

10:40-11:35 Presentation:

Airlines' and partners' experience with contrail mitigation

**COPENHAGEN
CONTRAILS
CONFERENCE**
25-26 March 2025 • Scandic Copenhagen



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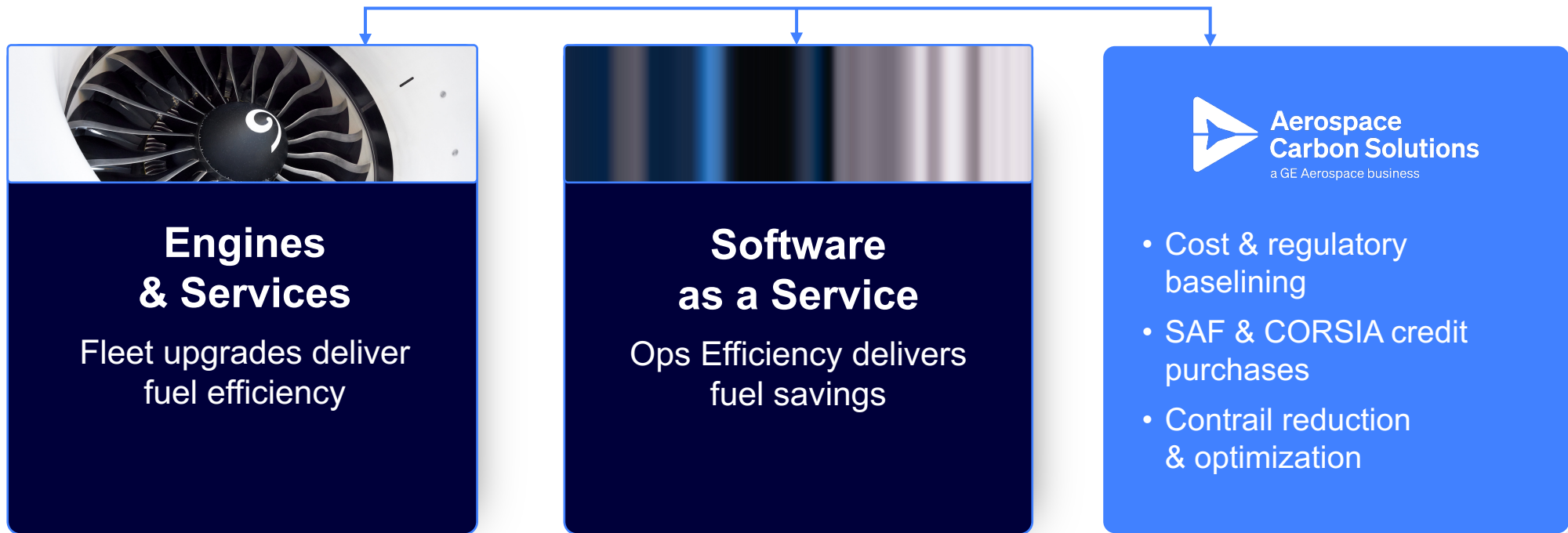


Aerospace Carbon Solutions

Rounding out GE Aerospace's
decarbonization offerings

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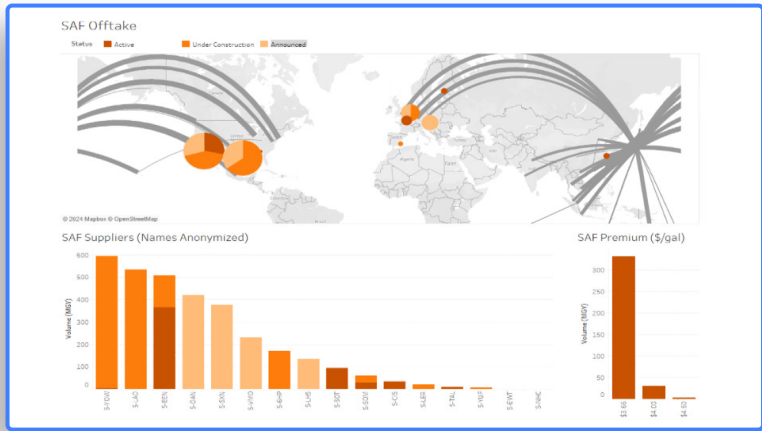
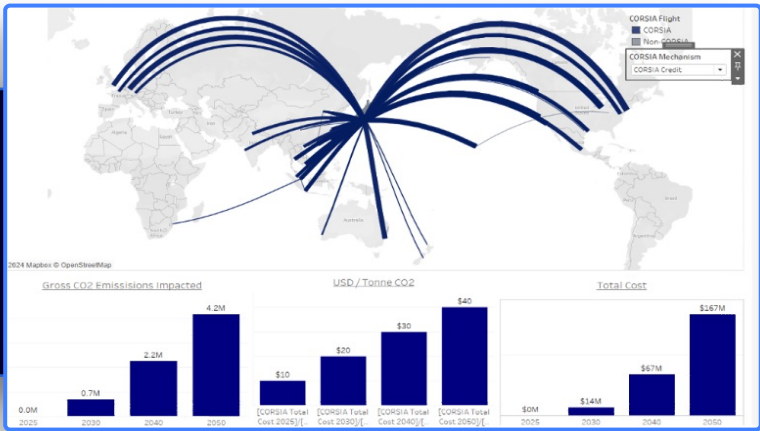
Aligned interests ...

— integrated offering across GE Aerospace —

ACS Product Portfolio

Compliance Preparedness

Budgeting & cost management

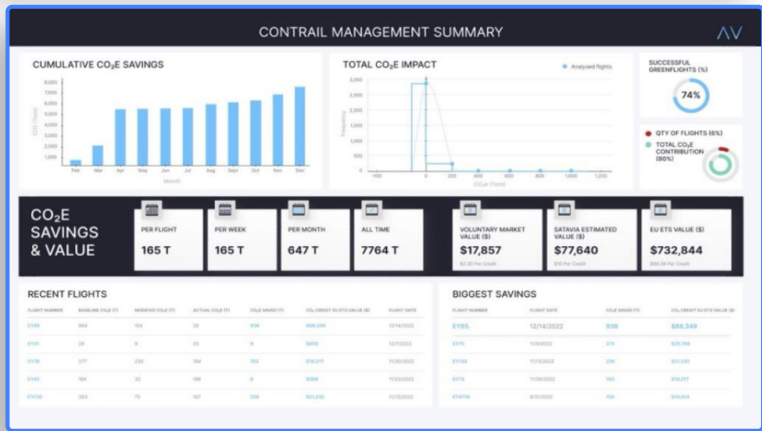
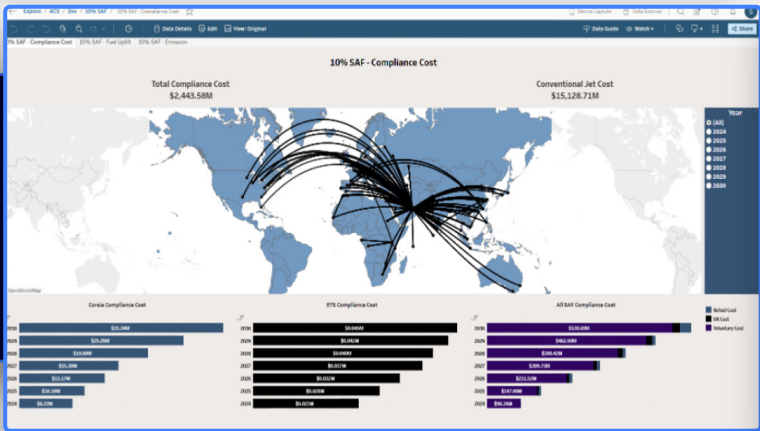


