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Examining the financial effect of net zero carbon emissions goal on Kenyan airlines.

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EXAMINING THE FINANCIAL EFFECT OF NET ZERO CARBON EMISSIONS GOAL ON KENYAN AIRLINES

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other university.

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May 2024

Approval

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ABSTRACT

Despite the adverse effects of aviation on the environment caused by the increase in global air traffic, there has been limited policy locally to mitigate carbon emissions. This was discussed on a global platform in October 2022 that culminated in an adoption of a long-term global aspirational goal (LTAG) of achieving a neutral carbon emissions goal by 2050. The roadmaps to net zero address two key points: reducing the amount of energy needed to fly and substituting the fuel used in aviation. Unfortunately, current national plans are behind schedule on achieving these milestones. This study specifically examined the impact of the LTAG net-zero goal on the local aviation sector and the effect of technological advancements, operational changes and implementation of sustainable aviation fuel on an airline's overall costs. This study was anchored on the Porter hypothesis which defines the impact of environmental regulation on business performance and the contingent resource-based theory that defines the correlation between a firm's strategy for managing how its activities interface with the environment and its competitive advantage. It was based on a pragmatic research philosophy in examining the relationships between the study variables while integrating qualitative and quantitative research methods to glean various perspectives on the research problem. The current research used on a mixed research approach with structured and semi-structured questionnaires that was instrumental in examining the causal link between ICAO LTAG recommendations and airline costs by gathering data from questionnaires and interviewing key experts in aviation management. The study population was drawn from the 69 local airlines. The sample study was 138 respondents who hold senior management positions in the airlines. A combination of primary and secondary data was utilized in this research. The secondary data was obtained from the Kenya Airports Authority (KAA), KCAA, aeronautical business reports and journals. The study employed standard deviation, means, regression and correlation analysis. The correlation analysis showed that technical improvement, operational improvement and SAF implementation all had a weak positive significant relationship with the airline costs in Kenya. Results from the regression analysis revealed that net zero carbon emission goal explained 36.7% of the airline costs in the Kenyan aviation industry. The study further found that technological improvement positively and significantly contributes to improved airline costs. The analysis also revealed that operational improvements had a positive and significant effect on airline costs in the Kenyan aviation industry. Lastly, the findings on the third variable revealed an insignificant effect of sustainable aviation fuel implementation on the airline costs in the Kenyan aviation industry. The study recommends that airlines should consider aviation emissions when undertaking fleet upgrades, aiming to incorporate more

environmentally friendly technologies. The study also recommends continued investment of resources in optimizing operational processes as improvement of these operations lead to an increase in the airline's margin. The study further recommends an increase in government support and incentives which may be necessary to facilitate the transition to SAF and alleviate the financial burden on airlines.

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DEFINITION OF KEY TERMS

Drop-in Fuels These are fuels produced from biological products and are compatible with current aircraft models.

Emissions These are the by-products of burning jet fuel from aircraft and include CO_2, water vapor, nitrogen oxides, oxides of sulphur, carbon monoxide and unburnt hydrocarbons.

Environmental Regulations This refers to guidelines provided by global aviation bodies and local aviation authorities on the control of emissions.

Fleet Modernization This refers to the purchase or lease of aircraft with modern technology.

Long-Term Achievement Goal This comprises of a combination of measures put in place to tackle emissions from global aviation.

Non-drop-in fuels This refers to biofuels that can only be used in aircraft after it is modified.

Propulsion system This refers to the engine and the related hardware that provides thrust to move an aircraft.

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
GHG	Greenhouse gases
ICAO	International Civil aviation Organization
ICCT	International Council on Clean Transportation
KCAA	Kenya Civil Aviation Authority
LCAF	Low Carbon Aviation Fuel
LTAG	Long-Term Aspirational Goal
SAF	Sustainable Aviation Fuel

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Air traffic has been recovering gradually since the pandemic and is expected to exceed pre-COVID levels by 2025. World passenger traffic is also projected to increase at an average yearly rate of 3.2% within the next two decades (Airbus, 2023). This rapid growth to meet increasing demand (Air Transport Action Group, 2020) creates an environmental challenge since aviation emissions account for 2.4% of man-made carbon emissions (Graver, 2019). Aviation's impact on climate change is now more evident and will definitely shape the industry's future (Lee et al., 2021). The decarbonization rate of the aviation sector has been lagging behind the growth in demand for air travel and the combination of these two trends could increase aviation's carbon footprint (ICCT, 2023).

Airlines will therefore need to prepare for the future by embracing sustainability measures proposed by the International Civil Aviation Organization (ICAO) to achieve net zero emissions by 2050 (ICAO, 2022). ICAO is a body within the United Nations tasked with developing standards and enabling the development of international air transport to ensure safe and sustainable growth (ICAO, 2021). The innovative level of aviation technology, the requirement to guarantee passenger safety and the global nature of aviation have all led to demands for more intricate and extensive safeguards and regulations. ICAO formulated three strategic objectives that guide its mandate of ensuring optimum safety, security, and sustainability through adoption of economically viable development of international civil aviation while mitigating its effect on the environment (ICAO, 2013).

Kenya formally became a member of ICAO on 1st May 1964 after ratifying the Chicago Convention. The stipulations ICAO standards contain are used by the Kenya Civil Aviation Authority (KCAA) to draft national laws. It was established on 24th October 2002 by an Act of Parliament and its core functions are to develop, regulate and ensure safe and cost-effective commercial aviation operations in Kenya (KCAA, 2021).

Net-zero is a term that originated in climate research but it is currently expanding to the social sciences as its political, economic and social aspects are studied. The Intergovernmental Panel on Climate Change (IPCC) defined net-zero as the state attained when human-caused carbon emissions to the atmosphere are balanced by anthropogenic removals over a defined period

(IPCC, 2018). The proposed strategies in achieving net-zero are increasing the fuel efficiency of aircraft, incorporating operational improvements and developing sustainable aviation fuels (SAF) (ICCT, 2023). The greatest reduction in emissions by 65% is attributed to SAF. However, it is three times more expensive than jet fuel and since fuel accounts for almost 30% of an airline's operating expenses, profitability will be impacted (IATA, 2023). The high valuation of SAF is attributed to the value of feedstocks, cost of conversion processes and limited supply (Bergero, 2023). Aviation demand is inelastic and therefore airlines will find it difficult to pass this additional cost of SAF to the consumer (Bharucha, 2016).

1.1.1 Decarbonization Overview

Actions taken to reduce the ecological impacts of aviation emissions have traditionally been anchored on energy intensity measures- technological and operational approaches to improve fuel consumption (ICAO, 2017), industry driven measures to decrease carbon emissions (World Bank, 2023), or emission intensity measures which include the adoption of biofuels (Staples et al, 2018). Aviation is an important pillar in economic growth since it enables tourism, facilitates trade, connects people through several city pairs, and is also a major employer (Graham, 2020). Growth can be defined in terms of income generated, value added (as perceived by the customer), and expansion in terms of trading volumes or market capitalization. Business growth can be explained using different theories. One category addresses the effect of company size and period of existence on growth (Coad, 2016) and the second addresses the influence of variables such as strategy, political climate, regulations, and the values of owners (Eshima, 2013).

The growth of the aviation sector and its increasing contribution to Kenya's economy, which stands at 4.6% of the country's GDP (IATA, 2019), has cast a spotlight on its share in carbon emissions. The figure below shows the Kenyan air traffic trends in the last decade for both international and local flights (KCAA, 2024) which signify an increase in emissions contributed by aviation. There is therefore a need for management in local airlines to proactively evaluate the regulatory environment and plan for investments required in reducing the greenhouse gas foot print of aviation (Brown & Kline, 2020).

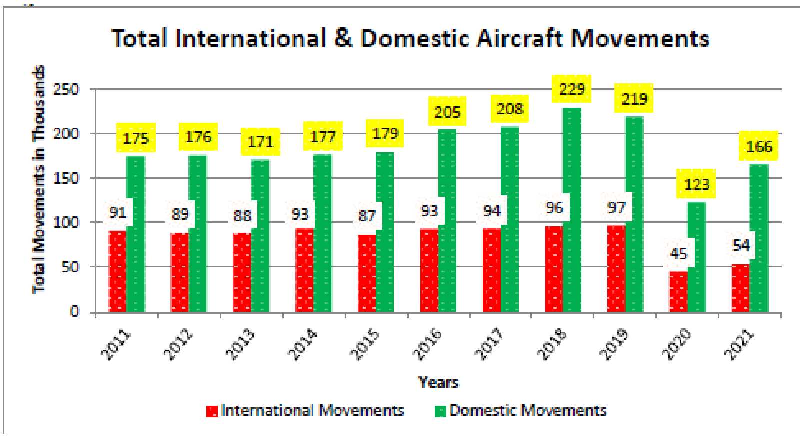

Figure 1.1 Total Aircraft Traffic in Kenya

The 2010 ICAO Assembly agreed to adopt the existing goals for the international aviation sector of 2% annual fuel efficiency improvements through to 2050, and carbon neutral growth from 2020 onwards. Establishing these goals had an impact on the progress of aviation response to climate change (ICAO Secretariat, 2022). The 41st ICAO Assembly held in Montreal from 27th – 7th October 2022 was a follow up to discuss the main agenda from the 40th session of March 2020 - viability of a long-term aspirational goal (LTAG) for international aviation carbon emissions reductions. It is therefore an appropriate time to analyse the ramifications of these policies for the Kenyan aviation industry considering the extent of decarbonisation regulations.

The emissions reduction targets and the goal of the global aviation industry should therefore comply with the principle of Common but Differentiated Responsibilities (CBDR) and consider the respective capabilities of developing countries. (ATD Fourth World, 2014). Airlines in these countries need to be more sensitized on the environmental impact of their operations and mitigation measures for sustainability and net zero emissions. The achievement of these goals will depend on the combined effect of the various CO_2 emissions reduction measures and innovations, including the fast-tracked adoption of new aircraft technologies, efficient flight operations, and the increased production and usage of sustainable aviation fuels (SAF) (ICAO, 2022). (See Appendix VI)

Mayer and Ding, (2023) conducted a study on the strategies that have been executed to mitigate civil aviation emissions both globally and locally and concluded that the international inititaives have not been as effective as national initiatives. The domestic proposals include ticket taxes, carbon pricing, sectoral governance and national target and technical standards adoption. According to the study, these proposals provide the best opportunity for effective mitigation action. The current study provided insight from Kenyan airlines on the impact of the net zero goals and valuable data to KCAA for the execution of Kenya's action plan for the reduction of carbon emissions in the aviation sector.

1.1.2 SAF Implementation

The LTAG assessment on fuels considered three categories: Drop-in fuels based on renewable resources, petroleum-based lower carbon aviation fuels (LCAF) and non-drop-in fuels which need modifications to aircraft and fuelling infrastructure (ICAO Secretariat, 2022). Alternative fuel must meet strict standards to be deemed sustainable: produce no or little emissions, preclude exhaustion of natural resources, and advance local social and economic development (Feray, 2023).

Prior to certification for aircraft use, the economic feasibility of converting biomass into liquid fuel that meets current jet engine designs needs to be established (Seamus et al, 2017). SAF implementation will also require infrastructure investment in airports, adoption of government policies, offtake agreements with SAF suppliers, certification of conversion processes and certification of commercial flights (Yilmaz, 2017). This explains why there are only five airports that have consistent SAF supply (Le Feuvre, 2019).

Airlines will have difficulty in justifying the additional SAF costs; the net cost must not exceed the cost of fossil-based jet fuel over a contract cycle. Wadud, (2015) undertook a study on this and identified evidence of asymmetries of pass-through from fuel prices to ticket prices. This affirms the problem that airlines need to tackle in determining whether or not to invest in SAF since it would potentially lead to reduction in demand due to increased airfare. Çabuk et. al, (2019) conducted a survey on passenger attitude and sustainability and concluded that only those in the high income group are more likely to be positive towards green airline opertaions, hence the need for airlines to align their green marketing activities with the correct focus group.

