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The Unique Challenges of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

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THE UNIQUE CHALLENGES OF THE CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSIA)

By

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ABSTRACT

Air transportation is a particularly contentious issue in climate disputes. This concern is because they emit emissions like those produced by the combustion of fossil fuels. Consequently, the aviation industry is recognized as one of the top ten emitters in the world, with emissions expected to soar. As the emissions from the industry begin to rise, the increase raises serious environmental concerns about its global impact and influence on people on the ground. When non-CO_2 effects are excluded, aviation emissions began to account for 2.1% of global emissions, leading the aviation industry, national governments, civil society, and international organizations to collaborate to reduce emissions drastically. Accordingly, this led to the establishment of the International Civil Aviation Organization (ICAO), which serves as a global platform for devising laws and standards for the industry, including a comprehensive set of measures to manage greenhouse gas (GHG) emissions to reach the 2050 carbon-neutral goal.

The ICAO aims to eliminate all GHG emissions using sustainable alternative fuels, advanced technology, and the world's first market-based mechanism to mitigate aviation emissions. It adopted the International Aviation Carbon Offsetting and Reduction Scheme (CORSIA) in 2016. While this market-based approach to reducing international aviation's runway emissions is viewed as a step in the right direction, more is needed to achieve the sector's required level of profound decarbonization. (CORISA). This study describes the connection between aviation and climate change. It analyses the efficacy of the policy implemented and the environmental benefits of CORSIA in addressing climate change challenges in the aviation industry and the scheme's potential to have a more significant impact and provide long-term solutions. According to the study's findings, adding a required option for binding enforcement will aid in expanding the scope of CORSIA.

DEDICATION

To God Almighty, my creator, helper, strong pillar, and source of inspiration, who has brought me this far. I dedicated this work to Him for blessing me with wisdom, knowledge, understanding, good health, and support throughout the very successful end of the study. Likewise, I dedicate this piece to my family for their unconditional love, constant support, encouragement, and prayers throughout my life. I am also grateful for the push, reassurance, and love. Finally, I dedicate this work to appreciating Dr. Geoffrey Callaghan for his help, listening ears, and enabling environment to carry out this project. Without patience, understanding and, most of all, love, completing this work would not have been possible.

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LIST OF ABBREVIATIONS

GHG(s)	Greenhouse Gas(es)
CO_2	Carbon Dioxide
IPCC	Intergovernmental Panel on Climate Change
ICAO	International Civil Aviation Organization
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
NO/NO2	Nitric Oxide/Nitrogen Dioxide
NOx	Nitrogen Oxide
SOx	Sulphur Oxides
EU	European Union
UN	United Nation
NDCs	Nationally Determined Contributions
ECOSOC	Economic and Social Council
WHO	World Health Organization
UNESCO	UN Educational, Scientific and Cultural Organization
IMO	International Maritime Organization
AU	African Union
ACAC	Arab Civil Aviation Commission
AFCAC	African Civil Aviation Commission
ECAC	European Civil Aviation Conference
LACAC	Latin American Civil Aviation Commission
SARPs	Standards and Recommended Practices
CAEP	Committee on Aviation Environmental Protection
GIACC	Group on International Aviation and Climate Change
UNDP	United Nations Development Programme
GEF	Global Environmental Facility
SIDS	Small Island Developing States
SDGs	Sustainable Development Goals
UNITAR	United Nations Institute for Training and Research
SPCP	Strategic Planning, Coordination and Partnerships
MRV	Monitoring, Reporting, and Verification
LTAG	Long-Term Aspirational Goal
SAF	Sustainable Alternative Fuel
EUC	Emissions Unit Eligibility
TAB	Technical Advisory Board
VCS	Verified Carbon Standard
ACR	American Carbon Registry
CDM	Clean Development Mechanism
CCUS	Carbon Capture, Utilization, and Storage

MAC	Marginal Abatement Cost
MSB	Marginal Social Benefit
SDM	Sustainable Development Mechanism
US	United States
ETS	Emission Trading Scheme
STP	Sustainable Transition Policy

CHAPTER ONE

INTRODUCTION

1.0 Background of Study

Researchers and scientists need help when seeking to explain the swings in climate patterns due to the dynamic nature of the climate system (Chakraborty et al., 2014). There have been slow and dramatic changes to the planet's system over time, demonstrating that it is more dynamic than static. Despite this, several studies have led scientists to conclude that a large variety of contributing factors has accelerated the rate of climate change on a global scale. Human conduct has profoundly impacted the climate, starting from rising urbanization, including industrialization, and the heavy pollution that has resulted from it.

This problem is adjacent to population growth, deforestation, globalization, economic growth, production, and consumption of industrial goods (Mikhaylov et al., 2020). It exacerbates a wider variety of changes occurring on our globe, such as rising sea levels, harsh weather conditions, rapid ice melt, glaciers receding, decrease in snow covers, volcanic eruptions, storms, and tornadoes (NASA, 2018). By destroying nature and changing the temperature of cities, these adversities produce environmental difficulties that endanger life in water, land, and air. In recent years, numerous floods and unpredictable earthquakes have happened in many unplanned settlements, leading to many deaths, life-threatening illnesses, and injuries (Celik, 2020).

The quantity and intensity of greenhouse gases (GHGs) such as water vapour, carbon dioxide, methane, ozone, and perfluorocarbons in the atmosphere for hundreds of years have long-lasting effects. They progress over time (Mikhaylov et al., 2020) (Raufer et al., 2022). For instance, scientists have proven that GHG emissions cover the globe, and as it does, it absorbs the heat from the sun. Due to this, the planet is changing and warming up faster, altering different weather patterns. For instance, the average global temperature has increased to 0.77 °C at its lowest and 0.8 °C at its highest, making 2022 the sixth warmest year (Lindsey & Dahlman, 2023). By 2021, the annual GHG index will reach 1.49, and if current trends in the use of fossil fuels and the loss of forests are not reversed, there is a tendency for the temperature to continue to rise. With over 75% of all GHGs and almost 90% of all carbon dioxide (CO_2) emissions coming from fossil fuels like coal, oil, and gas, they are by far the most significant cause of climate change in the world (United Nations, 2022).

Power generation is the primary driver of carbon emissions, but after this comes transportation. Most CO_2 emissions connected to energy come from transportation, and the share of emissions in this industry alone will continue to rise over the coming years (United Nations, 2022). While automobiles are the point of concentration for many scholars, scientists, and policymakers, an area that needs to be addressed is aviation. This is regrettable, as the aviation industry contributes significantly to the overall problem. GHGs from aircraft are considered one of the significant contributors to the issue of climate change because of the rapid growth in the industry over the years. It has reportedly eclipsed the electricity industry as the largest generator of carbon dioxide emissions in the United States. Due to the increase in the frequency of travel by many persons, aircraft operations are a rapidly expanding source of emissions in the transportation industry (Overton, 2022). The Intergovernmental Panel on Climate Change (IPCC) has reported that yearly CO_2 emissions from the transportation sector will climb to almost 12 billion tonnes (Liberman, 2019). Therefore, the effect of emissions from other means of transportation, especially planes, requires attention.

1.1 Significance and Purpose of Study

The aviation sector contributes to the global annual GHG data, and it has also experienced rapid growth in recent years (both before the COVID-19 and after). However, the sector has not received much attention in emission reduction, as not all nations have fully grasped the significance of regulating air pollution to eliminate harm to human health and the living environment. No consideration or study has been devoted to determining if the selected carbon price strategy for controlling emitters presents any issues. Meanwhile, the lack of emphasis in this sector hinders the strategy and progress for mitigating global emissions and addressing climate change. There needs to be an in-depth examination of deploying a market-based strategy for aviation pollution due to the method's failure to respect fundamental monitoring, reporting, verification, and punishment requirements. Therefore, this research aims to investigate the challenges associated with regulating and implementing emission reduction in the aviation sector. It will evaluate the implementation of carbon pricing and the obstacles and prospects for a thriving carbon market in the global aviation industry.

Although the phases outlined in the current scheme have not yet been met, the purpose of this paper is to identify the observational gaps in the carbon pricing approach to assist International Civil Aviation Organization (ICAO), nations, and the international system in recognizing the potential need for a comprehensive approach to reducing emissions in the aviation sector. This study compares the benefit of the ICAO carbon offsetting scheme with the European Union's aviation carbon market program. The report argues for a holistic strategy to promote more significant emission reduction and environmental sustainability in the aviation sector. As a universal criterion to maintain environmental quality using either technology-based or performance-based methodologies or economic mechanisms, this study proposes, alongside these methods, adopting a command-and-control strategy that would apply to every country. Unlike the current voluntary process, this would represent a substantial paradigm shift and would become an obligatory activity.

1.2 Research Question

The following questions will guide this research:

- Does emission from the aviation sector pose an existential threat to climate change?
- What are the core challenges in crafting an international regulation for international aviation emissions?
- Is there any existing mechanism in place to deal with the rise of emissions in the aviation industry?
- What are the benefits and drawbacks of the market-based approach to condense aviation emissions?