SAF and CORSIA

Supply visibility & price empowerment

Fleet-Wide Analytics

Track & optimize

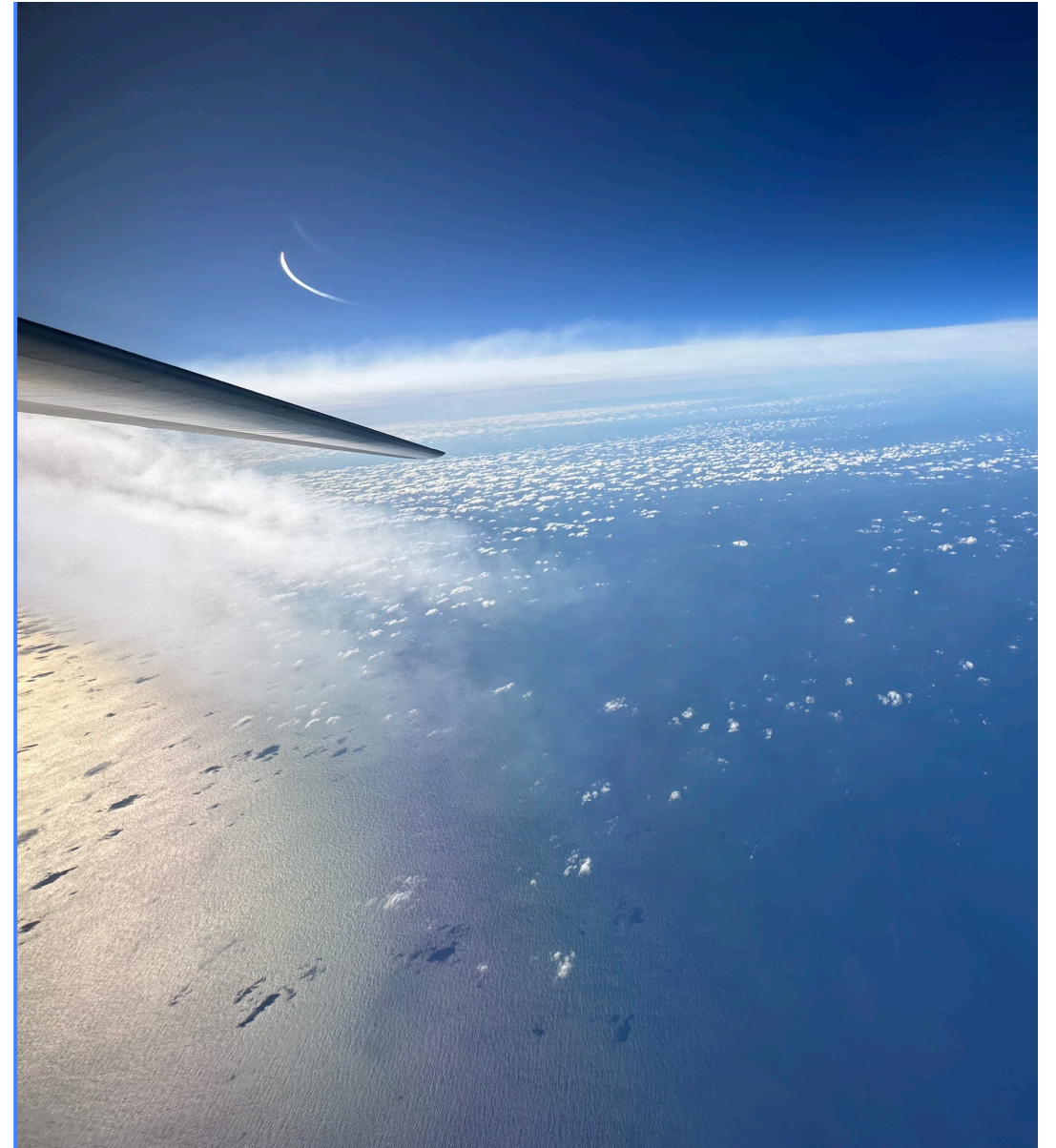


Contrails and Non-CO₂

Monitoring compliance & operational mitigation

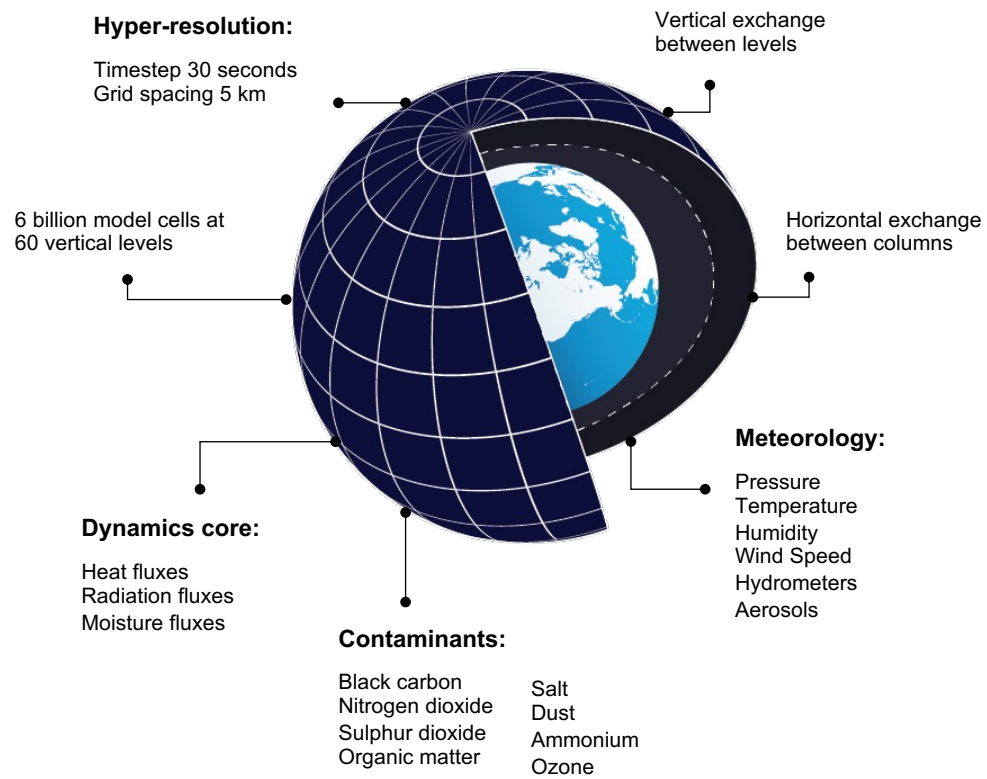
Prioritizing actions to improve environmental and financial performance

