

Development of Comprehensive Environmental Performance Indicators Aviation from the Perspective of Air Navigation Service Providers.

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Motivation

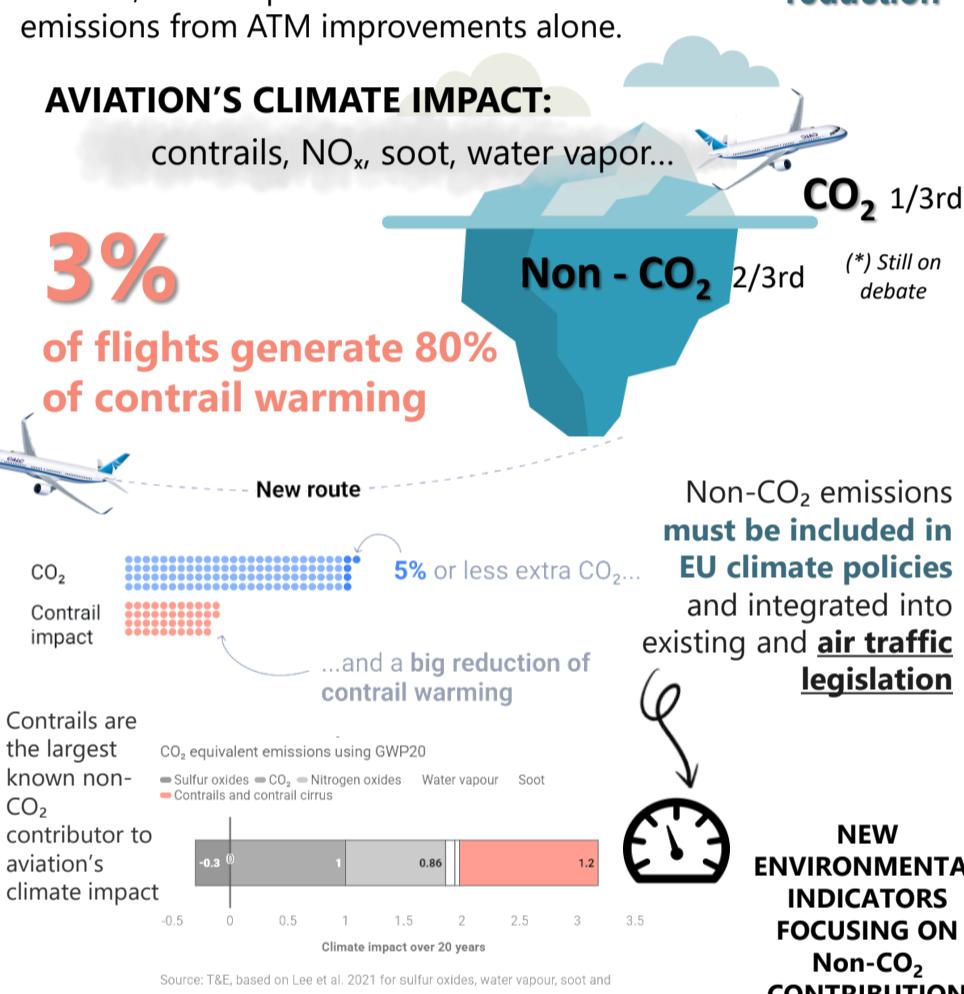
Net-zero carbon emissions by 2050

6%
ANSP Potential
emission
reduction

Air Navigation Service Providers (ANSPs) and airlines are working together to improve flight efficiency—both through better Air Traffic Management (ATM) and optimized aircraft operations—aiming for operational efficiency levels of up to 95–98%, with a potential 6% reduction in emissions from ATM improvements alone.

AVIATION'S CLIMATE IMPACT:

contrails, NO_x, soot, water vapor...

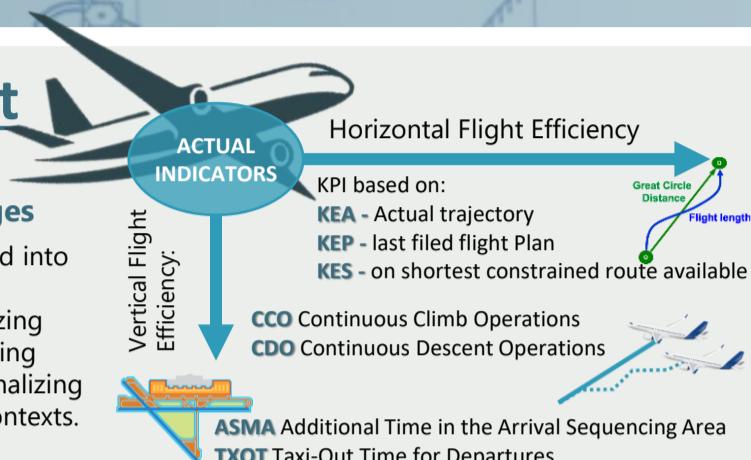


NEW ENVIRONMENTAL INDICATORS FOCUSING ON Non-CO₂ CONTRIBUTION

State of the art

CO₂ Conversion and Methodological Challenges

- Indicators are being translated into CO₂-equivalent values.
- Challenges include standardizing conversion formulas, integrating fuel and flight data, and normalizing results for different airport contexts.