On 11th May 2023, Kenya Airways participated in the second edition of the Sustainable Flight Challenge, a Sky Team Alliance project. As part of the initiative, KQ piloted the use of SAF on a return flight between Nairobi and Amsterdam on 25th May 2023 (KQ, 2023). Jambojet took part in the initiative as well on 26th May and operated the most sustainable flight from Nairobi to Mombasa (Jambojet, 2023). This is an important step in preparation for SAF implementation since there has been recent legislation in EU policy approaches to advance its production and mandate utilization by airlines. This puts a strain on airlines' finances especially if there is a lack of allocation of funds to reduce the price gap between SAF and conventional jet fuel. The current research supplemented the data and insights from these local initiatives and will assist in informing policy decisions and regulatory frameworks.

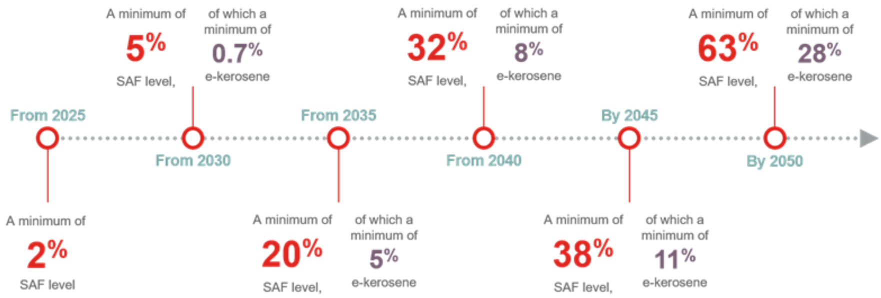

Figure 1.2 SAF Blending Quota

The SAF blending quota will commence with 2% in 2025 and increase to 5% in 2030 as shown in Figure 1.2. Every flight leaving the larger EU airports will have to carry a minimum amount of SAF, regardless of whether the airline is an EU airline or not (EASA, 2023). There are discussions ongoing in the UK and US to mandate SAF uptake in air transport. The regulations will also have a sub-mandate ensuring that a certain amount of SAF used are synthetic fuels (or e-fuels) (International Transport Forum, 2023). The SAF market is still in its infancy stages, hence there is a supply constraint that consequently results in higher prices. However, the production costs are expected to reduce over the next three decades and with proper policies, SAF will benefit from scale effects (McKinsey, 2020).

1.1.3 Technological Advancements

Aviation currently relies on fossil fuels and with innovative solutions such as fully electric aircraft still decades away (Epstein, 2019), manufacturers are making strides in aircraft and engine technology to improve fuel efficiency. Improvements in technology for CO_2 reduction are classified under: airframe – structures and aerodynamics, propulsion system - fuel efficient engines and advanced concepts and energy storage – hydrogen and electric aircraft concepts. To mitigate the environmental impacts, it would therefore be prudent for airlines to budget for fleet modernization (Miyoshi C. , 2016).

Fuel accounts for 25% of an airline’s expenses and a third of the global airline industry’s expenses. Fleet modernization is expected to improve an airline’s margin by reducing fuel consumption even though finance-related costs will increase (IATA, 2022). Kenyan national airlines have forecasted a mean annual fuel efficiency improvement of 0.7% for both domestic and international flights between 2022 and 2030 through additional fleet upgrades (KCAA, 2022).

Measures undertaken by airlines to reduce fuel consumption are divided into medium-term and long-term. The former includes upgrading current aircraft and modifying enhancements while the latter involves new aircraft or entry into service of new concepts in aircraft/engines. There is a production backlog of over 8,000 new aircraft from the major aircraft manufacturers that are expected to be part of the worldwide fleet over the next few years, signifying on-going advances in fleet efficiency (Air Transport Action Group, 2019).

In their work on factors determining airline fuel consumption and carbon emissions, Brueckner and Abreu, (2017), established that there is a strong linear relationship between fuel efficiency and passenger aircraft size, with a higher coefficient for single aisle than twin-aisle aircraft. The study also provided insights on how variations in an airline's fleet and operating characteristics affect fuel usage and level of carbon emissions. Babuder et. al. (2023) carried out research on the impact of sustainable aircraft technologies on operating network which comprised of airline operations, airport operations, and airport architecture. The study employed a qualitative research approach and was based on the collection of qualitative data through semi-structured interviews with aviation industry experts in both the European and American markets. The research, however, defined technology as hydrogen and electric aircraft concepts which are not yet available in the African market. The current research explored it from a fleet modernization point of view.

1.1.4 Operational Improvements

This category reflects changes to air traffic management (ATM) procedures and improvements to infrastructure and operations aimed at attaining a sustainable and efficient system. Examples of flight operation initiatives are single engine taxi, continual descent approaches, minimal reverse on landing, and automation of fuel efficiency solution system (KCAA, 2024). Ashok, (2016) in his study on the relationship between emisisons and aircraft operations at airports, concluded that pushback control strategy is effective in mitigating the environmental impacts of taxi operations at airports. He also established how derated takeoffs reduce NOx emissions and minimize fuel burn.

There has been limited research done on policies for reducing carbon emissions in airports despite the carbon footprint of their operations. Airport emissions, unlike those from aircraft, are fixed and released at ground level causing more damage to the environment. Budd et. al. (2023) carried out a study on the net zero startegies of the UK's 25 largest airports to assess their net zero readiness. Their research showed that while UK airports had awareness of the importance of net zero, they were still in the early stages of developing net zero strategies.

The costs incurred were apparent in infrastructure upgrades, investigation on testing and certification of new efficiency measures, implementation of the Aviation System Block Upgrades (ASBUs), research on operational procedure improvements and pursuit of aviation system engagement on new procedures and techniques for air traffic management. The ASBU concept is the technical roadmap for the aviation industry to facilitate the projected growth and ensure that ground and air infrastructure and equipment can accommodate the increase in aircraft and passenger traffic (ICAO, 2021).

1.1.5 Airline Costs

The costs of operating an aircraft can be divided into three parts: Direct Operating Costs (COC) associated with the type of aircraft being operated, aircraft finance-related costs and indirect operating costs (IOC). The DOCs are further subdivided into fuel costs, maintenance costs, crew costs, depreciation and amortization (Clark, 2017). Bieslich et al. (2018) established that DOCs are the most significant cost driver including all expenses associated with aircraft operation.

The regulatory demand to incoroprate green business practices has become a challenge that airlines need to address. Some have prioritized overcoming the new challenges of cost pressures and survival threats as they recover from COVID-19. The adoption of new technologies and new investment to replace aging aircraft with newer and more fuel-efficient fleets has been the foundation of policies adopted and a key contributor to increase in costs (Amankwah-Amoah, 2020).

The expenditures and capital costs associated with the LTAG are determined by the integration of technology, operations and SAF. Implementation progress was monitored via the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) (IATA, 2017). Figure 2.1 shows the scope of the costs considered by the LTAG task group, including those that were quantified, acknowledged as potentially relevant and assessed qualitatively (ICAO Secretariat, 2022). According to Narangajavana et al. (2014), airlines consider various pricing strategies, influenced by both internal and external factors, to determine ideal ticket costs. Carbon emission fees included in the ticket price constitute some of the external factors. Capital to cover any incremental aircraft prices (after technology improvements) may be required which would reduce the net savings to airlines. Increments of fuel minimum selling price compared to conventional jet fuel in a baseline scenario would have the largest impact on operators.

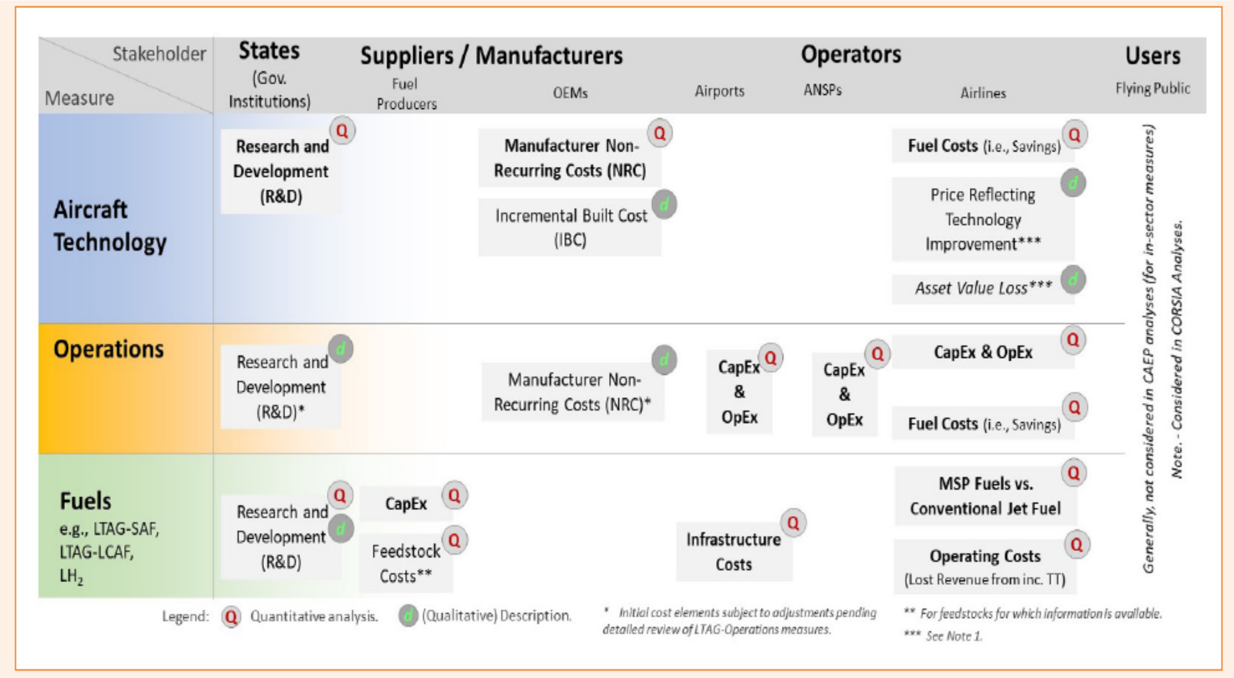

Figure 1.3 Expenses and Financing costs incurred in realization of the LTAG

1.2 Statement of the Problem

Implementation of the CO_2 emissions reductions measures presents challenges for developing countries in terms of funding, implementation pace and mandate policies. Airlines are still recovering from a collapse in passenger demand caused by COVID (Forsyth, 2020) and will require considerable support from governments to sustain operations (Abate, 2020). There is also a risk that airlines may deprioritise environmental sustainability policies (Davis-Peccoud, 2020), redirect resources away from environmental initiatives and concentrate on short-term survival.

The proposed regulations have not taken into account the varying rates of decarbonization and aviation growth as well as geopolitical environments. Developing countries have the same starting point with regard to the CO_2 reduction measures and will require more time for implementation even if all resources are availed. Without financial aid and if the target date isn't revised, realization of the emission reduction goal will not be possible (ICAO, 2022). A study on sustainability in the aviation industry revealed that it is the biggest challenge facing the aviation industry but the implementation pace was too slow and fast-tracked support is required to reach net zero by 2050 (GE Aerospace, 2023).

These new regulations require more compliance and will compel air operators to invest in new aircraft, operations, infrastructure and SAF. It will lead to reduced fuel burn and savings in the long run but the immediate effect is higher operational costs (Air Transport Action Group, 2020). Due to the competitive nature of the aviation industry, airlines won't be able to pass on these costs to passengers by increasing their fares. One of the challenges in advocating for climate policy initiatives is that promoting prevention and mitigation measures is an uphill task (Vetter, 2020). Generally, policy makers prefer not to take the necessary steps in preparation for events and for the community to support changes can be a long-drawn process. The cost of inaction will outweigh the net-zero compliance costs and this will be attributed to increased expenses in capital financing and carbon taxes related to climate policy measures. Growth will also likely be constrained due to a decrease in demand as a result of passengers reducing air travel based on climate concerns (ICAO, 2022).

Even though the aviation industry acknowledges the importance of reducing carbon emissions, airlines face various internal and external influences that impact their decisions and actions regarding investing in a green aviation. Political factors, such as government policies and regulations, can either enable or hinder the adoption of SAF. Economic considerations, such as availability, cost, and scalability of SAF, as well as market dynamics that determine fleet modernization, play a key role in the drive towards implementation. Sociocultural factors, including public awareness, passenger demand for sustainable aviation, and stakeholder expectations, shape firms' attitudes and actions towards net zero adoption. Furthermore, legal aspects, such as regulations, certifications, and compliance requirements, add to the barriers and influence the ability to adopt sustainability initiatives (Laugesen, 2023).