- ACS SATAVIA helps airlines reduce the climate impact of flying and optimize flight operations to **manage the costs of regulatory compliance**

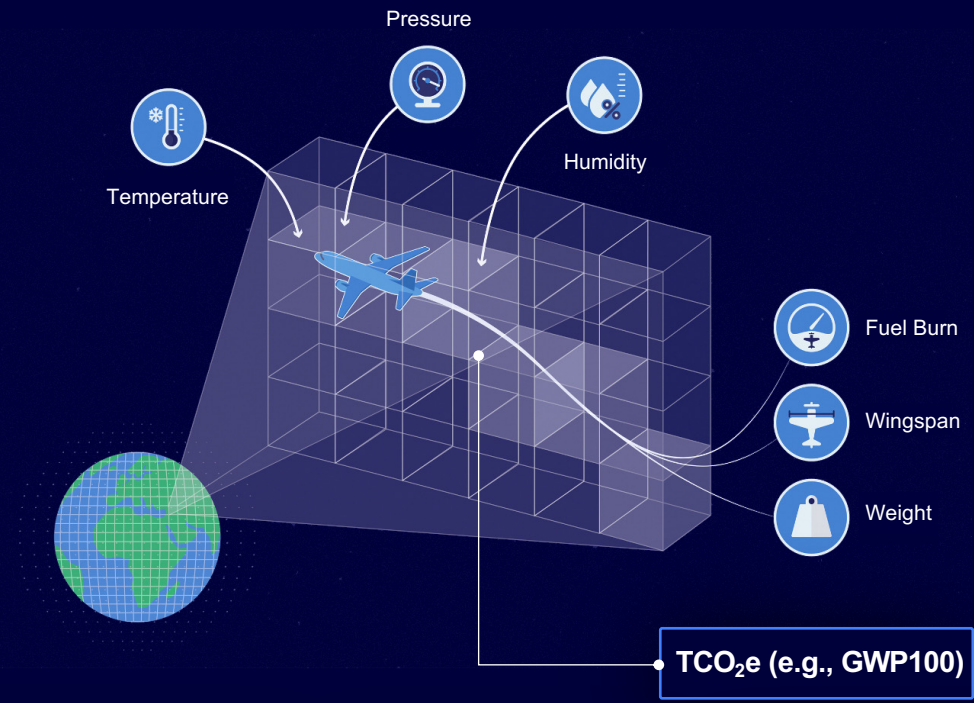


Solution Overview

Numerical Weather Prediction Modeling (ISSR forecasting)



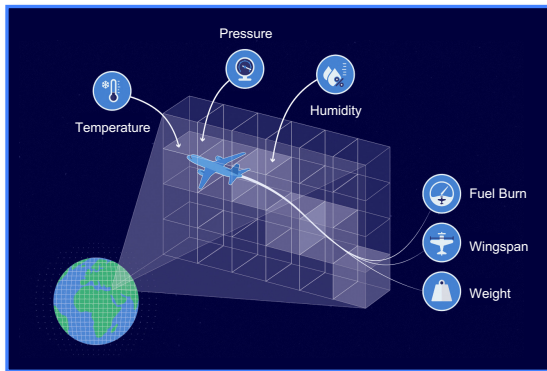
Aircraft Trajectory Climate Impact Modeling



- EU ETS MRV compliance
- Flight plan optimization
- Carbon market incentive

Science - Guiding Product and Impact

Best-in-class Modeling



- Trajectory-based contrail radiative impact models
- Quantify warming impact on a per flight basis

Collaborations



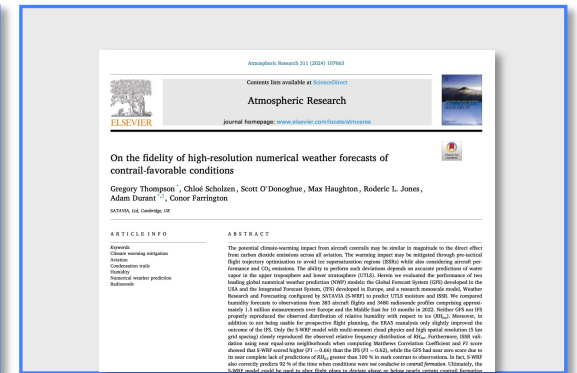
- Collaboration with NASA, DLR and others
- SATAVIA's team combines expertise from NCAR (USA) and University of Cambridge (UK)

Flight Test



- CODEX flight test campaign in 2024 with GE Aerospace, SATAVIA and NASA to advance the science
- Further flights planned to advance science validation