Some existing CO₂ and non-CO₂ Methodologies

- Cobos-Cuesta, E. (in press). Data-Driven Methodology Characterizing CO₂ Emission Discrepancies Between Actual and Optimum Operations. Journal of Air Transportation.
- Sanajou, K., & Tchepel, O. (2024). Modelling of Aircraft Non-CO₂ Emissions Using Freely Available Activity Data from Flight Tracking. Sustainability
- Lim, Yixiang & Gardi, Alessandro & Sabatini, Roberto. (2015). Modelling and Evaluation of Aircraft Contrails for 4-Dimensional Trajectory Optimization. SAE International Journal of Aerospace

Non-CO₂ Effects & Measurement Gaps



Advanced Metrics and Research Initiatives (EU projects)

- AEROPLANE & E-CONTRAIL:** AI and satellite data to predict contrail formation and guide climate-optimal routes.
- Green-GEAR:** satellite altimetry and impact-based route charging.
- CONCERTO:** integrates climate metrics into ATM systems and green flight plans. New metrics like Climate Index and Mitigation Index enable real-time climate-informed trajectory decisions.

Policy Recommendations

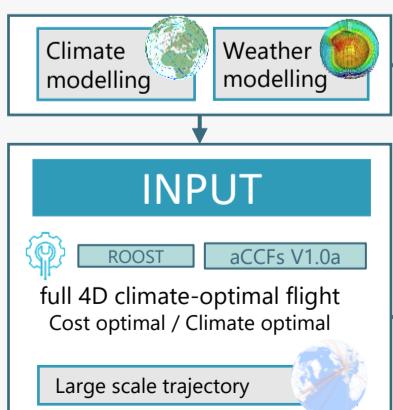


Objective

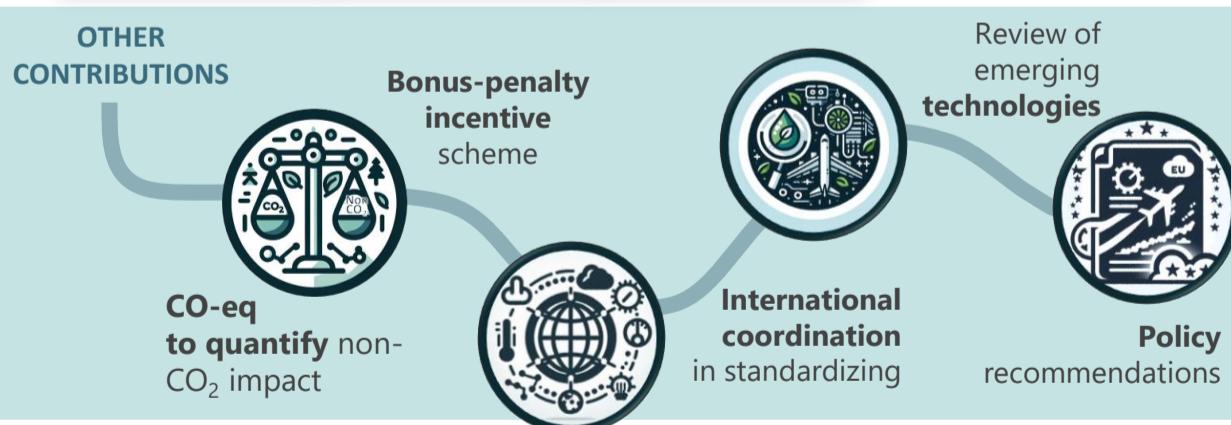
Proposal of advanced environmental indicators integrating non-CO₂ emissions

To develop robust performance indicators for ANSPs that capture both CO₂ and non-CO₂ climate impacts, with a focus on contrail mitigation strategies within performance-based regulatory frameworks.

Methodology



Source: Climate-optimized flight planning can effectively reduce the environmental footprint of aviation in Europe at low operational costs



Conclusions

In short: a **ROADMAP** toward a sustainable, forward-looking global aviation system.

Key Area	Proposed Action
Non-CO ₂ Impacts	Integrate into environmental performance metrics
Assessment Methods	Improve robustness and scientific relevance
Regulatory Alignment	Stay in sync with evolving frameworks
International Cooperation	Enhance collaboration and global standards
Incentives & Policy Design	Support future-oriented rules and reward systems