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Update on Environment Initiatives in Europe

Presented by
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SUMMARY

Air transport has played an important role in improving access and supporting the economic development of many countries and territories. It has driven an incredible expansion in relations between the peoples of the world. The combined effect of liberalisation and fuel and cost reductions has opened up access to long-distance travel for a large proportion of the population in developed countries, and this will continue in the rest of the world.

In the coming years, the European air transport sector aspires to be sustainable in the face of the climate challenge and is aiming for carbon neutrality by 2050.

This transition will have to be managed by all the stakeholders, from the EU, the government and the different actors in the sector together.

The Air Traffic Controllers will be asked to contribute to this societal challenge in their daily job. This can however only be achieved with intelligent and safe measures.

1. Introduction

1.1. This update will provide an overview of the ongoing initiatives in Europe to manage the sustainable transition in climate impact assessment on aviation. It also aims to summarize some of the ongoing research activities and highlight some of the latest ideas with regard to different interest groups on what aviation and air traffic control should be doing to assist the endeavour of improving the environmental performance of aviation. Further, it will propose that IFATCA embraces a way forward to how ATCOs should have to handle environmental related procedures. Noise will be mentioned as part of the illustration of the need to have a robust understanding of the impact of the sustainability measures imposed on aviation.

1.2. The paper is split into three parts. Part one will outline the possibilities of contributing to aviation climate neutral growth. Part two will summarize the ongoing European initiatives and Part three will highlight a possible way forward for IFATCA, which could be further studied.

1.3. A Environment TF was created in the past. A first coordination meeting took place after long in December 2024. This TF could be tasked to further assist in elaborating policies, should directors so wish. Alba Cruz (Spain), Benjamin van der Sanden (EVP Tech) Byron Post (South Africa), David Johnson (UK GATCO), Davide Bianchi (Italy), Marc Baumgartner (SESAR EASA coordinator) Roberta Mascherotti (Italy) and Tim Rees (Australia) are currently participating to the TF.

1.4. This report includes links to websites.

2. Discussion

Part I Aviation contribution to a sustainable future of the planet

2.1. Some sources claim that we are living in the period of Anthropocene. The Anthropocene is term that is used to refer to the period of time during which humanity has become a planetary force of change. The term is widely used in scientific discourse, especially with respect to accelerating geophysical and biochemical changes that characterize the 20th and 21st centuries on Earth[1] . Although not officially accepted as a scientific term it is widely used and the start is coined around 1950.

2.2. Thanks to increased measurement capabilities, a raise in the global average temperature can be observed.

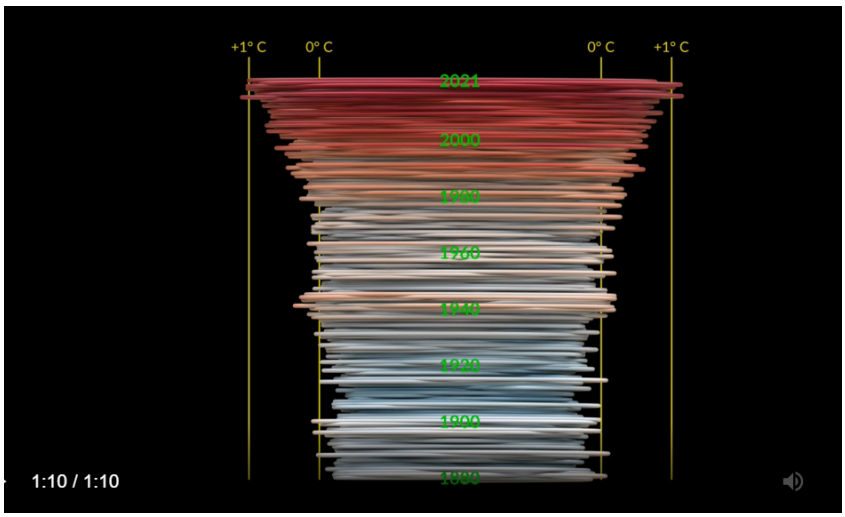

Figure 1

The visualization presents monthly global temperature anomalies between the years 1880-2021. These temperatures are based on the GISS Surface Temperature Analysis (GISTEMP v4), an estimate of global surface temperature change. Anomalies are defined relative to a base period of 1951-1980.The Goddard Institute of Space Studies (GISS) is a NASA laboratory managed by the Earth Sciences Division of the agency's Goddard Space Flight Center in Greenbelt, Maryland

[1] Wikipedia accessed 25.02.2025

2.3. What started with the Rio Earth Summit, is a United Nations led initiative to create the required political program based on scientific work, which led to the creation of the Intergovernmental Panel on Climate Change (IPCC) which is the United Nations body for assessing the science related to climate change. All the human activities and their respective impact on the increase of the global temperature are being assessed by the scientific community.

2.4. At the political level, different initiatives have been taken, either at the national or international level. At the international level, ICAO has launched CORSIA . The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is the first global market-based scheme that applies to a sector. It complements other aviation in-sector emissions reduction efforts such as technological innovations, operational improvements and sustainable aviation fuels to meet the ICAO aspirational goal of carbon neutral growth.

For international flights in excess of their 2020 level, airlines can purchase 'carbon credits'.

- For an additional payment, their passengers can offset their emissions.

Currently 976 million tons of CO2 are produced by aviation a year and only 20 million tons are offset.

The European Emission Trading Scheme EU ETS, created in 2005, wanted to initially include on a mandatory basis aviation as well. This was however opposed and thus the airlines prefer to participate to CORSIA which is non-binding. Initially foreseen for all the flights in the European Union, it was argued by airlines in Europe, that this would result in a market distortion. After lengthy negotiation, a compromise was found and thus airlines do not participate actively in the EU ETS for the time being.

2.5. The European Union, under the first van Leyen Commission, created the European Green Deal. This political initiative was broken down into different sub-initiatives touching upon different sectors.

2.6. As aviation contributes to the warming of the global temperature by producing CO2 and non-CO2 emissions, the challenge for aviation is to reduce its global footprint. Experts agree that aviation currently contributes to 2-3% of the overall CO2 production of all human activities. The contribution to non-CO2 emissions is for the time being scientifically not sufficiently robust and can therefore not be quantified. As the forecasted global traffic increase of aviation is raising between 3-5% per year the impact on the overall CO2 production is identified as being negative.

