ACTION PLAN

FOR THE REDUCTION OF GREENHOUSE GAS EMISSIONS BY INTERNATIONAL AVIATION IN MOZAMBIQUE

2022

BASE YEAR 2019

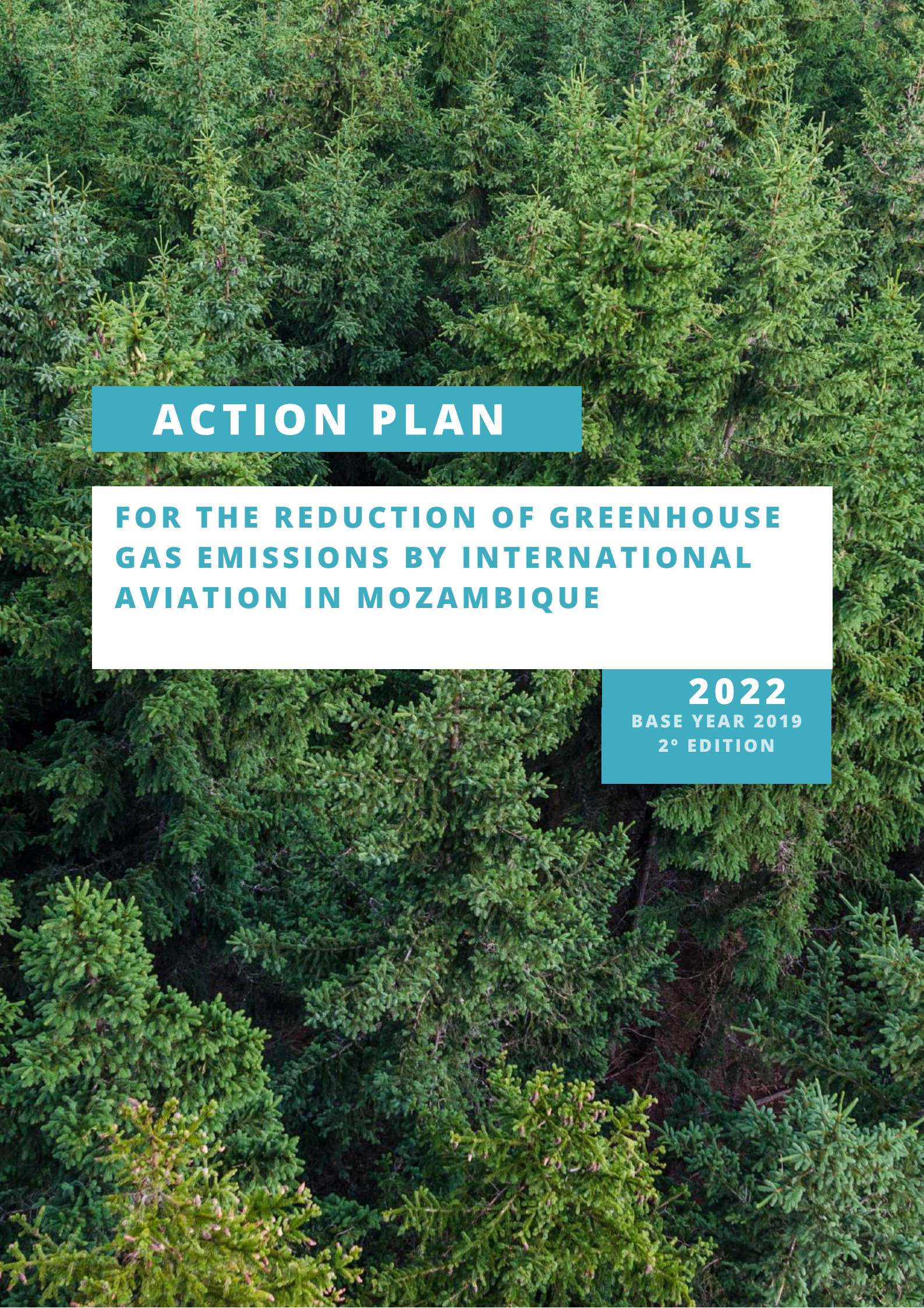
2º EDITION

ICAO

IACM

AUTORIDADE DE AVIAÇÃO CIVIL DE MOÇAMBIQUE

MINISTÉRIO DOS TRANSPORTES E COMUNICAÇÕES



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FOREWORD

Given the constant changes and the pressure of climate change resulting from human actions, which represent an urgent and potentially irreversible threat to human societies and to the planet, it has become increasingly compulsory to develop climate resilience actions through climate change adaptation and mitigation measures.

To this end, the Government of the Republic of Mozambique has in its priority agenda, the implementation of the National Strategy for Adaptation and Mitigation of Climate Change and to this end introduced legal institutional reforms necessary to respond to the challenges imposed by climate change.

The IACM, under the United Nations Framework Convention on Climate Change of June 1992, Resolution n° 1/94 of August 24, resolutions A37ª-19 of 2010, A38ª-18 of October 4, 2013, A39ª-2 of 2016, and ICAO Annex 16 (vol. I, II, III and IV) has been encouraging and monitoring practices on measures, which aim at mitigating and reducing CO2 and other Greenhouse Gases in Civil Aviation in Mozambique.

In coordination with airline operators, airports and other stakeholders, it has been developing actions to effectively implement the Paris Agreement and ensure the achievement of the objectives outlined at the ICAO's 37th-19th Assembly held in 2010.

This Action Plan objectively demonstrates the set of actions and measures adopted by the different actors of the civil aviation sector as part of the country's efforts to follow the guidelines laid out in the Paris Agreement as well as the status of the development of actions committed by the Civil Aviation sector in Mozambique, in the application of best practices of environmental sustainability, aimed at reducing emissions of CO_2 and other greenhouse gases, competing to meet the guidelines of the International Civil Aviation Organization (ICAO).

ABREVIATIONS

IACM – Mozambique Civil Aviation Authority

APU - Auxiliary Power Supply Unit (PMU

CH4 – Methane

CO2 - Carbon dioxide

CO2e - Carbon dioxide equivalent

COP - Character-oriented protocol

CQNUMC - United Nations Framework Convention on Climate Change

GHG - Greenhouse Gases

GPS - GPS Global Positioning System) - Global Positioning System - Satellite-based navigation system

GPU - Ground Power Unit

HFCs – Hydrofluorocarbons

IPCC - Intergovernmental Panel on Climate Change

N2O - Nitrous Oxide

ICAO - International Civil Aviation Organization

ODS - Sustainable Development Goals

ONU - United Nations

OSA - Operational Safety Assessment

PAG - Global Warming Potential

PEB - Biofuels Policy and Strategy

PFCs – Perfluorocarbons

RNAV - Navigation Area

RNP - Required Navigation Performance - navigation performance claim necessary for operation within a defined airspace

SF6 - Sulphur Hexafluoride

UNFCCC – United Nations Framework Convention on Climate Change

CORSIA – Carbon Offsetting Reduction Scheme

UNFCCC – United Nations Framework Convention on Climate Change

SARPs – Standards and Recommended Aeronautical Practices

EXECUTIVE SUMMARY

The Republic of Mozambique has been ensuring standards and procedures for the protection of the environment, according to the applicable legislation, as well as the protection of the environment in the vicinity of aeronautical infrastructures and, for this purpose, several legal instruments are being adopted, to regulate such activities that result in the reduction of GHG emissions.

The Republic of Mozambique has been an ICAO Contracting State since 1977 and ratified the Chicago Convention in 2008, by Resolution No. 63/2008 of November 28, 2008.

The Chicago Convention establishes the rights and obligations of all Contracting States and sets forth Standards and Recommended Practices - SARPs related to the safety, security, regularity and efficiency of air navigation. The Civil Aviation Authority of each ICAO Contracting State has the responsibility to establish the national regulatory framework for the reduction of emissions of pollutants from the civil aviation sector and for the certification of noise levels.

To reduce its emissions, the Civil Aviation Sector of Mozambique has been implementing several mitigation and reduction measures, among which we highlight:

- ✓ Infrastructure-related measures;
- ✓ Operational Measures;
- ✓ And technological ones.

Out of these, the most prominent is the implementation of measures in infrastructure and operations.

This document reflects the reissue of the GHG Reduction Action Plan, whose main target is carbon dioxide (CO_2), which is believed that its emissions are linked to global warming and climate change. The Action Plan discloses the actions that are being taken by the Aviation sector in Mozambique, in the implementation of actions aimed at reducing emissions, bringing approaches on the status of implementation of reduction and mitigation measures that were enrolled in the 1st edition, and also the actions under development, new actions planned for the coming years in the sector, as well as the challenges faced.

As far as the objectives of this Plan are concerned, we highlight the following:

1. Act in compliance with the objectives contained in ICAO Resolution A38-18;
   To update this Action Plan, the IACM has been disseminating actions and coordinating with the various civil aviation stakeholders, in order to encourage the practice of environmental measures and the actions that were committed to be implemented by the State in the civil aviation industry, through the inclusion of stakeholders in the participation in permanent meetings, and in workshops held by ICAO and various environmental organizations.

2. Reduce CO_2 emissions from International Civil Aviation;

The Civil Aviation Sector of Mozambique to reduce its emissions, has been Implementing several mitigation measures, among which are:

- ✓ Infrastructure-related measures;
- ✓ Operational Measures;
- ✓ And technological ones.

With more emphasis on the implementation of Operational measures, which are implemented by the Operators and in the infrastructures by the airport operators.

3. Examine the possibilities of the implementation of the precautionary measures listed by the regional operators committed to the cause;

The IACM monitors through periodic requests for statistical data on international emissions by national air operators. It also has currently introduced the practice of supervisions on the sector's environmental measures to airline and airport operators.

4. Ensure that regional operators act in compliance with the different Civil Aviation regulations.

In this context, the IACM is developing Civil Aviation regulatory documents for environmental issues such as, the Regulation and Technical Circular on CORSIA, in order to ensure that operators act in compliance with the different regulations.

CHAPTER I – GENERAL CONTEXT OF CIVIL AVIATION IN MOZAMBIQUE

1.1. NATIONAL LEGAL FRAMEWORK

As to the general-legal framework in Mozambique there has not been any revision of laws that can be considered updated, significant, comprehensive, adequate in many aspects and diversified, focusing on various aspects in the environmental problematic, basing fundamentally on the Environment Law, approved by Law No. 20/97 of October 1, the Civil Aviation Law, approved by Law No. 5/2016 of June 5, by the Civil Aviation Policy of Mozambique, approved by resolution n° 40/2002 of May 14 and the respective regulations, approved by Decree of the Council of Ministers. Therefore, the laws, the 1st Edition of the Mozambique Action Plan prepared and published in 2019, by ICAO remain the same.

1.2. THE INSTITUTIONAL FRAMEWORK OF CIVIL AVIATION IN MOZAMBIQUE

1.2.1 MOZAMBIQUE. CIVIL AVIATION AUTHORITY (IACM)

IACM is an autonomous entity responsible for the regulation of Civil Aviation in Mozambique. The Institute plays the role of technical and economic regulator of Civil Aviation, defining and enforcing the national policies and standards, and ICAO recommendations, supervising the sector. It is also responsible for certifying aeronautical infrastructures, issuing aeronautical and para-aeronautical licenses and authorizing aircraft.