CHAPTER TWO

METHODOLOGY

This study uses a qualitative approach to analyze documents from authoritative organizations like the ICAO and the International Air Transport Association. When surveying research that has already been conducted, most records of literature aim at scientific justifications for the effects of aviation on climate change. Alternative fuels, regulatory hurdles, and the scientific assessment of aircraft pollutants are only some of the topics seldom covered in publications on the transportation industry and aviation law. The inadequacy of international aviation emissions data also highlights a knowledge vacuum in assessing carbon offsetting systems, which poses crucial concerns and practical problems. Therefore, secondary documents like newspaper articles, a few journal publications and the like would be synthesized to evaluate how the offsetting carbon scheme under Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) contribution will likely achieve a net zero emission target aimed by ICAO and other international agreements.

The research methodology entails two parts: the first part is to examine research on the ICAO market-based mechanism critically adopted through CORSIA with the review of experience drawn primarily from the Europe Union Carbon Market policy on aviation and elaborating on the challenges and issues faced during implementation. The second part is to evaluate the challenges identified to further enhance further our understanding of how they are prevented and solved, as well as to help better understand possible venues for the successful facilitation and implementation of carbon emission reduction regulations.

2.0 Structure of Study

This research will be divided into seven chapters. The first chapter is an introductory insight and background to climate change and its link with the aviation industry. Chapter two explains the methods adopted to carry out the study. While chapter three gives a foundational section illustrating where things are coming from and how they have evolved. Chapter four focuses on where things are now with tackling climate change issues through the effect of airplanes. This chapter also provides insight into the full function of the offsetting carbon scheme adopted by the ICAO. Thereby, it explains the impact of the chosen scheme on the socio-economic sectors of nation-states to solve aviation emissions as compared with that of the EU. Chapter Five further explains the drawbacks of implementing the scheme and its effectiveness. Chapter six then makes a case for the scheme to have a mandatory effect by elaborating on the benefit of a mandatory regulation as against a voluntary regulation. Finally, chapter seven gives a summary and conclusion of the study analysis.

CHAPTER THREE

AVIATION AND CLIMATE CHANGE

By the 1960s and early 1970s, aviation's impact on the climate was understood in some detail. Aviation, a vital component of the contemporary world's infrastructure and economy, makes the support of commerce, tourism, and defence possible. However, safety and environmental dangers linked with both noise and air pollution have traditionally restricted the aviation industry's activities due to public concerns. Aircraft emissions significantly contribute to two global climate change concerns: changes in weather patterns and an increase in UV-B radiation. Approximately two to three percent of the world's yearly GHG emissions are now attributable to the aviation sector. How does this proportion, however slight it may seem, contribute to the problem of climate change?

The explanation of the relationships between aviation emissions, radiative forcing, climate change, possible implications and damages explains how aviation contribute to climate change issue. Emissions originate from both direct and indirect sources, aerosol impacts, and cloudiness caused by aircraft. These include CO_2, water (H_2O), nitric oxide (NO), and nitrogen dioxide (NO_2), generally referred to as nitrogen oxide (NOx), sulphur oxides (SO_x), and soot (IPCC, 1999). The emitted gases and aerosols retain solar radiation, enhancing cloud cover through contrail generation. Contrail formation evolves into cirrus clouds and causes widespread additional cloud cover that warms the earth’s surface, contributing to global warming (Tait, 2019). (Lee et al., 2020). Hence, these emissions influence the earth's climate system and result in a positive radiative force that promotes surface warming and other responses (Fahey & Lee, n.d.). Radiative forcing is the result of the accumulation of direct emissions in the atmosphere, which undergoes a variety of chemical transformations and contributes to their accumulation

(IPCC, 1999) (Klower et al., 2021) (Fahey & Lee, n.d.). Introducing this science aims to show that the aviation industry does not correspond to other modes of transportation on a one-to-one basis (as if the emissions from one could be compared directly with the emissions from the other). They have essential differences, and aviation appears to be especially hazardous (Banu, 2011).

Aviation stands out as a unique business and one of the transportation sector's fastest-growing sources of GHG emissions. While aviation generally relies on fossil fuels emitting combustion by-products that impact climate change, the number of passengers and a class of flight determines the amount of fuel consumed by any aircraft. With respect to first class or business class passengers, the aeroplane has aggregated more of the fuel used compared to passengers flying economy class. Additionally, the heavier a passenger's luggage is, the more fuel is consumed. As a direct result, the IPCC conducted research and forecasted in its report that the effect of aviation emissions on the climate will be between 2.6 and 11.1 times greater in 2050 than in 1992 (Mccarthy, 2009). According to the European Union (EU) in 2015, aviation emissions might account for twenty-two percent of world emissions (EU, 2015). This growth can be evident before the epidemic when the overall number of yearly international passengers in 2019 was 4.56 billion, and post-pandemic rose to 73.7% of the November 2019 level. It is also anticipated that by 2050, this number would climb by two to four times (Overton, 2022) (Fageda & Teixido, 2022) (Passenger Recovery Continues in November, n.d.). If, as many believe, GHG emissions must be cut by fifty to eighty percent within that time frame (Ritchie et al., 2020), aviation emissions must be severely lowered to provide a proportionate percentage of the reduction (Mccarthy, 2009).

However, aircraft emission effects on the environment have yet to be well known. More research is needed on how they may be measured to allow the relevance of environmental policy implementation. The most considerable uncertainties come from contrails and methane (Wuebbles et al., 2010). For this lack of knowledge, efforts to minimize aircraft emissions have gotten less attention (Raufer et al., 2022, p. 3257). An easy-to-use, accurate, analytic, and calculative tool that can be used to balance emissions and easily understood outcomes would be an excellent resource for policymakers to have at their disposal when communicating with scientists and the aviation sector about these emissions.

3.0 The Evolution of The International Civil Aviation Organisation (ICAO)

The ICAO was not established to address environmental problems or climate change issues brought about by the aviation sector. On the contrary, it was established to develop and monitor worldwide air transport safety standards. The impact of WWII on civil and military aviation exemplified the need for international cooperation and the development of aviation, which ultimately led to the Chicago International Civil Aviation Conference in November 1944 and to the signing of the agreement on International Civil Aviation in December of that year. This, in turn, gave birth to the ICAO (Mackenzie, 2010). The ICAO was founded and governed by a small number of solid governments at that time. Permanent operations began on April 4, 1947, in Montreal, Canada, and as additional nations ratified it, ICAO expanded into a genuinely diversified and worldwide international agency. As of October, of that year, it had become the fourth specialized agency of the UN connected to Economic and Social Council (ECOSOC), joining the World Health Organization (WHO), UN Educational, Scientific and Cultural Organization (UNESCO), and the International Maritime Organization (IMO) (Mackenzie, 2010).

The Assembly is the supreme authority within ICAO, while the Council is the organization's governing body. The Assembly gets together at a bare minimum once every three years. Every state party to the pact is given one vote, and those with the most votes win. A permanent organization, the Council is accountable to the Assembly and comprises 36 member nations for three years each (Rosa, 2022). The ICAO regional offices were established to plan and carry out new projects more efficiently. These offices may be found in Africa and the Indian Ocean (AFI), Asia, the Caribbean, Europe, the Middle East, North America, the North Atlantic, the Pacific, and South America (Rosa, 2022).

The primary objectives of the ICAO are, in a nutshell, security, safety, efficiency, and uniformity. The treaty granted the ICAO the responsibility of drafting international civil aviation regulations as well as disseminating, monitoring, and assessing their implementation. It also requires the ICAO to promote the development, building, and operation of appropriate aircraft, airports, and air navigation infrastructure (Chicago Convention, Article 80, Paragraphs 44(a), (b), (c), and (d)) (h). The ICAO is also required to meet the needs of the global population for safe, regular, efficient, and cost-effective air transport; to prevent economic waste caused by insufficient competition; and to ensure that the rights of contracting states are fully respected and that every contracting state has an equal opportunity to operate international airlines (Chicago Convention, Article 44 (d), (e), and (f)). Thus, the ICAO works primarily to ensure consistency and uniformity in creating international civil aviation technical standards, operational procedures, and aircraft designs to foster peace and mutual understanding among governments and to prevent war (Dempsey, 1987).

The ICAO has adopted a variety of regulations to live up to its responsibilities. When it started conducting its regular business, these policies were implemented. The first set of regulations specifies the minimum conditions for personnel licensing as stipulated in Annex 1 of the Chicago Convention. Other laws that were implemented in 1948 include the Dimensional Units for Air-Ground Communications (Annex 4), Aeronautical Charts (Annex 2), and the Laws of the Air (Annex 2). (Annex 5). The Convention on the International Recognition of Rights in Aircraft, more often referred to as the Geneva Convention, was the first piece of law passed by the ICAO Council in 1948. This was the organization's very first success in the field of law. It has henceforth helped the ICAO pursue sector-wide consistency and standardization (Milestones in International Civil Aviation, n.d.).

Regardless of how the ICAO standards are implemented, compliance with all relevant policies remains the basis for a state's safety program or law. Article 1 of the Chicago Convention recognizes every state's sovereignty over its airspace. The consequence of the principle of sovereignty in the air is that no aircraft may fly through the national airspace of a member state without obtaining prior permission on how high or low the aircraft should fly, safety procedures required for landing and take-off, assistance in the event the aircraft is in danger, and finally, the investigation of danger and aircraft accidents (Agustini et al., 2021). (Mackenzie, 2010). This is because national law will always take priority. What this mean is that the organization's policies are merely persuasive obligatory on member states and hence ultimately non-binding. For this reason, even in the global priority areas for which they were founded, they have limited effect on national governments. Instead, when particular states violate the Chicago Convention, ICAO utilizes its diplomatic abilities and position to help countries conducting negotiations, condemnations, and other international law-compliant measures consistent with the Chicago Convention (ICAO, 2019).