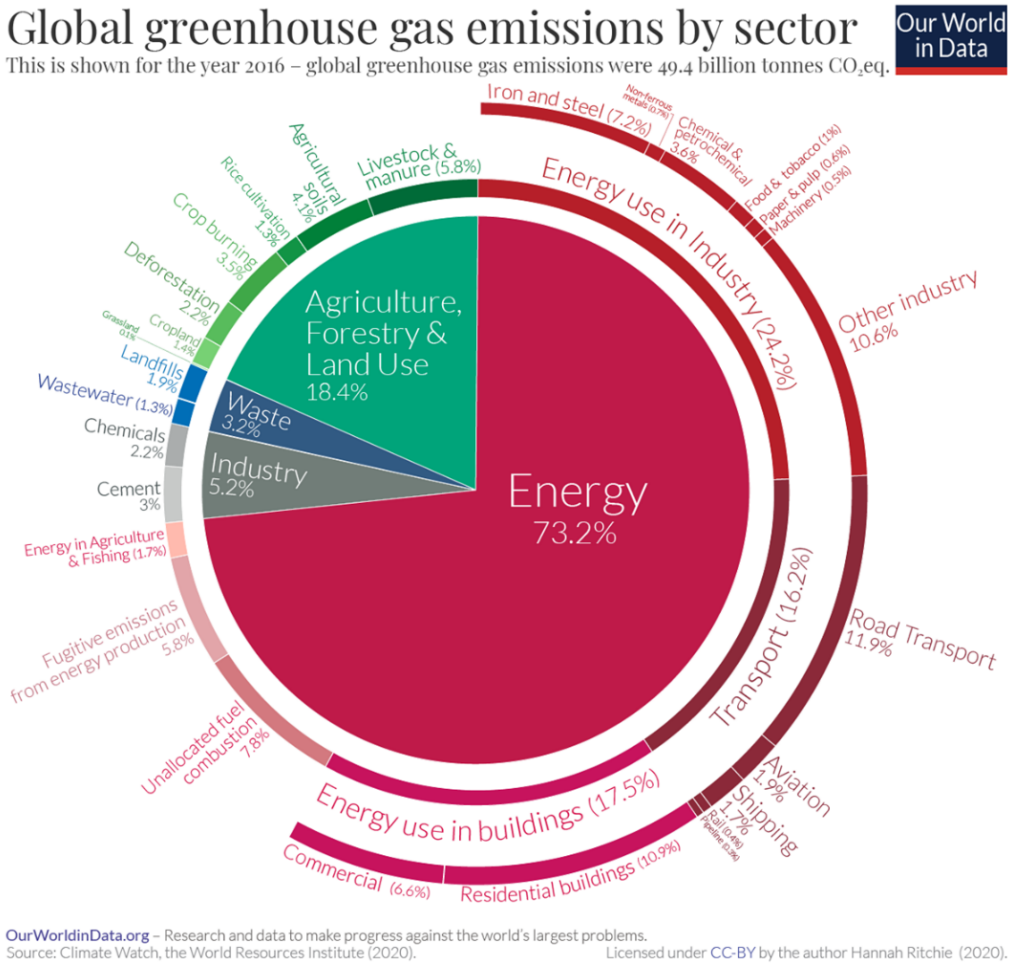

Figure 2 Global Green house emmission

2.7. To decarbonize is the main challenge for aviation. When talking[2] about decarbonization, the following elements arementioned:

(a) a sharp reduction in aircraft fuel consumption;
(b) the use of alternative fuels to kerosene;
(c) carbon capture and storage[3] [4]
(d) sobriety.

a) The acceleration in the replacement of aircraft fleets by recent aircraft (average age 12 years) and the appearance of a new generation of aircraft around 2035, will provide successive gains of 30 % and 25 % respectively in fuel consumption per passenger-kilometre-transported (pkt). Given that medium- and long-haul flights of more than 1,500 km departing from Europe generate over 70 % of CO2 emissions, it is on these flights that action must be taken as a priority.

b) Various SAF (Sustainable Aviation Fuels) variants compatible with current aircraft are in the early stages of industrial production and will enable a safe transition

[2] AAE_Avis20_UK_WEB.pdf

[3] These alternative fuels are called Sustainable Aviation Fuels (SAF). They are produced either from bio sources (bio-SAF), or from CO2 and hydrogen... and a large amount of electricity (e-SAF/e-fuel).

[4] For general aviation and short-haul aircraft with less than 100 seats, “all-electric” or “hybrid” or “hydrogen” alternatives seem interesting (see below). to “neutralise” emissions from the remaining fossil kerosene;

thanks to their like for like capability. SAF from bio-based sources have many advantages, but the quantity available in Europe for aviation will amount to only 20% of requirements[5]. Consequently, the use of a large quantity of e-fuels[6] is a necessary step, and will call for a great deal of decarbonised electricity

c) Measurable, certifiable carbon capture and storage operations will generate[7] 3 negative emissions" that offset the emissions from the remaining use of fossil kerosene on a tonne-for-tonne basis

2.8. The Eurocontrol Performance Review Commission published in June 2024, the Performance Insight #9, where it estimates the potential benefit for Air Traffic Management of reducing CO2 due to ATM work to 9.3% (note that the benefit pool will never go to 0%).

2.9. The biggest gains in CO2 from the current operations are for flights above 1500km. IFATCA in the past has requested the Network Manager to establish a program to manage the CO2 trajectory for the European Network. The NM has not been working on this.

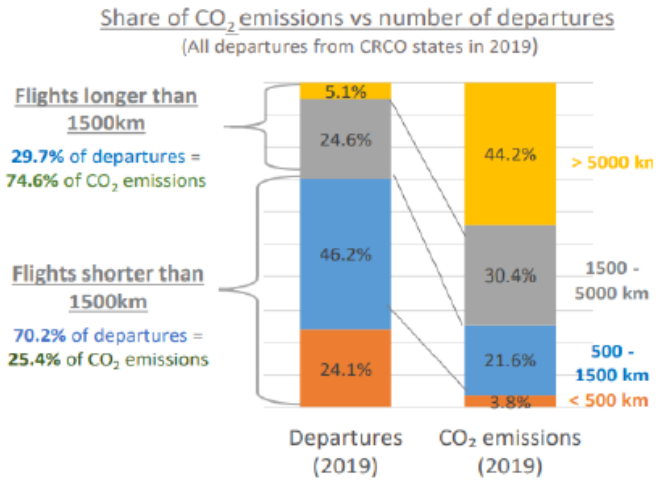

Figure 1-16: Distribution of flights and estimated CO_2 emissions by distance category (2019)

Figure 3 PRR report 2019 Eurocontrol

2.10. ATC can plan a certain role in assisting future CO2 trajectory by providing a safe service along the routes. An ATCO has, however, only limited possibilities to reduce the CO2 impact of a flight if only addressing the portion of the flight through their airspace. Initiatives like Free Route in Europe are providing at a systemic, flight planning level, the opportunity to systemically reduce the flying

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[6] Electrofuels, also known as e-fuels, are a class of synthetic fuels which function as drop-in (like for like) replacement fuels for internal combustion engines. They are manufactured using captured carbon dioxide or carbon monoxide, together with hydrogen obtained from water splitting.[1] Electrolysis is possible with both traditional fossil fuel energy sources, as well as low-carbon electricity sources such as wind, solar and nuclear power (Wikipedia accessed 07.03.2025

[7] This 20% figure is confirmed by a report by the French Académie des Technologies, June 2023: "La décarbonation du secteur aérien par la production de carburants durables" – https://shorturl.at/xGIKW "

distanceof an aircraft. However, a lot of operational uncertainties tend to reduce the CO2 related benefits.

2.11. With regard to non-CO2, the ATCO might as well be asked to influence a planned trajectory by providing a certain form of advice. Science is, however, not mature enough to be sure what is being done to influence the non-CO2 trajectory is not counterproductive. See comments in part 2 and 3 of this paper.

2.12. Regarding Noise abatement, a large experience exists throughout Europe and it has become part of the daily job of Tower and Approach controllers. This working paper will not discuss the issue of noise abatement procedure in part I.

Part II European initiative regarding environment

2.13. Several EU regulations call upon different sectors of transport to increase transparency with regard to CO2, non-CO2 and use of SAF.

2.14. Commission Regulation 2018/ 2066 requires aircraft operators to monitor and report their greenhouse gas emissions. This is mandatory for CO2 since 1.1.2021 and for non-CO2 since 1.1.2025.

2.15. Commission Regulation 2018/2067 specifies the need for verification and the mutual recognition of the verifier.

2.16. EU Regulation 2023/2405 on ensuring a level playing field for sustainable air transport (ReFuelEU Aviation). This regulation is in force since 1.1.2024 and It sets requirements for aviation fuel suppliers to gradually increase the share of SAF blended into the conventional aviation fuel supplied at EU airports.

2.17. Since the inception of the Single European Sky, Environment has been part of the Key Performance Areas of the Performance Regulation. The European Commission is publishing European Targets, which are then broken down to national targets. Two indicators have been created.

2.17.1. During RP3, (EASA 2025) environmental performance has been measured through one KPI, namely horizontal en-route flight efficiency of the actual flight path (KEA). KEA measures the additional distance flown in comparison to the great circle distance (shortest distance between two airports).

The higher the KEA inefficiency value, the worse the performance. However, other factors such as wind, weather, airspace structures, and network constraints influence the optimum trajectory. One of the objectives of the SES2+ proposal from the Commission, was to develop a more suitable KPI on environmental performance for RP4. However, due to the duration of the negotiations and adoption of the SES2+ legislation, this was not possible and is now planned for RP5.

2.17.2. The Performance Scheme includes various indicators that are only monitored at either EU-level or local level but with no binding targets. These include the average horizontal en-route flight efficiency of the last filed flight plan trajectory (KEP)2 and the shortest constrained trajectory (KES/SCR).