1.2.2 NATIONAL AIR CARRIERS OPERATING INTERNATIONAL FLIGHTS

There are two operators operating international flights in Mozambique, namely:

- ✓ LAM - Mozambique Airlines;

- ✓ MEX - Mozambique Express;

1.2.3. MITIGATION MEASURES FOR REDUCING CO_2 AND GHG IMPLEMENTED BY NATIONAL AIR CARRIERS OPERATING INTERNATIONAL FLIGHTS

(From year 2019 to 2021)

In order to contribute to the reduction of environmental impact, the airline operators have been implementing mitigation measures aimed at mitigating CO_2 and other GHGs in Mozambican Aviation, among them operational measures applied in their operations and among them we highlight:

- ✓ Improved use of optimum flight level, the extent to which it allows the (use of long range cruise);
- ✓ Taxiing the aircraft using an engine;
- ✓ Periodic washing of the aircraft
- ✓ Periodic washing of aircraft engines;

This measure is being implemented regularly, and it is included in the aircraft maintenance program for engine washing, and is done in all aircraft by recommendation of the manufacturers according to the type of aircraft. The implementation of this measure during the implementation period brought as expected results in terms of CO_2 emission reduction an annual average of 28.97% CO_2 reduction;

- ✓ Minimization of weight on board aircraft;
  Weight reduction was introduced in, electronic flight packages, and checked baggage reduction, bringing as expected results in terms of CO_2 emissions reduction 11,300 tons for the year 2019 and 13,890 tons for the year 2020;
  Comparing the first two years, with the introduction of this measure the emissions of CO2 reduced by 2,590 tons;

1.2.4. OTHER IMPLEMENTED MEASURES

- ✓ Replacing the use of plastics with cartridge paper in on-board aircraft catering services;
- ✓ Periodic washing of aircraft engines;
- ✓ Periodic washing of the aircraft;
- ✓ Collection and treatment of solid and liquid waste, from the spillage of fuel and oil from aircraft on the runways.

1.2.5. LONG-TERM MEASURES

- ✓ Reduction of aircraft manuals for introduction of IPADS;
- ✓ Installation of power generators and pre-conditioned air to the airplanes, in the stopovers;

1.3. MOZAMBIQUE AIRPORTS

AEROPORTOS DE MOÇAMBIQUE, E.P.

Under paragraphs a), b) and c) of No 1 of article of Decree No. 17/2022 of May 5, airports in the Republic of Mozambique are classified into 3 categories to be considered:

- ✓ International Airports;
- ✓ Entry Points; and
- ✓ Mixed entry points.

And in its articles 2, 3 and 4 it describes the category designation of international airports as follows:

Table 1 - International Airports in Mozambique

Maputo Airport	Beira Airport	Nacala Airport

1.3.1. GHG AND CO_2 MITIGATION MEASURES IMPLEMENTED BY AIRPORTS (From 2019 to 2021)

In order to improve the sustainability of existing airports in Mozambique, the airports have been implementing the following actions:

- ✓ PBN Implementation;

PBN (Performance-Based Navigation), whose implementation process began in 2014 with the approval of the national plan and its implementation, and in 2018 with the restructuring and improvement of the airspace.

The implementation of PBN procedures represents the quest for optimization and better utilization of airspace and its implementation is considered crucial to air navigation modernization programs. This is considered one of the mitigation measures for the reduction of CO_2 emissions and other greenhouse gases in the Civil Aviation sector, as it will shorten the distances and flight time of aircraft using such procedures, which, in turn, will contribute to the consumption of less fuel and consequently in the reduction of emissions.

Mozambique Airports are in the process of airspace restructuring and implementation of PBN (GNSS) in all airports.

The implementation of PBN has brought with it a positive impact for air traffic controllers, because now it allows aircraft to make direct flights, implying less flight time, and facilitating the location of aircraft coordinates, compared to the conventional system, that the controller was limited to follow the coordinates based on information from pilots.

- ✓ Replacement of fuels in generators by renewable energy use and replacement of conventional light bulbs by LEDs at airports;

This measure began in 2014, with the construction of Nacala Airport, an airport that complies with a green airport infrastructure (Sustainable Airports).

- ✓ Replacement of conventional lamps by LED lamps, both in buildings and runways: this action is taking place gradually, due to insufficient funds from LAM Company. This measure is planned to be included in all airports in Mozambique.

  The lack of funds means that this measure is being carried out gradually, starting in Nacala and Maputo Airport.

1.3.2. REGULATORY MEASURES

Although regulatory measures are not reflected, the following are being adopted by the Civil Aviation Authority in calculating the expected reduction in the level of CO_2 emissions from EBT:

- ✓ Air Operators must report the Carbon Emissions Transparency

  The Mozambique Civil Aviation Authority, has established an MRV unit, which has been monitoring through periodic requests for information regarding fuel consumption data and CO_2 emissions resulting from the operations of national Air Operators, as well as requesting the Monitoring Plans of their emissions;
- ✓ Conferences and Workshops.

The IACM has attended meetings and workshops on environmental issues, held by environmental entities in Mozambique, and other stakeholders, and has ensured the inclusion of the participation of Air Operators, Airports and other stakeholders of the Mozambican Civil Aviation sector.

1.3.3. METEOROLOGICAL MEASURES

- ✓ Improvement of Aeronautical Meteorological Information Service Plans. In recent years Mozambique has been presenting improvements in aeronautical forecast models, adopting to models that consist of safer and more reliable aeronautical meteorological information, making aeronautical meteorological data for more reliable air navigation;
- ✓ Improvements in the preparation and issuing of warnings for aircraft landings and takeoffs.

1.3.4. OTHER ADOPTED MEASURES

- ✓ Construction of retention ditches for river waters, the Beira Airport, in coordination with the Municipality of Beira, carried out the construction of an artificial lake near the airport, called (Marocanhe Lagoon) where a camping Lodge is located in that city, in order to not only solve the issue of river water runoff, but also the retention of animal life, in view of the natural relocation of birds in that region of the airport; because they are attracted and fed in that habitat;
- ✓ Existence of river water cisterns, accumulated by rainwater, which are reused by the fire department in some airports;
- ✓ Existence of wastewater treatment hectares, where the water is treated and used for irrigation at the Airport;
- ✓ Waste collection and treatment of solid and liquid waste from oil, fuel and other liquid waste spills on runways at Airports;
- ✓ For the Fauna issue, there has been regular cutting of the grass around the runways at the Airports;

1.3.5. MEASURES TO BE ADOPTED

- ✓ The installation of power generators and pre-conditioned air to the airplanes, which allows the APU to be turned off, is under implementation feasibility study;
- ✓ Enhanced Air Traffic Management (ATM) and infrastructure use;
- ✓ Replacement of track lamps with halogen lamps;
- ✓ Implementation of solar panels;
- ✓ Replacing the use of fuel-powered generators (Diesel) at airports with the use of solar panels;

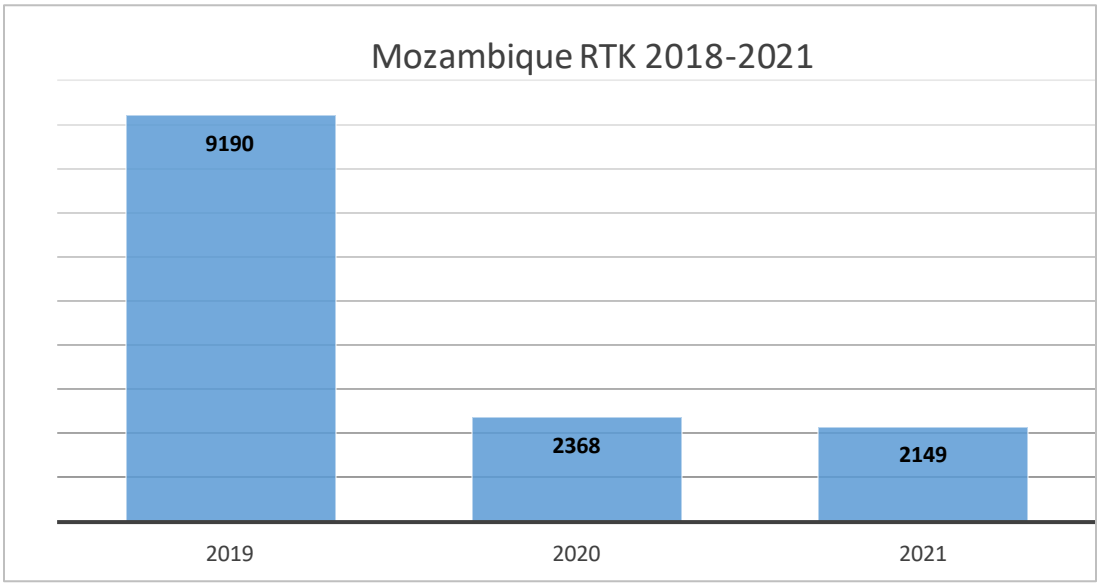
- ✓ Acquisition of weather radars for airports that, due to lack of funds, cannot be expanded to all airports in Mozambique;
- ✓ Improvements in the accuracy and quality of meteorological information, which allow the identification with a more comprehensive view of certain meteorological phenomena such as windstorms in a certain region.

CHAPTER II – HISTORICAL EMISSIONS DATA OF THE SECTOR

2. RTK OF NATIONAL AIR OPERATORS OPERATING INTERNATIONAL FLIGHTS (2019-2021)

Chart 1 shows the volume of passengers and cargo carried internationally by domestic carriers in terms of RTK. There was a significant increase in 2019, but from that year on there was a gradual decline in RTK in the country. The year 2021 was the year with the lowest volume of passengers and cargo carried by national air operators on international flights.