Despite this, there has been limited research on how the net zero carbon emissions goal will affect airlines especially in emerging markets. This research was borne out of the need to address this gap by interviewing the key stakeholders in the Kenyan aviation sector and requesting them to provide their views on the financial effect of net-zero implementation. This can be utilized by policymakers and decision makers in airlines to compose effective strategies for promoting sustainability initiatives.

1.3 Research Objective

The study's objective was to examine the effect of ICAO's CO_2 reduction measures on the costs that was incurred in the aviation sector.

1.3.1 Specific Objectives

i. To determine the effect of technological advancements in LTAG measures on airline costs in Kenya
ii. To determine the effect of changes in operations in LTAG measures on airline costs in Kenya
iii. To determine the effect of SAF implementation on airline costs in Kenya

1.4 Research Questions

i. How does ICAO's LTAG technological advancements influence airline costs in Kenya?
ii. What is the effect of the LTAG operational changes on costs of running an airline in Kenya?
iii. What is the effect of implementing SAF on costs of running an airline in Kenya?

1.5 Scope of the Study

The study contextually examines the financial effect of ICAO's LTAG CO_2 reductions measures on Kenya's aviation sector and individually examined how technology, operational changes and SAF affect airline costs. The study was grounded on the environmental regulation and contingent-resource based theories. The geographical scope of the study was limited to the aviation sector in Kenya and was carried out in April 2024.

1.6 Significance of the Study

The results of the study will help the airline management team tasked with fleet development to make informed decisions while considering the implementation of the emissions reduction measures. The findings will provide new insights into the cost implication of these measures from the perspective of a developing country which is yet to be addressed by LTAG task group.

The information and research pertaining to emission reduction measures is not widely available in developing countries. Through the analysis presented in this study, the gaps in policy, infrastructure investment and financial support were highlighted and will shed light on the need for capacity building required to ensure full implementation. The relevant government institutions can utilize the findings in deciding the budgetary support required.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This literature review explored the environmental regulation and contingent-resource based theories and the correlation between environment protection and business performance. This chapter examined the theoretical and empirical review of associated literature, research gaps and the conceptual framework of the study.

2.2 Theoretical Review

This section presented the theoretical framework for the study that was informed by the environmental regulation theory and contingent resource-based theory.

2.2.1 Environmental Regulation Theory

This study is anchored on the Porter hypothesis (1991) which defines the impact of environmental regulation on business performance. There main tenets of the environmental regulation theory are environmental regulation and trade, disputes of environmental regulation and trade, link between business resources and natural environment and enterprise response strategy theory. The relationship between enterprise resources and natural environment is established in three levels – pollution prevention, product liability and sustainable development (Khanra et al, 2021). These are closely aligned with ICAO's LTAG of GHG emissions reduction.

The effect of environmental regulation on a firm's performance can be evaluated in two ways. It has been established by multiple scholars that compulsory regulations have had a positive impact on the environmental and financial performance of companies by stimulating innovation to promote sustainable development, hence improving the firm's resilience (e.g. Krishnamoorthy, 2021; Broadstock et al., 2021; Weigelt, 2016). Lee, (2020) undertook research on firms listed on the Shanghai and Shenzhen Stock Exchanges and affirmed that environmental regulation has a positive effect on financial performance. An opposing view is that mandatory regulations are too rigid and detrimental to a firm's competitiveness (e.g. Sato, 2014; Wang & Lin, 2022; Kim, Park, & Ryu, 2017). However, Chomachaei & Golmohammadi, (2023) established that this effect is only evident in the short-term since the stringency of an environmental policy positively affects financial performance in the long run.

The implementation of environmental regulations will require additional resource investments. As a result, the cost of production or service provision will increase and be passed on to the consumer (Whitehead, 1994). Porter and van der Linder, (1995) had an opposing view on the impact of innovation on offsetting costs associated with environmental regulation. They opined that pollution is a product of inefficiencies and inefficient use of resources. The airline industry is a marginal profit industry due to high operating expenses and commoditization of the airline product (Pearce, 2013). The introduction of fuel-efficient aircraft, SAF and improvements in operations can be considered as innovation in an effort to differentiate the airline from its competitors.

The enterprise response strategy theory examines the factors driving implementation of environmental strategies. These are effects of regulation stress, influence of stakeholders and the obligation of social responsibility (Wang, 2016). Li et al. (2020) find that stakeholder pressures have had a significantly positive impact on proactive corporate environmental strategies. They also affirm that this is more evident in developed countries hence the need for aviation authorities in frontier markets to make concerted efforts in driving the sustainability agenda. The enterprise response strategy theory provides a guiding framework for understanding how environmental policies and regulations can drive airlines to adopt sustainable practices and technologies. The study's focus on fleet modernization, operational improvements, and SAF implementation can be seen as responses to such regulatory pressures.

2.2.2 Contingent Resource-Based Theory

This study is also based on the contingent resource-based theory that defines the correlation between a firm's strategy for managing how its activities interface with the environment and its competitive advantage. Luthans, (1976) suggested that a company's strategic vision and management should be aptly incorporated to complement the external dynamic environment. The strategy should always consider the shifting nature of environment and the business vision. Based on the resource-based view, enterprises will gain stronger competitive advantage and profitability by adjusting the internal distribution of vital strategic resources (Wernerfelt, 1984). These resources should be valuable, rare, difficult to imitate and non-substitutable (Kennedy, 2020).

Corporate strategies that guide the synergy between business and the natural environment can be grouped ranging from proactive to reactive. A reactive strategy entails a response to changes in environmental regulations and stakeholder pressures while a proactive one involves anticipating future regulations and designing operations, processes and products to preclude negative environmental impacts (Kim, 2018). Airlines will therefore strive to allocate resources to green business practices in an effort to comply with environmnetal regulations.

The theory is thus important in elaborating the benefits to airlines of early compliance to stay ahead of the curve and reduce the risk of higher costs that would be incurred when they are obliged to comply within a limited time frame. ICAO member states will have varying implementation paces for the LTAG as evident in developed countries that have begun implementation owing to readily available resources, capacity and stakeholder involvement (ICAO, 2022). Aviation is a competitive industry therefore countries will endeavour to protect their national carriers from foreign airlines by advocating the execution of the proposed GHG (Greenhouse gas) emission reduction measures. The EU parliament approved draft laws to increase the amount of sustainable aviation fuel blended with jet fuel in an effort to decarbonise the sector. In addition to navigation and landing fees, the higher blending target will likely result in higher airfares and negatively impact the margin of airlines flying through EU (Euractiv, 2022).

The contingent resource-based theory is relevant to the study as it helps explain why certain sustainable practices and technologies (like fleet modernization and operational improvements) are currently beneficial for Kenyan airlines, while others are not yet cost-effective. The theory underscores the importance of strategic adaptation and alignment with external environmental conditions to achieve competitive advantage and cost efficiency.

2.3 Empirical Review

2.3.1 Airline Costs

Most airline operating expenses are not completely within the control of the management with the uncertainty primarily driven by fuel price unpredictability. Fuel hedging is a mitigation measure taken by some airlines to cover them against this volatility but can only be a feasible option if there are sufficient cash reserves and optimized operations (Schweitzer, 2017). There have been several studies on the impact of fuel prices on airline operations that affirm the viability of fuel hedging (Adrangi et al. 2014; Kahn and Nickelsburg, 2016). However, according to a study done on US airlines by Lim and Hong, (2014) fuel hedging has a negative impact on operating costs after accounting for cost inefficiency.

Deciding the ideal time to invest in fleet modernization with the aim of reducing operating costs is a tough decision to make in the face of cost uncertainty (Clark, 2017). Airline

management therefore has to take this into consideration owing to the fact that the aviation sector has traditionally had low profitability margins (Macilree and Duval, 2020).
The costs incurred for LTAG would be in aircraft modernization, implementing changes in operations and development of SAF. The short-term priority for decarbonising the sector is to replace the 80% in-service fleet that lack modern technology. Modern aircraft can either improve fuel burn through aerodynamic efficiency (reduction in skin-friction drag), minimization of aircraft structural weight or reducing actual combustion use (mainly engine-related) (Air Transport Action Group, 2019). However, in his work on analysing factors affecting aircraft operating costs, Zuidberg, (2014) contended that the ownership costs (depreciation and leasing costs) of new aircraft are greater than the increasing maintenance expenses of older planes. The current research sought to examine how fleet modernization is considered in an airline's sustainability strategy.

Pagoni, (2016) conducted a survey on the impact of carbon emission fees on passenger demand and air fares. The researcher noted that implementation of a carbon policy in the U.S. aviation industry is expected to cause an increase in ticket prices and reduction in demand. The research paper, however, is only focused on the U.S. aviation industry, hence the current study bridged this knowledge gap. In an effort to further delve into passenger demand choices, Gössling and Dolnicar, (2023) conducted a study on the drivers of air-travel mitigation behavior. In their work, they presented three major theories used to understand and influence behavior with environmental consequences. Their study showed that travelers feeling accountable for emissions can either abstain from a desired flight, choose another transport mode, opt to fly using less energy or opt to fly and purchase a carbon offset to compensate the climate impact. The research also provided meaningful actions on how different groups (policymakers, aviation industry, passengers, society and researchers) may assist, and associates these to the drivers of air-travel mitigation behavior.

Bieslich, (2018) conducted a study on an airline's decision-making process on aircraft orders, route adaptions and business model changes. He established that direct operating costs are the most important cost driver, which include all expenses associated with aircraft operation. He also noted that ticket price is a crucial element in determining demand hence an increase in the cost of flying would reduce consumers' willingness to pay. Hagmann et. al. (2015) had a different persepective on this when they examined passenger perceptions on an airline's eco-friendliness. The researchers used a structured questionnaire to gather feedback from 394 passengers at Dusseldorf airport. The results indicated that almost 50% of the participants were willing to pay more for a flight with lower emissions. The study focused on customer insights whereas the current research considered the airline's management point of view and used a semi-structured questionnaire.

In their work on the approach of European low-cost airlines to sustainability, Katarína et. al. (2023) found that integration of sustainable development (environmental pillar) into strategy is achievable and can also be incorporated into the company's economic and social pillars. The current research sought to gain knowledge on the sustainability strategy of local airlines whose resources might not be sufficient for fleet modernization.

2.3.2 SAF Implementation

Airlines that invest in alternative fuel have to budget for high prices since its cost is currently an unknown variable. The price will only stabilize once feedstock availability is guaranteed and more options become certified. There are currently no hedging options for SAF but operators are signing uptake agreements hoping to stimulate the market and reduce prices as supply ramps up (OpenAirlines, 2023). In addition to impacting an airline's profit margins, the SAF-induced additional costs will create distorted competition between airlines or regions (Feray, 2023).

Kelso, (2021) conducted a study examining the projected capacity of SAF that can be produced in US and concluded that government policies have the ability to impact overall costs. Research on the capacity for SAF to reduce aviation emissions was undertaken by Staples, Malina and Suresh, (2018) by assessing the availability of SAF feedstcock, its scalability, and the number of bio-refineries and capital investment required to achieve the calculated emission reductions. These studies, however, are not limited to SAF uptake by local airlines which is the focus of this research. Bailis, Broekhoff and Lee, (2016) researched on the production and sustainability of carbon offsets and bio-fuels for global aviation. The study examined the offset programs grouped according to their emission reductions and sustainable development goals. It also examined the emission reductions from biofuels and the future global supply potential. The study focussed on the emission reduction measures from a global perspective whereas the current research considered the awareness and ability of local airlines to meet ICAO's carbon-neutral growth target.

In his work on incentivising SAF production and uptake in the United States, Ghatala, (2020) presented policy instruments grouped according to their area of impact and implementation approach. These options range from attracting investments to expand SAF supply, incentivising SAF production and use through tax reliefs, and demonstrating ongoing support through research and development activities. The study applied to the US aviation industry and explores all the policy instruments fro SAF incentivizing whereas the curernt study sought to gain knowledge from airlines on whether there is sufficient government support on SAF production and uptake. A viability study by ICAO-EU on the potential of SAF implementation was carried out in Kenya in 2018. The roadmap has three stages: Stage one (2018-2019) – collaboration and capacity development, Stage two (2020-2023) - establishing the potential and verifying the feasibility and Stage three (2023-2027) – Execution (ICAO, 2018). The study, however, fails to examine the effect of SAF implementation on airline costs. The current research filled the gap by examining the financial effect of SAF investment.

