EXPERT'S REPORT

INTERNATIONAL CIVIL AVIATION ORGANIZATION

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MODEL UNITED NATIONS

REDUCING THE NEGATIVE IMPACT OF AVIATION ON THE ENVIRONMENT

CONTENTS

INTRODUCTION

Climate change is one of the biggest and most complex global challenges of our time. Emissions from aviation are a significant contributor to climate change. Airplanes burn fossil fuel which not only releases CO2 emissions but also has strong warming non-CO2 effects due to nitrogen oxides. The amount of CO2 emissions released from a flight depends on various factors. Airlines, airports and regulators can control some of the factors, but some cannot be controlled, such as weather. One very important factor which contributes to aviation emissions is the aircraft type. The aviation market is composed of a very limited number of producers that are in high competition with one another. Technology is regarded as the most basic parameter in this sector, and currently, the entire focus is on energy efficiency. From the middle of the previous decade, new aircraft types like the Airbus A320neo, Airbus A350 and Boeing 787 were introduced, which have about 15% improvement in CO2 emissions. In 2023, the IPCC 6th Assessment Report noted that immediate, rapid, and large-scale reductions in greenhouse gas emissions are needed to limit warming to 1.5°C and that the aviation sector is still in the earlier stages of adaptation to increased climate hazards, aircraft noise and the decrease of air quality.

Climate change-induced phenomena are a tangible and growing risk to the aviation sector, with stakeholders already experiencing its impacts in the form of changes in rain, snow, wind, and storm patterns; more frequent and persistent droughts and wildfires; sea level rises and thawing permafrost. There are dozens of aircraft which have crashed into oceans, intentionally or not. All that debris and chemical contamination has an effect on the flora and fauna of such bodies of water, including the reduction in species diversity.

By the end of the century, under a high warming

scenario, we could face the risk of inundation due to sea level rise and extreme weather events. The majority of these are small airports with less than 10,000 air traffic movements per year. Nonetheless, many are important for connectivity and economic reasons. The cost of diverted and canceled flights from a one-day closure at an airport due to full flooding is estimated to be around €3 million for medium-size airports and €18 million for large airports. In addition, higher temperatures will also impact aircraft performance, potentially necessitating a reduction in maximum take-off weight at airports with shorter runways.

Additionally, the annual passenger air traffic growth rate and cargo air traffic from 2018 to 2037. There has been observed an increase in air traffic and aircraft movements, and also in the competition between service quality. The civil aviation industry in China has undergone huge expansion since the 1980s, and this drastic increase in the aviation sector is expected to continue. A recent study in Turkey mentioned that in the last 3 years, there had been an increase of around 14.48% in the number of commercial flights, and a 21.14% increase has been observed in the total number of people who travel by air.

Nowadays the aviation industry strives to reduce the environmental footprint of the air transport industry and contributes to cleaning the sky. At the international level, ICAO introduced several projects and initiatives on sustainable aviation and published a Climate Change Adaptation Synthesis and guidance material on climate change risk assessment and adaptation planning. This is to be done by integrating climate resilience considerations into the criteria applicable to construction and renovation of critical infrastructure.

Let's delve into the issues of regulating and reducing the negative impact of aviation on the environment in the current conditions and find out what measures need to be implemented.

CHAPTER 1. AVIATION INDUSTRY AND CLIMATE CHANGE: UN REGULATIONS

International Civil Aviation Organization serves as a multilateral platform for cooperation on international aviation environmental protection. Over the years, the national governments who participate together under the Chicago Convention, also commonly referred to as 'ICAO Member States', have agreed to concentrate their aviation environmental collaboration on three core areas:

- Climate changes and aviation emissions;
- Aircraft noise;
- Air quality.

For instance, the ICAO formulates and updates specific Standards and Recommendations Practices on aircraft emissions. These activities are conducted by the Secretariat and the Committee on Aviation and Environmental Protection (CAEP). Through the work of this committee, the ICAO Assembly adopted the key initiative — collective long-term global aspirational goal for international aviation (LTAG)[1] of net-zero carbon emissions by 2050, in support of the Paris Agreement's temperature goal. To limit global warming to 1.5°C, greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030. It recognizes that each State's special circumstances and respective capabilities (e.g., the level of development, maturity of aviation markets, sustainable growth of its international aviation, just transition, and national priorities of air transport development) will inform the ability of each State to

[1]Resolution A41-21: Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change. URL: https://www.icao.int/environmental-protection/Documents/Assembly/Resolution_A41-21_Climate_change.pdf

contribute to the LTAG within its own national timeframe. Each State will contribute to achieving the goal in a socially, economically and environmentally sustainable manner and in accordance with its national circumstances.