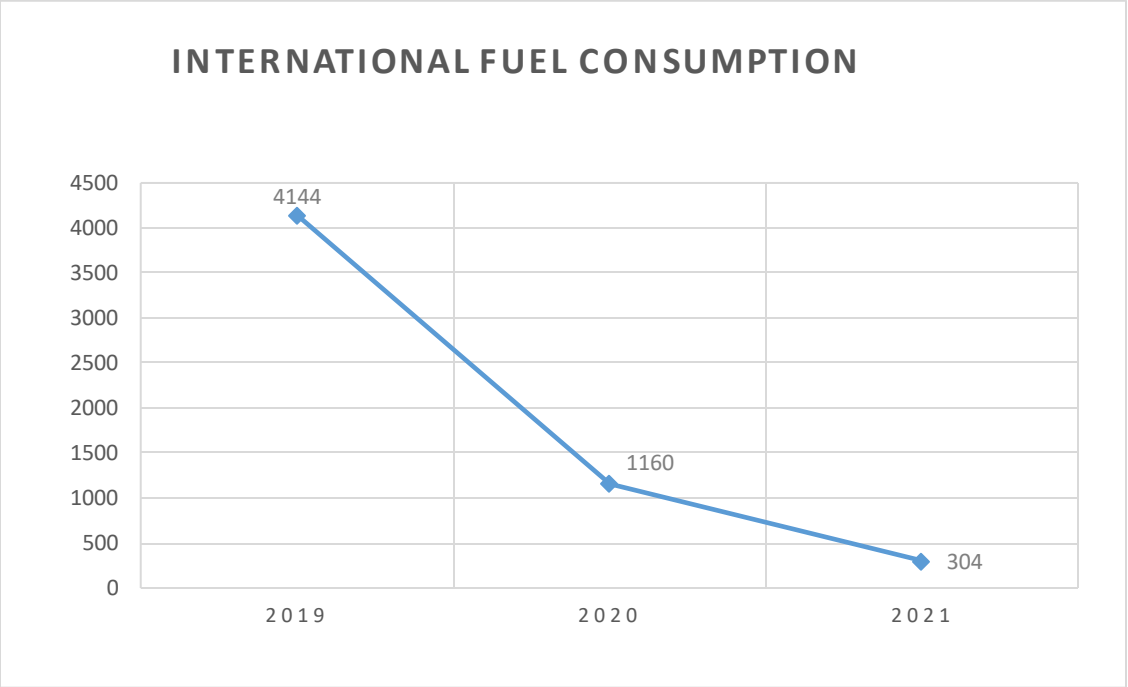
Chart n° 1. - Mozambique RTK. 2019 -2021



Source: Operator data

2.1. FUEL CONSUMPTION HISTORY OF INTERNATIONAL OPERATIONS

Chart No 2 - International JET-A fuel consumption



Source: Operator data

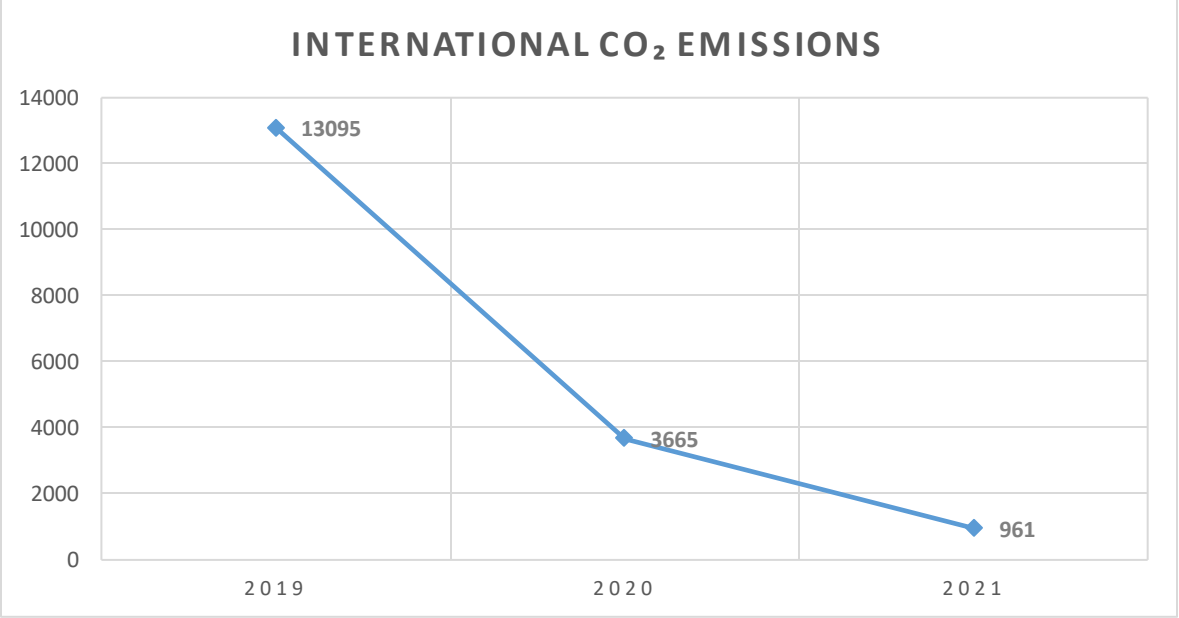
According to the data in chart n° 2 which illustrates the international fuel consumption in Aviation in international operations, a decrease in fuel consumption is observed, with a reduction in consumption occurring in the years 2020 to 2021. The decrease is justified by the direct proportionality in the ascendancy of the number of passengers transported and cargo transported regionally by national operators. This fact was due to COVID-19, which was declared a pandemic by the WHO on March 11, 2020 and had greater incidence in the years 2020 and 2021.

Chart No 3 presents the international CO_2 emissions for the period 2019 to 2021. Consistent with the method applied methodologically, to the calculation of CO_2 emissions by JET - A fuel.

The conversion factor and of 3.16 (in Kg CO /Kg fuel).

According to the data in chart nr°3 which illustrates the international emissions in Mozambican aviation in international operations, a decrease in emissions was observed in the interval of 2020 and 2021 and a reduction between the two years. The downward trend was due to the direct proportionality in the reduction of fuel consumption, relative to the weak movement of passengers and cargo transported internationally by domestic operators. It was also due to the pandemic of COVID-19, which affected the air transport market.

Chart n° 3 - International CO_2 emissions



CHAPTER III – ACTION PLAN

3.1. RANGE OF MEASURES FOR THE MITIGATION OF EMISSIONS FROM THE SECTOR IN MOZAMBIQUE

The mitigation measures selected for the reduction of CO_2 emissions from international aviation in Mozambique are focused on three of the categories in the range of measures employed by ICAO:

a) *Improvement of Air Traffic Control Management (ATM and PBN) and infrastructure use;*
b) *More efficient operations;*
c) *Airport Improvements;*
d) *Other measures*;

a) IMPROVED MANAGEMENT OF AIR TRAFFIC CONTROL (ATM and PBN) AND INFRASTRUCTURE USE

ATM

Dynamic and integrated air traffic and airspace management, including air traffic services, airspace management and air traffic flow management - safely, economically and efficiently - through the provision of continuous facilities and services in collaboration with all parties and involving airborne and ground functions and aggregation of airborne and ground functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations. This mitigation measure is under implementation, the Mozambican Airports have started the surveillance process, and the airport infrastructure is being upgraded, and the preparation of a plan to facilitate air traffic management at the Mozambican airports is also underway.

PBN

PBN (Performance-Based Navigation) – is a route or procedure whose execution requires that the set of aircraft systems, crew qualification and air traffic management systems meet specifications expressed in terms of accuracy, integrity, availability and continuity. The concept is formed by RNAV and RNP procedures associated with a certain level of accuracy for each type of operation. This is considered one of the mitigation measures for the reduction of CO_2 emissions and other greenhouse gases in the aviation sector, because with its introduction, it will shorten the distances and flight time of the aircraft using procedures, which will contribute to the use of less fuel and fewer emissions. Mitigation Measure implemented by the

company Mozambique airports, the PBN implementation process began in 2014, approval of the national plan and its implementation and the start of restructuring and improvement of airspace began in 2018.

The Mozambique Airports are in the process of restructuring the airspace and implementing PBN (GNSS) in all airports and this process is in its final stage.

PBN procedures are being implemented in all airports, namely:

- Maputo Airport;
- Beira Airport;
- Nacala Airport;
- Pemba Airport;
- Vilanculos Airport;
- Nampula Airport;
- Quelimane Airport;
- Tete Airport;
- Inhambane Airport;
- Chimoio Airport;
- Filipe Jacinto Nyusi Airport;

Missing their validation and verification flight.

Although there is not enough data to estimate the reduction of CO_2 emissions from this measure, it is expected that the implementation of en-route PBN will contribute significantly to the reduction of fuel consumption by domestic and foreign carriers operating in the country. This measure presents a degree of satisfaction and positive feedback from operators and air traffic controllers; although some air carriers also chose to use the conventional method.

It should be noted that the PBN has brought financial and operational benefits to airports, in financial terms, as it has reduced maintenance costs with the conventional system that had been used.

Before the implementation of PBN at the airports in Mozambique, the conventional system was used, which entailed costs with maintenance, and with the security of the infrastructure where the system was mounted, and the check flight, to perform the check of the VOR.

In operational terms, in the aircraft approach check, with the conventional system it was only possible to physically check the aircraft approach through radar at 14000 feet and based on the pilots' information, nowadays with the radar the Air Traffic Controller no longer relies only on the pilots' information.

b) MORE EFFICIENT OPERATIONS

The measures aimed at more efficient operation are implemented by the airlines of Mozambique, and relate

to the reduction of weight on board the aircraft, periodic washing of engines and aircraft. For the implementation of these measures, the national airlines, in addition to the introduction and reduction of the weight of checked baggage, intends to effect the introduction of searches on board the aircraft and, processes of aircraft manuals by scanning in electronic equipment (IPAD'S). This measure is in the feasibility study phase, and in search of internal procedures for its implementation.

Aircraft engine washing. It is being implemented by the airlines, according to the established periodicity for aircraft engine washing, defined in the aircraft maintenance program, by recommendation of the aircraft manufacturer.

c) AIRPORT IMPROVEMENTS

Airports in Mozambique have been presenting improvements in their infrastructure. With the preparation of Environmental Management Plans at airports, it has been implementing mitigation measures in order to mitigate and reduce emissions, among which we highlight:

The Reduction of energy consumption in Airports, as is evident in some airports in Mozambique, and the inclusion of these aspects in the construction projects of more sustainable airports, airports that obey a green infrastructure, highlighting the: Maputo International Airport, Filipe Jacinto Nyusi Airport, Vilanculos Airport. Nacala International Airport, which obey technical specifications for the construction of sustainable airports since the implementation of its construction project.

The major focus is on the use of renewable energy at airports, therefore the replacement of conventional energy by renewable energy for use in airports, and the following actions are being implemented in some airports:

- ✓ Gradual replacement of conventional lamps by LED lamps in airport infrastructures;
- ✓ Gradual replacement of conventional lamps by halogen lamps on the tracks;
- ✓ Replacing the use of diesel generators with solar panels;
- ✓ Implementation of solar panels for use at airports, which will benefit the population living near the airports;
- ✓ Preservation of Fauna and Flora in the vicinity of airports; and
- ✓ Proper treatment to liquid and solid residues at airports.

d) OTHER MEASURES IMPOSED BY THE CIVIL AVIATION SECTOR

In order to greatly contribute in the reduction of CO_2 emissions from the Aviation of Mozambique, under the 39th session of the ICAO Assembly, held in October 2016, in which the Carbon Emissions Offsetting and Reduction Scheme for International Aviation was launched, with the name CORSIA, which aims to reduce and stabilize carbon emissions from international aviation at 2019 levels. The Civil Aviation Regulatory Authority of Mozambique is in the process of drafting the CORSIA Regulation, which is expected to be completed, approved, and implemented by 2023.

The IACM, in order to control emissions, has been carrying out the process of monitoring, reporting, and verification of emissions by Mozambican airlines.

The Government of Mozambique approved on December 11, 2018 Mozambique's Nationally Determined Contribution NDC (2020-2030) and the related NDC Operational Plan 2020 - 2025. Both the NDC and the Operational Plan include adaptation and mitigation actions conditional on support in terms of means of implementation.