2.17.3. As with all other indicators, KEP and KES/SCR have been significantly affected by the war in Ukraine leading to general increases of inefficiency during 2022 and 2023, although there has been a reduction in the delta between KES/SCR and KEP. As with KEA, it is recognized that more suitable indicators are needed to give a clearer indication on the effectiveness of ANSP and Network Manager actions.

2.18. Under the Single European Sky, the Technological pillar includes the SESAR Joint Undertaking. Plenty of stakeholders work around the ATM Masterplan to research future technology which will assist in the modernisation of the European Airspace. The European ATM Masterplan outlines the research axes and sustainability and green ATM have a prominent place in the masterplan.

Current research to enable greener flights ongoing under the SESAR umbrella include the following projects:

2.18.1. **Green-GEAR**- Green operations with Geometric altitude, Advanced separation and Route charging Solutions.

IFATCA participates to the Advisory Board of Green-GEAR

2.18.2. **AEROPLANE-** Advancing Measures to Reduce Aviation Impact on climate and enhance resilience to climate-change

IFATCA has requested to join the Advisory Board

2.18.3. **E-CONTRAIL-** Artificial Neural Networks for the Prediction of Contrails and Aviation Induced Cloudiness

No IFATCA involvement

2.18.4. **CICONIA-** Climate effects reduced by Innovative Concept of Operations - Needs and Impacts Assessment

IFATCA has joined the Stakeholder Consultation Body and is represented by Alba Cruz and Roberta Mascherotti.

2.18.5. **DYN-MARS**- Dynamic Management of Aircraft Configuration and Route Structures

No IFATCA involvement

2.18.6. **CONCERTO**- Dynamic Collaboration to Generalize Eco-friendly Trajectories

No IFATCA involvement

2.18.7. **GALAAD**- Green Aviation – Lean Arrivals And Dynamicity

No IFATCA involvement

2.18.8. **GEESE**-Gain Environmental Efficiency by Saving Energy

No IFATCA involvement

2.18.9. **HERON** Highly Efficient Green Operations

No IFATCA involvement

2.19. Parallel to the SESAR Joint Undertaking, the European Union has as well, a Joint Undertaking called CLEANSKY. As this Joint Undertaking looks predominantly at the airborne parts (engine, fuel, electric etc.), IFATCA is not involved.

2.20. The European Aviation Safety Agency EASA, has created a European Network on the Impact of climate change on aviation (EN-ICCA). IFATCA participates in this Network with Byron Post, Alba Cruz and Roberta Mascherotti. Based on the IPCC assessment report No 6, the EN-ICCA works on phenomena like storms, hurricanes, heatwaves, heavy precipitation, flooding and drought.

2.21. Eurocontrol, together with ACI, has created the European Aviation Climate Change Adaptation Working Group. IFATCA is represented by Alba Cruz and Roberta Mascherotti.

2.22. Different publications are available on these topics.

- EASA, EC and Eurocontrol have published the European Aviation Environmental Report (EAER 2025)
- the EACCA WG has published the Adaptation Aviation to Changing Climate .

2.23. Regarding contrails avoidance, IFATCA had lately the opportunity to exchange with two NGOs.

- Breakthrough Energy
- Transport and Environment

Both organisations claim that contrail avoidance can be managed. In the discussion we found out that the scientific basis used by both organisations are the same as the ones known to IFATCA. Thus, some of the product sold to airlines to avoid contrails are scientifically not robust enough.

With the Monitoring, Reporting and Verification obligation regulated by EC Regulation 2018/2066 and 2018/2066, airlines will have to report non-CO2 emissions and thus there is a certain interest to avoid contrails, in order not to have to report them. NGOs have positioned themselves with sometimes challenging opinions, recommendations and reports towards EU Politicians. These lobbying activities might create an additional operational impact which is not recommended by IFATCA. Teaming up with the European Cockpit Association has provided IFATCA with further insight into the ongoing political activities.

2.24. D-KULT is a DLR lead initiative on predicting contrails and together with Lufthansa trial flights were conducted. No results are known so far.

2.25. Eurocontrol Maastricht UAC together with DLR has conducted trials in the past, and it is our understanding that new trials are starting again. The scientific basis for these trialsis not robust enough to avoid contrails.

PART III a possible way forward for IFATCA

2.26. The impact on Air Traffic Management of the Environment actions needed to meet the different decarbonisation initiatives of the Aviation sector can be split into the following categories:

- ATM Infrastructure
- ATM Operations

2.27. Under ATM infrastructure, the following sub-categories have been identified so far:

- Energy, IT, building, travel
- Reduce to net zero operation
    - Commuting of Staff
    - Offsetting the IT energy consumption
    - Solar panel and wind energy for remote sites

2.28. Under ATM Operations the following categories have been identified so far:

- Free route airspace
- Horizontal flight efficiency
- Vertical flight efficiency
- Noise abatement procedure
- Taxi out time
- Continuous climb/descent
- Contrail avoidance

2.29. The ENV TF is cognisant of the fact that PLC has discussed the current IFATCA policy on environment (2011) and the ENV TF wishes to contribute to this discussion with the following suggestion, based on the European experience.

Under the SESAR contract, IFATCA and other Professional Staff Organisations had the possibility to produce a position paper on environmental issues. Largely inspired by the IFATCA policy this paper (see annex) is called **Aviation Sustainability – Human Operators approach and considerations about the ATM component.**

The main request from the staff organisations were:

Ensure that the level of safety shall be maintained or improved when environmentally-driven procedures are introduced;

- Ensure that all individual environmental factors are identified and considered while establishing procedures.
- The actual values (noise levels, fuel consumption and the level of emissions) of the various individual environmental contributors of new or existing procedures should be established in detail for transparency purpose.
- The interrelation of the various individual environmental factors should be identified and addressed.
- IFATSEA propose to add ANS/ATM systems, services, architecture and configurations are ensuring the required resilience and QoS to enable operational efficiency and green operations.

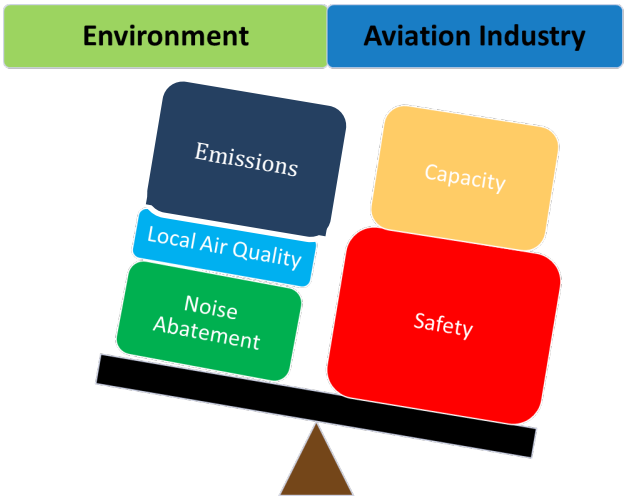


Figure 4 PSO illustration of the balanced approach needed

2.30. The position paper further requests an 'environment cases' in the same way we have 'safety cases' for all the changes in the ATM system.

Provisions for an environment case should comprise at least the following requirements:

- An environment case is a documented body of evidence that provides argument that a certain procedure is optimised for all individual environmental factors as prioritised by the appropriate authorities.

- An environment case should provide a detailed overview to the appropriate authorities for the determination of priorities of the individual environmental factors on a strategic level.

2.31. Further, the position paper argues that the front end-user (ATCOs, Pilots and ATSEPs to a certain extent) can manage the impact of environmentally driven procedures in a safe and efficient way. Thus, it was proposed to use the ICAO conflict management layer[8] when introducing new environmental procedures (including noise, CO2 and non-CO2). IFATCA, since the publication of this paper (2021), has repeatedly called upon the Eurocontrol Network Manager to manage the

[8] ICAO, Doc 9854

CO2 trajectory for flights above 1500km, as it is illusionary to leave the management of a CO2 trajectory by individual ANSP or ATS units. As the non-CO2 (contrails)[9] avoidance is scientifically on very insecure ground, IFATCA has not yet been able to identify the best vehicle to cross-border manage the areas prone for contrail formation.