2.3.3 Technological Advancements

The contribution of new technologies to achieving net zero is estimated to be around 13% (IATA, 2024). The potential incremental cost to airlines resulting from improvement in technical efficiency is challenging to quantify due to difficulty in establishing the relationship between aircraft acquisition costs and potential fuel savings and inaccessibility of aircraft transaction prices, therefore making it complicated to assess the input of fleet modernization in aircraft total prices (ATAG, 2022).

Pang and Chen, (2023) examined the impact of fleet modernization and the emissions trading system on an airline's profitability. The study findings indicated that emissions trading systems reduce the profit of airlines operating older aircraft and firms with newer aircraft are more sustainable in the long run from both a financial and environmental perspective. The study, however, failed to examine the need for a cost-benefit analysis when investing in fleet upgrades.

Brugnoli et al. (2015) conducted a study on advancements in airline technology geared towards lowering carbon emissions in Europe. The research examined whether these advancements were as a result of policies, market influence (fuel costs) or technical evolution within the aviation sector and concluded that the drive was mostly driven by endogenous technical progress. The current study sought to find out which of these was a determining factor for airline management to invest in fleet upgrades.

Oliveira, Caliari and Narcizo, (2022) evaluated the relationship between market concentration and rate of innovation implementation by Brazilian airlines. They found that high competition may reduce innovation adoption, and low-cost carriers are less likely to invest in fleet upgrades.

The current study examined the incentives for fleet upgrades in the local aviation perspective which was not considered in the previous study.
Airline management need to consider the impact of engine homogeneity and harmonization on the firm's technical and cost efficiency as they deliberate on aircraft modernization. Merkert, (2023) carried out his analysis on this topic with engine data of 12,035 aircraft and financial data of years with high (2013/14) and low (2016/17) fuel prices. According to his results, both airframe and engine standardization impact on airline cost efficiency, but engine cost effects are significantly larger than standard airframe cost effects. The study however failed to bring out the role of powerplant selection in local airlines. The current research reviewed whether powerplant selection (through procurement, redeliveries, maintenance and spare part optimization) is taken into consideration by local airlines as they deliberate on the cost of fleet expansion.

2.3.4 Operational Changes

The projected growth in air transportation demand is expected to surpass the redcutions in fuel comsumption, at least over the next two decades. In their work on analysis of the impact of air transporttaion on the environment, Schäfer and Waitz, (2014) found that adjustments in operations would be required to supplement the emission redcution mitigations from technology options. The scope of the study was the US and UK aviation industry; hence findings may not be applicable within the current study that focuses on Kenyan domestic airlines.

Ferrulli, (2016) undertook a research on the framework design for the sustainability performance-based evaluation of airport project design and policies to improve the environmental capacity of the infrastructure. The study employed the Green Airport Design Evaluation (GrADE) method and tools to define the airport sustainability index. Within the GrADE framework, seven categories have been defined, namely noise reduction, decrease in emissions and air quality, energy utilization, water use, waste management and materials, water pollution mitigation, biodiversity and land use. The results of the study showed that airports' conformance to regulations on economic viability, operational efficiency and natural resource conservation improved their sustainability ratings. The current study, however, sought to examine only local airlines' views on the green business practices in Kenyan airports.

A study on factors influencing airline's costs for climate protecting market-based measures was carried out for global aviation and was based on results of the interdisciplinary research project AviClim (Including Aviation in International Protocols for Climate Protection) (Scheelhaase et. al., 2017). The study identified four reduction scenarios which vary according to the international support for these climate protecting measures. The results indicated that a global emission trading scheme limiting aviation's full climate impact would be beneficial to minimize airlines' costs as compared to a climate tax. The study, however, does not take into consideration developing countries which are yet to implement the global climate protecting measures.

Van Dam, (2022) conducted a study to determine whether modifying flight plans can decrease aicraft emissions during the climb and descent phases. After evaluating 22,000 aircraft landing and taking off from Amsterdam Schipol airport using a generic algorithm, he concluded that optimized flight plans can reduce emissions by 8.6% and 18.6% on average for climb and takeoff phases. The current study sought to identify the possibility of local airlines adopting flight plan optimization to reduce emissions.

2.4 Summary of Literature and Research Gaps

Table 2.1 Research Gaps

Author	Title	Findings	Research Gap	Type of Gap	Focus of the current study
Zuidberg, (2014)	Identifying airline cost economies: An econometric analysis of the factors affecting aircraft operating costs	The ownership costs (depreciation and leasing costs) of new aircraft are greater than the increasing maintenance expenses of older planes	The study fails to identify how fleet upgrades are taken into consideration by airlines and the cost implication of the investment	Contextual	The current study solved this gap by gleaning airline management views on costs of fleet upgrades with regard to sustainability initiatives
Katarína et. al., (2023)	The approach of European low-cost airlines to sustainability	Integration of sustainable development into strategy is achievable and can also be incorporated into the company’s economic and social pillars	The study focused on European airlines which had sufficient capital for sustainability investments	Contextual	The current research surveyed all domestic airlines in Kenya to get data on their sustainability strategies
ICAO, (2018)	Feasibility study on the use of SAF in Kenya	Lack of technical expertise and research experience in SAF investments	Evaluation of financial implication of SAF investment on airlines	Methodological	Determine whether the local aviation industry has prioritized investment in SAF

Bailis, Broekhoff and Lee, (2016)	The production and sustainability of bio-fuels for global aviation	ICAO can meet its carbon-neutral target by working closely with airlines and expediting biofuel certifications	The study focussed on the emission reduction measures from a global perspective	Contextual	The current research considered the awareness and ability of local airlines to meet ICAO's carbon-neutral growth
Merkert, (2023)	The impact of engine homogeneity and harmonization on the firm's technical and cost efficiency	Both airframe and engine standardization impact on airline cost efficiency, but engine cost effects are significantly larger than standard airframe cost effects	The study does not take into consideration whether emisison reductions are conisdered during fleet standardization discussions	Conceptual	The current research examined whether powerplant selection is taken into consideration by local airlines as they deliberate on the cost of fleet expansion in relation to sustainability
Van Dam, (2022)	Trajectory optimization to minimize the environmental impact of departing and arriving aircraft	Optimized flight plans can reduce emissions by 8.6% and 18.6% on average for climb and takeoff phases	The study fails to identify the airline management perspective on making changes to their operations	Methodological	Glean the local airlines' perspective on the financial effect of operational changes to reduce emissions

2.5 Conceptual Framework

The conceptual framework focused on presenting the interaction between the independent and dependent variables adopted in the study. This is shown in Figure 2.1 below;

Independent Variables **Dependent Variable**

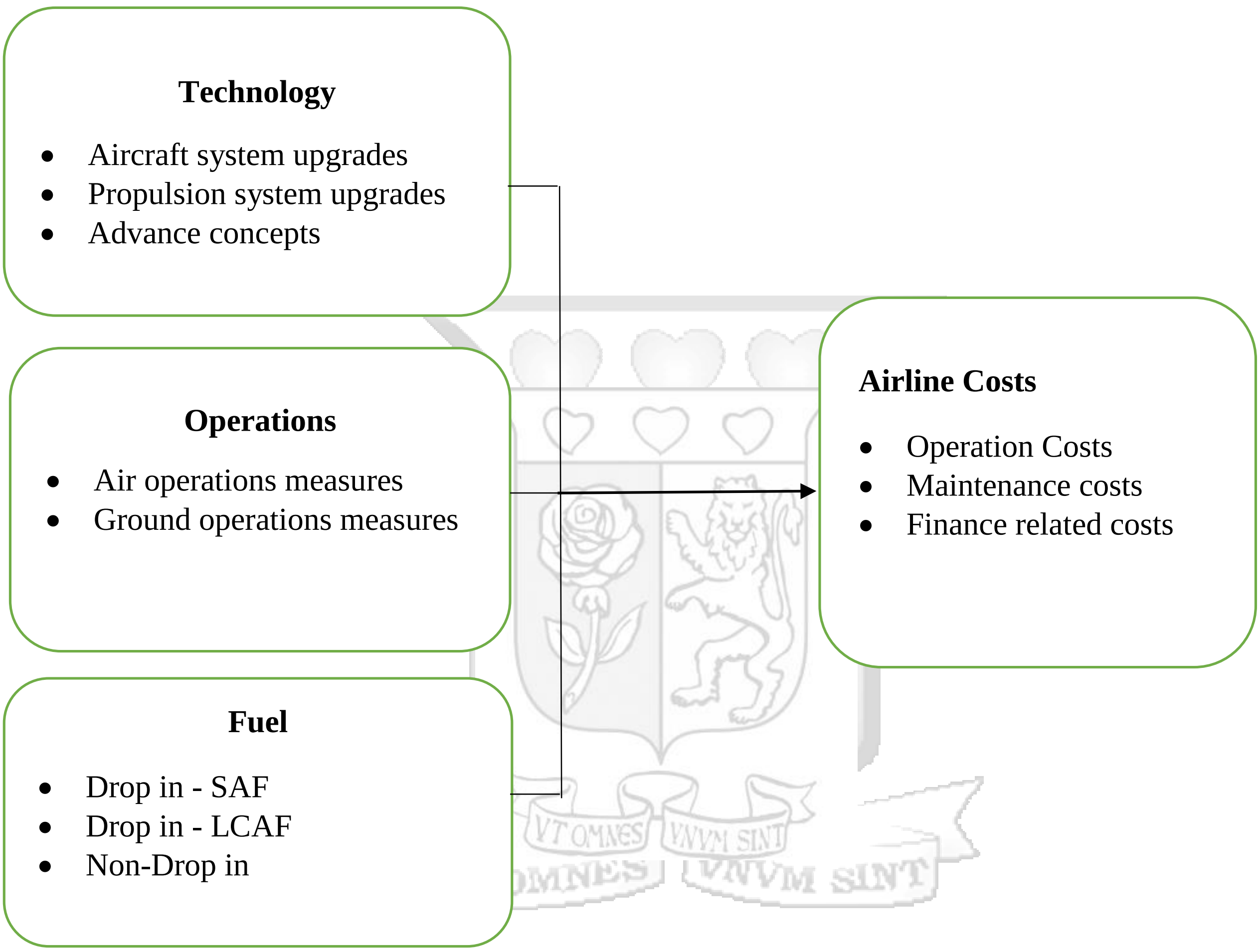

Figure 2.1 Conceptual Framework

Table 2.2 Operationalization of Variables

Variable	Indicators	Data Collection Tool	Data Analysis	Supporting Literature	Supporting Theories
Airline costs	Aircraft operating costs Maintenance costs Airline profitability Passenger perception	Semi-structured questionnaire	Regression tests Correlation tests	Clark, (2017); Macilree and Duval, (2020); Zuidberg, (2014);Gössling and Dolnicar, (2022)	Contingent Resource-Based Theory
Technology	Fleet modernization Aircraft emissions Advanced concepts Aircraft type standardization	Semi-structured questionnaire	Regression tests Correlation tests	Pang and Chen, (2023) Brugnoli et al., (2015); Epstein, (2019); Miyoshi, (2016)	Contingent Resource-Based Theory Environmental Regulation Theory
Operations	Operational improvements Government input Employee perception	Semi-structured questionnaire	Regression tests Correlation tests	Ashok, (2016); Ferrulli, (2016); Scheelhaase et. al., (2017)	Contingent Resource-Based Theory
Fuel	SAF production feasibility Capital costs Aircraft compatibility	Semi-structured questionnaire	Regression tests	ICAO, (2018); Feray, (2023); Kelso, (2021); Ghatala, (2020)	Environmental Regulation Theory Contingent Resource-Based Theory

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter described the approach utilized to conduct the primary research, how it was conducted, including the data that was collected and analysed. It further provided detail on the data analysis and ethical considerations.