Another initiative proposed by ICAO could be considered as the most significant project on measurement of standards — CORSIA[2]. Originally, the CORSIA (Table 1.) baseline was agreed to be an average of 2019 and 2020 emissions from international aviation. However, in 2020 the COVID-19 crisis caused a precipitous drop in demand for air transport. For example, the Revenue Tonne Kilometers (RTK) from international air traffic in 2020 witnessed an almost 60% drop from the 2019 level.

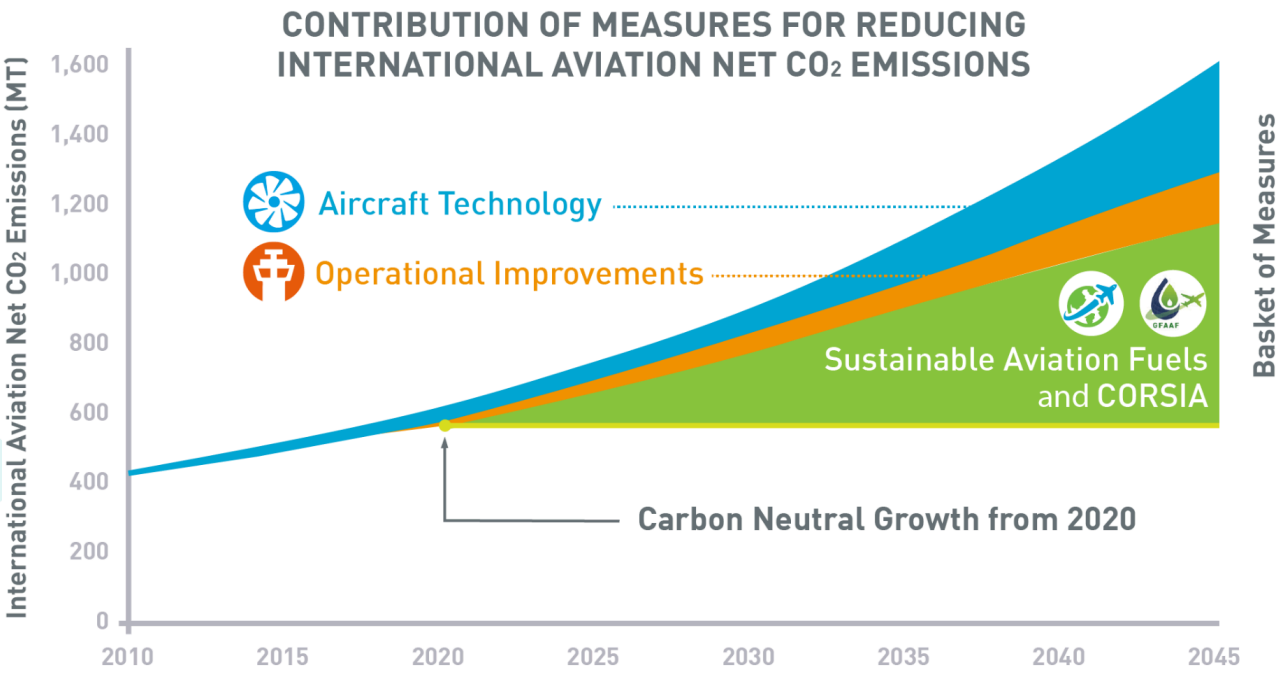

Table 1. Market-based measures (CORSIA)

[2]Carbon Offsetting and Reduction Scheme for International Aviation. ICAO. URL: https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx

As a result, the CORSIA baseline would have been significantly reduced, imposing an unexpected and severe economic burden on an already extremely weakened airline industry and contravening the spirit of the CORSIA framework. In 2022, at its 41st Assembly, ICAO set 85% of 2019 emissions as CORSIA's baseline from 2024 until the end of the scheme in 2035: a significantly more ambitious target than originally planned, which the industry supported.