2.32. The ICAO conflict management layer was created by ICAO during the discussion leading to the Global ATM Concept. This conceptual approach (see annex to this paper) is very helpful as it argues for a clear separation of strategical, tactical actions when introducing new procedures of any sort.

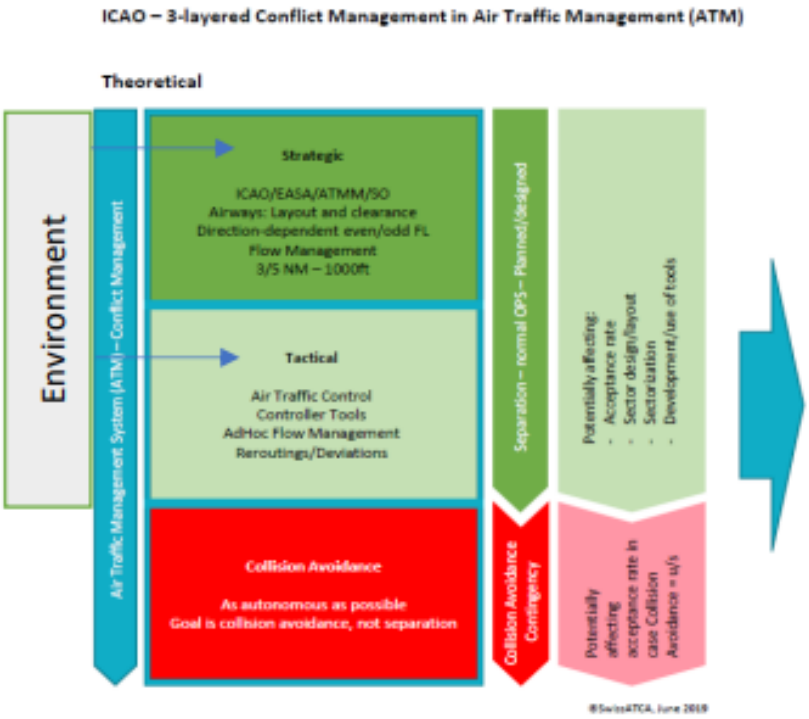


Figure 5 3 layered conflict management in ATM

2.33. Three examples chosen randomly to illustrate what this means in the daily work of an ATCO:

- At an airport, noise abatement procedures have to applied by the ATCOs during certain hours of the day. The ATCO, needs to be trained to apply this specific procedure, the controller working tool needs to be able to display the noise sensitive zones and an altitude indication shall be displayed on the map. This is all carried out on the strategic level. Asking the ATCO to apply the noise abatement procedure on a tactical level (meaning without training and the needed ATCO assistance tools), is not only hazardous but contra-productive for the noise abatement procedure.

- Non CO2 avoidance trial not communicated to ATC units. During the D-KULT trials, the pilots were instructed, based on a very unscientific flight planning tool, to stick to their flight plan to avoid contrail formation.

[9] Non-CO2 avoidance, measurement and scientific evidence can be found in AAE_Avis20_UK_WEB.pdf chapter 4 p. 41 ff

Pilots refused headings and level changes instructed by the ATCO, as the ATCOs were not informed.

- It is our understanding that MUAC Eurocontrol leaves at a tactical level the choice to the ATCO to apply contrail avoidance or not. These avoidance actions are not properly trained, no visual assistance is provided to the ATCO.

3. Conclusion

3.1. IFATCA has an Environmental policy which is being reviewed by PLC.

3.2. The ENV Taskforce has met once in 2024 for a virtual meeting

3.3. European activities on Environment are led by the European Commission and have a significant impact on Air Traffic control.

3.4. IFATCA has been able to contribute to the Environment discussion by participating to SESAR Research, discussion with regulators and agent such as the Network Manager.

3.5. IFATCA in Europe calls for action at the Network Manager level to manage the CO2 trajectories for flights with a length of above 1500km as a priority.

3.6. IFATCA, together with other Professional Staff Organisations, has published a position paper called Aviation Sustainability – Human Operators approach and considerations about the ATM component. (see attachment to this paper)

3.7. IFATCA argues that any environmental procedures need to be introduced at the strategical level using the ICAO 3-layer conflict management model.

4. Recommendation

4.1. That educational material for ATCOs is created by the ENV TF explaining the environmental challenges. This material could take the form of courses, educational videos etc.

4.2. That the IFATCA Environmental policy insists on the application of any environmental measure to be located on the strategic layer of the ICAO conflict management model layer.

Aviation Sustainability – Human Operators approach and considerations about the ATM component

Position paper by Professional Staff Organisations*

October 2021

*Professional Staff Organisations (PSO):

ATCEUC
ECA
ETF
IFATCA
IFATSEA

Motivation for this paper

The task

SESAR JU under the contract PSO Lot, assigned the the task *to write a single Position Paper, produced jointly by all PSO LOTs, under the technical leadership of ECA*.
The Paper will provide a view of how the Green Deal Challenge Area and Roadmap (section 3.7 and Roadmap 7 in the Strategic Research and Innovation Agenda (SRIA) for the Digital European Sky (available here (https://www.sesarju.eu/sria) relate to the environmental sustainability vision of the organisations contributing to the Paper. It is important that all views are taken into consideration, even if there are differences in priority between individual LOTs; such differences should be reconciled as far as possible, but remaining differences should be recorded and laid down in an annex to this paper. The Paper should include consideration of the human dimension, i.e. how the humans can contribute, which challenges they see from the human dimension point of view, and particularly where any strategies may have an impact on safety.

The approach taken by the PSO

The PSO met several times by teams and discussed via email how to complete the task of the SJU. A first meeting did assess the task and a ppt was provided by IFATCA to explain what is outlined in the SRIA. Following this meeting a draft paper was circulated for comments and two further phone conferences were organized by ECA to finalise the proposed paper.

Attached Annexes provide an overview of the efforts.

The SRIA, in particular section 3.7, were considered to be too complicated to be assessed by the PSO as they propose detailed changes which, from the PSO perspective, are solution-oriented and not covering the needs from a human contribution point of view. The Professional in the system need to be able to work according to the proposed new needs and challenges (e.g. Optimum green trajectories, new ways of flying, formation flights, advanced RNP green approaches and Environmentally optimized climb and descend operations or Non-CO_2 impact of aviation).

Therefore, the proposed PSO Paper provides in the beginning a high-level overview of the impact of aviation on CO_2 and non-CO_2 elements using publications of other institutions.

All strategies to reduce aviation's impact on climate essentially focus on four pillars. The paper focusses on the fourth pillar: Improved infrastructure and operations (operational efficiency).

Environmental impact from ground infrastructure such buildings, lighting, heating etc. are not included in this paper.

Due to the different nature of the PSO not all organisations were able to endorse all the proposed contribution.

IFATSEA has identified that the contribution of outages of the existing and forthcoming CNS & ATM systems derived enabling services are not considered as a Performance indicator and utilized to improve delays, capacity resilience and Operational efficiency.

When it comes to systems and related services, unavailable Surveillance systems, Navigation systems at airports or even inefficient communications can lead to alternative routes flown thus more fuel burn and lower capacity or even total lack of service delivery e.g. NATS outages, recent Rhodes airport (Greece) total ground communication failures etc.

If delays due to CNS outages and ATM systems outages are minimized, delays can be minimized and improvements in fuel burn can be made. Thus, the Greening of aviation objective benefits.

The recommendations from the PSO

Provisions for an ATM environment management system should comprise at least the following requirements:

- Ensure that the level of safety shall be maintained or improved when environmentally driven procedures are introduced.
- Ensure that all individual environmental factors are identified and considered while establishing procedures.
- The actual values (noise levels, fuel consumption and the amount of emissions) of the various individual environmental contributors of new or existing procedures should be established in detail for transparency reasons.
- The interrelation of the various individual environmental factors should be identified and addressed
- Ensure that the availability of ATM and CNS Systems is maximized, outages and restrictions in usage of said systems should not occur. Annex D to this paper further describes the recommendation details. A new metric on CNS availability and its' impact on Environment within the context of SRIA (3.7.AGD) is describe in there.