3.2 Research Philosophy

A research philosophy is a system of assumptions that guide how data in a certain field should be collected, reviewed and utilized (Tsang, 2016). A comprehensible research philosophy ensures consistency in the research process and is crucial in validating research choices. This study was based on a positivist research philosophy in examining the relationships between the study variables using quantitative research methods to glean various perspectives on the research problem.

3.3 Research Design

The research design defines the method chosen to combine the different components of the study in a systematic way, thereby, ensuring the research problem is effectively defined and tackled; it makes up the foundation for the collection, measurement, and analysis of data (Thakur, 2021). A strategy for articulating the analysed data should be included in the research design to provide satisfactory findings and conclusions (Jongbo, 2014). The current research employed a descriptive research design that was instrumental in examining the causal link between ICAO LTAG recommendations and airline costs by gathering data from questionnaires filled by key experts in the aviation sector.

3.4 Target Population

The target population is the group of people from whom the research data was used to make inferences. It sets clear direction on the scope and objective of the research, defines the characteristic variables of the individuals participating in the study and provides the scope of total population for defining the sample size (Whaley, 2020). The target population is 69 Kenyan airlines operating both local and international flights (KCAA, 2024). The study targeted employees in the technical, commercial and flight operations departments thus a total of 138 respondents. They were selected as they are deemed to be knowledgeable on the adoption ICAO's CO_2 reduction measures on the operational costs that in the aviation sector.

3.5 Sampling Design and Sample Size

Sample design refers to the approaches to be used in selecting a sample from the target population and the approximation formula for computing the sample statistics which reflect the population parameters (Muhammad, 2016). The sample frame for this study are employees in management from each of the local airlines drawn from the technical, commercial and flight operations departments. The research adopted random sampling in selection of the 138 respondents drawn from the local domestic airlines operating in the country. This ensured there was no bias in selection of respondents and there was equal representation for the officials drawn from the domestic aviation firms.

3.6 Data Collection Methods

The research employed both primary and secondary data. The main data collection tool was a semi-structured questionnaire to get in-depth feedback. The defined questionnaires to aviation management were shared as Google forms. The study sought the approval of KCAA to access details of registered airlines in Kenya.

3.7 Data Collection Procedures

The research procedures focused on the various scientific approaches that were adopted in the process of data collection. The study ensured that necessary guidelines such as obtaining institution ethical review approval and NACOSTI permit was done prior to collecting data. Further, the respondents were debriefed on the aims of the study and their rights to participate in the research data. The study adopted drop and pick method in the data collection with Google forms developed to enhance the response rate for the survey.

3.8 Research Quality

The research quality entails the various steps adopted by the researcher to ensure there is validity and reliability in the research instrument. The validity of the study instrument was checked using construct analysis which reviewed the adopted questionnaire to ensure that all conceptualized items are captured in the instrument. Further, content validity was conducted with the aid of the research supervisor in reviewing and revising the questionnaire for completeness to ensure its adequate in answering the research problem (Taber, 2018).

Reliability tests focused on determining the internal consistency of the research tool by checking if the tool can be applied for repeat studies. The study employed the Cronbach Alpha to determine the internal reliability (Taber, 2018). This is defined as the degree to which data collection, analysis and comprehension remains consistent. Cronbach Alpha is also ideal because it can be used for attitudinal measurements like the Likert scale which was utilized in this study (Lund Research, 2012). All research variables with an alpha score of 0.7 and above were considered in the research. The values were calculated and listed in the table below.

Table 3.1 Reliability Test

Variable	Cronbach's Alpha	Number of Items	Comment (Accepted or Rejected)
Implementation costs	.785	4	Accepted
Technology	.724	4	Accepted
Operations	.790	4	Accepted
Fuel	.750	4	Accepted

3.9 Data Analysis

The raw data was checked to correct any errors and to confirm rules in filter questions were followed (Saunders, Lewis, & Thornhill, 2019). The study collected the quantitative data that was analysed using descriptive statistics which will include mean, standard deviation and frequency counts. The relationship between the independent and dependent variables was explained through a correlation, multiple regression model and ANOVA tests to examine the statistical significance of the research model. The results were illustrated using tables, bar graphs and charts.

The regression equation is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Y = Airline costs

β_{1-4}= Coefficients of independent variables

X_1 = Technological improvements

X_2 = Operational improvements

X_3 = SAF

ε = error term

The statistical significance of the research model was tested at a 5% significance level.

3.10 Ethical Considerations

The study incorporated ethical considerations in the course of the research. The topic was sensitive since it requires details on an airline's strategic plans on fleet development and feedback from staff on the firm's profitability perspectives. The information collected was confidential and for research purposes only. The questionnaire comprised a consent form which was explained to the interviewee underlining his/her rights and purpose of the research prior to requesting for data. The research also ensured all the collected research data was only used for academic purposes and access was limited to authorized individuals only. Approval to conduct the study was received from the Institutional Ethical Review Committee and National Commission for Science Technology and Innovation.

CHAPTER FOUR

PRESENTATION OF RESEARCH FINDINGS

4.1 Introduction

The chapter presented findings on the collected research data which was analysed quantitatively. The main parts in the chapter were the background results, descriptive analysis, correlation and regression findings. These will be presented in line with the study objectives.

4.2 Background Results

The research was interested in obtaining 138 responses from 69 domestic airline firms with the study seeking information from technical, commercial and flight operations departmental heads in the airlines. Results on Figure 4.1 revealed that 109 participants (79%) were able to participate in the research with only 21% not returning questionnaires within the provided time-frame. The response was deemed suitable for utilization in the main research in obtaining results that are representative of the entire population.

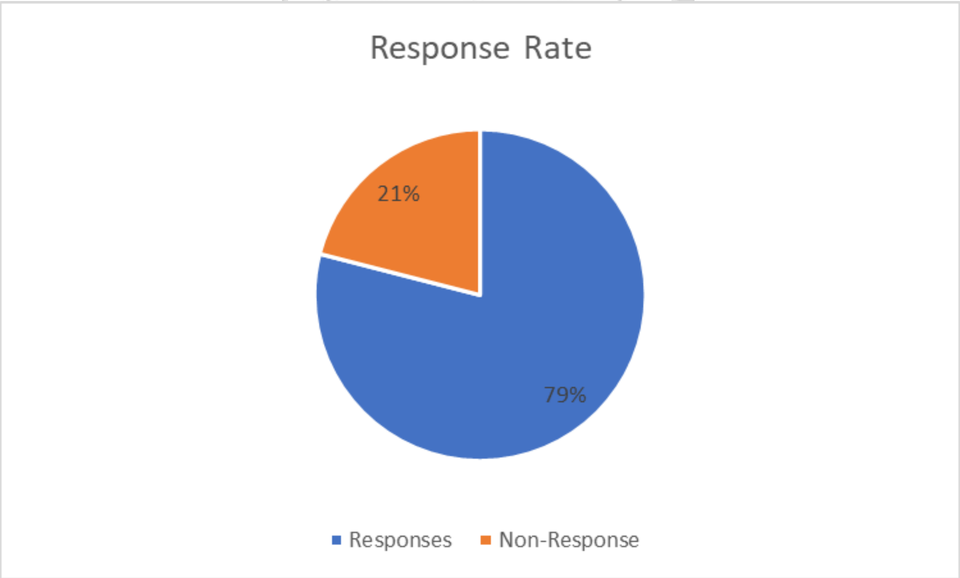

Figure 4.1 Response Rate

4.2.1 Profile of the Participants

The research analyzed the profile of the various respondents who were considered in the survey and the results are shown in table 4.1

Table 4.1 Participants Profile

		Frequency	Percent
Gender of respondents	Male	71	65.1
	Female	38	34.9
	Total	109	100.0
Age of Respondents	-30 years	16	14.7
	31-40 years	49	45.0
	41-50 years	40	36.7
	51+ years	4	3.7
	Total	109	100.0
Education Level	Diploma	18	16.5
	Graduate	59	54.1
	Post Graduate	32	29.4
	Total	109	100.0
Work experience in aviation industry	1-5 years	19	17.4
	6-10 years	47	43.1
	11-15 years	39	35.8
	Above 15 years	4	3.7
	Total	109	100.0
Work Department	Technical	19	17.4
	Operations	33	30.3
	Quality Assurance	33	30.3
	Commercial	24	22.0
	Total	109	100.0

Analysis of the data demonstrated that majority of the departmental heads (65%, n = 71) were male officials showing disparity in gender representation in senior positions. The findings showed that most of respondents (45%, n = 49) were 31-40 years with 37% between 41-50 years showing age inclusion within the firms. Most of the respondents 43% (n = 47) had worked for 6-10 years in the aviation industry with 35% having worked for 11-15 years which implied the participants had extensive experience in the industry that can provide information relevant to the survey. Lastly, findings indicated most of respondents 30% (n = 33) were operational managers and quality assurance managers with 22% of the participants drawn from commercial corporations showing they have relevant knowledge to respond to the research questions.

4.2.2 Challenges in the Aviation Industry

The analysis revealed that most of respondents 31.2% acknowledged human resource issues were the main challenge, followed by infrastructure (27.5%) and supply chain issues (24.8%). This was indicative of the myriad of issues that are facing the operational performance of the aviation industry firms.

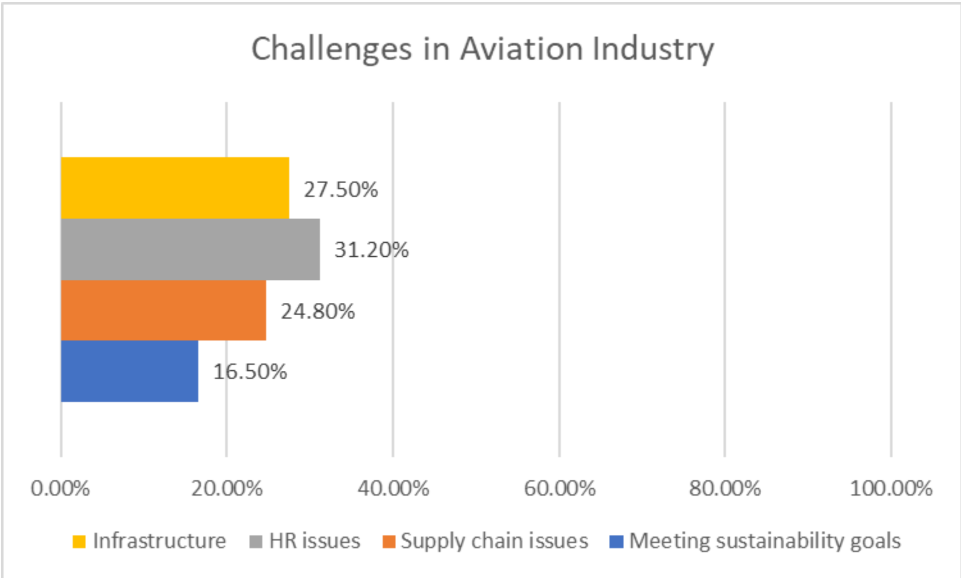

Figure 4.2 Challenges in the Aviation Industry

4.2.3 ICAO Recommendations on Reduction of Emissions

The research sought information on the adoption of the ICAO recommendations in the Kenyan aviation industry and summary of responses is shown in Table 4.2.

Table 4.2 ICAO Recommendations on Reduction of Emissions

		Frequency	Percent
Awareness of the ICAO recommendations	Yes	96	88.1
	No	13	11.9
	Total	109	100.0
Achievability of ICAO recommendations in Kenya	Agree	29	26.6
	Disagree	26	23.9
	Neutral	54	49.5
	Total	109	100.0
Pace of implementation of sustainability strategies	Too slow	31	28.4
	Too fast	9	8.3
	Right pace	69	63.3
	Total	109	100.0
Firms' sustainability strategy and carbon offsetting targets	Yes	99	90.8
	No	10	9.2
	Total	109	100.0
Impact of company's sustainability strategy had on operations	Major	31	28.4
	Moderate	34	31.2
	No influence	44	40.4
	Total	109	100.0
Dedicated team for fleet development	Yes	90	82.6
	No	19	17.4
	Total	109	100.0
Carbon footprint measurement metric	Yes	84	77.1
	No	25	22.9
	Total	109	100.0

Majority of the respondents (88%, n = 96) were aware of the ICAO recommendations on reduction of emissions in the aviation industry implying respondents were knowledgeable on the required information. The analysis revealed neutral agreement among 49% of the respondents on the achievability of ICAO recommendations in Kenya by 2050 while only 26% were in agreement they are attainable showing minimal confidence on the aviation industry capacity to achieve the targets. The majority of the respondents (63%, n = 69) of the firms were undertaking implementation of their internal sustainability at the right pace with 28% of the respondents indicating their firms were too slow. This was indicative of capacity gaps among aviation firms in pursuing sustainability strategies. More so, the findings showed 91% of the respondents acknowledged their firms have set sustainability strategy and carbon offsetting targets showing interest in achieving sustainable goals.

