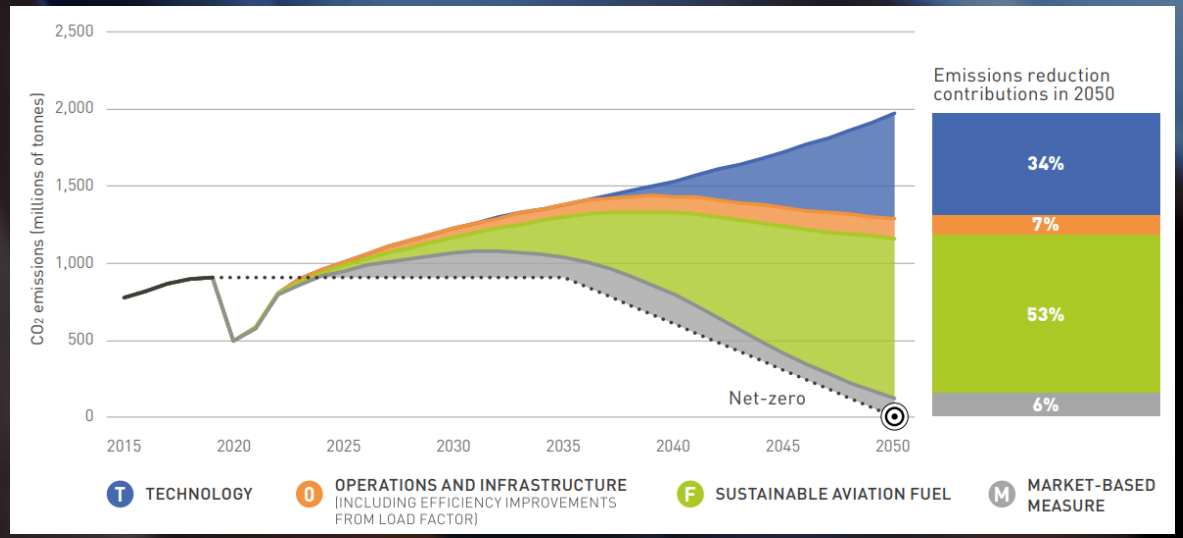
Why is SAF critical ?

boeing.com

Aviation decarbonization relies on 3 key pillars

- ✓ Fleet efficiency & technology
- ✓ Operations and infrastructures
- ✓ **Sustainable aviation fuels**



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Current SAF landscape

Market & regulations

- An expensive fuel
- Two major drivers : Refuel EU & UK mandate

SAF Standards & uptake capability

- Blending with conventional aviation fuel
- Co-processing up to 5%
- 8 approved pathways up to 50%

Production

- ~1Mt in 2024 : 0,3% of overall fuel consumption
- One pathway in commercial operations
- A handful of worldwide producers and technology suppliers

Distribution & operations

- Limited, but growing availability

freepik.com

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Future SAF landscape

Market & regulations

- Additional countries with incentives and mandates
- A complex market with strong competition

SAF Standards & uptake capability

- Diversity of conversion pathways and processes
- Up to 100% SAF uptake

Production

- In the 100s Mtpy
- Multiple technology providers and production assets
- Multiple active pathways

Distribution & operations

- Worldwide availability, diverse logistical schemes

Increased diversity and dispersion in fuel chemistries and qualities

pacific-international.com

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Operational constraints & drivers for SAF deployment

#1 SAFETY

Market & Regulations

- Environmental requirements,
- Regulation framework & market measures

Production

- Existing refining capacity, technology & capex
- Markets interdependence & evolving business model

Distribution & operations

- Standards and traceability
- Worldwide distribution & associated logistics

Compatibility

- Aero equipment
- Fleet lifetime & overall drop in considerations

menziesaviation.com

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Of the importance of fuel properties on aviation safety