Considering aircraft noise, the main overarching ICAO policy is the Balanced Approach to Aircraft Noise Management, which consists of identifying the noise problem at a specific airport and analyzing various measures available to reduce noise through the exploration of various measures which can be classified into four principal elements (Table 2.):

1. Reduction of Noise at Source (Technology Standards)
2. Land-use Planning and Management
3. Noise Abatement Operational Procedures
4. Operating Restrictions

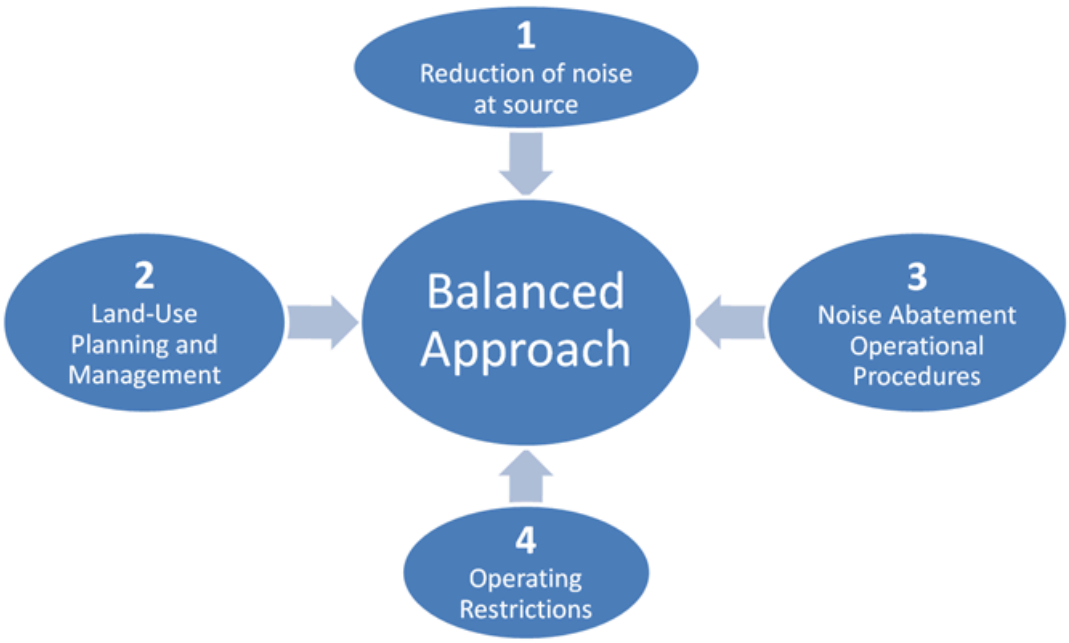

Table 2. The four principal elements of the Balanced Approach to Aircraft Noise Management

In the context of emissions, the United Nations' aviation arm ratified an agreement to control global warming emissions from international airline flights[3]. It is considered to be the first climate-change pact to set worldwide limits on a single industry that was created in 2020. Airlines that exceed that limit in future years, as most are expected to do, will have to offset their emissions growth by buying credits from other industries and projects that limit greenhouse gas emissions. Airlines that keep their emissions down through more fuel efficient planes and aircraft operations will spend less on carbon credits. But since aviation is growing rapidly, emissions growth is expected to far outstrip increased efficiencies. The deal applies only to international flights, which account for about 60 percent of aviation. Emissions from domestic airline flights fall under the Paris accord, which goes into effect next month. That accord commits rich and poor countries to take action to curb the rise in global temperatures that is melting glaciers, rising sea levels and shifting rainfall patterns. Governments must present national plans to reduce emissions to limit global temperature rise less than 2 degrees Celsius (3.6 degrees Fahrenheit).

[3]An agreement to control greenhouse gas emissions from international airline flights. URL: https://www.climatelinks.org/blog/international-aviation-emissions-deal-ratified-un

CHAPTER 2. THE RELATION OF AVIATION INDUSTRY TO ENVIRONMENTAL ISSUES

Aviation is a critical part of the economy of a nation, providing for the movement of people and goods throughout the world, enabling its economic growth. Global air travel growth rates have been in an annual order of 6% in the period 1970-2000; in present-day which increases almost five times higher as that was in 1970. Globally, almost 42% of international tourist activities now take place by air.