Additionally, since its inception, the ICAO has continued to expand and has shown its flexibility and agility within the international system. In 2010, it signed a memorandum of cooperation with other regional organizations, including the African Union (AU), the EU, the Arab Civil Aviation Commission (ACAC), the African Civil Aviation Commission (AFCAC), the European Civil Aviation Conference (ECAC), and the Latin American Civil Aviation Commission (LACAC), to improve progress on the issue of aviation safety. The purpose of the collaboration was to further the continued development of a safe, efficient, and sustainable air transport system while harmonizing civil aviation rules and practices across member nations (*Critical Events in the History of Civil Aviation Around the World, n.d*.). Nevertheless, following the end of the Cold War, the ICAO also evolved to address new developments that threatened aviation safety and its mission to promote peace. The obstacles include increased plane hijackings, international aviation terrorism, military attacks on civil aviation, and environmental issues (Mackenzie, 2010).

The Council of the ICAO concentrates its environmental cooperation on three primary areas: climate change and aviation emissions, aircraft noise, and local air quality (Environmental Protection, 2019). Owing to its function as a worldwide watchdog, the ICAO has had to prioritize environmental concerns above all others. This is particularly true for aviation GHG emissions. ICAO formulates policies, creates and revises Standards and Recommended Practices (SARPs) on aviation emissions, and engages in outreach initiatives (Climate Change, n.d.). At the thirty-second session of the organization in 1998, the ICAO Council created the Committee on Aviation Environmental Protection (CAEP) while discussing climate change and aviation emissions. CAEP supports the ICAO Council's formulation of policies for lowering international aviation CO_2 emissions, such as aircraft technology, operational improvement, sustainable aviation fuels, and market-based measures (Environmental Protection, n.d.). The new committee evaluated several possible courses of action, including adopting a gasoline tax or an emissions trading system amongst groups and implementing voluntary measures that individual states may undertake on their own (Mackenzie, 2010).

3.1 The Groundwork for The Debate Over Policy Options

Due to the uncertainty of which policy should the ICAO adopt, people are by turns optimistic and skeptical that humanity can take responsibility for finding solutions. Optimistic individuals favour proponents of structural solutions above individual action for lessening the environmental effect of aviation. Those who believes that human actions are unimportant often claim that wealthy individuals who frequently travel are shielded from the worst consequences of climate change and the required individual efforts. While low-income individuals currently pay a disproportionate amount of the hardship associated with growing airline ticket prices and the effects of severe weather, this percentage is likely to increase.

In addition, the argument favouring structural action challenges individual responsibility because airline firms can use them as a shield to avoid accepting their own share of responsibility for climate change. Individual action proponents think this technique will help people to realize how their actions contribute to the climate crisis and how they may also make a global impact (Ropke, 2009) (Dolak & Prakash, 2022). On the other hand, there is also the counterargument that nations that have gained the most remarkable economic gains from industrialization and are the world's largest emitters of GHGs should pay a more significant proportion of the burden. In contrast, poor prioritization, greed, and the need for cooperation on several dimensions have hampered attempts to cut aircraft sector emissions (Marlon et al., 2019). State governments prefer to see the issue as hypothetical since most climate change-related problems are predicted to occur without a specific date or time. Officials are argued to be without an obligation to act since it would not benefit those in the region (Baskin, 2019).

Regardless of the above controversy, it is still necessary to have in mind the negative effect of CO_2 constant concentration in the atmosphere and work out a regulatory policy. Reason be that it was predicted that worldwide aviation would produce forty-three billion tonnes of CO_2 emissions through to 2050 if left unattended too, which is an increase of between three hundred to seven hundred percent (Centre for Biological Diversity, 2010). Thus, to regulate the aviation industry's fuel efficiency, nations and the international system must finance decarbonization efforts because stabilizing (or even reducing) atmospheric CO_2 concentrations requires the globe to achieve net-zero emissions. To achieve this, drastic emission cuts are needed, and soon. Emissions from international aviation, nevertheless, are not initially subject to international climate change regulatory responsibility regimes and, indeed, as not included in the international accountability of the international regulation of the environmental system. For instance, aviation was not included in the Kyoto Protocol negotiated in 1997 because an agreement was needed to determine that international aviation emission reduction responsibility should be calculated (Romera & Asselt, 2015).

The Paris Agreement of 2015 set out a long-term goal for CO_2 emissions, to hold increases in global mean surface temperature to below 2°C above pre-industrial levels and to pursue efforts to limit this increase to 1.5°C according to article 4. However, emissions from international aviation were not explicitly mentioned in the agreement and are still separated from domestic aviation emissions as directed initially by the Kyoto protocol. The management of international aviation emissions was never explored nor debated during post-Kyoto emissions reduction negotiations at COP-13 in Bali, Indonesia, in December 2007 and COP-21 in Paris, in 2015. It has been a disappointment to many who had high hopes for an international treaty to take charge of the international aviation emission issue, and this silence contribute to a growing fear that ICAO would permanently deal with this sector without any leverage for the United Nations (UN) climate regime to ensure an effective response (Doelle, 2016).

Nevertheless, the brighter side of the Paris Agreement is that all emissions that affect the climate were implied to be subject to its targets. This inclusion is done so that global GHG emissions can be rapidly reduced in the second half of this century. It can further be argued that there is an implied inclusion of international aviation emissions in the Paris Agreement even though not expressly stated because the agreement aimed at removing CO_2 from the atmosphere, therefore any continued emissions of CO_2 from aviation using fossil fuel beyond 2050 will be inconsistent with the agreed goals. Hence, countries are still required to follow the Kyoto protocol declaration to continue to work with ICAO to manage emissions from international aviation travel according to article 2.2. It also further requires that states pledge to limit the rise of carbon dioxide emissions from domestic aircraft through Nationally Determined Contributions (NDCs) (Beevor & Alexander, 2022). This indicated that the ICAO has the mandate to make committed efforts to manage international travel and since they are independent of the UN, has the option to either cooperate with the Paris Agreement as well as measures under the UN climate regime or to implements on measures. This makes the debate about including international aviation emissions and other non-GHG aviation emissions in future international agreements an open question to date (Lee et al., 2020).

3.2 Evolution of Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

As the organization's environmental concerns expanded, it took more deliberate strides forward. At the 2007 convention of the ICAO, the Group on International Aviation and Climate Change (GIACC) was founded to recommend minimizing engine emissions. The group's purpose is to develop a dialogic approach. In 2009, it published a report on methods to cut emissions (ICAO, 2019). According to them, the review should begin in 2005, with short-term targets lasting through 2012, medium-term objectives through 2020, and long-term objectives through 2050. The ICAO endorsed the plan, and during the 37th Session of the ICAO Assembly in 2010, it was adopted as a global goal with an annual aim of 2% higher fuel efficiency. Moreover, in 2013, the ICAO and the United Nations Development Programme (UNDP) filed a proposal to the Global Environmental Facility (GEF), which began operations in 2015. The effort "Transforming the global aviation sector: emissions reductions from international aviation" is intended to aid low-income countries and Small Island Developing States (SIDS) in decreasing their CO_2 emissions from international flights.

This GEF-UNDP partnership was also established to assist these countries in developing the capacity needed to meet the organization's technological and international operational requirements (*ICAO - United Nations Development Programme (UNDP) Project - Financed by the Global Environment Facility (GEF), n.d.)*. With the support of the partnership, research was conducted to determine how the execution of the ICAO requirement may contribute to the prevention of climate change challenges. The study developed the solar-at-gate project, a small-scale initiative whose output was successful and was concluded in June 2019. The solar-at-gate pilot project at Norman Manley International Airport in Kingston, Jamaica, was initiated as an experiment to show both the use of renewable energy and the corresponding reductions in CO_2 emissions for international aviation operations. The experiment enabled the ICAO to use the project's execution as a model for establishing solar power facilities to supply the energy needs for aircraft at the gates where international flights are serviced, thus eliminating the CO_2 emissions caused using aircraft auxiliary power units (APUs). Thus, the project serves as a model for other airports to reduce emissions (ICAO, 2019).

However, via the work of CAEP, the ICAO promotes a fuller knowledge of the effects of noise and emissions on local air quality and health. At the 39th ICAO assembly in 2016, it also investigated the viability of a long-term global aspirational objective for international aviation. Member states have pledged to achieve carbon-neutral growth by deploying efficient technology, sustainable aviation fuel (SAF), operational and infrastructural improvements, and a global market-based system for offsetting aviation emissions. (Reducing Carbon Dioxide Emissions from Aircraft, 2020) By 2050, CO_2 emissions per seat or tonne-kilometre flown are projected to be lower than 2005 levels (Raufer et al., 2022).

Consequently, in October 2017, ICAO adopted a declaration and endorsed the "2050 ICAO Vision for Sustainable Aviation Fuels" as an inspirational living path, calling on states, industry, and other stakeholders to replace a significant portion of aviation fuels with sustainable aviation fuels by 2050 *(Environmental Protection's Contribution to The Sustainable Development Goals (SDGs), n.d.)*. Hence, the ICAO has held regional workshops and seminars on State Action Plans throughout the last decade. In collaboration with the United Nations Institute for Training and Research (UNITAR) and as part of the ICAO-EU mutual assistance initiative, ICAO created a tutorial on State Action Plans. The ICAO provided this training as part of its efforts to accomplish the UN 2030 Agenda for Sustainable Development Goals (SDGs).