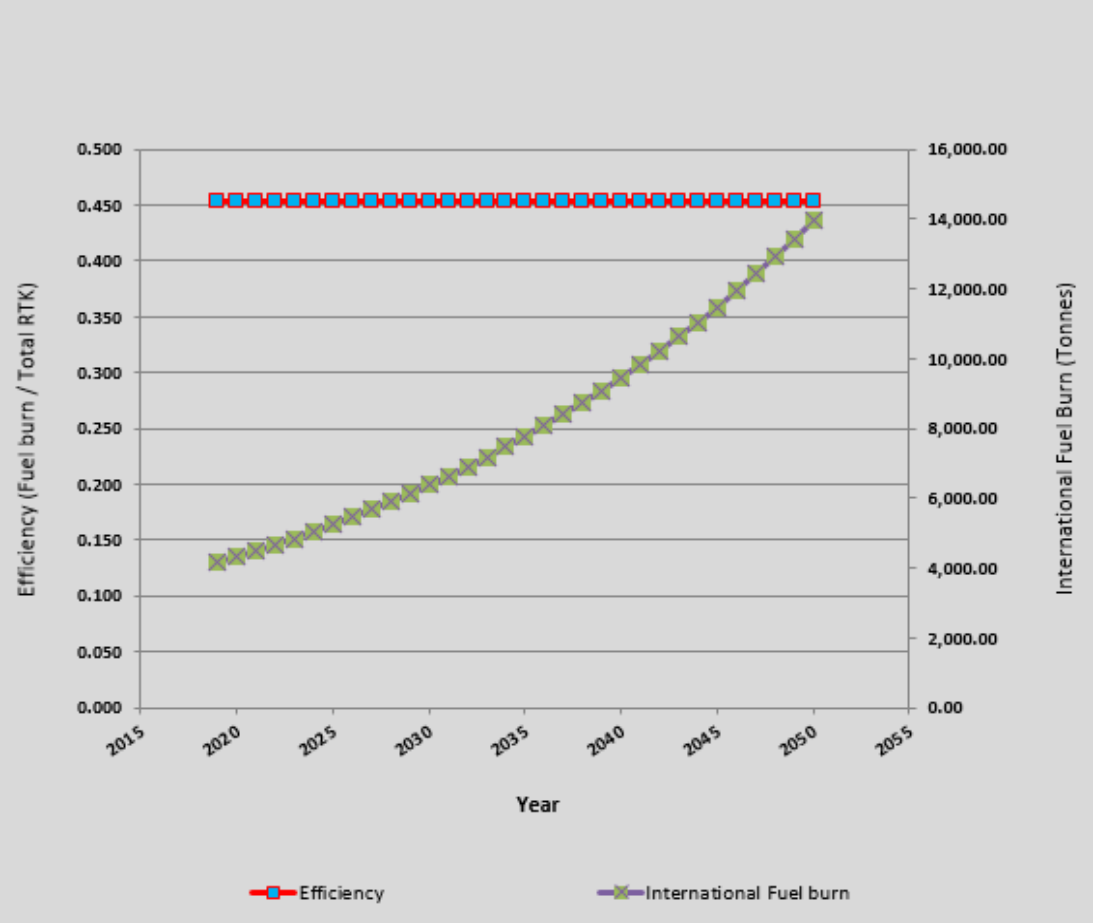
In order to contribute to the Government of Mozambique's commitments on environmental issues, the transport sector - Civil Aviation, is implementing several mitigation and adaptation measures to climate

change in order to reduce the spread of natural phenomena and their negative impact on the population. Having registered its mitigation and adaptation actions in Mozambique's NDC lacking financial resources for the full implementation of adaptation and mitigation actions.

3.2 EMISSION DATA FROM INTERNATIONAL AVIATION

The baseline of CO_2 emissions up to 2050 is described in Table No. 1 attached and in Chart No 4, according to the results, in the absence of mitigation measures implemented by Mozambique, CO_2 emissions from international aviation will increase from 13,095.45 to 44,172.70 tons of CO_2 by the year 2050. Once according to this baseline scenario, with the implementation of the mitigation measures will reduce from 12,702.59 to -5,021.28 t CO_2 from international aviation in Mozambique in the years 2019 to 2050.

Chart No 4 – Baseline until 2050



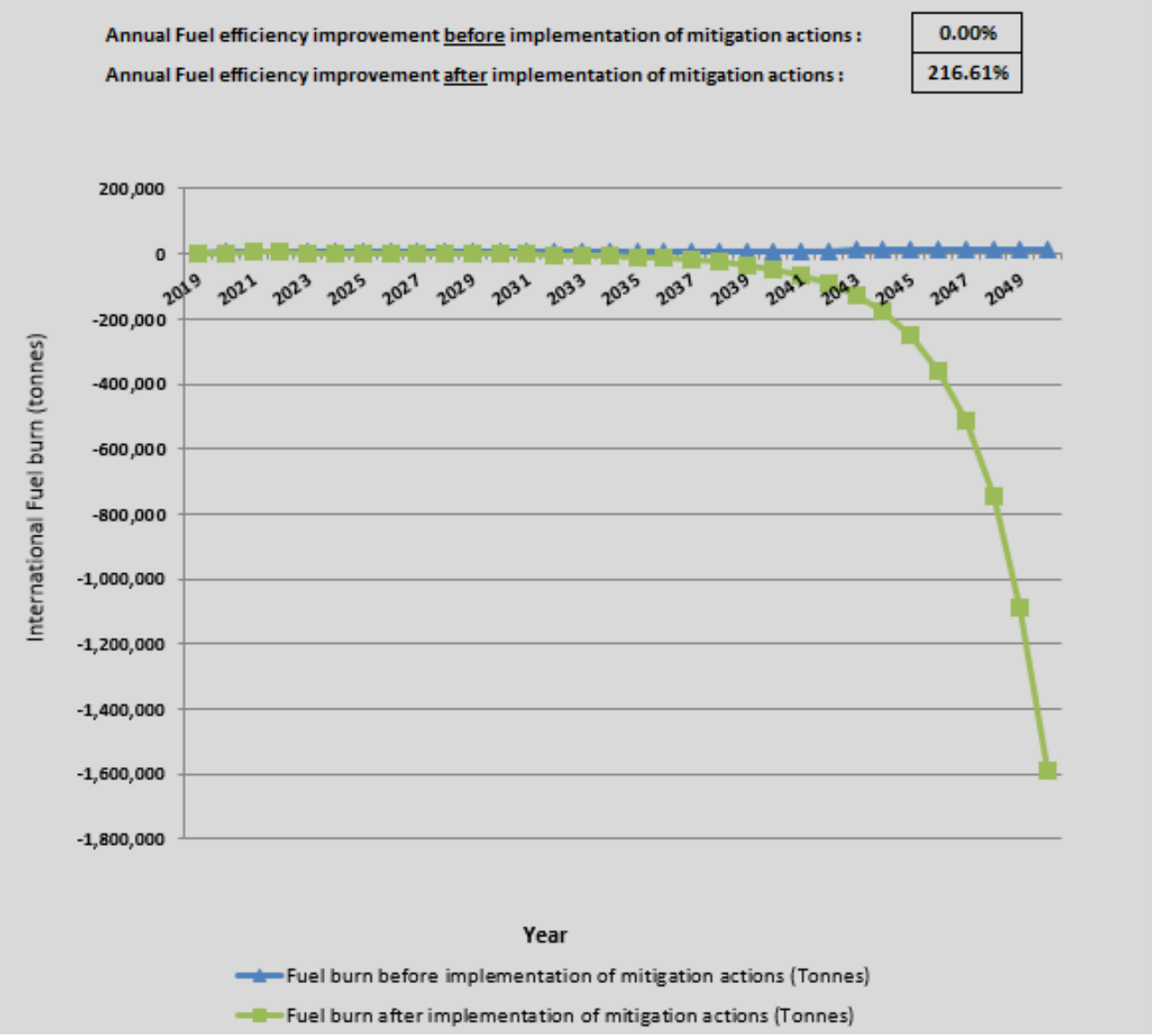
*Source of information: ICAO EBT.

3.3. EXPECTED RESULTS.

For the quantification and estimation of CO_2 emission reductions, the environmental benefit tool (EBT) was used.

According to the data generated by the EBT, we expect that on average annually approximately 468,912 tons of CO_2 will be mitigated per year as a result of implementing the measures in the range of measures implemented by Mozambique.

Chart No 5 - Baseline Results Expectations



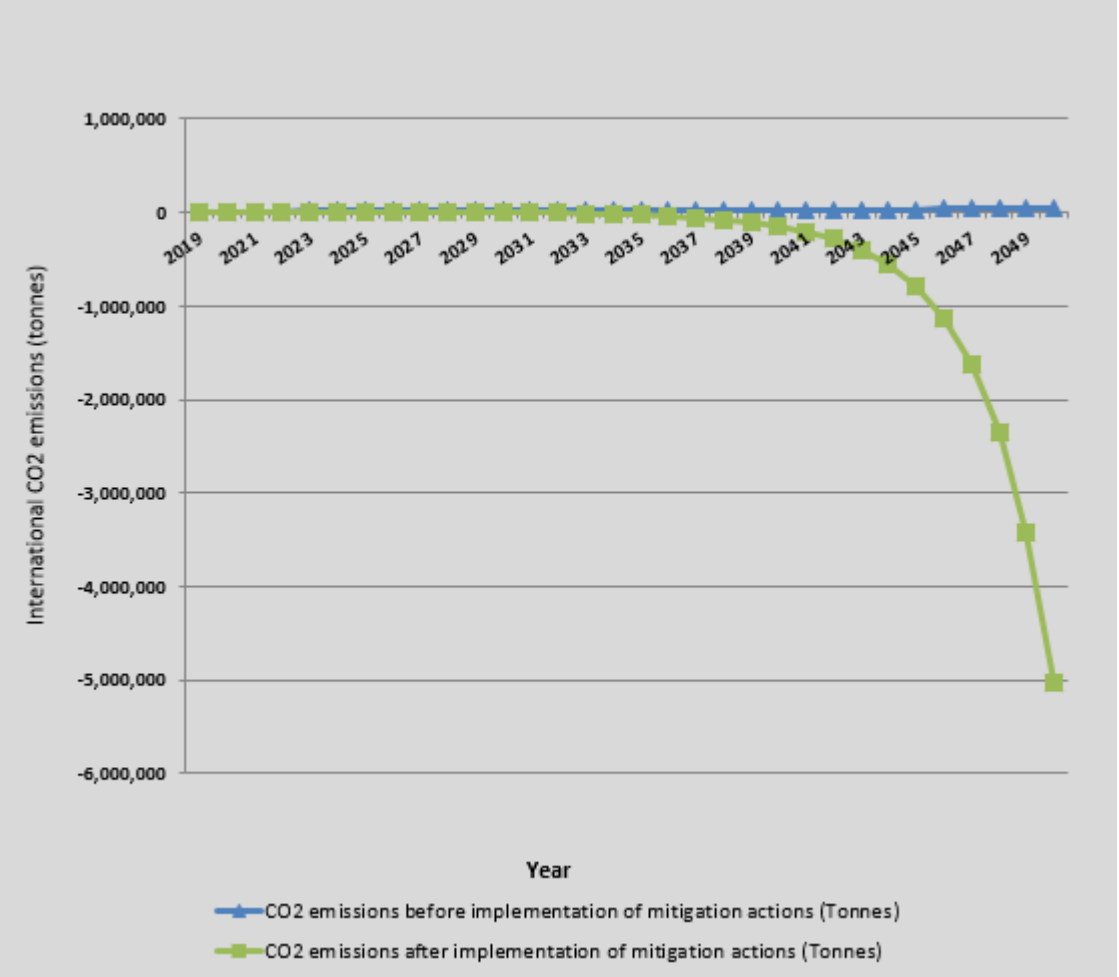
In the baseline scenario, the annual fuel efficiency improvement was 0%. With the implementation of the proposed measures, the annual fuel efficiency improvement rate is expected to grow to 216.61%. The expected results are described in Table No 2 attached to the document. Figure 5 provides a representation of the results compared to the CO_2 emission reduction and expected fuel efficiency improvements compared to the baseline scenario.