The major two civilian aviation giants Airbus and Boeing predict an annual growth rate of 5.3% and 4.8% till the year 2024, considering strong competitions, more airline entrants and lower fare. Another example of the evidence of the negative impact is Ryanair, Europe's top polluting airline for the third year in a row, a new study on 2023 aviation emissions by green group Transport & Environment shows. Lufthansa and British Airways are the second and third biggest polluters, but are still below their pre-Covid levels of flying. Budget airlines Ryanair and Wizz Air polluted more than ever last year.

Despite low-cost growth, legacy carriers and selected third country carriers are still responsible for the bulk of European aviation emissions (42.2%) because they fly long-haul. In fact, the study finds that 20 airlines (European legacy carriers and the biggest third country carriers) are responsible for a larger share of emissions than that of over 400 airlines flying from Europe combined. The carbon markets for aviation (also known as Emissions Trading Scheme) in the EU, Switzerland and the UK apply to intra-European flights only, meaning that legacy carriers operating most of their flights outside of Europe don't have to pay for the majority of their emissions.

Under Corsia, less than a third of international aviation emission would be addressed by 2030, as airlines must only pay to offset growth in emissions above a certain baseline. Major aviation markets like China, Russia, Brazil, India partly apply the scheme, further weakening the efficacy of the system. The baseline has progressively been lowered as a result of industry pressure.

Considering the positive aspects, whereas ICAO and its Member States recognize the critical importance of providing continuous leadership to international civil aviation in limiting or reducing its emissions that contribute to global climate change, nowadays companies have begun to implement the projects on Sustainable Aviation Fuels[4] that can reduce emissions by 80% according to the International Air Transport Association (IATA). The Registry will ensure that the sector's agreed SAF[5] accounting and reporting principles are adhered to and fully in alignment with international protocols and industry best practices. SAF can be made from several sources ranging from agricultural waste to carbon captured from the air. It is fully compatible with existing aircraft and fueling infrastructure. However, high production costs and limited supply has slowed its adoption. It is estimated that SAF comprises less than 0.1% of all jet fuel currently used. IATA estimates that SAF could make up around 65% of the emissions reduction needed by aviation to reach net-zero by 2050. The industry is working on adopting best practices for globally recognized accounting systems that would allow SAF uptake regardless of uplift location to help facilitate vital economies of scale in SAF production.

Key and unique among the project's stakeholders is the participation of governments with the specific aim

[4]The IATA SAF Registry. URL: https://www.cbnme.com/news/iata-saf-registry/

[5]Sustainable aviation fuels. URL: https://www.airbus.com/en/innovation/energy-transition/sustainable-aviation-fuels

of ensuring compliance with the requirements of civil aviation authorities. Relevant authorities can swiftly validate and approve claims, update national emission inventories, and align their actions with international standards, such as those set by the International Civil Aviation Organization. It will also avoid the long-distance shipping of SAF, which would only degrade its climate credentials.

CHAPTER 3. THE DECREASE OF NEGATIVE IMPACT OF AVIATION: DEVELOPMENT SCENARIOS

One very important factor which contributes to aviation emissions is the aircraft type. The aviation market is composed of a very limited number of producers that are in high competition with one another. Technology is regarded as the most basic parameter in this sector, and currently, the entire focus is on energy efficiency[6]. Concerns have arisen with the ongoing environmental impacts of aviation have become the priorities for the aviation industry. However, the global nature of the aviation sector has made it more difficult for new strategies to be implemented. In the past few years, many industrial initiatives have gained significance to search for alternative ways[7]:

1. **Electric aircrafts[8].** In comparison to conventional aircrafts, electric aircraft that are less dependent on fuels that are carbon-based eventually produce less NOx and carbon emissions. Moreover, they have more reliability and efficiency and produce less noise that could result in ending the ban on night-time flights at various airports. While the existing battery technology may not support long- and medium-haul flights at a full capacity, the First Generation Electric

[6]Trends in Emissions that affect Climate Change. URL: https://www.icao.int/environmental-protection/Pages/ClimateChange_Trends.aspx

[7]Unprecedented Impacts of Aviation Emissions on Global Environmental and Climate Change Scenario. URL: https://link.springer.com/article/10.1007/s40726-021-00206-3

[8]The Future of Aviation: Aircraft Electrification. URL: https://blogs.cranfield.ac.uk/aerospace/the-future-of-aviation-aircraft-electrification/?_gl=1*xkxcz9*_gcl_au*ODkwODg4MTkwLjE3Mjc3MDg3NTQ.