4.3 Descriptive Analysis

The research conducted quantitative data analysis using means and standard deviation in line with study objectives. Further, the qualitative data was presented in line with the research themes within the section.

4.3.1 Airline Costs

The dependent variable examined the airline costs associated with aviation firms in Kenya and summary of results are shown below.

Table 4.3 Analysis of Airline Costs

	N	Mean	Std. Deviation
Fuel cost has the highest impact on profit margin	109	3.9817	1.09698
Maintenance expenses has the highest impact on profit margin	109	4.0917	1.07618
Aircraft financing costs have the highest impact on profit margin	109	3.8349	1.11815
Profitability in the airline industry is always achievable	109	2.9817	1.09698
Passengers are willing to pay more for sustainable flights	109	2.6055	1.27670

Respondents were in agreement (mean = 4.0917) the maintenance expenses have the highest impact on profit margin. The study found that respondents agreed that aircraft financing costs have the highest impact on profit margin (mean = 3.8349). The analysis showed disagreement among respondents on whether passengers are willing to pay more for sustainable flights (mean = 2.6055).

4.3.2 Technological Improvements

The researcher was interested in reviewing the technological improvement taking place in the aviation industry and findings are showed in Table 4.4

Table 4.4 Analysis of Technological Improvements

	N	Mean	Std. Deviation
Fleet modernization will make an airline more competitive	109	3.8991	1.22433
Airlines have prioritized fleet upgrades	109	3.4312	1.27197
There is a potential market for advanced aircraft concepts in Kenyan aviation	109	3.0459	1.18935
Aviation emissions are considered during fleet upgrades	109	3.8532	.92121
Aircraft type standardization will reduce costs	109	3.2385	1.40039

The respondents agreed (mean = 3.8991) fleet modernization will make an airline more competitive as well as aviation emissions are considered during fleet upgrades (mean =

3.8532). The participants were in disagreement on whether there is a potential market for advanced aircraft concepts in Kenyan aviation (mean = 3.0459).

4.3.3 Operational Improvements

The study considered the operational improvements being taken by aviation industry firms and the summary of responses is shown in Table 4.5.

Table 4.5 Analysis of Operational Improvements

	N	Mean	Std. Deviation
Operational improvements should be prioritized	109	4.3853	.88095
KAA and KCAA are working with airlines on operational improvements	109	3.9725	1.02251
Operational improvements have a significant impact on an airline's margin	109	4.2018	.81400
Employees not involved with operations need to be apprised of any changes	109	4.1284	.95356
Kenyan airports have prioritized sustainability initiatives	109	3.0917	1.14294

Findings in Table 4.5 above noted strong agreement among respondents that operational improvements should be prioritized (mean = 4.3853). The results also showed strong agreement that operational improvements have a significant impact on an airline's margin. However, the analysis revealed disagreement among participants that Kenyan airports have prioritized sustainability initiatives (mean = 3.0197).

4.3.4 Sustainable Aviation Fuel Implementation

The research further analyzed the extent of Sustainable Aviation Fuel utilization among domestic airlines and results are presented in Table 4.6

Table 4.6 Analysis of Sustainable Aviation Fuel Implementation

	N	Mean	Std. Deviation
SAF production is feasible in Kenya	109	3.2477	1.17974
Airlines will have to invest significantly on SAF implementation	109	4.0459	1.00356
Current aircraft models are fully compatible with SAF	109	3.2202	1.03957

SAF implementation is more expensive than conventional jet fuel	109	3.9817	1.06268

The respondents were in agreement (mean = 4.0459) that airlines will have to invest significantly in SAF implementation. The research showed agreement that SAF implementation is more expensive than conventional jet fuel (mean = 3.9817). There was disagreement (mean = 3.2202) that current aircraft models are fully compatible with SAF.

4.4 Correlation Analysis

The study undertook correlation analysis with the intention of establishing the nature of the relation between the variables. The preferred correlation method was Spearman rank correlation and findings are shown in table 4.7

Table 4.7 Correlation Results

			Airline Costs	Technological Improvement	Operational Improvements	SAF Implementation
Spearman's rho	Airline Costs	Correlation Coefficient	1.000			
		Sig. (2-tailed)	.			
		N	109			
	Technological Improvement	Correlation Coefficient	.260**	1.000		
		Sig. (2-tailed)	.006	.		
		N	109	109		
	Operational Improvements	Correlation Coefficient	.138	.159	1.000	
		Sig. (2-tailed)	.152	.099	.	
		N	109	109	109	
	SAF Implementation	Correlation Coefficient	.300**	.250**	.141	1.000
		Sig. (2-tailed)	.002	.009	.145	.
		N	109	109	109	109

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis showed that technical improvement had a weak positive significant relationship with the airline costs in Kenya (r =.260**, p = 0.006<.05). Further, the findings revealed that operational improvement had a weak positive insignificant relationship with the airline costs in Kenya (r =.138, p = 0.152>.05). Lastly, the tests confirmed SAF implementation had a weak positive significant relationship with the airline costs in Kenya (r =.300**, p = 0.002<.05).

4.5 Regression Analysis

The study conducted regression analysis with the aim of determining the magnitude of impact of net zero carbon goals on airline costs in the Kenyan aviation industry. The summary is presented below.

Table 4.8 Regression Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.606[a]	.367	.349	.40236

a. Predictors: (Constant), SAF Implementation, Operational Improvements, Technological Improvement

The model summary is shown in Table 4.8. The regression model showed that, r square = .367, this reveals that net zero carbon emission goal explained 36.7% of the airline costs in the Kenyan aviation industry. However, 63.3% of the airline costs in the Kenyan aviation industry are accounted for by other factors outside this model.

Table 4.9 ANOVA Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.851	3	3.284	20.284	.000[b]
	Residual	16.999	105	.162		
	Total	26.850	108			

a. Dependent Variable: Airline Costs

b. Predictors: (Constant), SAF Implementation, Operational Improvements, Technological Improvement

The ANOVA test was used to determine the significance of the model in predicting the dependent variable. According to the ANOVA results, net zero carbon emission goal correctly predicts airline costs in the Kenyan aviation industry, F = 20.284, Sig = .000<.05.

Table 4.10 Regression Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
1 (Constant)	1.230	.299		4.108	.000

Technological Improvement	.149	.060	.224	2.475	.015
Operational Improvements	.321	.068	.397	4.751	.000
SAF Implementation	.132	.073	.164	1.810	.073

a. Dependent Variable: Airline Costs

Based on the findings above the resulting regression model can be plotted as follows;

$$Y = 1.230 + .149X_1 + .321 + .132X_3 + .299$$

Thus, we can confirm that technological improvement had a coefficient β_1 = .149 with a sig. = .015< .05 thus revealing the variable can positively and significantly contribute to airline costs by a factor of .149. The analysis showed a coefficient for operational improvements β_2 = .321 with a sig. = .000< .05 thus revealing the variable can positively and significantly contribute to airline costs by a factor of .321. Lastly, the findings on the third variable had a coefficient β_3 = .132 with a sig. = .073> .05 thus revealing an insignificant effect of sustainable aviation fuel implementation on the airline costs.

4.6 Chapter Summary

The research obtained data from 79% of the intended participants with a majority being male between 31 to 40 years of age with 6 to 10 years of experience. For the main objective, the study found that net zero carbon emission goal had a positive and significant effect on airline costs in the Kenyan aviation industry. The study further found that technological improvement and operational improvements had a positive and significant effect on airline costs while sustainable aviation fuel implementation had an insignificant effect on the airline costs in the Kenyan aviation industry.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter presents the summary of findings and discusses them based on the previous studies. The chapter then presents the conclusion and recommendations. Lastly, the chapter highlights the areas for further research that can be conducted in the future.

5.2 Summary of Study

This study examined the impact of the LTAG net-zero goal on the local aviation sector. Specifically, the study sought to find out the effect of technological advancements, operational changes and implementation of sustainable aviation fuel on an airline's overall costs. This study was anchored on the Porter hypothesis which defines the impact of environmental regulation on business performance and the contingent resource-based theory that defines the correlation between a firm's strategy for managing how its activities interface with the environment and its competitive advantage. The study population was drawn from the 69 local airlines. The sample study was 138 respondents who hold senior management positions in the airlines. The study employed standard deviation, means, regression and correlation analysis.

The correlation analysis showed that technical improvement, operational improvement and SAF implementation all had a weak positive significant relationship with the airline costs in Kenya. Results from the regression analysis revealed that net zero carbon emission goal explained 36.7% of the airline costs in the Kenyan aviation industry. The study further found that technological improvement positively and significantly contributes to airline costs. The analysis also revealed that operational improvements had a positive and significant effect on airline costs in the Kenyan aviation industry. Lastly, the findings on the third variable revealed an insignificant effect of sustainable aviation fuel implementation on the airline costs in the Kenyan aviation industry.

5.3 Discussion of Findings

5.3.1 Technological Advancements and Airline Costs

The study sought to determine the effect of technological advancements in LTAG measures on airline costs in Kenya. The study found that technological advancements positively and significantly contribute to airline costs. The study findings align with the environmental regulation theory, which posits that regulatory pressures drive firms to adopt environmentally friendly technologies and practices. In this case, the findings suggest that technological improvements, such as those that reduce emissions, is positively associated with improved airline costs, potentially driven by compliance with environmental regulations or market pressures for sustainability. The study findings also align with the contingent resource-based theory framework as the findings indicate that technological improvement enhances the firm's resource base, particularly in terms of environmental capabilities. This aligns with the notion that firms must adapt their resources to environmental contingencies to achieve competitive advantage.

The current study's findings complement Pang and Chen's work by reinforcing the importance of fleet modernization in improving airline costs. While Pang and Chen focused on the impact of emissions trading systems on profitability, the current study adds to this by emphasizing the role of technological improvement in achieving these goals. Both studies also highlight the importance of newer aircraft for long-term financial and environmental sustainability. The findings were also in line with Brugnoli et al. (2015) study which brings out the importance of technological progress in reducing carbon emissions and improving efficiency within the aviation sector.

The study findings were also aligned with studies by Oliveira, Caliari, and Narcizo (2022) and Merkert (2023). The current study's examination of incentives for fleet upgrades in the local aviation perspective resonates with Oliveira et al.'s findings regarding innovation adoption by Brazilian airlines as both studies suggest that market competition and cost considerations play a significant role in shaping airline management's decisions regarding fleet upgrades. Merkert's (2023) findings regarding engine standardization's impact on airline cost efficiency were consistent with the current study's consideration of engine homogeneity and harmonization in the context of fleet modernization. These two studies suggest that engine-related factors significantly influence the cost efficiency of airline operations and should be carefully considered in fleet expansion decisions.

5.3.2 Operational Improvements and Airline Costs

The study sought to determine the impact of changes in operations in LTAG measures on airline costs in Kenya. The analysis revealed that operational improvements had a positive and significant effect on airline costs in the Kenyan aviation industry. The study findings are supported by the environmental regulation theory since by improving operational efficiency, airlines can reduce their environmental footprint while potentially lowering costs, aligning with the objectives of the theory. Furthermore, operational improvements enhance the firm's operational capabilities, which is within the contingent resource-based theory framework enabling it to respond more effectively to environmental contingencies.

The study findings were corroborated by Schäfer and Waitz (2014) whose findings regarding the need for operational adjustments to complement emission reduction technologies are consistent with the current study. The emphasis on operational improvements in the Kenyan aviation industry aligns with the notion that addressing environmental concerns requires more than technological advancements alone. Operational changes, such as optimizing flight plans or improving air traffic management, can contribute to reducing emissions and enhancing sustainability. Van Dam (2022): The focus of Van Dam's study on optimizing flight plans to reduce emissions during the climb and descent phases aligns closely with the current study's exploration of operational improvements in the Kenyan aviation industry. Similar to the current study, the study noted the potential for operational changes to mitigate environmental impact and improve cost efficiency within airline operations.