Flight BA38, January 17th, 2008

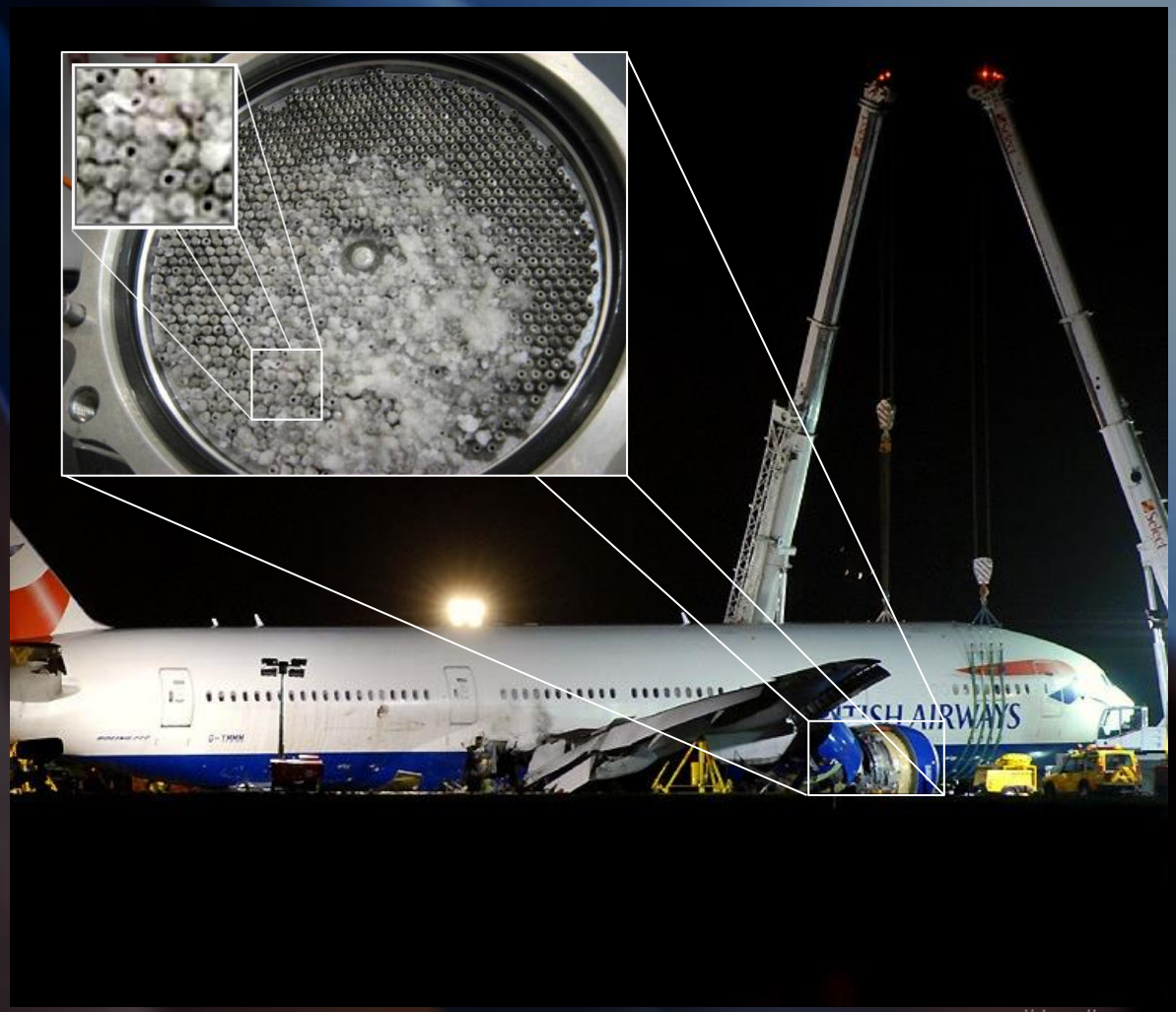
- Boeing 777-200ER - from Beijing to Heathrow
- **Crash-landed** short of the runway at Heathrow
- 152 people onboard, no casualties, 47 injured

Root cause

- Ice crystals in the jet fuel clogging the fuel/oil heat exchanger (FOHE) of both engines
- Restricted fuel flow to the engines when thrust was demanded during the final approach to Heathrow

Contributors & mitigations

- Water solubility and release rate
- Additives and contaminant
- In flight fuel temperatures
- Fuel logistics and handling



commons.wikimedia.org
Richard Vandervord

Very few fuel quality related incidents due to stringent quality requirements and control

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Technical challenges for an OEM

Small molecules, critical functions

Engine & APUs

- Combustion systems
- Elastomer materials
- Energy metering, Heat management, Actuating

Aircraft

- Fuel management and distribution
- Gauging systems and technologies
- Inerting systems and fire prevention
- …