The ICAO also created the Strategic Planning, Coordination and Partnerships (SPCP) Office with the intention to better coordinate and support the management of efficient partnerships and to facilitate fundraising for aviation across the SDGs. In other words, SPCP is responsible for raising awareness and promoting the interconnections between aviation and the SDGs. Moreover, through the convening of seminars and training, such as the ICAO Green Airports Seminar and the Seminar on Global Aviation Partnerships on Emissions Reductions (E-GAP), ICAO encourages and facilitates the exchange of information and best practices amongst stakeholders on clean energy to reduce the impact of airport operations on the environment, as well as to promote cooperation and action on a global scale *(Environmental Protection's Contribution to the Sustainable Development Goal (SDGS), n.d.)*. ICAO imparted practical teaching to the States and enabled their participation in discussions (Hupe, 2020).

The ICAO Assembly approved a resolution creating the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to offset CO_2 emissions from international civil aviation that exceed 2020 levels. Beginning in 2021, CORSIA wants to battle any annual rise in international civil aviation's total CO_2 emissions. The initiative would help governments assess emissions comprehensively (i.e., biofuels) to promote the expanded use of SAF. The aviation sector is committed to upgrading technology, operations, and infrastructure to continue decreasing carbon emissions. The purpose of offsetting is to supplement these efforts. Neither will the CORSIA make fuel economy less of a daily focus. Alternatively, CORSIA can help the industry's short- and medium-term climate objectives by supporting sector-wide carbon reduction efforts *(Carbon Offsetting for International Aviation Three Goals, n.d.)*. The strategy is also a result of the most recent and upcoming environment-driven technologies and innovations being developed to establish a more focused, strict monitoring, reporting, and verification (MRV) system (Raufer et al., 2022).

During its 41st Assembly in October 2022, the ICAO established a new long-term aspirational goal (LTAG) of reaching net-zero CO_2 emissions by the year 2050. The CORSIA plan was designated as the major instrument for mitigating emission reduction. Nevertheless, the aim agreed upon should have delegated specific responsibilities or obligations in the form of objectives for reducing emissions to individual governments. Instead, it accepts that each state's specific circumstances and capabilities will make it possible for that state to contribute to the accomplishment of the long-term goal within the framework of its national timeline and under the conditions it deems appropriate. Notwithstanding this, the goal helps ICAO improve its leadership on international aviation and climate change *(Feasibility of a Long Term Global Aspirational Goal for International Aviation, n.d.)*.

CHAPTER FOUR

AN ANALYSIS OF THE ICAO POLICY SCHEME - CORSIA

The number of global carbon pricing mechanisms, such as carbon taxes and emissions trading systems, has grown dramatically. Deploying numerous carbon pricing mechanisms for aviation would result in a costly and unsustainable patchwork of solutions for operators and governments. As a result, the ICAO approved the CORSIA system. So, what exactly is CORSIA? It is the first global market-based benchmark for any sector and demonstrates a collaborative approach that moves away from a collage of national or regional regulatory measures. It establishes a standardized mechanism for decreasing emissions from international aviation while avoiding market distortion and allowing consideration of the specific circumstances and capabilities of ICAO member states. The strategy offsets CO_2 emissions that cannot be reduced by technological developments, operational improvements, and SAF (ICAO, 2019).

CORSIA requires members to offset the increase in CO_2 emissions from their international routes by obtaining carbon credits or investing in environmental programmes to reduce carbon in the environment. Airlines must get certificates that they may sell to comply with CO_2 emissions regulations (Guan et al., 2022). The market-based scheme is divided into three phases: 2021-2023 (pilot phase), 2024-2026 (first phase), and 2027-2035 (second phase). Because of the effect of the Covid-19 virus on aviation, the scheme's 2019-2020 baseline for all three phases has been shifted to 2019. Also, participation is optional for the first two phases (2021-2026) and will be based on revenue tonne kilometres (RTK) figures from 2018 (Carbon Offsetting for International Aviation Three Goals, n.d.). Carbon offsetting is the technique used by the market-based approach, which engages participants to pay for their emissions by subsidizing a reduction in emissions elsewhere. Carbon offsetting is a kind of carbon pricing by which governments may purchase offsets (permits) from other sectors to compensate for their emissions. In aviation, airlines must acquire carbon offsets from approved projects that have reduced or eliminated carbon emissions (Altexsoft, 2022).

In addition, member states must construct their own MRV systems to allow the annual reporting of emissions from international aviation activities undertaken by air carriers. Member states must also document every emission starting in 2020 in the ICAO's unified register. (Guan et al., 2022). Starting in 2021, if both the state of origin and the state of destination are CORSIA partners, emissions from international flights will be subject to yearly offsetting requirements. Prior to considering CORSIA-eligible fuels, it is the role of the state to determine, for each of its operators, the number of CO_2 emissions that must be offset in a particular year. This figure is derived by multiplying the operator's annual emissions report by the growth factor, which is set by the ICAO and is defined by the percentage increase in total emissions from the base year to a specified future year. As seen in the diagram below (Figure 2), the growth factors shift significantly from year to year due to the industry's overall growth and the emissions of each operator (ICAO, 2019).

Figure 4.1: The Growth Factor to Calculating CO_2 Offsetting Requirement

	PILOT PHASE	FIRST PHASE	SECOND PHASE		
	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035
SECTORAL	100%	100%	100%	Up to 80%	Up to 30%
INDIVIDUAL	0%	0%	0%	At least 20%	At least 70%

Source: (ICAO, 2019) (Altexsoft, 2022).

The diagram illustrates a gradual transition from an exclusive "sectoral" (aggregated industry value) to a "sectoral" and "individual" (considering just the unique operator's emissions) approach. This transformation will use a "sectoral" lens (an aggregated industry value). In either scenario, the airline is required to pay for the additional emissions. The operator must painstakingly record the fuel used on each trip to quantify the amount of CO_2 emitted by a given activity. Operators may be qualified to employ simplified monitoring and estimate emissions using the CO_2 Estimating and Reporting Tool (CERT), developed by ICAO for the CORSIA programme. This option is usable only under certain conditions (Altexsoft, 2022).

Further mechanisms for implementing the CORSIA plan require operators to employ SAF for a three-year compliance period. The state must account for the benefits of operators' use of SAF. Despite this, the ICAO mandated implementing these requirements to ensure that CORSIA would provide a credible and efficient method for reducing carbon footprints and contribute to the long-term goals agreed upon at its forty-one-council assembly (Khalifa et al., 2022). In March 2019, the Emissions Unit Eligibility Criteria (EUC) was authorized as a set of standards for assessing various offset programmes and projects. With the implementation of this worldwide market-based policy, the ICAO ensures that carbon-offsetting programmes fulfil eligibility requirements and are carried out correctly in order to reach the final objective.

4.0 CORSIA Emissions Unit/Program Eligibility Criteria

The following principles are used to evaluate the acceptability of an offsetting carbon programme in the industry: programmes must generate units that represent additional emissions reductions, avoidance, or removals; it must have a clear and transparent chain of custody within the offset programme; it must represent permanent emission reductions; and the programme should also represent projects that do not produce net harm, and the program should assess and mitigate against the potential increase in emissions elsewhere (CORSIA, 2022) (ICAO Document on CORSIA Emissions Unit Eligibility Criteria, 2019).

In addition to reducing carbon emissions, carbon offset projects should provide additional environmental and social advantages, such as biodiversity conservation, improved air and water quality, and socioeconomic development. For member states and airline operators to deploy offsetting measures, they must be measured and certified by a recognized standard. It must comply with social and environmental safeguards and reveal which institutions, processes, and procedures are used to design, monitor, and enforce safeguards to identify, analyze, and manage social and environmental risks. Programs should have procedures for offsetting credits given, retired, or revoked, subject to any discounts, as well as the length of the crediting period and whether it is renewable. These procedures must be open to the public. To that purpose, all initiatives must pass a regulatory compliance test, indicating that they conform with relevant regulations (CORSIA, 2022) (ICAO Document on CORSIA Emissions Unit Eligibility Criteria, 2019).

The ICAO Council formed the Technical Advisory Board (TAB) in 2019 to guarantee that all standards are adhered to with sufficient effectiveness. TAB is tasked with analyzing emission unit programmes concerning EUCs and proposing to the Council which emission unit programmes must be eligible for usage in the direction of CORSIA compliance. The TAB stipulates this as a prerequisite. The TAB comprises many technical experts, each proposed by a member state and then accepted by the Council. TAB will continue to conduct annual assessments using a rigorous methodology to ensure they are credible and fact-based. Each annual assessment cycle consists of five significant steps: calls for applications by emission unit programmes; a reviews or evaluation of the applications; a recommendation of potential projects or EUC potential programmes to the ICAO Council; ICAO Council decision, which will take that recommendation into account; and publication of CORSIA eligible emissions units on the ICAO website (Baribeau & Rahim, n.d.).