The study findings were also supported by Ferrulli (2016) whose study noted the importance of operational efficiency on economic viability and therefore aligns with the current study's focus on operational improvements within the Kenyan aviation industry. Both of these studies recognize the importance of operational efficiency in enhancing sustainability performance, albeit from different contexts. On the other hand, Scheelhaase et al. (2017) examined the concept of minimizing costs through emissions reduction strategies which resonates with the findings of the current study. The study notes that operational improvements, such as optimizing flight plans or implementing market-based measures, can contribute to minimizing airline costs while reducing environmental impact which align with the study findings.

5.3.3 Sustainable Aviation Fuel Implementation and Airline Costs

The study’s aim was to determine the influence of SAF implementation on airline costs in Kenya. The findings on this third variable revealed an insignificant effect of sustainable aviation fuel implementation on the airline costs in the Kenyan aviation industry. The study findings were however contrary to the environmental regulation theory. SAF implementation can be seen as a response to environmental regulations and market pressures to reduce carbon emissions in the aviation sector. However, the findings suggest that despite regulatory incentives or societal demands for sustainability, SAF adoption may not yet offer significant financial benefits for Kenyan airlines

The current study's findings align with the concerns raised by OpenAirlines and Feray regarding the uncertainties and additional costs associated with SAF implementation. The lack of hedging options for SAF and the potential for distorted competition between airlines or regions due to additional costs underline the challenges faced by airlines in adopting SAF. These concerns were also raised by airlines from developing countries during the ICAO Global Aviation Dialogues on Long-term Aspirational Goal and have likely contributed to the insignificant effect of SAF implementation on airline costs observed in the Kenyan aviation industry. Additionally, Staples, Malina, and Suresh (2018) et al. assessed the availability and scalability of SAF feedstock and noted various challenges that may have relevance to the current study's findings. The challenges related to SAF feedstock availability, scalability, and investment required for production could contribute to the limited uptake and insignificant impact on airline costs observed in the Kenyan aviation industry.

Additionally, the roadmap outlined by ICAO and the EU for SAF implementation in Kenya highlights the collaborative efforts and stages involved in assessing the potential and feasibility of SAF adoption. The findings of the current study may contribute to ongoing discussions and efforts to execute the roadmap in Kenya by addressing the challenges and considerations identified by local airlines regarding SAF implementation. The study findings were however disputed by Kelso (2021) who concluded that government policies have the ability to impact overall costs. Additionally, the study findings were not consistent with Bailis, Broekhoff, and Lee (2016) who conducted research on the production and adoption of carbon offsets and biofuels for global aviation and noted a significant relationship between adoption of carbon offsets and biofuels for global aviation and increased production expenses.

5.4 Conclusions

The study results from the first variable revealed that technological improvement positively and significantly contributes to airline costs. Based on these findings, the study concludes that within the Kenyan aviation industry, there is a clear recognition of the importance of technological improvement, particularly in terms of fleet modernization, for enhancing airline competitiveness. The study concludes that airlines in Kenya prioritize fleet upgrades and consider aviation emissions during these upgrades, indicating a proactive approach to sustainability and efficiency. Furthermore, the study indicates a potential market for advanced aircraft concepts in Kenyan aviation, suggesting an openness to innovation and adaptation to newer, more environmentally friendly technologies. Additionally, the findings suggest that aircraft type standardization could be a strategy to reduce costs, possibly through streamlining operations and maintenance processes.

The study also revealed that operational improvements had a positive and significant effect on airline costs in the Kenyan aviation industry. The study therefore concludes that operational improvements should be prioritized, due to their significance in enhancing airline efficiency and reducing costs. The findings also indicate that operational improvements have a significant impact on an airline's margin, emphasizing the financial benefits of investing in operational efficiency measures. The study also highlights collaboration between the Kenya Airports Authority (KAA) and the Kenya Civil Aviation Authority (KCAA) with airlines on operational improvements, suggesting a coordinated effort to address operational challenges and optimize performance across the industry. Additionally, the study concludes that effective communication and involvement of all employees, including those not directly involved with operations, is important for implementing operational changes successfully. The study also noted that Kenyan airports have not prioritized sustainability initiatives as highly as operational improvements suggesting a potential area for further development.

Lastly, the findings on the third variable revealed an insignificant effect of sustainable aviation fuel implementation on the airline costs in the Kenyan aviation industry. The study therefore concludes that, despite the feasibility of sustainable aviation fuel (SAF) production in Kenya, there is currently an insignificant effect of SAF implementation on airline costs in the Kenyan aviation industry. The study further notes that airlines anticipate significant investment requirements for SAF implementation, indicating a recognition of the financial commitment involved in transitioning to sustainable fuel sources. The study also posits that the perception that SAF implementation is more expensive than conventional jet fuel indicates a financial barrier that may be influencing the adoption of SAF in the industry.

Attaining the net zero climate goals will require investment from both government and the airline industry, and will also warrant cooperation between the key stakeholders (KCAA, KAA and airlines). Given the magnitude of the challenges (across several years and a rising demand in air travel) and the cost of status quo, the research shows that airlines are aware of the need to prioritize sustainability initiatives and affirm the costs associated with net zero will in the long run make them more competitive while facilitating sustained growth and mitigating emissions.

5.5 Recommendations

Based on the conclusions, the study developed various recommendations that aim to support the Kenyan aviation industry in transitioning towards more sustainable and cost-effective operations. Based on the conclusion that technological improvement positively and significantly contributes to improved airline costs, the study suggests that airlines should prioritize fleet modernization efforts as they have been shown to positively impact airline costs and competitiveness. The study also recommends that continued investment in advanced aircraft concepts should be encouraged, as there appears to be a potential market for such innovations in the Kenyan aviation industry. The study also recommends that airlines should consider aviation emissions when undertaking fleet upgrades, aiming to incorporate more environmentally friendly technologies.

The second variable operational improvements was determined to have a positive and significant effect on airline costs in the Kenyan aviation industry. Based on this conclusion the study recommends that relevant stakeholders, including Kenya Airports Authority (KAA), Kenya Civil Aviation Authority (KCAA), and airlines, should collaborate on operational improvements to enhance efficiency and reduce costs. The study further recommends prioritization of communication and involvement of all employees, including those not directly involved in operations, to ensure successful implementation of operational changes. The study also recommends continued investment of resources in optimizing operational processes as improvement of these operations lead to an increase in the airline's margin.

The study also concluded that sustainable aviation fuel implementation had an insignificant effect on the airline costs in the Kenyan aviation industry. The study therefore recommends further research and development focusing on SAF production in Kenya so as to reduce the cost of SAF production and implementation, making it a more financially viable option for Kenyan airlines. The study further recommends an increase in government support and incentives which may be necessary to facilitate the transition to SAF and alleviate the financial burden on airlines. Finally, the study encourages collaboration between stakeholders, including airlines, regulatory bodies, and fuel producers, which is crucial to overcome barriers and promote the adoption of SAF in the Kenyan aviation industry.

The study further suggested various policy recommendations. KCAA should implement stricter emission standards for airlines operating in Kenya, encouraging the adoption of newer, more efficient aircraft and operational practices. KCAA should also establish clear standards and certification processes for SAF to ensure quality and reliability, making it easier for airlines to adopt SAF. The government should promote research and development in aviation technologies by offering grants or tax incentives for innovations that improve fuel efficiency and reduce emissions. The government should also provide financial subsidies for SAF production facilities to lower the cost of SAF and make it a more viable option for airlines.

5.6 Suggestion for Further Research

The current study was focused on the Kenyan aviation industry. Further research could be done to compare the financial impact of sustainability initiatives in the Kenyan aviation industry with that of international airlines. The study findings could be applied to improve sustainability efforts in Kenya. The study investigates the financial impact of net zero carbon emissions goal therefore more research can be done on the various other non-financial impacts in the Kenyan aviation industry. Additionally, with the goal to make the country more sustainable, further research can be conducted targeting various other industries in Kenya to find out the impact of the net zero carbon emissions goal. An environmental impact assessment of sustainability initiatives in the Kenyan aviation industry can also be conducted to quantify their contribution to reducing carbon emissions and mitigating environmental impact.

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APPENDICES

Appendix I: Introduction Letter

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Strathmore UNIVERSITY BUSINESS SCHOOL

Tuesday, February 27, 2024

To Whom It May Concern,

RE: FACILITATION OF RESEARCH – SYLVESTER OTIENO OBARA

This is to introduce Sylvester Otieno Obara who is a Master of Business Administration (MBA) Student at Strathmore University Business School, admission number MBA/148832/22. As part of our MBA Programme, Sylvester is expected to do applied research and undertake a project. This is in partial fulfilment of the requirements of the MBA course. To this effect, he would like to request appropriate data from your organization.

Sylvester is undertaking a research paper on "**Examining the financial impact of the net zero carbon emissions goal on Kenyan airlines.**" The information obtained shall be treated confidentially and shall be used for academic purposes only.

Our MBA Programme seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share our findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support and shall be willing to provide any further information if required.

Yours sincerely,

Alois Njenga
Manager – Graduate Programmes
Strathmore University Business School.

Appendix II: Ethical Review Permit

Strathmore UNIVERSITY

8th March 2024

Mr Obara Sylvester,
sylvester.obara@strathmore.edu

Dear Mr Obara,

RE: Examining the Financial Impact of the Net Zero Carbon Emissions Goal on Kenyan Airlines

This is to inform you that SU-ISERC has reviewed and **approved** your above **SU-masters** research proposal. Your application reference number is **SU-ISERC2073/24.** The approval period is from **8th March 2024 to 7th March 2025.**
This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 72 hours.
v. Clearance for the export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days of completion of the study to SU-ISERC.

Before commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

Mr Ambrose Rachier,
Chairperson; SU-ISERC

STRATHMORE UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICAL REVIEW COMMITTEE
(SU-ISERC)
08-Mar-2024
Email:ethicsreview@strathmore.edu
P.O BOX 59857-00200
NAIROBI-KENYA

Ole Sangale Rd, Madaraka Estate. PO Box 59857-00200, Nairobi, Kenya. Tel +254 (0)703 034000
Email admissions@strathmore.edu www.strathmore.edu

Appendix III: NACOSTI Research Licence

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **751539**

Date of Issue: **14/March/2024**

RESEARCH LICENSE

This is to Certify that Mr.. Sylvester Otieno Obara of Strathmore University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: Examining the financial impact of the Net Zero Carbon Emissions Goal on Kenyan airlines for the period ending : 14/March/2025.

License No: **NACOSTI/P/24/33892**

751539

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix IV: Research Questionnaire

Kindly select the appropriate box that corresponds to the response meant for each of the categories.

PART A: GENERAL INFORMATION

1) **Gender**

Male [ ]

Female [ ]

2) **Age Bracket**

Below 30 years [ ]

31– 40 years [ ]

41 – 50 years [ ]

51 and above [ ]

3) **Education Level**

Diploma [ ]

Graduate [ ]

Post-Graduate [ ]

4) **How long have you worked in the aviation industry?**

1-5 years ( )

6-10 years ( )

11-15 years ( )

Above 15 years ( )

5) **In which department do you work?**

Technical ( )

Operations ( )

Quality Assurance ( )

Commercial ( )

6) **Which of the following would you say is the biggest challenge that the aviation sector currently has to tackle?**

   Meeting sustainability goals ( )

   Supply chain issues ( )

Human resource issues ( )

Infrastructure challenges ( )

7) Are you aware of the ICAO recommendations for reduction in aviation emissions by 2050?

Yes [ ]

No [ ]

8) Do you think they are achievable in Kenya within that timeframe?

Agree [ ]

Disagree [ ]

Neutral [ ]

9) Do you feel the implementation pace of sustainability strategies in the aviation industry is

Too slow [ ]

Too fast [ ]

At the right pace [ ]

10) Does your company have a sustainability strategy and carbon offsetting targets?

Yes [ ]

No [ ]

11) What impact has your company's sustainability strategy had on operations?

Major impact [ ]

Moderate impact [ ]

Minor impact [ ]

12) Does your company have a dedicated team for fleet development?

