Q&A - JANUARY 2026

How to scale up contrail avoidance in Europe?

1. What is a contrail? How do we avoid them?

When an aircraft burns jet fuel, it emits water vapour, soot and other particles. Sometimes, the water vapour condenses around the particles, creating ice crystals that make up contrails - the white lines we see behind planes. On average, contrails trap heat that would normally escape from Earth into space, and their **warming impact on the climate is estimated to be comparable to that of aviation's CO_2 emissions**.

Contrails can be mitigated via navigational contrail avoidance: small adjustments to flight paths, notably minor climbs or descents, to avoid those cold and humid atmospheric areas where contrails form.

2. If the aim of avoiding contrails is to climate impact, wouldn't burning more fuel actually increase emissions?

Studies and flight trials suggest that contrail avoidance at scale would increase fleet-wide CO_2 emissions by less than 1%. T&E's analysis shows that **strategies focused on avoiding only the most climate-damaging contrails are a clear no-regret option**. The climate benefits of reducing contrails could be 15x larger than the impact of the CO_2 emissions from extra fuel burn. The contrail benefit over the additional CO_2 goes up to 40x using values from real-life tests. The potential harm from inaction on contrails is large, while the risk of acting prematurely is small.

3. If more fuel should be burnt to perform these manoeuvres, will this impact prices of flights?

Since the **expected additional fuel burn from navigational contrail avoidance is less than 1%**, any impact on ticket prices would also be very small. T&E estimates that contrail avoidance would cost less than a coffee at the airport: around €1 for an intra-EU flight and around €4 for a flight beyond the EU.

4. Considering the manoeuvres needed, is avoiding contrails safe?

Safety always takes precedence in aviation. Contrail avoidance would only be implemented when it does not affect the safe operation of the aircraft.

In practice, contrail avoidance can be planned in advance, before take-off, using weather forecasts and flight planning tools. This allows any potential adjustments to be assessed alongside existing operational and safety constraints. If conditions do not allow for safe execution, contrail avoidance would simply not be applied.

5. You say that most contrails form at cruise altitudes and that the solution is to make small altitude adjustments. But is there not a reason why cruise levels are set at those altitudes?

One of the main reasons why aircraft currently fly at altitudes between 10,000 m and 12,000 m is fuel efficiency. **Vertical deviations of aircraft for contrail avoidance therefore lead to higher fuel consumption**. But since contrails are a very concentrated problem - less than 3% of global flights generated 80% of contrail warming in 2019 - only a handful of flights would need to be adjusted. The result: minimum additional fuel burn and low operational impacts.

6. Contrails formed at night and in autumn/winter tend to be very warming. What about in summer and spring? Should no contrail avoidance strategy be implemented during that period?

Critics sometimes suggest that contrail avoidance is impossible to implement effectively due to the significant impact it could have on air traffic control when performed at scale, particularly during busy periods such as peak summer travel days.

We argue, however, that the **focus should shift from where contrail avoidance is hardest to where it is arguably easiest and most impactful**. Therefore, contrail avoidance should be scaled up gradually, starting from less busy periods such as night flights in autumn and winter and less complex airspaces. This allows science, legislation, and operational experience to co-evolve responsibly.

7. You say that weather forecasts are key to effectively avoiding contrails, aren't they too uncertain to rely so much on them?

Recent research shows that forecasts with lead times relevant to flight planning are stable enough to be used for contrail avoidance. Still, more accurate weather forecasts will help make contrail avoidance more effective. It is therefore crucial to improve weather models for better understanding where the most warming contrails occur.

8. You say early-morning flights can create cooling contrails. Can't shifting night flights to the early morning address the contrail warming challenge?

Shifting night flights to early morning **could likely reduce a share of contrail warmin**g. However, early-morning contrails are not automatically harmless: They can still be warming. There is also a **significant noise co-benefit from reducing night-time operations**, especially for residents around airports. Still, it is important to keep in mind that there are **practical limits to how much night flying can be moved to the morning** without knock-on effects. Many cargo and express networks depend on overnight operations to meet next-day delivery windows, and maximising aircraft utilisation often requires night legs. In addition, concentrating operations into the morning would likely run into airport and air traffic management capacity constraints.

9. In a context where air traffic controllers are already facing significant operational pressures, how might additional contrail mitigation measures affect workload and working conditions?

T&E argues that contrail avoidance should be scaled up **gradually**, starting from less busy periods such as night flights in autumn and winter and less complex airspaces. Wherever possible, **decisions should be shifted to the pre-tactical planning phase**, reducing controller burden. The climate benefits are already significant with pre-tactical contrail avoidance and as satellites, weather forecasts and the familiarity of air traffic controllers with these types of manoeuvres improve, tactical avoidance can gradually be increased.

10. Is T&E not oversimplifying the issue?

Contrail formation and climate impact are indeed an active and complex area of scientific research, and there remains uncertainty around the precise magnitude of contrail warming, for instance. We fully acknowledge this complexity and the limits of current knowledge.

However, **scientific uncertainty does not imply policy inaction**. We argue that there is a case for action based on the precautionary principle: The potential harm from inaction is large, while the risk of acting prematurely is small. Our objective is therefore not to resolve all remaining scientific questions, but to **distil what is known and translate it into actionable policy recommendations**. This allows science, legislation, and operational experience to **co-evolve responsibly**, rather than ignoring the problem or waiting for perfect data that could lock in years of avoidable climate warming.

Concretely, our analysis relies on **state-of-the-art contrail models** and focuses on **system-level trends in contrail warming**, rather than precise flight-by-flight impacts. We are transparent that these models involve uncertainties and simplifying assumptions. As a result, our findings should be interpreted as **indicative of patterns and orders of magnitude**, not as exact estimates of contrail warming.

11. Is contrail avoidance realistic? Aren't there too many elements in the process that need to be adjusted?

Contrail avoidance is **technically feasible and operationally realistic**, as demonstrated by a growing number of real-world flight trials led by airlines and air navigation service providers. These include the D-KULT project (with participating airlines including Lufthansa, TUI, Condor and DHL), American Airlines' trials supported by Google and Breakthrough Energy, MUAC's trials, conducted in collaboration with the German Aerospace Center DLR, or NATS's trial as part of CICONIA among others.

These trials have tested the key building blocks of contrail avoidance such as route planning, on-board execution, and dispatcher procedures in practice. Trials are crucial to assess whether avoidance can be integrated into air traffic management safely, predictably, and with acceptable workload and fuel implications. The fact that contrail avoidance requires coordination between different aviation stakeholders underscores the **need for structured collaboration between airlines, the Network Manager, ANSPs and other aviation stakeholders.** With this report, T&E aims to clarify which stakeholders need to be involved and where trials could be scaled up.