3.4. EXPECTED CO_2 REDUCTION IN EMISSIONS FROM INTERNATIONAL AVIATION

For the quantification and estimation of CO_2 emission reduction, the environmental benefit tool (EBT) was used.

According to the data generated by the EBT, reflected in table No 3, attached to the document we expect that on average annually approximately 468,912 tons of CO_2 will be mitigated per year as a result of the implementation of the measures provided in the range of measures implemented by Mozambique.

Chart No 6 - Expected CO_2 reduction in emissions from international aviation



*Source of Information: ICAO EBT.

4. ASSISTANCE AND SUPPORT NEEDS

- ✓ The Mozambique Civil Aviation has faced difficulties regarding the scarcity of financial resources for the full implementation of the mitigation action plan for the reduction of international CO_2. For the implementation of the plan, it resorts to the State Budget, which is scarce to cover the needs of the sector;
- ✓ The Aviation of Mozambique has made efforts to implement the plan, using its own resources, which in turn are scarce, so there is a need for financial support to address environmental issues;
- ✓ On the other hand, Mozambique is not subscribed to certified environmental projects, making projects illegible to be chosen for state compensation even though the state has higher levels of international CO_2 emissions;
- ✓ Sector-specific trainings to respond to the implementation of the Plan's actions.

CONCLUSION

The Action Plan for the reduction of CO_2 and other greenhouse gases in Mozambican civil aviation is a commitment made from the various ratifications for the country such as the Paris agreement - on climate change and with ICAO.

Aviation in Mozambique has taken qualitative steps in terms of concern for the improvement of the quality of ecosystems, nationally, regionally, as well as internationally. And, on the other hand, it plays an important role in the development of the country's economy, in terms of international business, trade, and tourism. International aviation has been growing in recent years, as well as domestic aviation in Mozambique.

The Government of Mozambique has supported the growth of the sector as an important vector for the national integration and international connection of the country, which in a sustainable way has taken into consideration the need to minimize the impact on climate change, adverse to the activities of the sector.

This document presents some of the actions adopted by the aviation related sectors that contribute significantly to the reduction of GHG emissions. The aeronautical industry, has advanced in the operational development of aircraft that contributed to the efficiency in fuel consumption and reduced the emissions intensity of the sector.

Air Operators in Mozambique have implemented measures to improve the efficiency of their operations and methodologies to calculate their GHG emissions. Airports in Mozambique have also sought to develop infrastructure improvements in order to increase the operational efficiency of airports and adopt other measures that contribute to the growth of airport infrastructure in a sustainable manner.

Mozambique has adopted in recent years an Economic Regulation with broad freedom to act according to the market (both with free determination of tariffs and routes), which contributes to the efficiency of the sector, considering that civil aviation is a highly interconnected sector, in view of the fundamental harmonization of rules, standards and procedures for its effective development.

This document is part of the contribution of the Government of Mozambique in the ICAO's efforts to reduce the impact of international aviation on climate change. It is the result of a joint work of various sectors linked to the themes of fuel efficiency, environmental management and reduction of GHG emissions in the various segments that make up the national civil aviation system, of which: Government Agencies, Airports, Aircraft Operators and the aeronautical industry.

The partnership between public and private entities is fundamental for the effective implementation of the mitigation measures described throughout the document. One of the challenges that remains is the measurement of the impact of mitigation measures on GHG emissions. Some sectors have calculated this impact and presented the figures in tons of CO_2, as well as the methodologies adopted. This result represents an evolution in relation to the 1st edition of the Action Plan, in which we obtained reduced or almost scarce data on emission reductions associated with mitigation measures. However, there is a need to establish harmonized methodologies, concepts and basic performance indicators that allow the appropriate monitoring of the impact of the measures.

This Action Plan provides a general framework on greenhouse gas emissions from domestic and international aviation in Mozambique. The Government of Mozambique intends to monitor these indicators and update the data presented every 3 years, as requested by ICAO.

It is understood that this process of periodic update of the Action Plan provides an important articulation between the sector stakeholders involved in the task of seeking the sustainable development of Mozambique's Aviation, with reduction of its impact on climate change.

TECHNICAL TEAM

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ANNEXES

ANNEX 1 - Baseline Table (2019-2050 Data)

BASELINE

Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Fuel burn / RTK)
2019	9,140.00	4,144.13	0.453
2020	9,505.60	4,309.90	0.453
2021	9,885.82	4,482.29	0.453
2022	10,281.26	4,661.58	0.453
2023	10,692.51	4,848.05	0.453
2024	11,120.21	5,041.97	0.453
2025	11,565.02	5,243.65	0.453
2026	12,027.62	5,453.39	0.453
2027	12,508.72	5,671.53	0.453
2028	13,009.07	5,898.39	0.453
2029	13,529.43	6,134.32	0.453
2030	14,070.61	6,379.70	0.453
2031	14,633.43	6,634.89	0.453
2032	15,218.77	6,900.28	0.453
2033	15,827.52	7,176.29	0.453
2034	16,460.62	7,463.34	0.453
2035	17,119.05	7,761.88	0.453
2036	17,803.81	8,072.35	0.453
2037	18,515.96	8,395.25	0.453
2038	19,256.60	8,731.06	0.453
2039	20,026.87	9,080.30	0.453
2040	20,827.94	9,443.51	0.453
2041	21,661.06	9,821.25	0.453
2042	22,527.50	10,214.10	0.453
2043	23,428.60	10,622.67	0.453
2044	24,365.74	11,047.57	0.453
2045	25,340.37	11,489.48	0.453
2046	26,353.99	11,949.05	0.453
2047	27,408.15	12,427.02	0.453
2048	28,504.47	12,924.10	0.453
2049	29,644.65	13,441.06	0.453
2050	30,830.44	13,978.70	0.453

ANNEX 2- Baseline Results Expectation Table (2019-2050)

EXPECTED RESULTS : FUEL SAVINGS

Year	Annual Fuel burn before implementation of mitigation actions (Tonnes)	Annual Fuel burn after implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2019	4,144.13	4,019.81	124.32	-3.00
2020	4,309.90	4,180.60	129.30	-3.00
2021	4,482.29	4,347.82	134.47	-3.00
2022	4,661.58	4,521.74	139.85	-3.00
2023	4,848.05	2,491.25	2,356.80	-48.61
2024	5,041.97	2,402.85	2,639.12	-52.34
2025	5,243.65	2,262.93	2,980.72	-56.84
2026	5,453.39	2,058.10	3,395.30	-62.26
2027	5,671.53	1,771.31	3,900.22	-68.77
2028	5,898.39	1,380.65	4,517.74	-76.59
2029	6,134.32	857.67	5,276.65	-86.02
2030	6,379.70	165.00	6,214.70	-97.41
2031	6,634.89	-747.00	7,381.89	-111.26
2032	6,900.28	-1,945.08	8,845.36	-128.19
2033	7,176.29	-3,520.07	10,696.37	-149.05
2034	7,463.34	-5,597.06	13,060.41	-174.99
2035	7,761.88	-8,350.25	16,112.13	-207.58
2036	8,072.35	-12,024.77	20,097.12	-248.96
2037	8,395.25	-16,968.92	25,364.17	-302.13
2038	8,731.06	-23,681.85	32,412.91	-371.24
2039	9,080.30	-32,884.21	41,964.51	-462.15
2040	9,443.51	-45,623.35	55,066.86	-583.12
2041	9,821.25	-63,429.84	73,251.09	-745.84
2042	10,214.10	-88,550.99	98,765.09	-966.95
2043	10,622.67	-124,299.42	134,922.09	-1,270.13
2044	11,047.57	-175,574.10	186,621.67	-1,689.26
2045	11,489.48	-249,639.37	261,128.84	-2,272.77
2046	11,949.05	-357,290.84	369,239.90	-3,090.12
2047	12,427.02	-514,600.80	527,027.81	-4,240.98
2048	12,924.10	-745,532.20	758,456.30	-5,868.54
2049	13,441.06	-1,085,854.95	1,099,296.01	-8,178.64
2050	13,978.70	-1,589,014.36	1,602,993.07	-11,467.39

ANNEX 3- Table of Expected CO_2 Results in International Aviation Emissions

EXPECTED RESULTS : CO_2 SAVINGS

Year	Annual CO_2 emissions before implementation of mitigation actions (Tonnes)	Annual CO2 emissions after implementation of mitigation actions (Tonnes)	Annual CO_2 savings (Tonnes)	Change CO_2 savings (%)
2019	13,095.45	12,702.59	392.86	-3.00
2020	13,619.27	13,210.69	408.58	-3.00
2021	14,164.04	13,739.12	424.92	-3.00
2022	14,730.60	14,288.68	441.92	-3.00
2023	15,319.83	7,872.34	7,447.49	-48.61
2024	15,932.62	7,593.01	8,339.61	-52.34
2025	16,569.92	7,150.85	9,419.07	-56.84
2026	17,232.72	6,503.59	10,729.13	-62.26
2027	17,922.03	5,597.34	12,324.69	-68.77
2028	18,638.91	4,362.86	14,276.05	-76.59
2029	19,384.47	2,710.24	16,674.22	-86.02
2030	20,159.84	521.40	19,638.44	-97.41
2031	20,966.24	-2,360.52	23,326.76	-111.26
2032	21,804.89	-6,146.45	27,951.34	-128.19
2033	22,677.08	-11,123.43	33,800.52	-149.05
2034	23,584.17	-17,686.72	41,270.89	-174.99
2035	24,527.53	-26,386.78	50,914.32	-207.58
2036	25,508.64	-37,998.26	63,506.90	-248.96
2037	26,528.98	-53,621.80	80,150.78	-302.13
2038	27,590.14	-74,834.64	102,424.78	-371.24
2039	28,693.75	-103,914.11	132,607.85	-462.15
2040	29,841.50	-144,169.79	174,011.28	-583.12
2041	31,035.15	-200,438.30	231,473.45	-745.84
2042	32,276.56	-279,821.11	312,097.68	-966.95
2043	33,567.62	-392,786.18	426,353.80	-1,270.13
2044	34,910.33	-554,814.15	589,724.48	-1,689.26
2045	36,306.74	-788,860.41	825,167.15	-2,272.77
2046	37,759.01	-1,129,039.07	1,166,798.08	-3,090.12
2047	39,269.37	-1,626,138.52	1,665,407.89	-4,240.98
2048	40,840.15	-2,355,881.75	2,396,721.89	-5,868.54
2049	42,473.75	-3,431,301.64	3,473,775.39	-8,178.64
2050	44,172.70	-5,021,285.38	5,065,458.09	-11,467.39

TECHNICAL SPECIFICATIONS

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FOREWORD

Given the constant changes and the pressure of climate change resulting from human actions, which represent an urgent and potentially irreversible threat to human societies and to the planet, it has become increasingly compulsory to develop climate resilience actions through climate change adaptation and mitigation measures.