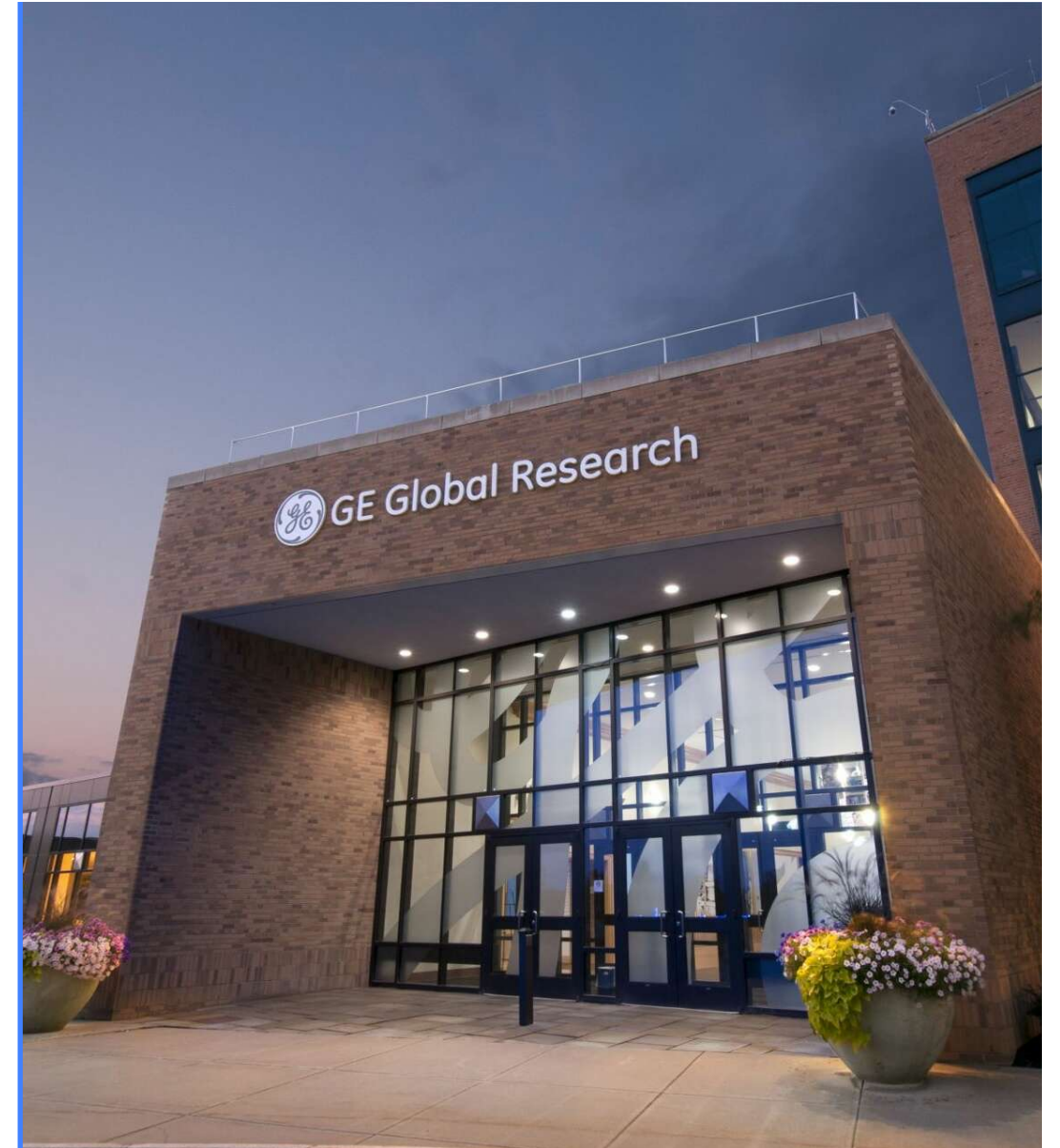
Validation



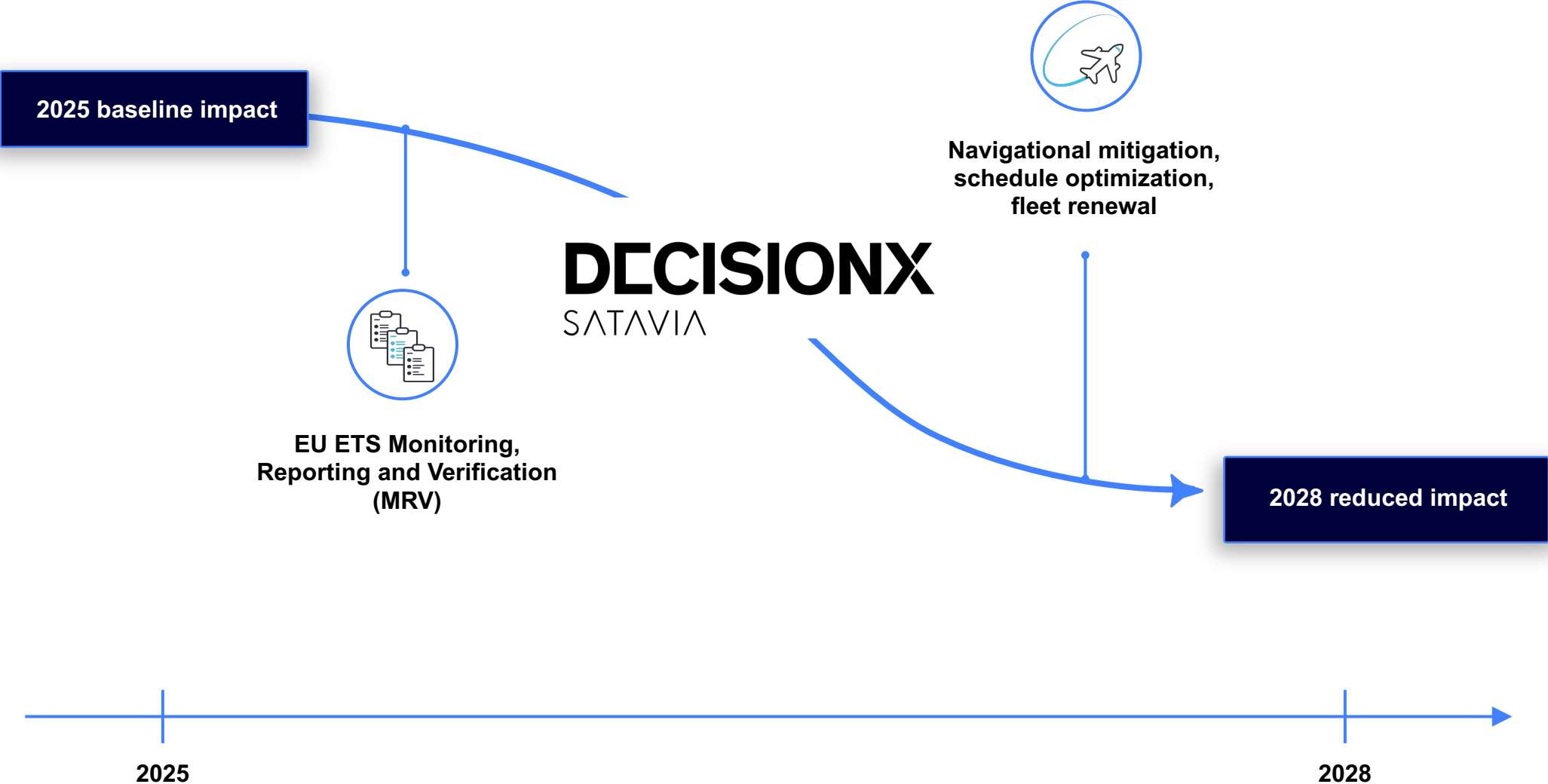
- Proprietary validated numerical weather prediction (NWP) model humidity forecasts
- Published Dec 2024 in *Atmospheric Research*

Science – GRC Team and EU ETS System

- GE Global Research Center (GRC) bridges science and flight operations with 700 researchers
- Applying best-in-class engineering and science in line with EU ETS MRV system architecture
- Supplying cutting-edge aircraft and climate modeling for enhanced fleet analysis