While each TAB assessment cycle requires substantial specialized knowledge and time commitment, the board holds three formal meetings every year. To sustain its effectiveness over time, the board has decided to undertake a re-evaluation of emission unit projects that are now available for consideration of comments about their eligibility after the conclusion of the pilot period. Despite this, the TAB has dealt with twenty-five applications for review in compliance with the EUC and several significant adjustments to previously examined programmes. The TAB has supplied the Council with recommendations based on these assessments, and the Council has approved eight suitable CORSIA emissions unit programmes for the 2021–2023 compliance period (Baribeau & Rahim, n.d.).

Current carbon emission unit programmes under CORSIA consist of the Gold Standard, Architecture for REDD+ Transactions (ART), Verified Carbon Standard (VCS), American Carbon Registry (ACR), China GHG Voluntary Emission Reduction (VER) Program, Global Carbon Council (GCC), Climate Action Reserve, and Clean Development Mechanism (CDM). To participate in any of the programmes, ICAO has identified their designated registries' websites in the CORSIA eligible emissions units document for comprehensive information on the environmental projects that can be funded, allowing members to choose with whom they wish to partner and decide on their best investments. In addition, the document contains eligible unit dates, any requirements for activities or unit types, and procedural techniques. During the compliance cycle 2021-2023, all relevant emission unit projects are certified. (ICAO Document on CORSIA Eligible Emission Unit, 2022).

The CDM, the world's largest market-based carbon offsetting scheme that dates back to the 1997 Kyoto Protocol, is one of the qualifying emission reduction projects under CORSIA. As with the Kyoto Protocol, the CDM permits the production and transfer of carbon credits, which may be used to offset emissions. Nonetheless, the two techniques use this idea in quite different ways. CORSIA, in contrast to the Kyoto Protocol, solely uses CDM to reduce emissions in the international aviation sector (Raufer et al., 2022). CORSIA CDM is provided for afforestation and reforestation activities, both as temporary CERs (tCERs) and long-term CERs (lCERs), despite criticism of the programme for failing to reduce emissions in terms of overall environmental integrity (Colantuono, 2021).

Purchases and cancellations of qualifying emissions units via any of the programmes mentioned should be comparable to the operator's ultimate CO_2 offsetting requirements for the compliance period. To illustrate, one emissions unit corresponds to one tonne of CO_2, equivalent to one offset. Any eligible emission unit cancelled must be imputed inside the register specified by a CORSIA emission unit programme. Each programme registration must make the cancellation information of each emission unit available on its website. The operators must then submit verified cancellation reports for emission units to the state, which must then analyze the records and inform ICAO (Strouhal, 2020). Hence, offset emission units represent reductions achieved by implementing a project outside the programme. In a carbon market, emission units may be traded, and their price is determined by supply and demand, similar to other carbon-priced commodities (Strouhal, 2020).

4.1 Why Choose Carbon Pricing Approach to Tackle Climate Change Issues?

Introducing the carbon pricing technique developed by economists to combat climate change solves the issue of cost-effectiveness, as it allows emission reduction at the lowest overall cost to the economy. It also solves the issue of government's incapacity to maintain essential monitoring, reporting, verification (MRV), and punishment criteria (IATA, 2022). It is believed that the marginal abatement cost (MAC) of pollution control should equal the marginal social benefit (MSB) of such abatement. In other words, for every dollar spent on pollution management, environmental amenities should be purchased (Raufer et al., 2022). Moreover, experts believe carbon pricing is the most crucial measure for accomplishing the objective. A further rationale for the ICAO to adopt this kind of carbon pricing is because harmful GHGs mix and spread throughout the atmosphere. Reducing them everywhere contributes to improving global environmental circumstances. There is no credible method for predicting how the climate system will change due to rising GHG emissions. Hence this method is used to track the trail of uncertainty (Raufer et al., 2022). As of January 1, 2022, 107 states have shown interest in joining CORSIA, with an additional eight states planning to join starting January 1, 2023. (ICAO, 2019).

However, there are different types of carbon pricing. Carbon pricing can be made more accessible with the help of a variety of policy instruments, including carbon taxes, cap-and-trade systems, offsetting, emission reduction credits, clean energy standards, and reductions in fossil fuel subsidies (Aldy & Stavins, 2012). Metcalf (2007) states that the simplest carbon pricing method is a carbon tax. Carbon taxes increase the cost of fuel or energy use. It is also known as Arthur Cecil Pigou's price-based technique (Raufer et al., 2022). The method is an incentive framework for the government to identify more cost-effective low-carbon choices (United Nations, 2017). It is claimed that such a tax would increase the cost of pollution and encourage polluters to modify their behaviour, such as deploying technology to minimize pollution rather than paying the tax. However, this technique has garnered substantial criticism because it increases energy costs. Nevertheless, economists contend that the earned income might be returned to society via refunds (Newburger, 2019). It has also been criticized for including political dynamics that create questions about income distribution and the ability of polluters to persuade government officials to prevent the adoption of this policy (Raufer et al., 2022).

The cap-and-trade system, also known as emission trading, is the procedure through which the government establishes a limit or cap on the total quantity of permitted emissions. Allowances are provided to enterprises governed by the system at no cost or via an auction. Each company is then permitted to emit up to their allocation of permits. Additionally, they may exchange allowances to achieve their emission quotas. Those who emit more than their allotment may buy more; those who emit less may sell or bank their surplus supply (Green, 2021). This mechanism has grown in popularity over the last several decades, and its success led to the formation of the Kyoto Protocol's carbon market (Raufer et al., 2022). The advantage of this system over the carbon tax is eliminating the barrier of setting an economically efficient price since it permits flexibility.

Some of these mechanisms have been successfully used in other environmental sectors in addition to the price of CO_2 emissions. After 1990, the sulphur dioxide (SO_2) cap-and-trade program in the United States reduced power plant SO_2 emissions by more than 50 percent. It resulted in compliance costs that were half of what they would have been under formal regulatory requirements (Carlson et al., 2000). The success of the SO_2 allowance trading program influenced the design and implementation of the European Union's Emission Trading Scheme (EU ETS), one of the world's most extensive cap-and-trade programs aimed at reducing

CO_2 emissions from power plants and extensive manufacturing facilities in Europe and China ETS (Ellerman & Buchner, 2007). These examples demonstrate that carbon pricing typically improves emission responsibility and facilitates the development of successful climate policies by corporations in collaboration with regulatory bodies *(CCUS and Hydrogen|Who We Are|Home, n.d.)*.

However, carbon offsetting is an efficient strategy for achieving short- and medium-term climate change goals by augmenting industry-wide emission reduction efforts. Carbon offsetting is more effective than a carbon tax since it only requires firms to pay for their emissions without guaranteeing that the payment will result in emission reductions. However, cap-and-trade is a regulatory method in which the government sets a limit or cap on the total amount of allowable emissions (Green, 2021). In contrast to cap-and-trade, which allows airlines to acquire credits in return for authorization to emit more, this model requires members to engage with ICAO to advise operators of the number of offset credits they need. This programme also compels aircraft operators to report their annual international flight emissions of more than 10,000 metric tonnes of CO_2e (calculated using fuel consumption) to their respective national authorities (Aegis hedging: CORSIA: The future of carbon offsetting in International Aviation 2022).

Even though both programs have been embraced domestically and globally and have been lauded for their efficacy, recognizing the distinction between them may aid emerging nations in determining which policies work best for their economies. First, carbon taxes give cost certainty since the government sets the price. However, there is no emission cap so long as regulated firms are willing and able to pay the fee. In contrast, carbon trading gives quantity certainty: the government-set cap represents the top limit on emissions. The price will vary based on permits' scarcity (or surplus) and other design characteristics. Carbon taxes are also straightforward to create and implement. Governments have a long history of collecting taxes.

In contrast, ETSs are complicated. Governments must establish limits. In addition to being influenced by science, this is also dependent on predicted prices. They must distribute and auction allowances and develop a system for monitoring, trading, and retiring these allowances. Frequently, governments auction off permits for many years at once, which may influence future pricing. Suppose offsets are authorized as part of a carbon price strategy. In that case, governments will be required to establish or adopt procedures for offset projects, which qualify as emissions reductions, by allowing polluters to fund decarbonizing efforts elsewhere. Additionally, offsets need a method for ensuring that initiatives provide the claimed reductions (Green, 2021).

Pricing carbon has been a significant component of the global climate change management framework. It began with the Kyoto Protocol, which was meant to lead a worldwide cap-and-trade system and establish specific GHG emission reduction targets for rich and developing nations. However, the 2015 Paris Agreement expands carbon pricing's function. Article 6.2 permits governments to exchange "internationally transferred mitigation results." In essence, a country that has surpassed the reductions indicated in its Paris commitment may sell the surplus to another nation. The Sustainable Development Mechanism (SDM) is a new worldwide carbon market regulated by the United Nations (Green, 2021). SDM replaces the CDM, introduced by the Kyoto Protocol, to provide carbon credits for projects in developing nations (Raufer et al., 2022). According to the World Bank Survey 2022, 68 direct carbon pricing mechanisms are now in operation, including thirty-six carbon taxes and thirty-two emission trading systems (Report: State and Trends of Carbon Pricing, n.d.).