To this end, the Government of the Republic of Mozambique has in its priority agenda, the implementation of the National Strategy for Adaptation and Mitigation of Climate Change and to this end introduced legal institutional reforms necessary to respond to the challenges imposed by climate change.

The IACM, under the United Nations Framework Convention on Climate Change of June 1992, Resolution n° 1/94 of August 24, resolutions A37ª-19 of 2010, A38ª-18 of October 4, 2013, A39ª-2 of 2016, and ICAO Annex 16 (vol. I, II, III and IV) has been encouraging and monitoring practices on measures, which aim at mitigating and reducing CO2 and other Greenhouse Gases in Civil Aviation in Mozambique.

In coordination with airline operators, airports and other stakeholders, it has been developing actions to effectively implement the Paris Agreement and ensure the achievement of the objectives outlined at the ICAO's 37th-19th Assembly held in 2010.

This Action Plan objectively demonstrates the set of actions and measures adopted by the different actors of the civil aviation sector as part of the country's efforts to follow the guidelines laid out in the Paris Agreement as well as the status of the development of actions committed by the Civil Aviation sector in Mozambique, in the application of best practices of environmental sustainability, aimed at reducing emissions of CO_2 and other greenhouse gases, competing to meet the guidelines of the International Civil Aviation Organization (ICAO).

ABREVIATIONS

IACM – Mozambique Civil Aviation Authority

APU - Auxiliary Power Supply Unit (PMU

CH4 – Methane

CO2 - Carbon dioxide

CO2e - Carbon dioxide equivalent

COP - Character-oriented protocol

CQNUMC - United Nations Framework Convention on Climate Change

GHG - Greenhouse Gases

GPS - GPS Global Positioning System) - Global Positioning System - Satellite-based navigation system

GPU - Ground Power Unit

HFCs – Hydrofluorocarbons

IPCC - Intergovernmental Panel on Climate Change

N2O - Nitrous Oxide

ICAO - International Civil Aviation Organization

ODS - Sustainable Development Goals

ONU - United Nations

OSA - Operational Safety Assessment

PAG - Global Warming Potential

PEB - Biofuels Policy and Strategy

PFCs – Perfluorocarbons

RNAV - Navigation Area

RNP - Required Navigation Performance - navigation performance claim necessary for operation within a defined airspace

SF6 - Sulphur Hexafluoride

UNFCCC – United Nations Framework Convention on Climate Change

CORSIA – Carbon Offsetting Reduction Scheme

UNFCCC – United Nations Framework Convention on Climate Change

SARPs – Standards and Recommended Aeronautical Practices

EXECUTIVE SUMMARY

The Republic of Mozambique has been ensuring standards and procedures for the protection of the environment, according to the applicable legislation, as well as the protection of the environment in the vicinity of aeronautical infrastructures and, for this purpose, several legal instruments are being adopted, to regulate such activities that result in the reduction of GHG emissions.

The Republic of Mozambique has been an ICAO Contracting State since 1977 and ratified the Chicago Convention in 2008, by Resolution No. 63/2008 of November 28, 2008.

The Chicago Convention establishes the rights and obligations of all Contracting States and sets forth Standards and Recommended Practices - SARPs related to the safety, security, regularity and efficiency of air navigation. The Civil Aviation Authority of each ICAO Contracting State has the responsibility to establish the national regulatory framework for the reduction of emissions of pollutants from the civil aviation sector and for the certification of noise levels.

To reduce its emissions, the Civil Aviation Sector of Mozambique has been implementing several mitigation and reduction measures, among which we highlight:

- ✓ Infrastructure-related measures;
- ✓ Operational Measures;
- ✓ And technological ones.

Out of these, the most prominent is the implementation of measures in infrastructure and operations.

This document reflects the reissue of the GHG Reduction Action Plan, whose main target is carbon dioxide (CO_2), which is believed that its emissions are linked to global warming and climate change. The Action Plan discloses the actions that are being taken by the Aviation sector in Mozambique, in the implementation of actions aimed at reducing emissions, bringing approaches on the status of implementation of reduction and mitigation measures that were enrolled in the 1st edition, and also the actions under development, new actions planned for the coming years in the sector, as well as the challenges faced.

As far as the objectives of this Plan are concerned, we highlight the following:

1. Act in compliance with the objectives contained in ICAO Resolution A38-18;
   To update this Action Plan, the IACM has been disseminating actions and coordinating with the various civil aviation stakeholders, in order to encourage the practice of environmental measures and the actions that were committed to be implemented by the State in the civil aviation industry, through the inclusion of stakeholders in the participation in permanent meetings, and in workshops held by ICAO and various environmental organizations.

2. Reduce CO_2 emissions from International Civil Aviation;

The Civil Aviation Sector of Mozambique to reduce its emissions, has been Implementing several mitigation measures, among which are:

- ✓ Infrastructure-related measures;
- ✓ Operational Measures;
- ✓ And technological ones.

With more emphasis on the implementation of Operational measures, which are implemented by the Operators and in the infrastructures by the airport operators.

3. Examine the possibilities of the implementation of the precautionary measures listed by the regional operators committed to the cause;

The IACM monitors through periodic requests for statistical data on international emissions by national air operators. It also has currently introduced the practice of supervisions on the sector's environmental measures to airline and airport operators.

4. Ensure that regional operators act in compliance with the different Civil Aviation regulations.

In this context, the IACM is developing Civil Aviation regulatory documents for environmental issues such as, the Regulation and Technical Circular on CORSIA, in order to ensure that operators act in compliance with the different regulations.

CHAPTER I – GENERAL CONTEXT OF CIVIL AVIATION IN MOZAMBIQUE

1.1. NATIONAL LEGAL FRAMEWORK

As to the general-legal framework in Mozambique there has not been any revision of laws that can be considered updated, significant, comprehensive, adequate in many aspects and diversified, focusing on various aspects in the environmental problematic, basing fundamentally on the Environment Law, approved by Law No. 20/97 of October 1, the Civil Aviation Law, approved by Law No. 5/2016 of June 5, by the Civil Aviation Policy of Mozambique, approved by resolution n° 40/2002 of May 14 and the respective regulations, approved by Decree of the Council of Ministers. Therefore, the laws, the 1st Edition of the Mozambique Action Plan prepared and published in 2019, by ICAO remain the same.

1.2. THE INSTITUTIONAL FRAMEWORK OF CIVIL AVIATION IN MOZAMBIQUE

1.2.1 MOZAMBIQUE. CIVIL AVIATION AUTHORITY (IACM)

IACM is an autonomous entity responsible for the regulation of Civil Aviation in Mozambique. The Institute plays the role of technical and economic regulator of Civil Aviation, defining and enforcing the national policies and standards, and ICAO recommendations, supervising the sector. It is also responsible for certifying aeronautical infrastructures, issuing aeronautical and para-aeronautical licenses and authorizing aircraft.

1.2.2 NATIONAL AIR CARRIERS OPERATING INTERNATIONAL FLIGHTS

There are two operators operating international flights in Mozambique, namely:

- ✓ LAM - Mozambique Airlines;

- ✓ MEX - Mozambique Express;

1.2.3. MITIGATION MEASURES FOR REDUCING CO_2 AND GHG IMPLEMENTED BY NATIONAL AIR CARRIERS OPERATING INTERNATIONAL FLIGHTS

(From year 2019 to 2021)

In order to contribute to the reduction of environmental impact, the airline operators have been implementing mitigation measures aimed at mitigating CO_2 and other GHGs in Mozambican Aviation, among them operational measures applied in their operations and among them we highlight:

- ✓ Improved use of optimum flight level, the extent to which it allows the (use of long range cruise);
- ✓ Taxiing the aircraft using an engine;
- ✓ Periodic washing of the aircraft
- ✓ Periodic washing of aircraft engines;

This measure is being implemented regularly, and it is included in the aircraft maintenance program for engine washing, and is done in all aircraft by recommendation of the manufacturers according to the type of aircraft. The implementation of this measure during the implementation period brought as expected results in terms of CO_2 emission reduction an annual average of 28.97% CO_2 reduction;

- ✓ Minimization of weight on board aircraft;
  Weight reduction was introduced in, electronic flight packages, and checked baggage reduction, bringing as expected results in terms of CO_2 emissions reduction 11,300 tons for the year 2019 and 13,890 tons for the year 2020;
  Comparing the first two years, with the introduction of this measure the emissions of CO2 reduced by 2,590 tons;

1.2.4. OTHER IMPLEMENTED MEASURES

- ✓ Replacing the use of plastics with cartridge paper in on-board aircraft catering services;
- ✓ Periodic washing of aircraft engines;
- ✓ Periodic washing of the aircraft;
- ✓ Collection and treatment of solid and liquid waste, from the spillage of fuel and oil from aircraft on the runways.

1.2.5. LONG-TERM MEASURES

- ✓ Reduction of aircraft manuals for introduction of IPADS;
- ✓ Installation of power generators and pre-conditioned air to the airplanes, in the stopovers;

1.3. MOZAMBIQUE AIRPORTS

AEROPORTOS DE MOÇAMBIQUE, E.P.

Under paragraphs a), b) and c) of No 1 of article of Decree No. 17/2022 of May 5, airports in the Republic of Mozambique are classified into 3 categories to be considered:

- ✓ International Airports;
- ✓ Entry Points; and
- ✓ Mixed entry points.

And in its articles 2, 3 and 4 it describes the category designation of international airports as follows:

Table 1 - International Airports in Mozambique

Maputo Airport	Beira Airport	Nacala Airport

1.3.1. GHG AND CO_2 MITIGATION MEASURES IMPLEMENTED BY AIRPORTS (From 2019 to 2021)

In order to improve the sustainability of existing airports in Mozambique, the airports have been implementing the following actions:

- ✓ PBN Implementation;

PBN (Performance-Based Navigation), whose implementation process began in 2014 with the approval of the national plan and its implementation, and in 2018 with the restructuring and improvement of the airspace.

The implementation of PBN procedures represents the quest for optimization and better utilization of airspace and its implementation is considered crucial to air navigation modernization programs. This is considered one of the mitigation measures for the reduction of CO_2 emissions and other greenhouse gases in the Civil Aviation sector, as it will shorten the distances and flight time of aircraft using such procedures, which, in turn, will contribute to the consumption of less fuel and consequently in the reduction of emissions.