Yes [ ]

No [ ]

13) Does your company have a carbon footprint measurement metric?

Yes [ ]

No [ ]

PART B: EFFECT OF ICAO 2050 EMISSION REDUCTION PROPOSALS ON AIRLINE COSTS

Please tick the level of agreement on the following statements. Please indicate in the table with a tick (√) or a cross (×) with a scale of;

5= strongly agree **4=** Agree **3=** Disagree **2=** Strongly Disagree **1=** Undecided

No	**Increase in airline costs**	**1**	**2**	**3**	**4**	**5**
1.	Fuel cost has the highest impact on profit margin					
2.	Maintenance expenses has the highest impact on profit margin					
3.	Aircraft financing costs have the highest impact on profit margin					
4.	Profitability in the airline industry is always achievable					
5.	Passengers are willing to pay more for sustainable flights					

1) **From your own experience within aviation, what other costs are significant to an airline?**

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2) **What do you see as the biggest obstacle to meeting the net zero goal?**

____

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____

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No	**Technological improvements and airline costs**	**1**	**2**	**3**	**4**	**5**
1.	Fleet modernization will make an airline more competitive					
2.	Airlines have prioritized fleet upgrades					
3.	There is a potential market for advanced aircraft concepts in Kenyan aviation					
4.	Aviation emissions are considered during fleet upgrades					

5.	Aircraft type standardization will reduce costs					

3) **What are the barriers to the successful implementation of technological improvements in airlines?**

4) **What factors are considered when making a cost benefit analysis on fleet modernization?**

5) **Which investment in technology would be a viable source of additional revenue for airlines?**

No	**Operational improvements and airline costs**	**1**	**2**	**3**	**4**	**5**
1.	Operational improvements should be prioritized					
2.	KAA and KCAA are working with airlines on operational improvements					
3.	Operational improvements have a significant impact on an airline’s margin					
4.	Employees not involved with operations need to be apprised of any changes					
5.	Kenyan airports have prioritized sustainability initiatives					

6) **From your understanding of flight and ground operations, do you think there is enough support from the government, KAA and KCAA?**

7) **What are the barriers to the successful implementation of operational improvements at the airlines and airports?**

No	SAF Implementation and airline costs	1	2	3	4	5
1.	SAF production is feasible in Kenya					
2.	Airlines will have to invest significantly on SAF implementation					
3.	Current aircraft models are fully compatible with SAF					
4.	SAF implementation is more expensive than conventional jet fuel					

8) **What are the barriers to SAF implementation in Kenya's aviation sector?**

9) **What technology do you think is likely to be the yield the greatest results in the net zero initiative?**

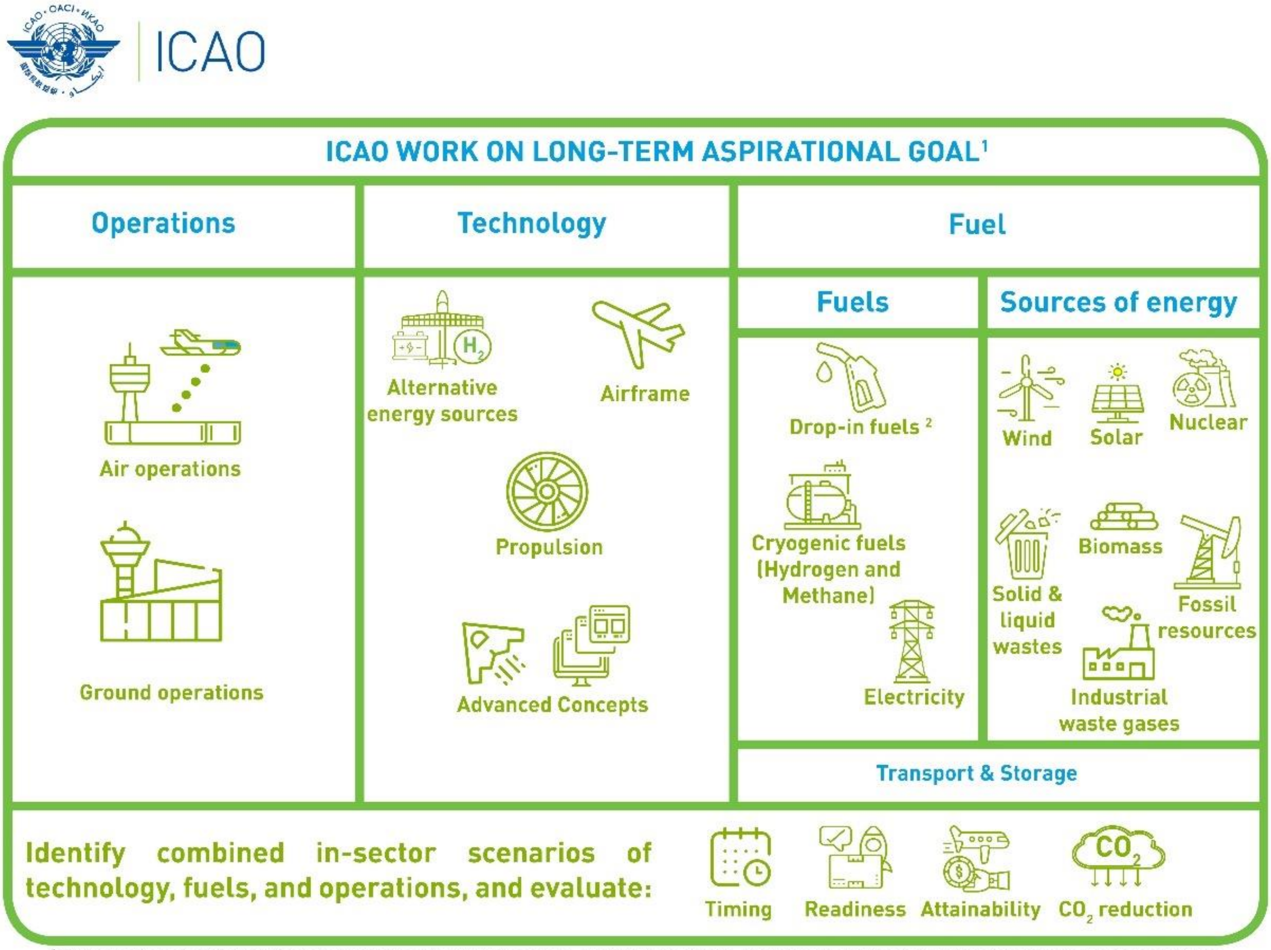
Appendix V: List of Domestic Airlines

NO	AOC NUMBER	OPERATOR
1.	1	Z.Boskovic
2.	6	Aim Air
3.	11	Governors' Balloons Safaris Limited
4.	12	TransAfrican Air Ltd
5.	14	Mission Aviation Fellowship (MAF)
6.	15	Balloon Safaris Limited
7.	16	Mombasa Air Express
8.	20	Kenya Airways PLC
9.	21	Photomap
10.	23	Rudufu Limited
11.	26	Fanjet Express Ltd
12.	27	Advantage Air Travel Ltd
13.	35	Twinstar Aviation
14.	36	BuffAir
15.	38	Transworld (EA) Ltd
16.	57	East African Air Charters
17.	47	Bluebird Aviation
18.	49	Adventures Aloft (K) Ltd
19.	50	African Express
20.	58	ALS
21.	69	Farmland Aviation Ltd
22.	223	SAC (K) Limited
23.	72	Tropic Air Limited
24.	261	Jambojet
25.	118	748 Air Services
26.	133	Everett Aviation

27.	140	Yellow Wings Air Services
28.	149	Heliprops (K) Ltd
29.	164	Phoenix aviation
30.	165	Airworks (K) Limited
31.	166	Astral Aviation Ltd
32.	173	Aeronav
33.	180	Luca Safari Ltd
34.	182	Safarilink Aviation Ltd
35.	187	Safari Express Cargo
36.	189	Airtraffic Limited
37.	200	Air Kenya Express
38.	204	Governor's Aviation Limited
39.	211	Trident Aviation
40.	212	Sicham Aviation
41.	215	Penial Air Ltd
42.	216	Aberdaire Aviation
43.	217	Kasas Limited
44.	218	Skyship Company Limited
45.	221	Jubba Airways Limited
46.	224	Freedom Airlines Express Ltd
47.	226	Lady Lori
48.	228	Northwood Agencies
49.	232	Scenic Air Safaris Ltd
50.	235	Helicopter Charters (E.A) Limited
51.	236	Africa Eco Adventures
52.	239	Kwae Island development Limited

53.	240	Flex Air Charters
54.	242	Ramani Geosystems
55.	243	Mara Wildlife Balloon Services
56.	244	Sandpiper
57.	245	Muhwai Limited
58.	247	Westwind Aviation Limited
59.	248	Youth Aviation Limited
60.	251	Skyward Express Ltd
61.	252	Renegade Air
62.	256	Prime Aviation
63.	257	Amref Flying Doctors
64.	263	Hamco Aviation Limited
65.	264	Pro-Flight Limited
66.	265	Jetways Airlines Ltd
67.	267	Ventura Aviation Limited
68.	269	Airborne African Antics ltd
69.	270	I-Fly Solutions Limited

Appendix VI: In-Sector Measures for ICAO LTAG on Reduction of CO_2 Emissions

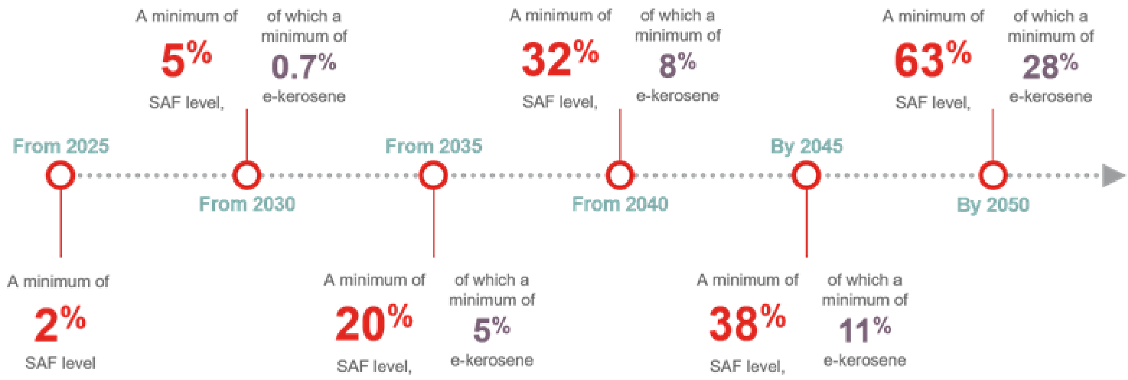


[1] This work should identify and evaluate existing, foreseen, and innovative in-sector measures in technology, fuels and operations, and their enablers, including information of probable costs. This will assist in identifying gaps, and information and expertise needed, in order to complete a thorough assessment of all in sector CO_2 reductions for international aviation. This should include timing, readiness, attainability and the quantity of CO_2 reduction possible, based on a feasible roll out into the aviation sector.
[2] Sustainable Aviation Fuels (SAF), Low Carbon Aviation Fuels (LCAF), E-Fuels. Icons made by Freepik from www.flaticon.com

Source: ICAO 2022 Environmental Report

	Fuel Category	Fuel Name	Carbon source in fuel feedstock
Drop-in fuels	LTAG - Sustainable Aviation Fuels (LTAG-SAF)	Biomass-based fuel	Primary biomass products and co-products
		Solid/liquid waste-based fuels	By-products, residues, and wastes
		Gaseous waste-based fuels	Waste CO/CO_2
		Atmospheric CO_2-based fuels	Atmospheric CO_2
	LTAG - Lower Carbon Aviation Fuels (LTAG-LCAF)	Lower carbon petroleum fuels	Petroleum
Non drop-in fuels	**Fuel Category**	**Fuel Name**	**Carbon source in fuel feedstock**
	Non drop-in fuels	Electricity	Not applicable
		Liquefied gas aviation fuels (ASKT)	Petroleum gas, "fat" natural gas, flare gas, and propane-butane gases
		Cryogenic hydrogen	Natural gas, by-products, non-carbon sources

Source: ICAO LTAG Special Supplement



Source: EASA - Fit for 55 and ReFuelEU Aviation