A price on GHG emissions through price mechanisms like carbon taxes and emissions trading systems (ETSs) can significantly contribute to developing a financially viable climate policy framework. These pricing instruments equalize marginal abatement costs across individual emitters while providing them with ongoing incentives to look for cheaper abatement solutions using existing and future technology. Carbon pricing is said to play a significant role in enhancing climate ambitions by increasing efficiency gains. It shows they are inherently cost-efficient (Dellink et al., 2014). Moreover, effective policies should capitalize on the opportunities to reduce energy-related CO_2 emissions throughout the economy. Based on the carbon content of fossil fuels, a carbon tax reduces CO_2 emissions. This fee covers future fuel combustion CO_2 emissions. As previously stated, carbon pricing increases the price of fossil fuels, but the resulting price increases stimulate all emission reduction opportunities. Carbon offsetting does not reduce CO2 as effectively as a carbon tax.

By putting a price on CO_2 emissions (or, equivalently, by pricing the carbon content of the three fossil fuels—coal, petroleum, and natural gas), governments defer to private firms and individuals to find and exploit the lowest cost ways to reduce emissions and invest in the development of new technologies, processes, and ideas that could further mitigate emissions. Considering market-based instruments in the aviation industry is encouraged by these promising experiences.

4.2 Impacts of CORSIA On CO_2 Emission Reduction as Against the European Union Emission Trading Scheme (EU ETS)

It is predicted that CORSIA will be less costly for aircraft operators than the EU ETS-adopted Cap-and-Trade scheme, which is financially lucrative for the EU. Because of the incentive obtained, the EU ETS is used for the environmental and socioeconomic advantage of the EU community. Although it is known that CORSIA is inexpensive because offset programs are implemented in poor or developing countries, there is concern that the poor or developing countries' lack of internal control may jeopardize the verification of offset credit obtained and the effectiveness of implementing those projects (Strouhal, 2020). In contrast to market driven CORSIA programmes, the EU ETS is based on costs (Carlson et al., 2000). It is predicated on notions and rules that remain consistent across time. So, both present and future operators must comply with the same CO_2 emission baselines. Consequently, these two market-based systems are related but fundamentally unique.

Under the EU ETS, a limit on GHG emissions is imposed on European businesses. Businesses in Europe that want to pollute more than the allowed amount must either obtain licences from companies that emit less or reduce their production, raising the cost of producing GHGs for companies. Due to extensive air travel usage, the EU Commission asked the union to include aviation emissions in its ETS in 2012. Any aircraft arriving at or departing from an airport inside the European Economic Area (EEA) must be controlled under the EU ETS, irrespective of origin, destination, or airline country. The EU ETS limits aeroplane CO_2 emissions to ninety-seven percent of the 2004-2006 average in 2012, then to ninety-five percent annually from 2013 to 2020. (Eriksson, 2019). In April 2013, aircraft operators were required to submit emission allowances (permits) for flights entering or leaving EU airports the previous year. Free allowances covered eighty-two to eighty-five percent of airline operators' emissions in 2010. When an airline has extra licences, it may sell them to other airlines or keep them for future use. Additional permits may be sold to airlines in need by the EU, other airlines, other emission sources in the EU ETS, brokers, and global emission trading networks. A limited number of free licences will be available to airlines that are new or rapidly developing (Leggett et al., 2012).

In addition to international anger from nations such as the United States and China, the unilateral implementation of the EU ETS was considered to violate the 1944 Chicago Agreement. Consequently, the European Commission backed down. It restricted the proposal's scope (the "stop-the-clock" law) to cover only flights inside the EEA, regardless of the airline's home nation (Colantuono, 2021) (Fageda and Teixido, 2022). While CORSIA applies to all nations globally, ICAO members are not obligated to participate in the mandatory phase. According to Aakre and Hovis (2010), compliance rates for mandatory programmes are often lower than those for voluntary programmes (Eriksson, 2019). Consequently, starting with voluntary compliance offers factors that motivate higher participation than a forced compliance plan, such as self-interest for economic and environmental gain and the desire to do good.

CORSIA's MRV is the linchpin of their CO_2 reduction process's effectiveness. CORSIA MRV supports airlines and verification institutions in enhancing the veracity of emission reports and supporting ICAO and the public in maximizing the validity and dependability of data processing procedures for aviation carbon emission data. In addition, it assists in identifying violations of any kind, discrepancies in carbon emission reports, the promotion of issue resolution within the scheme, policy implementation, and the avoidance of recurrences of problems. CORSIA's MRV would not provide any environmental benefits or reduce the carbon intensity of the aviation industry. For instance, some impoverished countries with a substantial supply of offset credits need more expertise or capacity to regulate the offset credit system, which may result in the trading of credits that are not valid for inclusion as emission reductions (Tian et al., 2022).

Moreover, CORSIA is known to exclude some flights from certain nations under its regulations. For example, the offsetting criteria must apply to an aircraft operator that conducts international flights between member states. Thus, what happens when an international flight connects a participating state with a non-participating state? It also excludes domestic flights, which has a strange impact given that CORSIA standards do not restrict emissions on these routes. Hence, accepting the global plan would result in the need for appropriate laws for all domestic air travel in the participating countries. For the first three years, or until their yearly emissions surpass 0.1% of total 2020 emissions, whichever comes first, new entrants (airline operators) are immune from CORSIA offsetting obligations. It further explains why CORSIA has a limited impact on CO_2 reduction since CO_2 emissions may continue to grow. For the EU ETS, it could be argued that, despite some differences, the European countries share a common cultural and long-established administrative foundation, as opposed to the global scheme of CORSIA, which has an undetermined number of participating States, resulting in a greater administrative capacity (Colantuono, 2019).

Notwithstanding the incompatibilities between the two schemes, the EU Commission has chosen to adopt CORSIA, even though it may result in a regulatory change in the aviation sector inside the EU and a violation of the EU's Paris Agreement responsibilities. The EU agreed to participate in CORSIA because it brings together different types of actors who are all believed to play essential roles in emission reduction. These actors include national or regional actors and local actors, businesses, and civil society, all expected to contribute to emission reduction in general. The Commission expects non-state entities with various interests to contribute to emission reduction (Eriksson, 2019).

CHAPTER FIVE

CHALLENGES OF REGULATING AVIATION EMISSION THROUGH CORSIA

Since sectoral marginal abatement costs are quite large, carbon offsetting is a possible second-best option in aviation (Wozny et al., 2022). Nevertheless, carbon offsetting is very complex and requires a considerable body of rules, supported by transparency and enforcement, to ensure effective operation. Given aviation's impact on the environment, GHG reduction measures must be sufficiently effective. Failing to do so would jeopardize the goal of the Paris Agreement to limit global warming to 1.5 degrees Celsius. Moreover, whether ICAO's own mechanisms can generate such a strong carbon market is doubtful. CORSIA is voluntary, which means that governments are not required to join if they do not choose to, and they may leave CORSIA at any time with a six-month notice. Hence, determining who would be liable for existing disadvantages under the system becomes a compliance challenge (the state or the airline operator). If ICAO cannot identify culpability, the compliance system will collapse. The following obstacles are identified to hinder the efficiency of the scheme: -

5.1 The Nature of Voluntary Participation:

CORSIA's MRV requirement may be hindered by the voluntary nature of the plan. States may implement CORSIA differently if they so choose, either by submitting a reservation to the assembly resolution creating the scheme or by submitting a difference to the SARPs and, as a result, by implementing various features of the SARPs. Hence, this implementation freedom, which should be a benefit, might be a drawback if states file differently, resulting in a lack of consistency and confusion. Moreover, it involves the reporting and tracking of emissions. To preserve the integrity of the program, operators must adhere to comparable MRV emission standards. Enabling multiple nations to monitor and report emissions necessitates more consistent reporting. This might result in anomalies in emission figures that reduce the scheme's effectiveness *(Why ICAO and CORSIA Cannot Deliver on Climate, 2019).*

5.2 Inadequate Data Management Facility:

In addition, the most prominent obstacles to the MRV requirement are a lack of adequate data retention and administration, the use of quality control techniques, and the use of a methodology to assess the uncertainty of such data. Due to the political rewards available in the state, an operator may be forced to submit an emission report for monitoring purposes. Because the state is responsible for monitoring and maintaining massive fuel consumption inventories on international routes, some airline operators are more likely to submit the proper record for their profit-making, or the entire process can be politically manipulated *(Assembly -40th Session Executive Committee Agenda Item 17: Environmental Protection - Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), n.d.)*.

Another reason for such a failure might be the cost of maintaining governments' and airlines' systems to handle the exponential increase in the amount of data that must be collected, evaluated, and reported for carbon offsetting. Data management would benefit more from a focus on establishing capacity and strategic transformation. Considering the complexities of CORSIA's enormous data management and reporting requirements, discovering non-scheduled operators that fit CORSIA's criteria is a significant undertaking. Due to the unpredictability of their actions on international routes, the threshold value might change at any time, making it impossible to keep track of these operators (Guan et al., 2022).

5.3 Lack of Binding Enforcement:

Enforcement of the CORSIA scheme is challenging, as there is no global regulator with the power to enforce compliance. Thus, ICAO's needs to be ordered to implements its actions to fulfil its role. Even though ICAO's mandate is to "protect and promote international aviation safety and security," which is outside the scope of climate change, compared to the UNFCC's mandate for GHG reduction, the lack of legal guidance to hold states or airline operators accountable for enforcing CORSIA SARPs shall pose a high risk of non-compliance *(Assembly -40th Session Executive Committee Agenda Item 17: Environmental Protection -Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), n.d.)* (Guan et al., 2022). If an operator fails to cancel enough qualified carbon offset units to meet its commitments, it should face legal and financial repercussions. CORSIA's success relies on the number of offsets utilized, hence it needs a force (Wozny et al., 2022). ICAO's lack of an enforcement mechanism is due to their inexperience in international agreements. Hence, created SARPs to advise member states but need additional alternatives for mandated adoption (Guan et al., 2022).