Solution - Roadmap



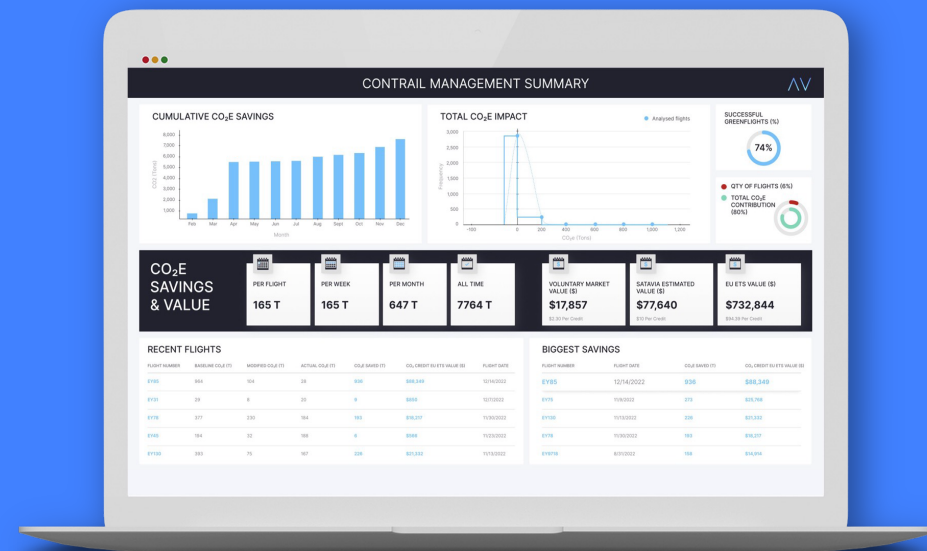
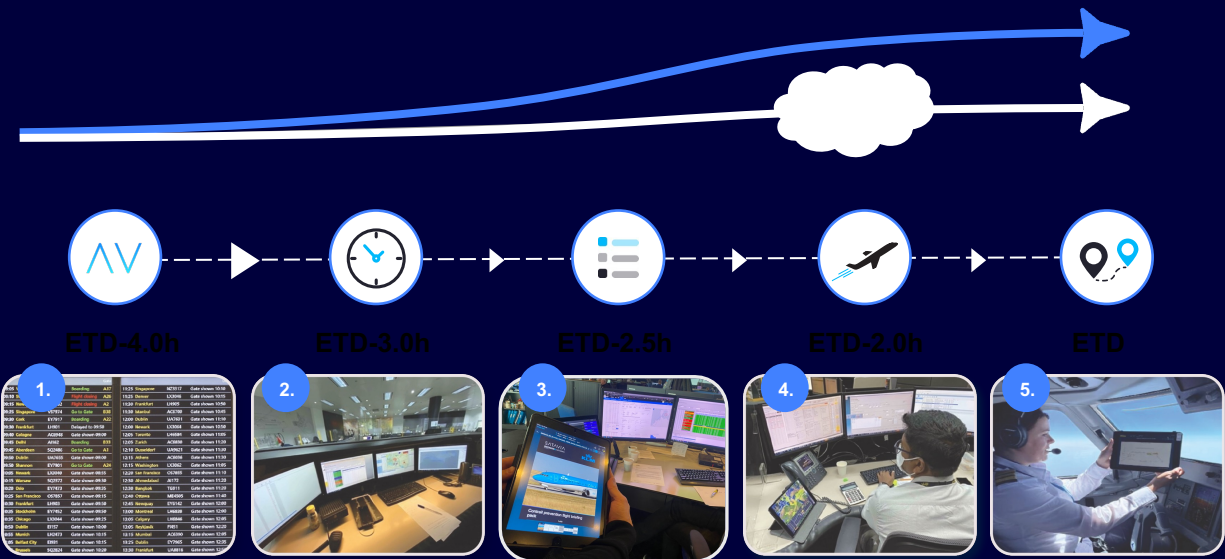
DECISIONX x ACS Signpost

Benefits:

- Mitigate total climate impact (CO₂ and non-CO₂ emissions)
- Accurately account for climate impact
- Reduce future EU ETS obligation
- Build long-term competitive advantage

Features:

- Optimize flight plans via API through navigational avoidance of ISSRs
- Per-flight reporting of avoided impact
- Future market-based incentive