Provisions for an environment case should comprise at least the following requirements:

- An environment case is a documented body of evidence that provides argument that a certain procedure is optimized for all individual environmental factors as prioritized by the appropriate authorities.
- An environment case should provide a detailed overview to the appropriate authorities for the determination of priorities of the individual environmental factors on a strategic level

Contents

1. Introduction

The objective[10] of net-zero greenhouse gas emissions by 2050 set by the European Green Deal, in line with the EU's commitment to global climate action under the Paris Agreement, requires accelerating the shift to smarter and more sustainable mobility. This implies the need for aviation to intensify its efforts to reduce emissions, in line with the targets set in Flightpath 2050. To this end, a set of operational measures to improve the fuel efficiency of flights will have to be put in place. At the same time, to ensure sustainable air traffic growth, it is necessary to speed up the modernization of the air infrastructure to offer more capability and capacity, making it more resilient to future traffic demand and adaptable through more flexible air traffic management procedures and a charging scheme that does not make it interesting to fly unnecessary distance. Furthermore, reducing aircraft noise impacts and improving air quality will remain a priority around airports.

In this context, European research programs are calling on all sectors to step up their combined efforts, as one of the cornerstones of the "Green Deal" for Europe, featuring much more ambitious objectives and investment.

Within the framework of the SESAR contract, the professional Staff Organisations (ATCEUC, ECA, ETF, IFATCA, IFATSEA) were tasked to deliver some views on the positive contribution the ATM component could play to decarbonize aviation and under which conditions, be it thanks to the delivery and use of breakthrough technologies or thanks to new, well thought through operational concepts. As organizations representing all the Staff in the Aviation sector, we would like to thank SESAR for providing us with this opportunity.

2. Preconditions

Aviation [11]climate impact originates from direct or indirect effects from emitting carbon dioxide (CO2), nitrogen oxides (NOx), particular matter (PM) and water vapour into the atmosphere.

[10] Strategic Research Agenda
[11] PRC, FABEC env day

Because of its long residence time in the atmosphere, CO2 is a global issue irrespective when and where the emissions take place. Non-CO2 effects of aviation have a much shorter lifecycle and depend on location and time which makes them much more complex to understand.[12]

Aviation is estimated to be responsible for around 2-3% of the total anthropogenic CO2 emissions globally [ICAO, ourworldindata.org].

In Europe (EU27+UK), aviation accounted for 4.3% of total GHG emissions in 2019 (latest year for which EEA data is available).

The steady growth of aviation has led to an increase of the GHG emission of aviation of more than 125% since 1990 in Europe.

As a result of the COVID-19 pandemic and the dramatic drop in air traffic demand, CO_2 emissions from aviation in Europe in 2020 more than halved compared to 2019. Despite this reduction, it is clear that the environmental challenge for aviation will remain throughout the recovery phase and beyond.[13] The PRC's assessment of the COVID impact on Environment performance has been added as Annex A

3. Relevant Areas

The truth is that it will be extremely challenging to reduce aviation emissions quickly with current available technologies. All strategies to reduce aviation's impact on climate essentially focus on four pillars:
(1) Aircraft technology (airframes and engines),
(2) Sustainable aviation fuels (SAF),
(3) Market based measures (MBM), and
(4) Improved infrastructure and operations (operational efficiency).

As this paper focuses on the Professional Staff Organisations' view it expands on point 4.

3.1. Improved infrastructure and operations (operational efficiency)

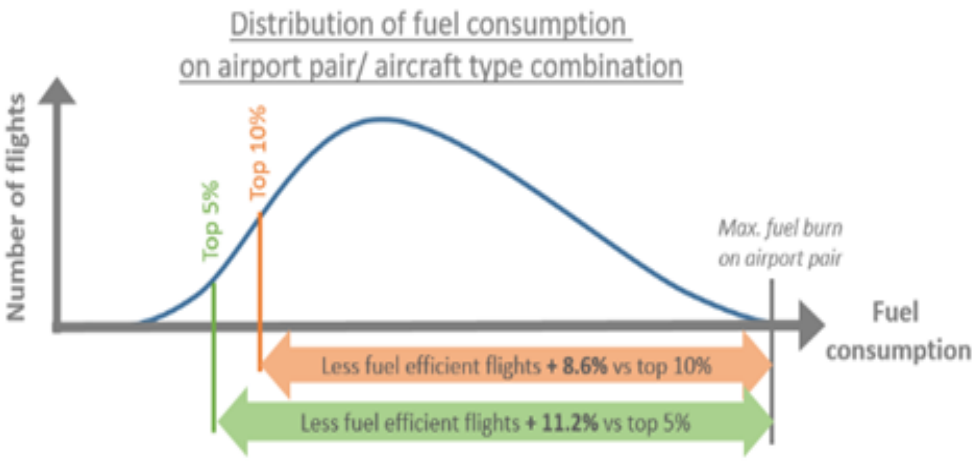
With[14] benefits from aircraft technology and SAF only taking real effect beyond 2030, ATM can help reducing emissions by addressing operational inefficiencies in the ATM system already in the short to medium term. For every ton of fuel saved, an equivalent amount of 3.15t of CO2 can be avoided.

In political discussions, ATM is frequently mentioned to be able to improve fuel efficiency by 10% or more. In reality, it is often not clear what measures are involved and how the results need to be interpreted.

[12] Lee., D., et al., Greater fuel efficiency is potentially preferable to reducing NOx emissions for aviation's climate impacts
[13] PRR 2020
[14] PRC

There are many different studies aimed at quantifying fuel and flight efficiency. While those studies provide useful and valuable insights, the differences in scope and methodologies make direct comparisons often difficult if not impossible.

Previous PRC work [PRR 2019] has estimated that the benefit pool that can be influenced by ANS is approximately 6-8% of the total gate-to-gate fuel burn (emissions) in the ECAC area.
A recent study focusing only on flights within the EUROCONTROL area (long haul flights excluded) estimated the average fuel inefficiency from take-off to landing between 8.6% and 11.2%.



Most studies apply similar methodologies which compute efficiency gains compared to a theoretical reference which in reality cannot be achieved at system level.

There is clearly scope for further improvement in ANS operational performance. However, it is important to stress that the often-quoted benefit pools cannot be fully recovered nor can the inefficiencies be entirely attributed to ANS.
Full efficiency as envisaged is impossible due to technical and safety aspects (separation minima, adverse weather, avoidance of 'Danger Areas' and temporarily segregated areas) or tactical decisions (trade-offs).

In fact, environmental objectives for ANS can even be conflicting; for example, noise abatement procedures at airports might lead to longer trajectories and hence additional emissions.

ANS performance can help reducing the environmental impact of aviation which can be broadly divided into the impact on (i) global climate, (ii) local air quality (LAQ), and (iii) noise.

Generally, the management of noise is considered to be a local issue which is best addressed through local airport-specific agreements developed in coordination and cooperation with all relevant parties including ANS. Due to the complexity of those local agreements, there are presently no commonly agreed Europe-wide indicators specifically addressing ANS performance in the noise context.
Apart from the active support in noise management decisions, the areas where ANS can contribute to the reduction of aircraft noise are mainly related to operational procedures. Continuous climb (CCO) and descent operations (CDO), noise preferential routes and

runways are all in the ANS portfolio and help to avoid unnecessary exposure to aircraft noise

The ATM-related impact on climate is closely linked to operational performance (fuel efficiency) which is largely driven by inefficiencies in the flight trajectory and associated fuel burn (and emissions). Hence, the focus has been traditionally on the monitoring of ANS-related operational efficiency by flight phase which served as a proxy for environmental performance since the distance or time saved by operational measures can be converted into estimated fuel and CO2 savings.
Previous PRC work has indicated that the benefit pool that can be influenced by ANS is
Figure 1-16: Distribution of flights and estimated CO2 emissions by distance category (2019)