5.4 Lack of Regulatory Integrity of the Eligible Carbon Offset Programs:

The EUC evaluation requirement, which was implemented to evaluate offset programs against the initial difficulty of proving that a project only occurred because of offset revenues generated, or that the emission reduction is accurately estimated, permanent, or replaces an emission reduction that would have occurred elsewhere, presents significant obstacles. It is still maintained that the bulk of carbon credits are not environmentally sound, notwithstanding the criteria analysis and TAB's advise. In addition, this was necessitated by the need for TAB evaluation methods to be more uniform across all EUCs. To guarantee additionality, emission reductions or removals from a project are included if the project would have been completed even without the incentive given by carbon credits. Yet, since the additionality requirement varies across programs, quantifying the net carbon reductions via offsets is challenging (Broekhoff et al., 2020).

The climate effect of carbon offsets is dependent on whether or not the project would have occurred without the offsets. If the project had been implemented, the offset plan would not have reduced emissions; hence, they would not have been contributed. The additionality issue, created by uneven information and baseline uncertainty, affects all project types. To assure the additionality of nature-based solutions, for instance, a precise baseline indicating the quantity of emissions that would have occurred in the absence of this project is necessary. In the case of forest-based carbon storage, baseline uncertainty is relatively high due to the fact that inappropriate tree planting may cause carbon-rich soils to emit more carbon into the atmosphere than they absorb (Wozny et al., 2022) (West et al., 2020).

Non-permanence and carbon leakage are an additional concern with the EUC criterion. Yet, there are issues unique to reforestation and land-use sector programs. There is the concern and danger of a recurrence and a reversal in emission reduction. For instance, in the case of a forest fire, the release of carbon into the atmosphere (carbon leakage) exacerbates climate change concerns, resulting in the failure to meet the zero net reduction objective. Hence, the possibility of such reversals grows as the consequences of climate change become more severe. In another instance of drought, for instance, the permanence criterion is tested by human activities and natural forces. The greater the attractiveness of reforestation land for agricultural production, the greater the likelihood that unprotected forests will be chopped down as a replacement carbon sink. Thus, climatic integrity is greater in places with degraded land that is not used for agriculture (Wozny et al., 2022) (Chagas et al., 2019) (Schneider & Wissner, 2022).

Yet, it is shown that a firm guarantee for long-term biological carbon is beyond the capabilities of most carbon offsetting programs outlined in the preceding section. The ICAO's present strategy to tackling non-permanence must adequately account for these threats and has serious flaws. Thus, the EUC must be substantially reinforced. Small-scale forest programs should be prioritized given that large-scale forest programs, for instance, are more difficult to control and predict due to the size of territories, political priority shifts, fluctuations in the price of agricultural commodities, and variations in government budgetary spending on forest protection. These weaknesses in the methodology of EUC programs might significantly damage the environmental impact and economic efficacy of CORSIA if the long-term effects of CO_2 emissions from aviation are not considered (Schneider & Wissner, 2022).

5.5 Baseline adjustment and Price Volatility Issue:

Beyond the realm of verification standards, there are several other problems that must be resolved. One is the reduction of the standard baseline from 2020 to 2019. This reduction has resulted into a surplus of carbon offset credit availability during the pilot program's phase owing to the decrease in aircraft traffic caused by COVID-19. Thus, resulting into having more than twice as many offsets as needed to cover airlines' demand in the pilot phase. This issue then demonstrates that this oversupply of offsets will never lead to a price increase in carbon credit because there will always be enough cheap credits to cover demand, if there is any demand *(CORSIA: Worst Option for the Climate Briefing on Assessment of ICAO's Offsetting Scheme, 2021)*.

The price of carbon offset can therefore be volatile, and it can lead to a risk of low-price discouraging investment in carbon reduction projects. While high prices may increase the cost of air travel and affect demand. Similarly, an oversupply of carbon credits might lead to a problem known as double counting. Double counting occurs when the same emission reduction or removal is tallied several times to meet climate mitigation goals (Schneider et al., 2019). Since the conclusion of the Paris Agreement, every state is required to have a reduction target to combat climate change, and double counting is likely to occur in scenarios involving double issuance of carbon credits, double use of carbon credits, or double claiming of the same emissions reduction or removal by both the country where the emission reductions occur and the buyer of carbon credits (Schneider & Wissner, 2022).

Nevertheless, governments must ensure that they cannot use the authorized EUC for emission reductions to satisfy their NDCs to prevent double counting. Because the parties haven't agreed on a methodology or criteria, it's unclear how duplicate counting may be avoided. Hence, offset carbon reductions must not count toward the host country's Paris deal goal. However, most ICAO-approved applications lack suitable procedures, regulations, or mechanisms to avoid the three forms of duplicate counting. Nonetheless, it has been urged that ICAO follow the best practices integrated into the Paris Agreement, defining the type of host country authorizations necessary to transfer emissions units to CORSIA and what information must be supplied in host country letters of authorisation to be approved (Schneider & Wissner, 2022) (Broekhoff et al., 2020).

5.6 Lack of Production Guidelines for Eligible SAF and Exclusion of Non-CO_2:

Generating "CORSIA-eligible fuels" may increase pollutant exposure (alternative fuel). Yet, the ICAO should set manufacturing standards for these alternative fuels to reduce pollution as they have lower GHG emissions (ICAO Document, 2022). However, these rules must be changed. Alternative fuels must emit 10% less than kerosene, for instance. These figures are questionable, thus other fuels may release more than kerosene. However, 10% is a small emission reduction compared to the Paris Accord's drastic reduction. CORSIA risks blaming alternative fuels for failing to reduce real-time emissions *(Why ICAO and CORSIA Cannot Deliver on Climate, 2019)*.

The exclusion of non-CO_2 emissions does not improve aviation emission reductions and CORSIA effectiveness. CORSIA's exclusive focus on CO_2 emissions is well-known. As described in section one, the true effect of aviation on climate change is the combination of CO_2 and non-CO_2 emissions. Non-CO_2 emissions result in a net warming effect on the climate. Depending on the criteria used to compare these climatic impacts, it is estimated that they account for approximately two-thirds of aviation's net global radiative forcing (Lee et al., 2021). In light of this, the ICAO probe is significant. In addition, the elimination of non-CO_2 makes it hard for aircraft to distinguish between CO_2 and other greenhouse gases generated in order to get offset credit in their emission estimates. This omission would put doubt on the predicted percentage of emissions reductions after the scheme's implementation.

As research provides technical and operational techniques, CORSIA has the ability to address non-CO_2 emissions. These strategies include the use of fuels and combustion procedures that create less non-CO_2 emissions, as well as the avoidance of geographical or temporal regions where non-CO_2 consequences are more likely to occur. CORSIA already has one, such as a rule mandating the use of SAF and the establishment of a no-fly zone (Schneider & Wissner, 2022). Given the significance of non-CO_2 effects, it is strongly recommended that ICAO begin addressing their inclusion if it continues to pursue its long-term goal of net zero, either by implementing the recommended policies or by adding a multiplier to CO_2 emissions to account for the additional climate impact of non-CO_2 effects (Graichen & Graichen, 2020).

5.7 Lack of Transparency:

This paper's last criticism with the CORSIA system is the unpredictability of the number of foreign participants, which may rise or decrease, and ICAO's lack of openness, which may prevent the program from reaching its aim. CORSIA must cover emissions globally to mitigate the scheme's environmental impact. Nevertheless, the analysis suggests that foreign nations representing substantial percentages of aircraft emissions, such as China, Russia, and India, are unlikely to apply CORSIA bindingly, again demonstrating its ineffectiveness in controlling aviation emissions. However, ICAO is unlikely to get the freedom to publish some necessary information for compliance verification and public knowledge, such as the ratio of alternative fuels to emissions units surrendered for compliance, the type of offsets surrendered, and whether airlines have surrendered enough offsets. Countries should publicize each airline's final offsetting needs and emissions unit surrenders, but they don't have to. Hence, it cannot be ensured that all carbon credits utilized to offset the actual rise in international aviation emissions precisely represent genuine and permanent emission reductions that would not have happened and are of high environmental integrity. ICAO's CORSIA program and its role in addressing aviation's climate effect are called into doubt by its lack of transparency and failure to enforce its standards *(CORSIA: Worst Choice for the Climate Briefing on Evaluation of ICAO's Offsetting Scheme, 2021)*.

CHAPTER SIX

THE SIGNIFICANT NEED FOR A MANDATORY MEASURE AGAINST A DISCRETIONARY MEASURE

There is consensus that the CORSIA system will not result in the degree of carbon reductions that the world needs immediately. This highlights the urgent need for more aggressive reduction goals, since the commitments made under the Paris Agreement are insufficient to limit warming to two degrees Celsius. There is no research detailing the benefits of implementing such a strategy inside CORSIA.