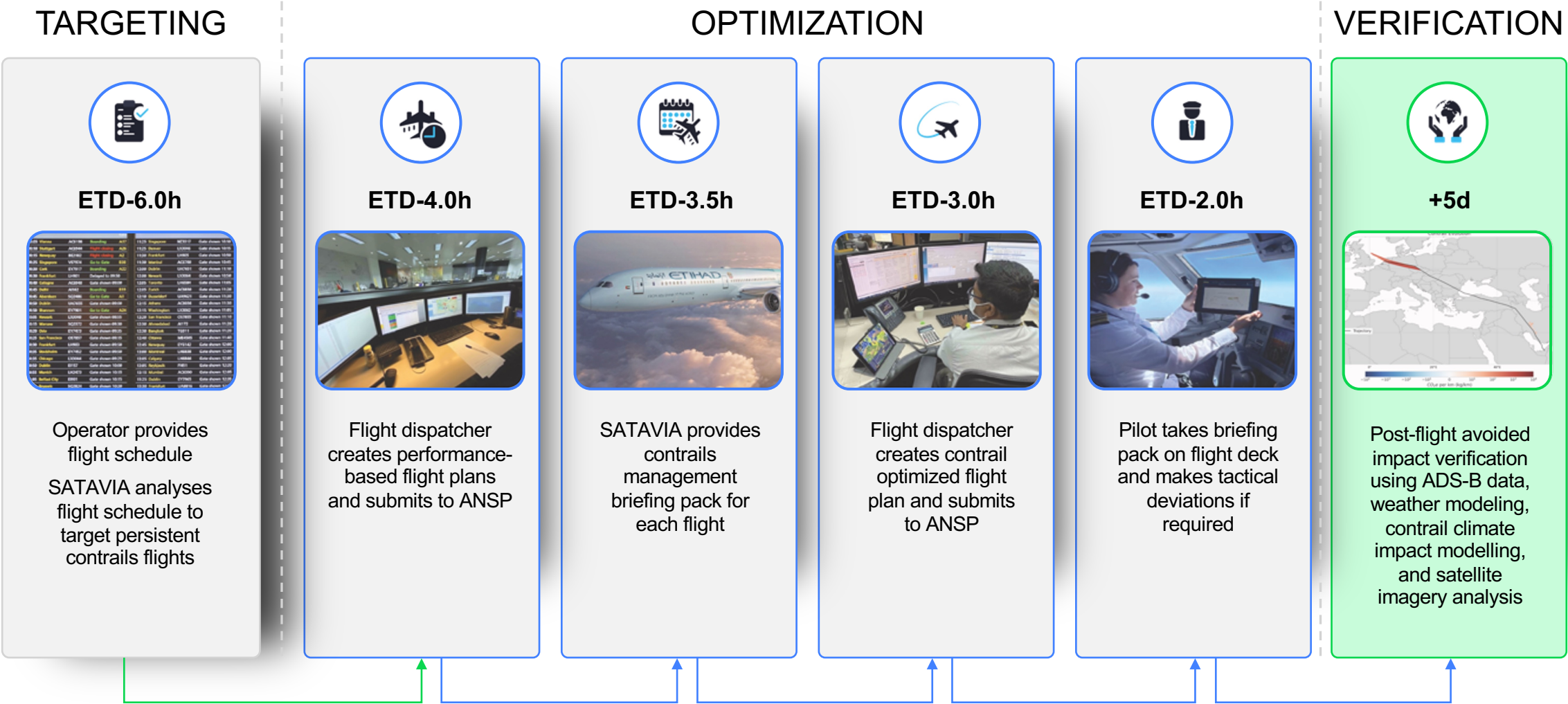


Solution - Mitigation

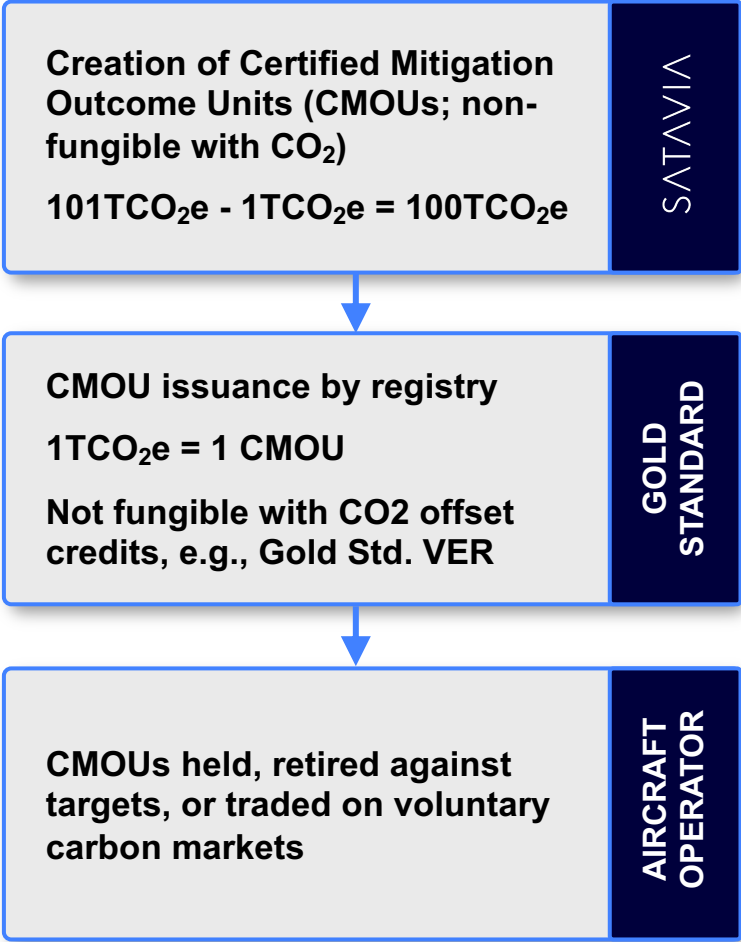
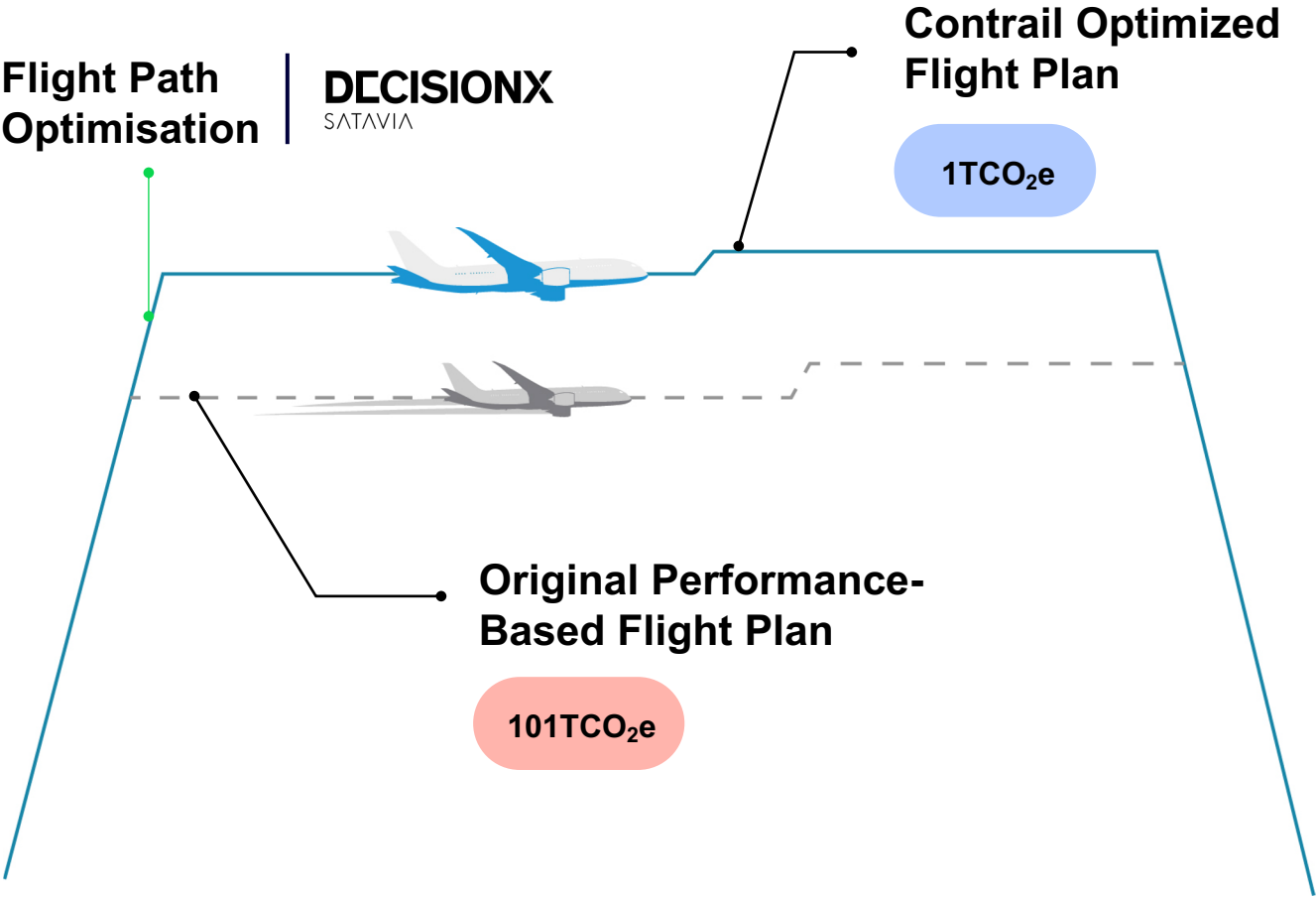
Pioneered pre-tactical flight operations optimization process with Etihad in 2021



