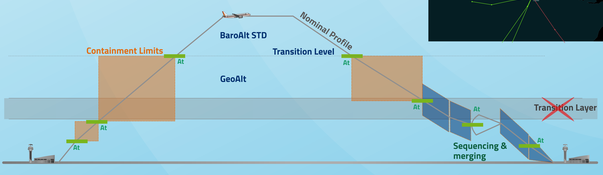
Green-GEAR

Green operations with **Geo**metric altitude,
Advanced separation and Green **R**oute charging Solutions

Solution 1: GeoAlt
Vertical guidance using Geometric Altimetry

Replacing barometric with geometric altimetry for vertical navigation to allow more fuel-efficient flight paths while removing potential for human and instrumental error.

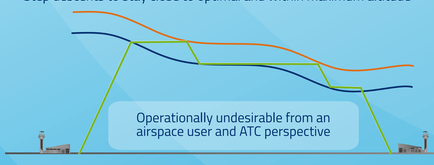


Terminal Manoeuvring Area

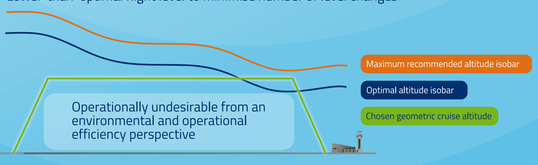
Reference Scenario
Barometric Altimetry with Altitude and Flight Level Constraints at Waypoints

GeoAlt Scenario
Fixed Climb/Descent Gradients based on geometric point-to-point vertical paths

Cruise flight
Step descents to stay close to optimal and within maximum altitude



Lower-than-optimal flight level to minimise number of level changes

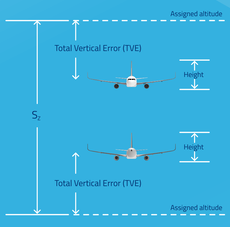


TMA
- Safer & more efficient airspace usage
- Removes need for Transition Layer
- Significant fuel benefit

Cruise
- Operational drawbacks
- Increased fuel consumption

Overall
- Enabler for reduction of minimum vertical separation
- Facilitates Separation Minima
- Slight fuel savings

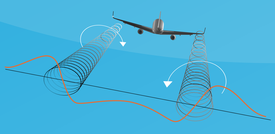
Elements of the ICAO Model
Calculating Total Vertical Error



Collision Risk Calculation
Multiplications, convolutions and overlaps

Solution 2: Separation Minima
Reduced vertical separation under GeoAlt conditions

Assessing the viability of reducing vertical separation through geometric altimetry, initially in en-route airspace, thereby facilitating optimised trajectories and increasing airspace capacity.



Wake Vortex Encounter Risk
Calculation of vortex envelopes, encounter likelihood and potential severity

Is RVSM2 safely possible?
Reduction of minimum vertical separation to 500 ft between FL290 and FL600

Aircraft Collision Risk
- Acceptable under certain conditions
- Main challenges: jamming and spoofing of GNSS, ACAS

Wake Encounter Risk
- Increased traffic proximity raises wake encounter risk by a factor of approx. 4
- Advisory tool and/or conditional application of reduced separation necessary

Overall
- Increased capacity and flight efficiency predicted
- Wake Encounter Risk needs further study
- Regulatory challenges need to be overcome
- Facilitates GRC Full solution

Solution 3: Green Route Charging
A two-step approach to incentivising environmentally-conscious route planning

Initial solution: New en-route charging mechanisms to help reduce CO_2 emissions and promote more environmentally friendly flight paths.

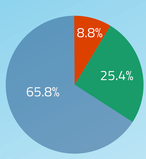
Modulation of Route Charges
Reducing demand-capacity imbalance whilst minimising the flown distance

The approach is in line with general ICAO principles (Doc 9082)

Opposing Stakeholder Interests

Route Charging Cost Development
with Initial Solution

Higher costs | Lower costs
Identical costs

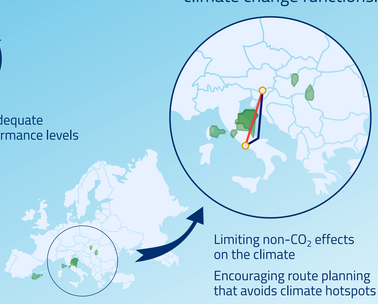


On average, route charges are reduced by 0.72%.

Network Level Results (Initial)

- 0.25 to -1.36% (Fuel, CO_2)
- 0.44 to -1.39% (Distance Flown)

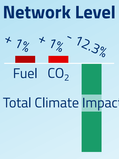
Full solution: Reducing aviation's climate impact (CO_2 and non-CO_2) through the avoidance of climate hotspots as defined by algorithmic climate change functions.



Limiting non-CO_2 effects on the climate

Encouraging route planning that avoids climate hotspots

Network Level Results (Full)



Total Climate Impact (ATR20)

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The Green-GEAR Consortium

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linkedin.com/company/sesar-green-gear

www sesar-green-gear.eu/

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