To see why, we must go further into the politics of carbon pricing to eliminate the obstacle to its implementation. Experts have urged that carbon pricing be adopted in conjunction with other policies, despite the fact that the majority of governments prioritize carbon pricing above investments in renewable energy and other climate efforts (Bergquist et al., 2020). In accordance with the previous scholar's suggestion that depending alone on carbon price might deliver the quick solution that the global system desires by 2050, it is possible that relying purely on carbon price will be the most expedient solution. Yet, a single mandated carbon price marketplace for regulated industrial sectors with carbon-neutral aspirations, especially the aviation industry, looking to achieve compliance duties would enable credit trades to occur in seconds as opposed to weeks of bilateral discussions.

This strategy will increase market liquidity, therefore inviting investors to level playing fields. While it is possible to claim that CORSIA is an umbrella for all nations, the scheme's voluntary, opt-in basis does not suggest this. This section analyses the difference between a mandatory approach and voluntary governance approach, as well as the benefit and reason for the suggested chosen practice. It highlights that best practice standards need mandatory ways of governance at the present time.

The definition of obligatory regulations is legally assigned norms with consequences for noncompliance. While the word "voluntary" refers to a company's choice to employ corporate governance processes or standards in the absence of a legislative requirement, "voluntary" does not imply that corporate governance procedures or standards are optional (Anand, 2005). Following the nature and premise of addressing climate change problems, regulation has always adopted a voluntary approach, making the resolution of climate change issues less straightforward due to the ambiguity of scientific statistics and political objectives. If more governments or businesses adopt these techniques of governance, these regulations may become the norm for most businesses. According to academics and elected officials, such a regulatory model encourages long-term compliance. In the initial year of a voluntary regime, only a limited number of enterprises and governments are expected to adhere to the voluntary code. Yet, a 2019 analysis by Zürich & Siemon indicated that few candidates to the CORSIA system had satisfied the ICAO criterion over time. Many individuals did not meet the requirements and are likely not interested in the program.

The conventional legal framework for each regulated activity consists of a set of regulations prescribing certain conduct, accompanied by consequences for lawbreakers. This paradigm, which assumes that the fundamental motivation for compliance is fear of repercussions for noncompliance, may be referred to as a "command-and-control" structure. A key benefit of the required structure is that it enables ICAO to define minimum requirements that market players must adhere to. If the ICAO's mission compels it to provide safety regulation and environmental protection in the aviation industry, it will attempt to accomplish this purpose. One of the ways it will accomplish this is by enacting obligatory legislation, which will allow it to achieve its goal directly, since market players will be pushed to comply if they do not desire to face regulatory fines for noncompliance. In contrast, entirely voluntary law offers no assurances that the basic governance criteria specified by the state will be met (Anand, 2005).

There are also societal advantages to having the option of an obligatory rule. An important one is a robust and stable international aviation business that provides a great economic market for the CORSIA plan. This strategy promotes the development of the offsetting program in developing countries by contributing to the expansion of their financial markets, the creation of employment opportunities, and the provision of necessities such as food and shelter. Traditionally, the command-and-control system has adopted universal standards to protect environmental quality utilizing technology-based or performance-based methodologies, since it ensures consistency of compliance and predictability. As with the previous two stages of CORSIA, noncompliance is anticipated to be a serious shortcoming of voluntary regimes. Even if it contains an obligatory segment beginning in 2027, there must be confidence that governments and other market participants would adhere to it as there is no penalty for noncompliance. Hence, it results in an uneven compliance rate over the duration of scheme implementation. Contrary to the rigid character of a required action, there is no question that a voluntary method is adaptable for the purpose of being cost-effective and capable of adjusting to any essential social change. But statutory regulations do not need to necessitate social movements to exert pressure on businesses to comply with them; businesses might choose not to join and remain uninvolved (Anand, 2005).

An additional advantage of executing a necessary strategy to tackle environmental problems in the aviation industry is the chance to remove negative externalities produced by market behaviour (Field, 2017). Coase (1960) and Hardin (1968) verified that obligatory regulation is essential in a world of imperfect knowledge and transaction costs, and that societies would suffer a tragedy of the commons in the absence of a binding rule, in which the world's natural amenities are quickly depleted (Aragn-Correa et al., 2020). Yet, the need of a contractual agreement has also been questioned due to gaps in the application of legislation and corporate participation in the political process (Stigler, 1975). Nonetheless, the great majority of management studies concur that mandated environmental legislation has had a significant impact on the environmental performance of businesses (Testa et al., 2018). Examples from domestic law, such as the Clean Air Act of 1970 in the United States, illustrate how sanctions and the loss of legitimacy for noncompliance with these criteria have been effective engines for attaining improved environmental performance (Aragn-Correa et al., 2020).

To eliminate the constraint technique of the command-and-control mechanism, a market-based approach is used. Nonetheless, it is better to contemplate the possibility of governments and airlines preferring short-term profits above environmental measures. Their environmental obligations are limited to avoiding reputational harm (Aragn-Correa et al., 2020). However, investigating climate change is necessary to counteract the risk that lies in the future, regardless of scientific uncertainty. As a result, we must not allow regulatory ambiguity to act as a barrier to environmental progress. After analysing the CORSIA pilot phase in 2023, ICAO could consider completely incorporating a comprehensive alternative option known as sustainable transition policy (STP).

STP is based on the idea that a low-carbon transition will necessitate several concurrent societal and technological transformations (Rosenbloom et al., 2020). STP stresses quick and effective emission reductions, system change and radical innovation, the creation of contextsensitive solutions, and decarbonization's intrinsic political aspect. The implications of STP examination would concentrate regulatory decision-making on states on associated developments in technology, business models, and practices—all of which jointly drive potential decarbonization trajectories for sociotechnical systems under circumstances of complexity and unpredictability. Moreover, it enables established and enforceable requirements to accelerate the progress of reaching the 2050 targets. STP is concerned with decline and innovation in general. To put it another way, it entails policies to encourage and scale up low-carbon innovations, as well as policies to put pressure on carbon-intensive goods, services, and behaviours to hasten their eventual extinction, and as a result, the political barriers to the efficacy of carbon pricing and mandatory regulation would be reduced (Rosenbloom et al., 2020) (Fischer & Jacobsen, 2021).

In conclusion, for the suggested regulatory approach to be effective, it is necessary to devise a monitoring panel that can receive complaints and identify answers to the corresponding issues. This avoids the reaction against any administration that takes an unorthodox approach to the subject of climate change, which is one of the benefits. It would encourage practical collaboration and policy coordination via platforms formed by nations, international organizations, corporations in sectors subject to GHG regulations, and non-governmental organizations.

CHAPTER SEVEN

SUMMARY, CONCLUSION AND FURTHER RECOMMENDATION

By generating CO_2 and other climate-relevant species such as NOx, H_2O, and soot, as well as contrails and contrail cirrus, air transport contributes to anthropogenic global warming. Even though air transport's overall contribution to global warming is predicted to be relatively minor, this proportion is likely to expand owing to the sector's huge growth rates. CORSIA was adopted in the 2016 ICAO Assembly to reduce CO_2 emissions from aviation. CORSIA is the world's first worldwide strategy to regulate CO_2 emissions from aviation. Although it is a welcome start toward decreasing the environmental impact of aviation emissions, various issues may restrict its efficacy or implementation in light of CORSIA's environmental goals.

Several of the measures for maintaining a strong verification quality on its EUCs criteria do not ensure the environmental integrity of the produced carbon credits. Additional criticisms include the scheme's limited reach, since it only applies to foreign flights, leaving domestic aviation emissions ignored; the scheme's voluntary nature, which weakens its efficacy; and the need for more transparency. To address these difficulties, international collaboration, and a commitment to lowering carbon emissions from air travel will be required. Rather than relying on governments' and airlines' desire to join, making membership mandatory would boost the scheme's effect and efficiency in cutting carbon emissions. It would increase openness and reporting requirements by ensuring compliance with the scheme's commitments and providing more accountability.

Apart from arguing the necessity for urgent required obligations, a set of recommendations to remedy the problem of duplicate counting is being developed to further assure the improvement and regulatory integrity of CORSIA. The ICAO should have a design structure that distinguishes CORISA's EUCs from other market-based carbon credits. Central to its mandate, the ICAO can play a more significant role by increasing transparency, such that it should seek to establish an open-source international aviation data centre that provides researchers and practitioners worldwide with an open platform to perform relevant international aviation data analytics and to increase scientific peer-reviewed publications in scientific journals and conferences, while addressing CORSIA's objectives and evolution as it progresses (Guan, 2022). Carbon offset certificates are known to be deceptive and may have a negative impact on communities if they do not reflect appropriate GHG reduction. Because of this problem, the ICAO devised verification standards to certify chosen qualified offset schemes. As a result, it is further recommended to ICAO that, while selecting programs based on TAB recommendations, evaluate the programs' environmental, economic, and social aspects, as well as their advantages in these areas.

It is strongly recommended that the ICAO facilitate the collection and dissemination of information about carbon offsetting mechanisms that are specific to the international aviation industry. By adhering to these recommendations, ICAO will be able to make well-informed decisions regarding the reduction of emissions in the international aviation sector through carbon offsetting mechanisms and will be able to support practical offset projects that contribute to global efforts to mitigate climate change. Nevertheless, to implement any of the recommended strategies, ICAO would have to engage in drawn-out negotiations. The length of these negotiations would be determined by the results of the pilot project as well as the first phase of the scheme's implementation year. After the evaluation of the pilot phase, which is scheduled to take place by the end of this year, 2023, a change is expected to be implemented, which gives us something to look forward to.

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