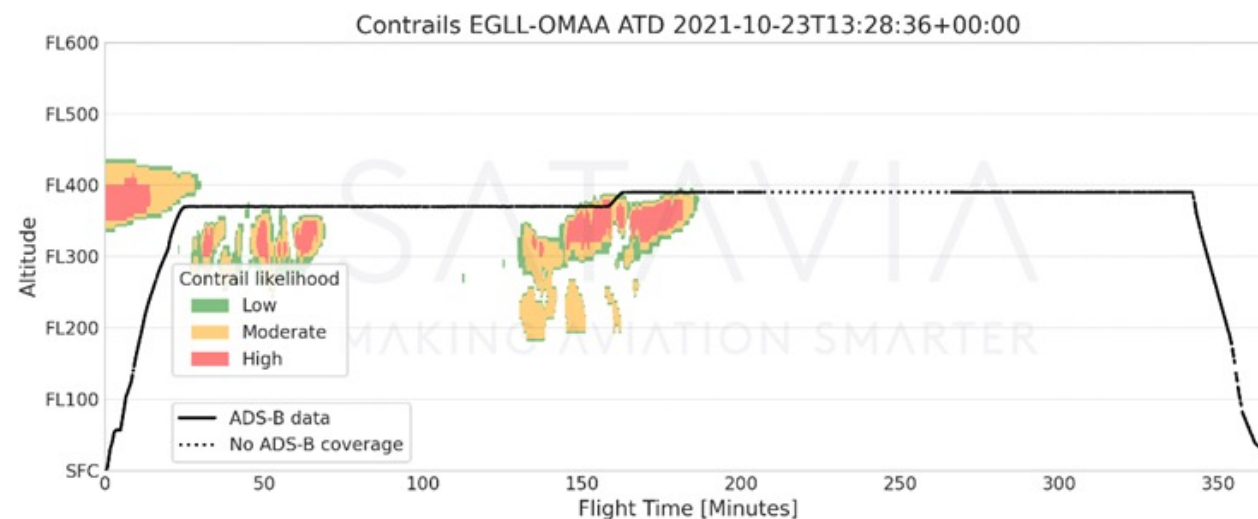
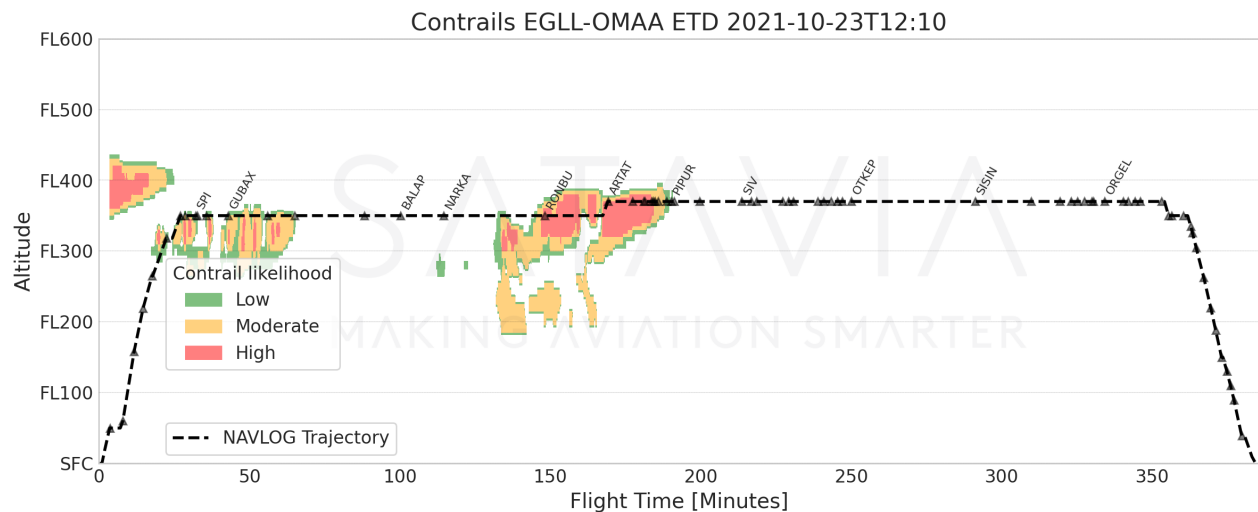
Solution - Mitigation



Solution - Incentive



October 2021 EY Sustainable Flight



Original flight plan

Max contrail lifetime (hrs)	6.8
Avg contrail lifetime (mins)	55.2
Total energy forcing (GJ)	96,142
Total CO2 equivalent (tons)	64.6
Time spent forming contrails (mins)	34.6

ADSB post-flight analysis

Max contrail lifetime (hrs)	0.73
Avg contrail lifetime (mins)	3.4
Total energy forcing (GJ)	365
Total CO2 equivalent (tons)	0.25
Time spent forming contrails (mins)	5.9

ESA Flight Trials - Introduction



SATAVIA ran ESA ARTES project 2022-2023



Worked with 12 airlines over 10 months



Analyzed 445 flights



Successfully modified 65 flights (44% success rate)

KPI	Value
Number of flights analysed	445
Number of flights recommended for modification	147
% of flights analysed that required modification	33%
Number of flights implemented by dispatch	51
Number of successful flights (including tactical modification)	65
Success rate	44%