Aircraft (FGEA) can significantly contribute to short-haul flights in the future. For instance, MagniX, an electric motor manufacturing company for aircrafts, conducted a grand caravan with the world's largest electric aircraft in May 2020, along with AeroTEC. The accelerating development of electric cars also brought intensive innovations to develop cheaper, and for avionic industry important, lighter batteries. This offers important benefits for the future development of electric planes.

2. **The Use of Non-Stop Routes.** Air traffic management (ATM) is a programme to follow the best fuel-efficient and environmentally friendly routes. It has a significantly important role in decreasing the impacts of aviation on the environment, which is achieved by reducing the inefficient activities in the routes flown by aircraft, and non-stop routes to destinations could reduce the level of carbon emissions aircrafts. It was seen that direct routes had generally outperformed the connecting routes relating to carbon emissions with several exceptions. Furthermore, it was seen that, on average, non-stop pathways decreased carbon emissions roughly by 100 kg/person as compared to the adjoining best option of flight. Another study concluded that for short trips (< 500 km), aviation is not a fuel-efficient option mainly because of large emissions associated with landing and take-off and also due to emissions from ground support equipment related to any trip.
3. Technological Improvements. Many airlines and manufacturers have invested heavily to find sustainable alternative jet fuel to reduce greenhouse gas emissions of the air transport industry. Manufacturers such as Boeing are currently in the production of aircraft that can transport passengers solely on sustainable alternative fuels. Recently, it has been reported that scientists are now able to

convert CO2 into jet fuel with the help of a cutting-edge method bypassing it from an iron catalyst with hydrogen, manganese, potassium, and citric acid.

To ensure a sustainable and equitable future for the aviation industry, efforts must be made to bridge the digital divide and support the widespread adoption of sustainable practices[9]. Challenges in electrification include thermal management, systems design for integration into the airframe, battery management, power-to-weight ratios, testing, reliability and certification of new aircraft technology. Aircraft electrification will not succeed without parallel development in airport infrastructure, power supply and distribution, and assessment of the impact of aviation on the environment.

Several key initiatives could help mitigate the risks associated with this issue such as investments, technology transfer, capacity building and training. Building digital literacy within the aviation workforce is crucial. Training programs that focus on new technologies, from air traffic management systems to smart airport solutions, can help reduce the skills gap and foster a more inclusive and sustainable aviation sector. Additionally, high-income countries and technologically advanced airlines should collaborate with developing nations through technology-sharing programs. By transferring knowledge and providing access to sustainable innovations, such partnerships can accelerate the adoption of green technologies across the aviation industry.

According to the Federal Aviation Administration's Aerospace Forecast Fiscal Years 2021–2041 report[10]

[9]Exploring the Intersection of the Digital Divide and Sustainability in Aviation: Implications and Future Consequences. URL: https://www.aviationfile.com/digital-divide-and-sustainability-in-aviation/

[10]The Growth in Greenhouse Gas Emissions. The Federal Aviation Administration's Aerospace Forecast.

there will be rapid year-over-year growth from the low levels of 2020/2021 until pre-pandemic levels are reached in 2024, and then more typical growth from 2025 (Table 3.). The connection between passenger traffic growth estimates and carbon emissions is highlighted in an analysis by the International Council on Clean Transportation (ICCT). A few percentage points difference in growth predictions can generate very different projections of total emissions. ICCT forecasts an annual growth in passenger traffic to 2050 of 3 percent for its central scenario, and 3.7 percent and 2.4 for its high- and low-growth scenarios, respectively. According to the ICCT analysis, if there are "no drastic changes in aircraft design or fuel that would affect emission factors," the difference between a low-growth and high-growth scenario would be 700 million tons of CO2 by 2050, and 400 million tons between the central and high-growth scenarios.