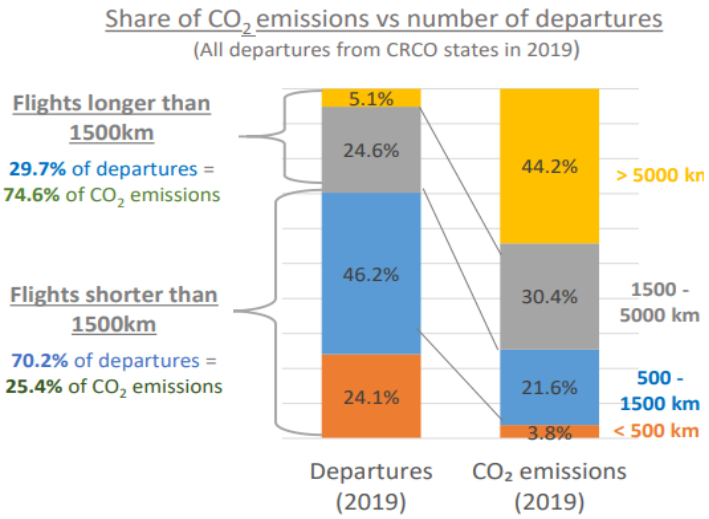


Figure 1-16: Distribution of flights and estimated CO_2 emissions by distance category (2019)

Although there is clearly scope for further improvement, it is important to point out that the inefficiencies cannot be reduced to zero nor can they be attributed entirely to ANS. A certain level of “inefficiency or contingency” is in fact necessary (separation minima, adverse weather, avoidance of ‘Danger Areas’) or even desirable (trade5 offs). Using the theoretical upper ceiling, the ANS contribution to reduce emissions is limited to some 0.3-0.4% of the total CO2 emissions in Europe (SAF ≈ 3.8%). Figure 1-17 provides an overview of the various factors influencing aviation’s CO2 efficiency, including a high-level estimate of the potential benefit pool for further improving environmental performance.

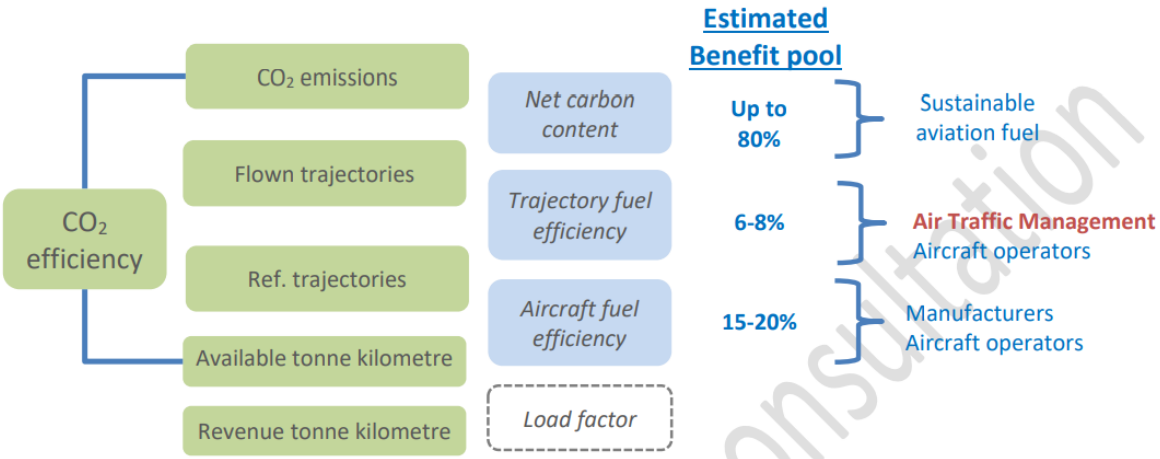


Figure 1-17: Factors affecting aviation CO_2 efficiency

So what can ATM do to help?

Increased operational efficiency leads to increased fuel efficiency and a subsequent reduction in emissions. Figure 1-18 provides an overview of the gate-to-gate efficiency by phase of flight including an indication of the supporting ATM related projects/ enablers.

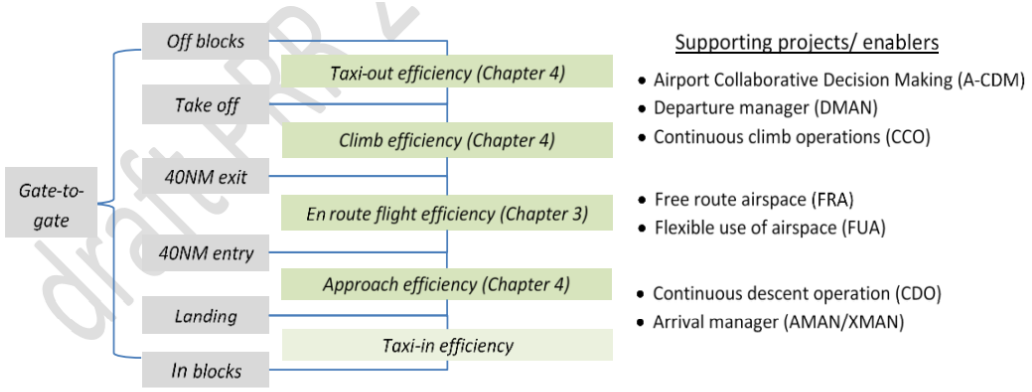


Figure 1-18: Gate-to-gate efficiency by phase of flight

Figure 1-19 provides an initial high-level summary of the evolution of the ANS operational metrics with environmental impact detailed in the respective chapters of this report and outlined in Figure 1-18.

Ground infrastructure as a contributor to the Greening of Operations through efficiency improvement.

ICAO, with the support of its Committee on Aviation Environmental Protection (CAEP),

actively pursues its technical work on measures to reduce the environmental effects of aviation. As it is stated in ICAO DOC 10013[15] "*Operational Opportunities to Reduce Fuel Burn and Emissions",*
significant fuel and emissions savings ***can be realized by an efficient ATM system****. New and established technologies and concepts of operations in communications, navigation and surveillance (CNS) can provide opportunities to improve the efficiency of ATM. CNS/ATM can permit more direct routings and the use of more efficient flight conditions such as optimum altitude and speed.* ;"

Furthermore, it is stated in Chapter 6 ATM "New and established technologies and concepts of operations in communications, navigation and surveillance (CNS), such as data link communications, performance-based navigation (PBN), automatic dependent surveillance (ADS), flexible use of airspace (FUA) and airport collaborative decision making (A-CDM) can provide opportunities to **improve the efficiency of ATM**"

However, degraded or low Availability and Continuity of CNS Systems and services (e.g. at airports) can lead to alternative routes flown thus more fuel burn and lower capacity or even total lack of service delivery.
So, a new study of a new concept that analyzes the relation between CNS outages or systems unavailability with the impact on the environment and safety issues could help to arrive in the future at the elaboration of new useful metrics or KPIs as requested by SRIA.

4. Environmental performance in the ATM system

When balancing the requirements of safety, efficiency, capacity and the environment, the level of safety shall always be maintained or improved at all stages of the ATM system (operation, maintenance and development). Said in other words, respect to environment should not undermine respect for safety.

In case environmentally-driven procedures are introduced in the ATM System, these must take into consideration the increased complexity for the front-end users, namely controllers and pilots, especially the related human factor and HMI issues . This complexity must be managed at the appropriate, strategic level, never at tactical stage. A trade-off between environment and capacity must be considered as part of this management of complexity, as safety is paramount. Any environmentally driven procedure shall not expose the ATCOs and Pilots to undue liability issues.[16]

Individual environmental aspects shall be considered by an ATM environmental management system and documented in an ATM environment case[17] as part of an

[15] (http://www.icscc.org.cn/upload/file/20190102/Doc.10013-EN%20Operational%20Opportunities%20to%20Reduce%20Fuel%20Burn%20and%20Emissions.pdf)
[16] As experienced in 2009. 2016 and 2017 by the Tower controller in Brussels, who were summoned by the prosecutor for an alleged misuse of new noise abatement routes (see BGATC publication 2017)
[17] SESAR Environment Assessment Process PJ 19.4. 2019
(

overall performance case. Provisions for an ATM environment management system should comprise at least the following requirements:

- Ensure that the level of safety shall be maintained or improved when environmentally-driven procedures are introduced;
- Ensure that all individual environmental factors are identified and considered while establishing procedures;
- The actual values (noise levels, fuel consumption and the level of emissions) of the various individual environmental contributors of new or existing procedures should be established in detail for transparency purpose;
- The interrelation of the various individual environmental factors should be identified and addressed.
- Provisions for an environment case should comprise at least the following requirements:
    - An environment case is a documented body of evidence that provides argument that a certain procedure is optimized for all individual environmental factors as prioritized by the appropriate authorities;
    - An environment case should provide a detailed overview to the appropriate authorities for the determination of priorities of the individual environmental factors on a strategic level[18].
- IFATSEA proposes to add ANS/ATM systems, services, architecture and configurations are ensuring the required Resilience and QoS to enable Operational Efficiency and Green operations
-

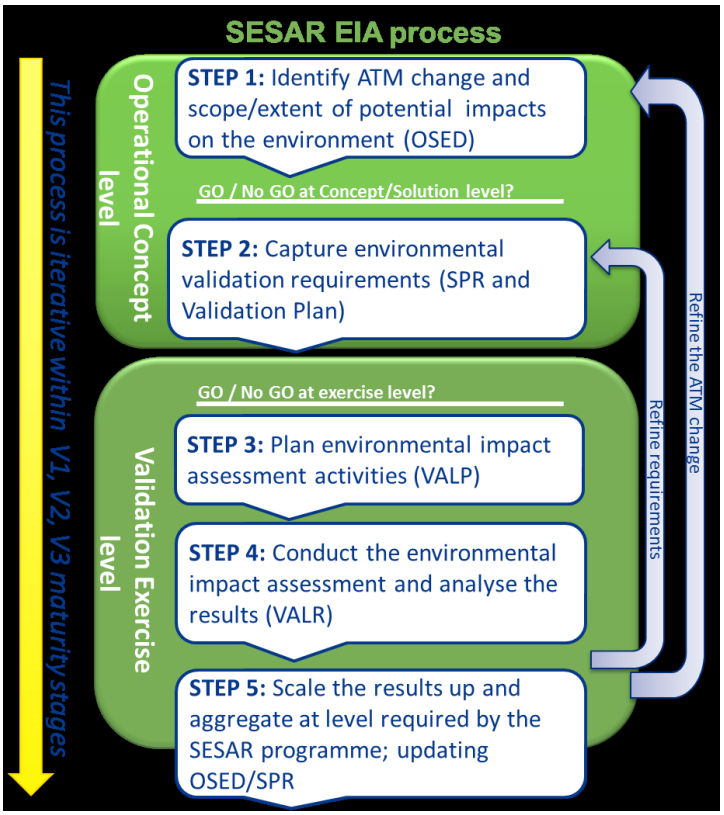


Figure 6 Environmental impact assessment process of SESAR

[18] IFATCA policy

When talking about strategic level, the PSO understand the following conceptual approach from the 3 layered Conflict management in Air traffic management by ICAO. Annex B of this paper provides the ICAO description.

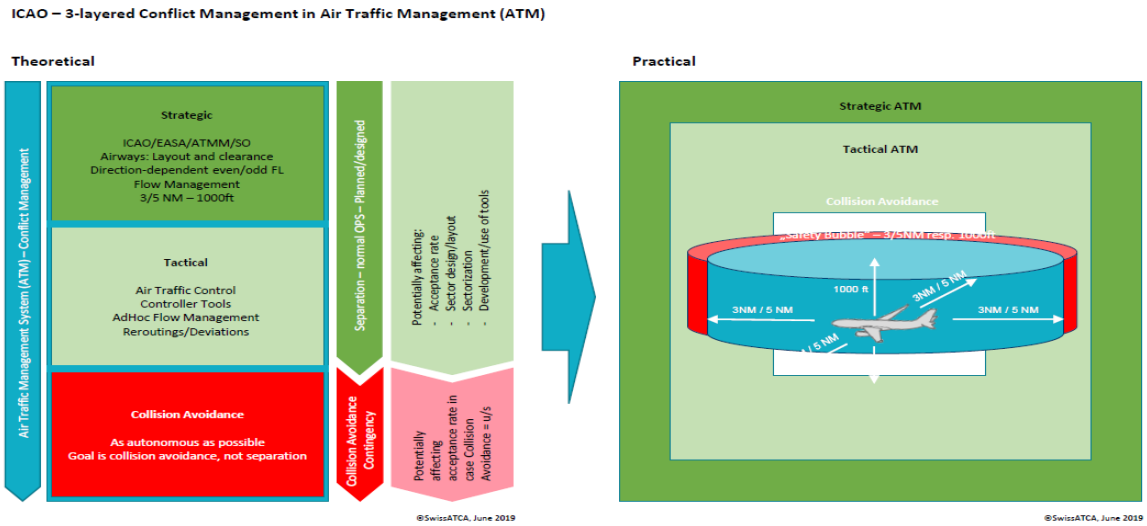


Figure 7 ICAO conflict layer management – conceptual approach source Swiss ATCA

The **Strategic Research Agenda** outlines in chapter 3.7.[19]what could be possible research and innovation needs and challenges.

Some of proposed R&D needs described in the SRIA are too detailed and propose solutions or air industrial conceptual ideas which might not be developed before 2050. The PSO would **support the need for the development of the assessment toolset** which shall enable the environmental case as outlined above.
Reference to the most efficient way of managing the impact of aviation on CO_2 and non-CO2 is missing from the SRIA. By focusing too much on small benefit pools, the bigger picture might be missed.

As an example of the above, the Network Manager could be entrusted to create the most environmental-friendly trajectory for city pairs taking into consideration daily weather and wind conditions and the airlines shall be incentivized to use them. That will need to change some of the current "first comes first served" rules. Moreover, trajectory management must be put in place at political level. As it would be a fundamental change to todays' first come first served principles (to maybe best equipped best served), a transition phase would have to be introduced. Natural gaming to attract traffic and subsequent revenue streams for ANSP would have to be carefully taken into consideration during this transition phase. Competing for revenue or lesser impact of CO_2 by the ATM operations might create unwanted reactions by ANSP.

[19] Strategic research agenda

Research could assist decision-makers to have confidence that this is the right way to go. An increased level of transparency for all actors and stakeholders in the aviation system needs to be put in place. Again, research shall assist in achieving this transparency. CNS systems, for instance, can provide staff with the right tools in their daily job to reduce aviation environmental footprint. Such tools should be given special attention in research programmes to develop the CNS systems of the near future. This is further developed in Annex D.

It is also to be noted that trade-offs between KPIs and interdependencies are crucial parameters of the equation. For example, if priority is given to 'green trajectories' it is a political decision to be made transparently, also addressing openly all trade-offs and the related operational consequences of such a decision. Frankfurt airport is a striking example with strict noise abatement procedures generating extra CO2 emissions in contradiction with the objective to decarbonise aviation. In the same way a compromise will have to be found between carbon footprint objectives and other current priorities such as economical indicators. Some of the current KPIs might need to be reviewed to take into account the Green Deal objectives and that should also be reflected in the SES2+ legislative package.

5. The PSO position – conclusion

The PSOs are aware of the need to reduce emissions in aviation according to the objective of the European Green Deal and the EU's commitment to global climate action under the Paris Agreement.
Plans and measures need to be balanced in regard to the climate impact and in regard to aviation in the overall emission record. This includes a holistic approach which requires capacity, reliability and resilience of the aviation systems and availability and continuity of ATM and CNS services, to effectively implement emission reducing measures.

The PSOs welcome technological research and improvements to reduce emissions like SAF and aircraft engines with higher efficiency.

Program and measures of emission reductions should take into account:

- Safe operation has the highest priority and might require additional resources
- **Balancing of emission reduction with competing factors (e.g. noise reduction) needs to be finalised at organisational (strategical level) level and be transparent.** However, adjustments need to be possible in the tactical phase with the appropriate training of the concerned staff.
- **New procedures and tasks need to be in range of the normal workload and system changes need to enhance the assistance of the staff**, including the handling of congested situations.
- Information about emission reduction measures and training of the staff members involved is required to achieve optimal support.

- SJU is also requested to ***evaluate the recommendation for the development of a new Metric on CNS Availability and its' impact on Environment within the context of SRIA***.

The research and development of the SESAR projects will have to focus on considering the aspects that we have highlighted so far. Although we are aware of the need to aim for an ATM system that is increasingly attentive to emissions and environmental issues, **it is necessary to ensure that these objectives do not conflict with the highest safety standards**. Furthermore, it is necessary that any new procedures studied are not to further load the personnel involved with new tasks that could, in an already particularly congested situation, further aggravate the work of the operating personnel.