Mozambique Airports are in the process of airspace restructuring and implementation of PBN (GNSS) in all airports.

The implementation of PBN has brought with it a positive impact for air traffic controllers, because now it allows aircraft to make direct flights, implying less flight time, and facilitating the location of aircraft coordinates, compared to the conventional system, that the controller was limited to follow the coordinates based on information from pilots.

- ✓ Replacement of fuels in generators by renewable energy use and replacement of conventional light bulbs by LEDs at airports;

This measure began in 2014, with the construction of Nacala Airport, an airport that complies with a green airport infrastructure (Sustainable Airports).

- ✓ Replacement of conventional lamps by LED lamps, both in buildings and runways: this action is taking place gradually, due to insufficient funds from LAM Company. This measure is planned to be included in all airports in Mozambique.

  The lack of funds means that this measure is being carried out gradually, starting in Nacala and Maputo Airport.

1.3.2. REGULATORY MEASURES

Although regulatory measures are not reflected, the following are being adopted by the Civil Aviation Authority in calculating the expected reduction in the level of CO_2 emissions from EBT:

- ✓ Air Operators must report the Carbon Emissions Transparency

  The Mozambique Civil Aviation Authority, has established an MRV unit, which has been monitoring through periodic requests for information regarding fuel consumption data and CO_2 emissions resulting from the operations of national Air Operators, as well as requesting the Monitoring Plans of their emissions;
- ✓ Conferences and Workshops.

The IACM has attended meetings and workshops on environmental issues, held by environmental entities in Mozambique, and other stakeholders, and has ensured the inclusion of the participation of Air Operators, Airports and other stakeholders of the Mozambican Civil Aviation sector.

1.3.3. METEOROLOGICAL MEASURES

- ✓ Improvement of Aeronautical Meteorological Information Service Plans. In recent years Mozambique has been presenting improvements in aeronautical forecast models, adopting to models that consist of safer and more reliable aeronautical meteorological information, making aeronautical meteorological data for more reliable air navigation;
- ✓ Improvements in the preparation and issuing of warnings for aircraft landings and takeoffs.

1.3.4. OTHER ADOPTED MEASURES

- ✓ Construction of retention ditches for river waters, the Beira Airport, in coordination with the Municipality of Beira, carried out the construction of an artificial lake near the airport, called (Marocanhe Lagoon) where a camping Lodge is located in that city, in order to not only solve the issue of river water runoff, but also the retention of animal life, in view of the natural relocation of birds in that region of the airport; because they are attracted and fed in that habitat;
- ✓ Existence of river water cisterns, accumulated by rainwater, which are reused by the fire department in some airports;
- ✓ Existence of wastewater treatment hectares, where the water is treated and used for irrigation at the Airport;
- ✓ Waste collection and treatment of solid and liquid waste from oil, fuel and other liquid waste spills on runways at Airports;
- ✓ For the Fauna issue, there has been regular cutting of the grass around the runways at the Airports;

1.3.5. MEASURES TO BE ADOPTED

- ✓ The installation of power generators and pre-conditioned air to the airplanes, which allows the APU to be turned off, is under implementation feasibility study;
- ✓ Enhanced Air Traffic Management (ATM) and infrastructure use;
- ✓ Replacement of track lamps with halogen lamps;
- ✓ Implementation of solar panels;
- ✓ Replacing the use of fuel-powered generators (Diesel) at airports with the use of solar panels;

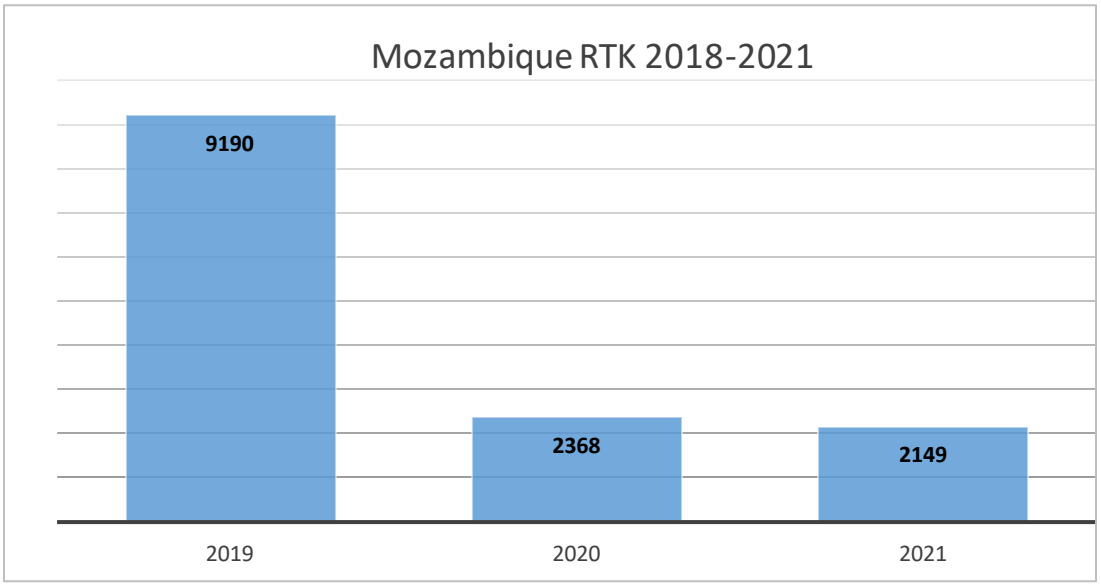
- ✓ Acquisition of weather radars for airports that, due to lack of funds, cannot be expanded to all airports in Mozambique;
- ✓ Improvements in the accuracy and quality of meteorological information, which allow the identification with a more comprehensive view of certain meteorological phenomena such as windstorms in a certain region.

CHAPTER II – HISTORICAL EMISSIONS DATA OF THE SECTOR

2. RTK OF NATIONAL AIR OPERATORS OPERATING INTERNATIONAL FLIGHTS (2019-2021)

Chart 1 shows the volume of passengers and cargo carried internationally by domestic carriers in terms of RTK. There was a significant increase in 2019, but from that year on there was a gradual decline in RTK in the country. The year 2021 was the year with the lowest volume of passengers and cargo carried by national air operators on international flights.

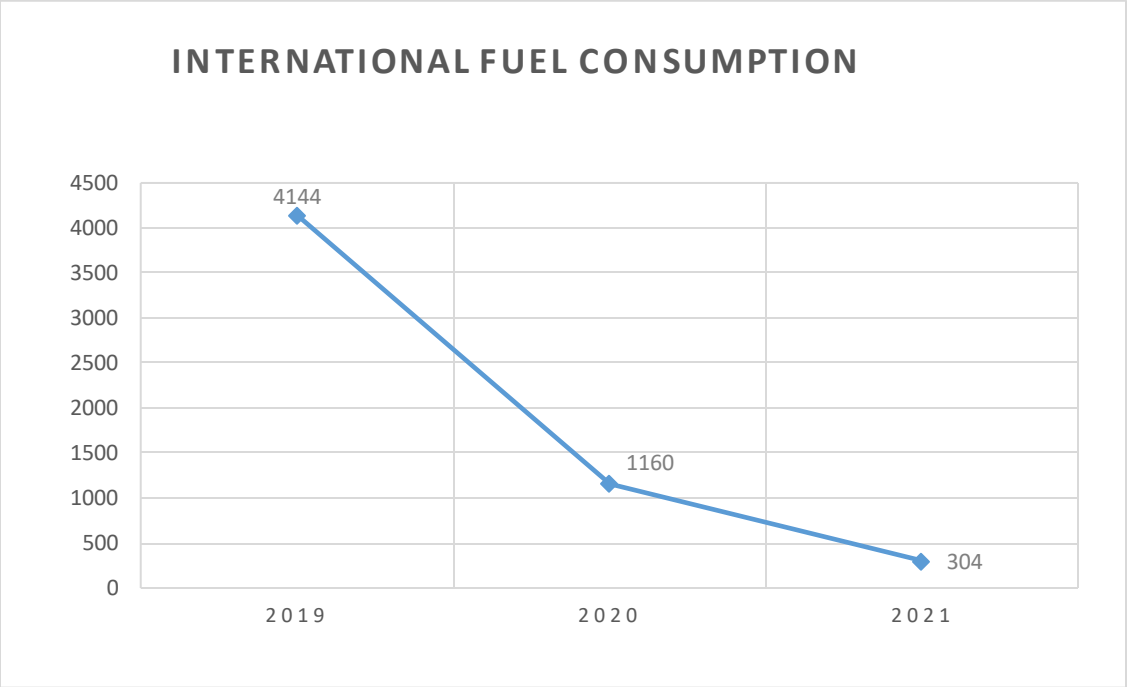
Chart n° 1. - Mozambique RTK. 2019 -2021



Source: Operator data

2.1. FUEL CONSUMPTION HISTORY OF INTERNATIONAL OPERATIONS

Chart No 2 - International JET-A fuel consumption



Source: Operator data

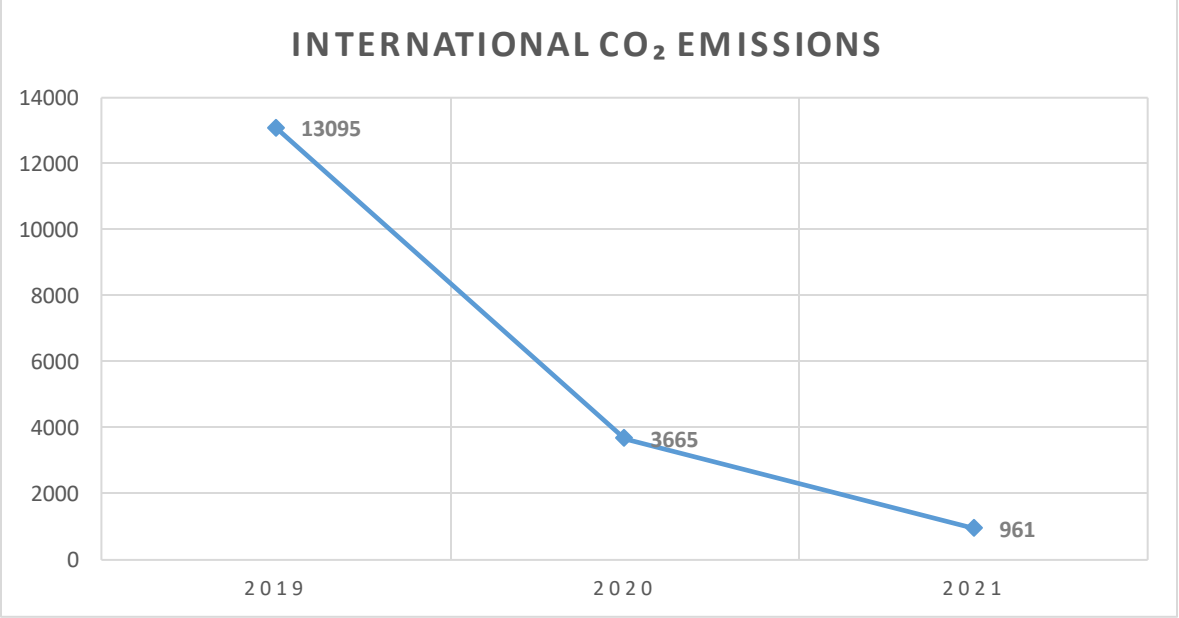
According to the data in chart n° 2 which illustrates the international fuel consumption in Aviation in international operations, a decrease in fuel consumption is observed, with a reduction in consumption occurring in the years 2020 to 2021. The decrease is justified by the direct proportionality in the ascendancy of the number of passengers transported and cargo transported regionally by national operators. This fact was due to COVID-19, which was declared a pandemic by the WHO on March 11, 2020 and had greater incidence in the years 2020 and 2021.