ESA KPIs – Overview

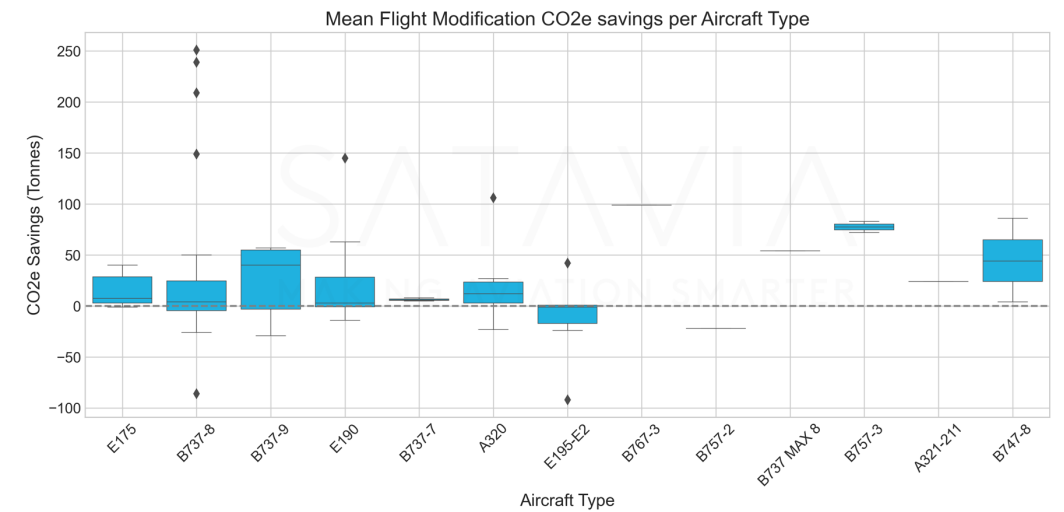
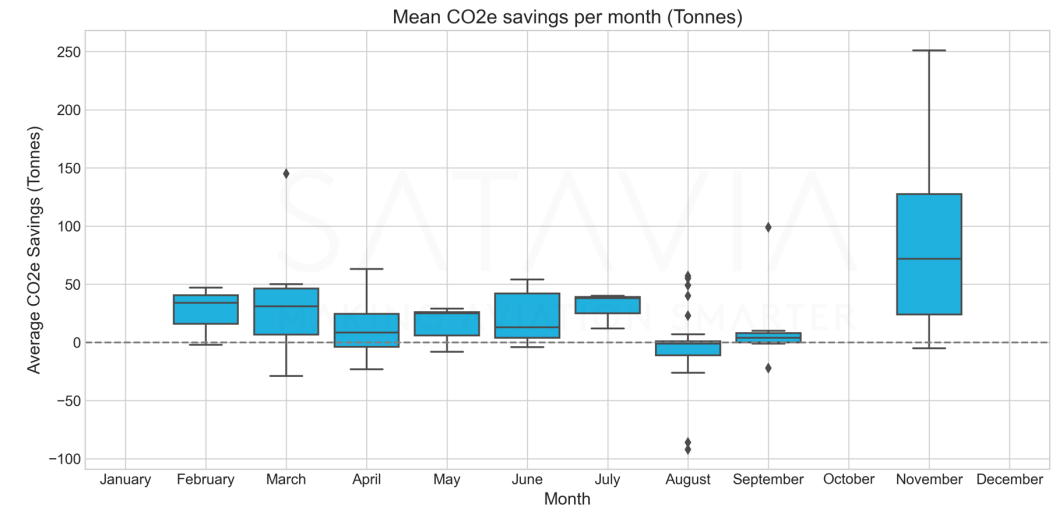
KPI	Unit
Total CO ₂ e saved (GWP100)	TCO ₂ e
Total number of contrail management flights implemented	N/A
Average CO ₂ e saving across all flights (GWP100)	TCO ₂ e
Total fuel burn delta	kg
Block time delta	mins
Average fuel burn delta	%
Block time delta	%

ESA KPIs – Results

Short haul $x < 180$ mins (Count = 28)	CO ₂ e (T)
Average baseline per flight	51.5
Average saving per flight	23.43
Average saving per flight	45.46%

Medium haul $180 \leq x \leq 300$ (Count = 10)	CO ₂ e (T)
Average baseline per flight	71.3
Average saving per flight	36.4
Average saving delta per flight	51.05%

Long haul $x > 300$ (Count = 13)	CO ₂ e (T)
Average baseline per flight	141.2
Average saving per flight	80.8
Average saving delta per flight	57.2%



ESA Trials - Challenges and Recommendations

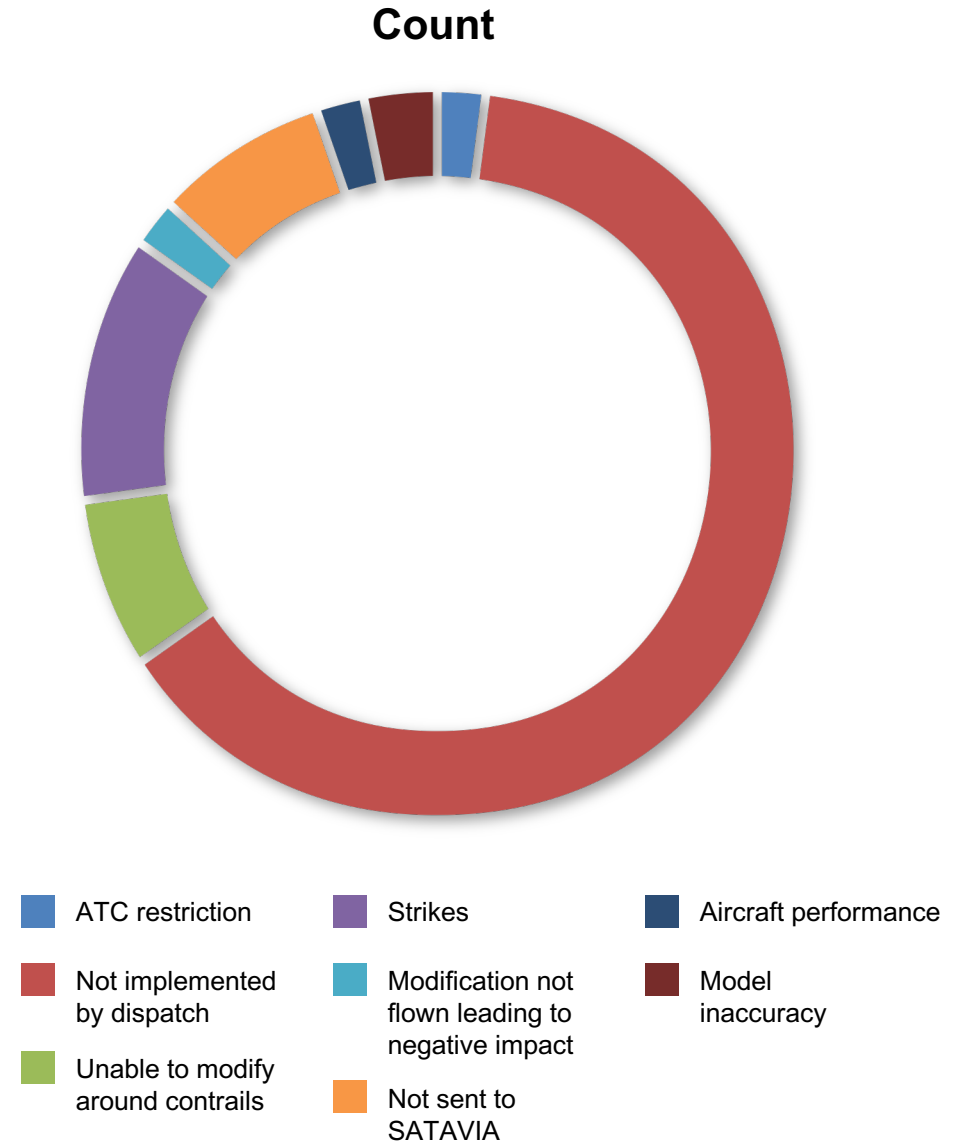
ESA trial showed value of **operational experience** as opposed to 'dry-run' simulations.

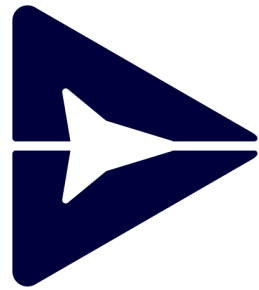
Key operational challenges:

- ATC restrictions
- Aircraft performance restrictions
- Flight planning time and resource challenges
- ATC strikes

Recommendations:

- Embed in routine day to day schedules to confirm targets for ATC enhancement
- Engage ANSPs to explore potential for enhanced ATM rules





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a GE Aerospace business

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