Annex A - Impact of COVID on Environmental performance

Following the dramatic drop in traffic due to the COVID-19 pandemic in March 2020 all operational metrics improved, with a positive effect on fuel burn and environmental impact. But even with record low numbers in Air Traffic and direct routings to all aircraft wherever it was possible, the horizontal flight efficiency could not be better than 97.5%. This provides a unique opportunity for ANS to review and remove existing constraints in the ATM system, to further improve the efficiency of the ATM system and to maintain the achieved efficiency levels when traffic returns after the COVID-19 crisis, taking into consideration the impossibility to reach 100% HFE.

For example, at the top 30 airports in Europe the additional taxi-out time dropped by 2 minutes on average while airport holdings decreased by almost 1 minute in 2020. Vertical efficiency at the top 30 airports during approach, measured as average time flown level, decreased by 48 seconds compared to 2019. Achieving this performance with the traffic level of 2019 would have saved 3.2 million minutes (6.1 years) in level flight with the corresponding savings in terms of fuel and CO2 emissions (see Chapter 13 4 for more details).

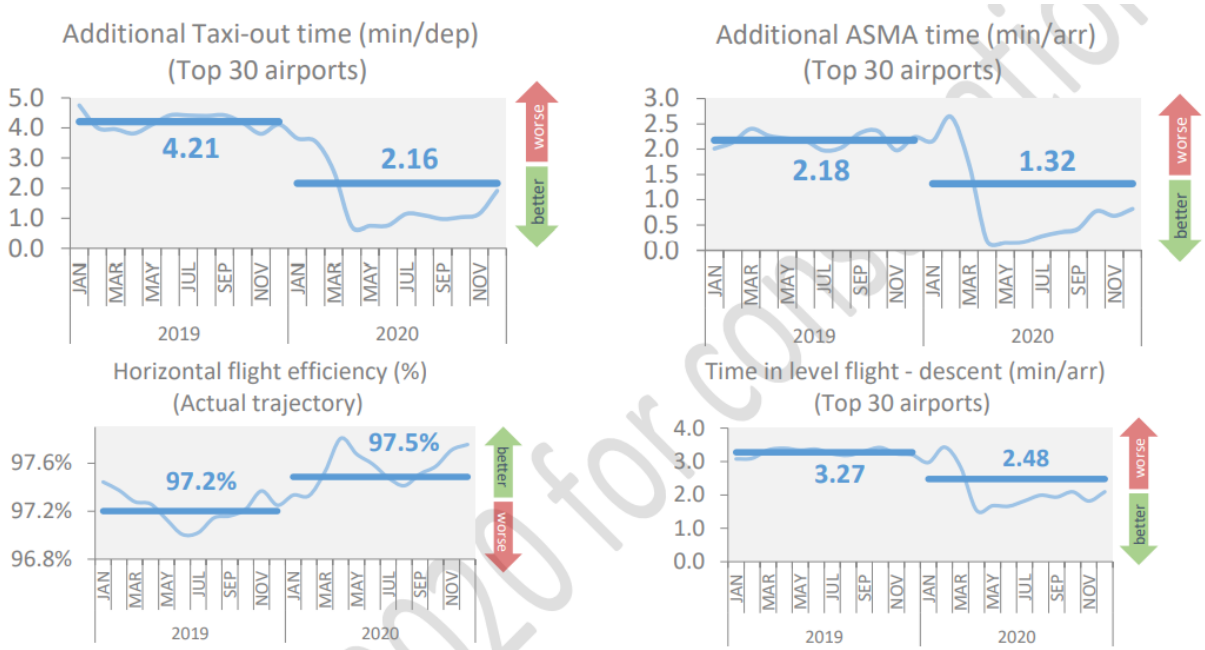


Figure 1-19: Flight efficiency improvements in 2020 – The big picture

Since the beginning of the COVID-19 pandemic in March 2020, NM - in collaboration with operational stakeholders - removed 1,200 Route Availability Document (RAD) measures in the network which enables more direct routings and hence more efficient flights. Horizontal flight efficiency improved by 0.3 percent points in 2020. Although this seems small, achieving the 2020 efficiency level with the traffic of 2019 would have saved a total of 29.7 million kilometers of additional distance flown (see Chapter 3 for more details).

Annex B - ICAO conflict management layer concept

Conflict management[20]

2.1.7 Conflict management will consist of three layers: strategic conflict management through airspace organization and management, demand and capacity balancing, and traffic synchronization;
separation provision; and collision avoidance.

2.1.8 Conflict management will limit, to an acceptable level, the risk of collision between aircraft and
hazards. Hazards that an aircraft will be separated from are: other aircraft, terrain, weather, wake
turbulence, incompatible airspace activity and, when the aircraft is on the ground, surface vehicles and other obstructions on the apron and manoeuvring area. Key conceptual changes include:

a) strategic conflict management will reduce the need for separation provision to a designated level;

b) the ATM system will minimize restrictions on user operations; therefore, the predetermined separator will be the airspace user, unless safety or ATM system design requires a separation provision service;

c) the role of separator may be delegated, but such delegations will be temporary;

d) in the development of separation modes, separation provision intervention capability must be considered;

e) the conflict horizon will be extended as far as procedures and information will permit; and

f) collision avoidance systems will be part of ATM safety management but will not be included in determining the calculated level of safety required for separation provision.

[20] ICAO doc 9854

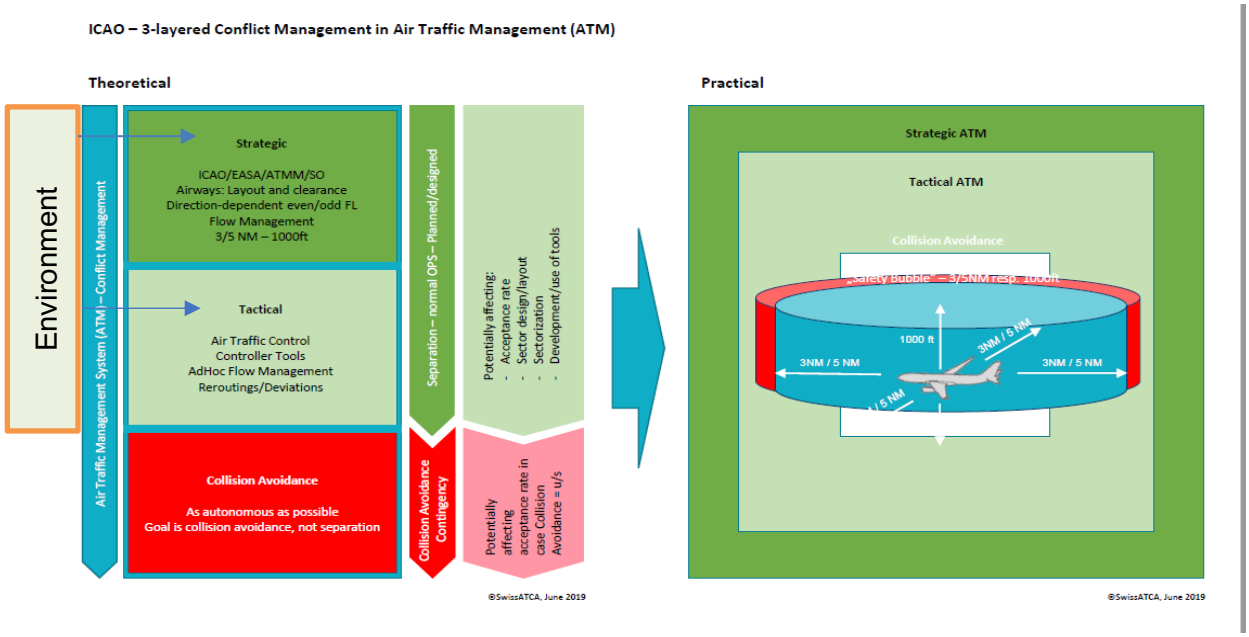


Figure 8 schematic representation of Environmental requirements integrated in the conflict management