	Projected year of return to pre-COVID (2019) traffic levels		**Anticipated average annual growth**
Boeing	U.S. domestic International (regional) International (long haul)	2022 2023 2024	**2019 – 2041:** 4% global domestic & international combined **Unit of measure:** revenue passenger kilometers (RPK)
Federal Aviation Administration	U.S. domestic U.S. International	2024 2025	**2025 – 2041:** 2.3% U.S. domestic; 3.3% U.S international **Unit of measure:** passenger count
International Civil Aviation Organization (central scenario)	North, South America Europe, Mideast, SW Asia Asia, Pacific Africa (ICAO projections are for seat capacity)	2022 2023-2024 2024-2025	**2018 – 2050:** 3.6% global domestic & int. combined (RPK). **Unit of measure:** revenue passenger kilometers (RPK); **2018 – 2050:** 3.5% freight (RTK) **Unit of measure:** revenue ton kilometers (RTK)
Air Transport Action Group (central scenario)	Global passenger	2024	**2019 – 2050:** 3.1 %. (RPK). Forecast traffic in 2050 approximately 8% lower than pre-COVID forecast. **Unit of measure:** revenue passenger kilometers (RPK)

Table 3. The Federal Aviation Administration's Aerospace Forecast.

As airlines bring new equipment into their fleets, their overall fleet performance will improve. Given the efficiency of new model aircraft, the ICAO standard is not expected to change current projections of CO_2 emissions for the industry, and the standard does not address contrail formation.

Potentially, we could change the architecture of the systems in favor of hybrid ones. In the short term, we will probably witness a 'More Electric-Hybrid' commercially sized aircraft rather than an 'All-Electric' alternative. This 'More Electric-Hybrid' version could deliver real benefits through reduced emissions and allow for the development of motors and power electronics for the transition to fully electric operation.

There is a need for new regulations regarding the emerging technologies, platforms and systems related to electrification. Firstly, as new technologies are created in the field of electric aviation, each technology will need regulatory backing to determine the airworthiness of the technology. This is critical to establish broad regulatory acceptance for enabling technologies like high-power batteries, voltage distribution systems and boundary layer ingestion.

CONCLUSION

The intersection of the digital divide and sustainability in aviation presents a complex but critical challenge. Without coordinated action, the persistence of this divide could undermine global efforts to achieve sustainability targets, exacerbate environmental inequality, and marginalize regions economically. The aviation industry must prioritize investments in digital infrastructure and sustainable technologies, ensuring that all countries have access to the tools necessary to participate in a greener, more equitable future. By addressing the digital divide today, we can lay the groundwork for a more sustainable and inclusive aviation industry tomorrow.

To achieve these goals and to reduce the impact of the aviation industry, three actions are recommended. The goal of the first is to promote coordination and communication among stakeholders. The second addresses the development of more effective tools and metrics for guiding policy decisions and for planning research investments. The third focuses on specific technological, operational and policy options to support a balanced approach to long-term environmental improvements. While the third recommendation is the most important in terms of directly addressing the needs, it will not be successful unless the first two recommendations are implemented in parallel. Below each recommendation current activities are reviewed and an implementation plan for responding to the recommendation is suggested.

The initiatives lead to the following ideas for actions, which are intended to stimulate ideas beyond short-term SDG actions, as the time frame for implementation is rather long-term. These actions are presented to support the baseline of sustainability – the prevention of different types of crises. Sustainable aviation will allow understanding how the aviation industry operations

impact the environment and support identifying solutions to mitigate these impacts to enable the sustainable development of the aviation sector. As it is currently difficult to reduce emissions from this sector, flying less is the only way to reduce emissions in the critical decade before 2030. Whatever the means of achieving it, demand reduction should not be a taboo subject

It is also expected that in the near future the civil aviation industry will recover and continue to grow due to trends such as digitalization and automation, supplier diversification, as well as sustainable development and environmental responsibility.

CLOSSARY

1. **Accountable Officer** - the Officer of the UN who is overall responsible for air transport operations and aviation safety and who exercises authority on behalf of the UN organization for the management of air transport and aviation safety.
2. **CORSIA** - is a carbon offset and carbon reduction scheme to lower CO2 emissions for international flights and curb the aviation impact on climate change.
3. **Long Term Aspirational Goal** - the ability of each State to contribute to the LTAG within its own national timeframe. Each State will contribute to achieving the goal in a socially, economically and environmentally sustainable manner and in accordance with its national circumstances.
4. **Maintenance** - the performance of tasks to ensure the continuing airworthiness of an aircraft, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.
5. **SAF** - Sustainable aviation fuel (SAF) is certified jet fuel (Jet-A/A1).