For all fleets and market segments

For all legacy, current and future technologies and systems

For all combinations of current and future fuels

SAFRAN actions

Enable 100% SAF for current and future systems

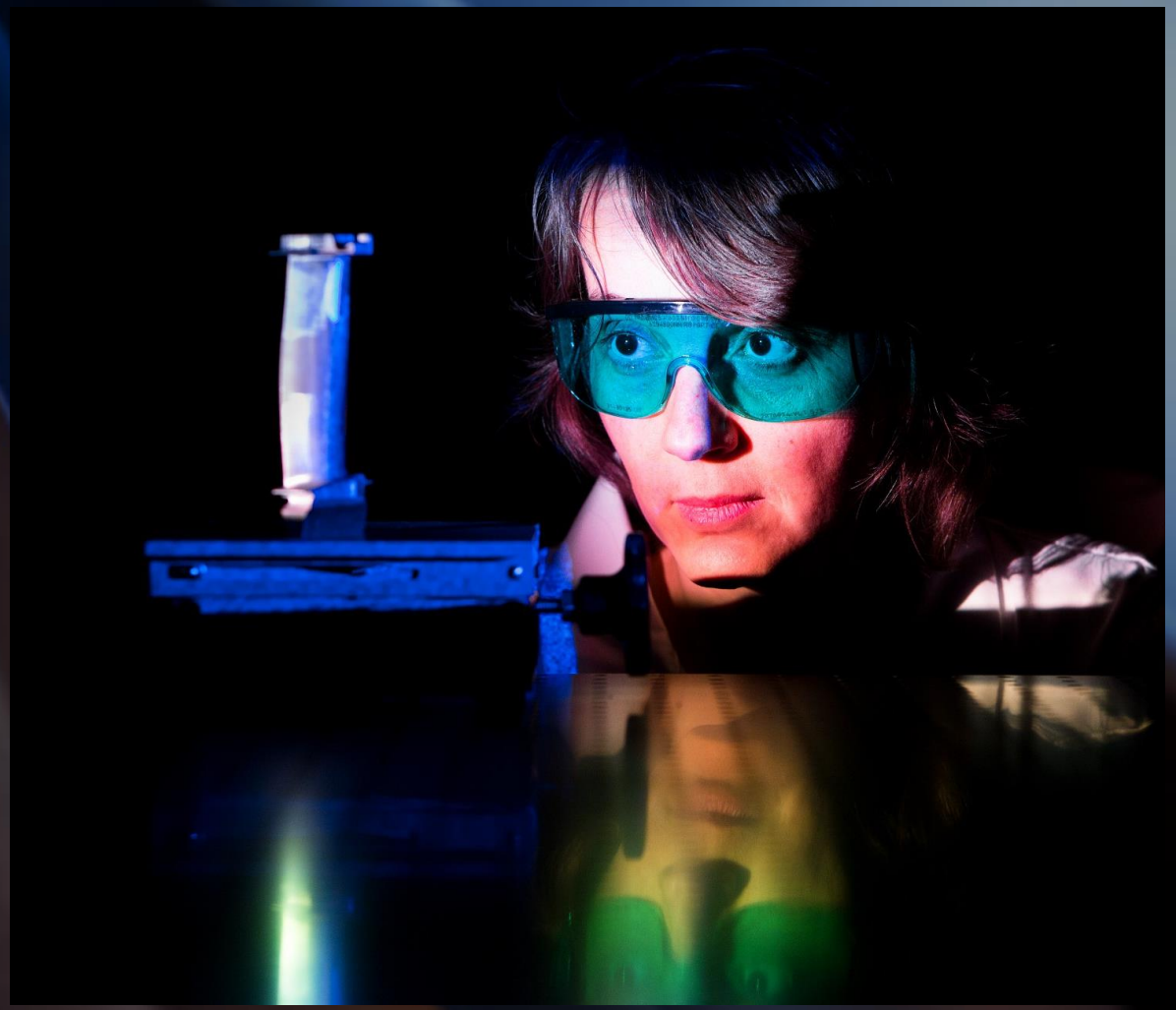
- Better understand fuel / systems interactions
- Quantify the additional benefits of these Fuels (non CO2 effects, mro...)
- Develop key technologies for improved performance and fuel flexibility

Assist in SAF ramp-up effort

- Invest in techno bricks for future SAF projects
- Contribute to market stimulation through significant SAF uptake in operations
- Participate in community coordination at the national, European and international levels

Deploy ambitious technology & energy roadmaps

- High efficiency, lightweight systems
- Alternative renewable energies with electric and H_2 propulsion



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Addressing the complexity of the future SAF landscape

Successfully

- ✓ **Consider all the variables**
  - Market, regulations, production, logistics … will all contribute to the future SAF landscape
- ✓ **Adopt a pragmatic, consolidated and steady approach**
  - The fuels of tomorrow will be rooted in today's existing infrastructure and economy but have significantly different business models involving strong public support mechanisms
- ✓ **Don't be afraid to go back to the basics**
  - 100% SAF will challenge current understandings on critical function, fundamental research and engineering evaluations will be necessary
- ✓ **Engage the whole value chain**
  - Regulators, academia, aero industry competitors, customers & suppliers, fuel producers, existing and future… must share a common goal and roadmap

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