Chart No 3 presents the international CO_2 emissions for the period 2019 to 2021. Consistent with the method applied methodologically, to the calculation of CO_2 emissions by JET - A fuel.

The conversion factor and of 3.16 (in Kg CO /Kg fuel).

According to the data in chart nr°3 which illustrates the international emissions in Mozambican aviation in international operations, a decrease in emissions was observed in the interval of 2020 and 2021 and a reduction between the two years. The downward trend was due to the direct proportionality in the reduction of fuel consumption, relative to the weak movement of passengers and cargo transported internationally by domestic operators. It was also due to the pandemic of COVID-19, which affected the air transport market.

Chart n° 3 - International CO_2 emissions



CHAPTER III – ACTION PLAN

3.1. RANGE OF MEASURES FOR THE MITIGATION OF EMISSIONS FROM THE SECTOR IN MOZAMBIQUE

The mitigation measures selected for the reduction of CO_2 emissions from international aviation in Mozambique are focused on three of the categories in the range of measures employed by ICAO:

a) *Improvement of Air Traffic Control Management (ATM and PBN) and infrastructure use;*
b) *More efficient operations;*
c) *Airport Improvements;*
d) *Other measures*;

a) IMPROVED MANAGEMENT OF AIR TRAFFIC CONTROL (ATM and PBN) AND INFRASTRUCTURE USE

ATM

Dynamic and integrated air traffic and airspace management, including air traffic services, airspace management and air traffic flow management - safely, economically and efficiently - through the provision of continuous facilities and services in collaboration with all parties and involving airborne and ground functions and aggregation of airborne and ground functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations. This mitigation measure is under implementation, the Mozambican Airports have started the surveillance process, and the airport infrastructure is being upgraded, and the preparation of a plan to facilitate air traffic management at the Mozambican airports is also underway.

PBN

PBN (Performance-Based Navigation) – is a route or procedure whose execution requires that the set of aircraft systems, crew qualification and air traffic management systems meet specifications expressed in terms of accuracy, integrity, availability and continuity. The concept is formed by RNAV and RNP procedures associated with a certain level of accuracy for each type of operation. This is considered one of the mitigation measures for the reduction of CO_2 emissions and other greenhouse gases in the aviation sector, because with its introduction, it will shorten the distances and flight time of the aircraft using procedures, which will contribute to the use of less fuel and fewer emissions. Mitigation Measure implemented by the

company Mozambique airports, the PBN implementation process began in 2014, approval of the national plan and its implementation and the start of restructuring and improvement of airspace began in 2018.

The Mozambique Airports are in the process of restructuring the airspace and implementing PBN (GNSS) in all airports and this process is in its final stage.

PBN procedures are being implemented in all airports, namely:

- Maputo Airport;
- Beira Airport;
- Nacala Airport;
- Pemba Airport;
- Vilanculos Airport;
- Nampula Airport;
- Quelimane Airport;
- Tete Airport;
- Inhambane Airport;
- Chimoio Airport;
- Filipe Jacinto Nyusi Airport;

Missing their validation and verification flight.

Although there is not enough data to estimate the reduction of CO_2 emissions from this measure, it is expected that the implementation of en-route PBN will contribute significantly to the reduction of fuel consumption by domestic and foreign carriers operating in the country. This measure presents a degree of satisfaction and positive feedback from operators and air traffic controllers; although some air carriers also chose to use the conventional method.

It should be noted that the PBN has brought financial and operational benefits to airports, in financial terms, as it has reduced maintenance costs with the conventional system that had been used.

Before the implementation of PBN at the airports in Mozambique, the conventional system was used, which entailed costs with maintenance, and with the security of the infrastructure where the system was mounted, and the check flight, to perform the check of the VOR.

In operational terms, in the aircraft approach check, with the conventional system it was only possible to physically check the aircraft approach through radar at 14000 feet and based on the pilots' information, nowadays with the radar the Air Traffic Controller no longer relies only on the pilots' information.

b) MORE EFFICIENT OPERATIONS

The measures aimed at more efficient operation are implemented by the airlines of Mozambique, and relate

to the reduction of weight on board the aircraft, periodic washing of engines and aircraft. For the implementation of these measures, the national airlines, in addition to the introduction and reduction of the weight of checked baggage, intends to effect the introduction of searches on board the aircraft and, processes of aircraft manuals by scanning in electronic equipment (IPAD'S). This measure is in the feasibility study phase, and in search of internal procedures for its implementation.

Aircraft engine washing. It is being implemented by the airlines, according to the established periodicity for aircraft engine washing, defined in the aircraft maintenance program, by recommendation of the aircraft manufacturer.

c) AIRPORT IMPROVEMENTS

Airports in Mozambique have been presenting improvements in their infrastructure. With the preparation of Environmental Management Plans at airports, it has been implementing mitigation measures in order to mitigate and reduce emissions, among which we highlight:

The Reduction of energy consumption in Airports, as is evident in some airports in Mozambique, and the inclusion of these aspects in the construction projects of more sustainable airports, airports that obey a green infrastructure, highlighting the: Maputo International Airport, Filipe Jacinto Nyusi Airport, Vilanculos Airport. Nacala International Airport, which obey technical specifications for the construction of sustainable airports since the implementation of its construction project.

The major focus is on the use of renewable energy at airports, therefore the replacement of conventional energy by renewable energy for use in airports, and the following actions are being implemented in some airports:

- ✓ Gradual replacement of conventional lamps by LED lamps in airport infrastructures;
- ✓ Gradual replacement of conventional lamps by halogen lamps on the tracks;
- ✓ Replacing the use of diesel generators with solar panels;
- ✓ Implementation of solar panels for use at airports, which will benefit the population living near the airports;
- ✓ Preservation of Fauna and Flora in the vicinity of airports; and
- ✓ Proper treatment to liquid and solid residues at airports.

d) OTHER MEASURES IMPOSED BY THE CIVIL AVIATION SECTOR

In order to greatly contribute in the reduction of CO_2 emissions from the Aviation of Mozambique, under the 39th session of the ICAO Assembly, held in October 2016, in which the Carbon Emissions Offsetting and Reduction Scheme for International Aviation was launched, with the name CORSIA, which aims to reduce and stabilize carbon emissions from international aviation at 2019 levels. The Civil Aviation Regulatory Authority of Mozambique is in the process of drafting the CORSIA Regulation, which is expected to be completed, approved, and implemented by 2023.

The IACM, in order to control emissions, has been carrying out the process of monitoring, reporting, and verification of emissions by Mozambican airlines.

The Government of Mozambique approved on December 11, 2018 Mozambique's Nationally Determined Contribution NDC (2020-2030) and the related NDC Operational Plan 2020 - 2025. Both the NDC and the Operational Plan include adaptation and mitigation actions conditional on support in terms of means of implementation.

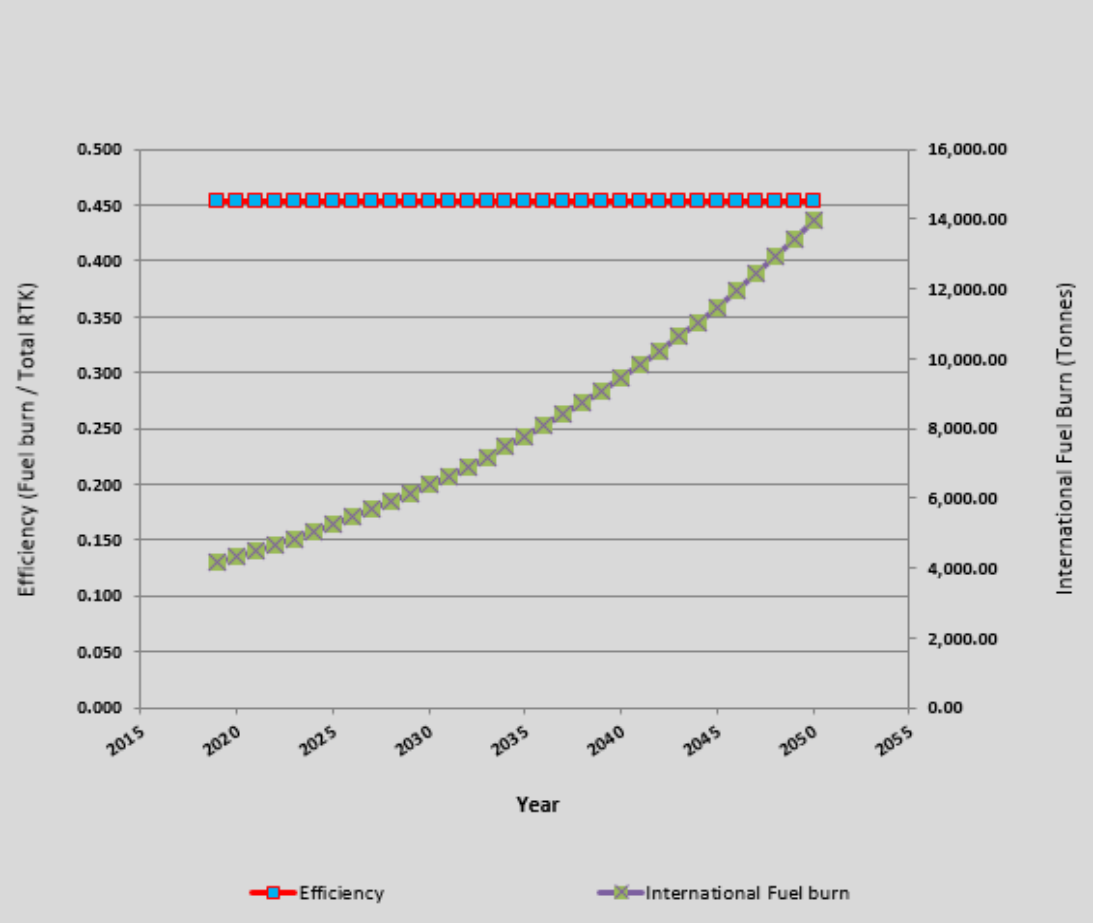
In order to contribute to the Government of Mozambique's commitments on environmental issues, the transport sector - Civil Aviation, is implementing several mitigation and adaptation measures to climate

change in order to reduce the spread of natural phenomena and their negative impact on the population. Having registered its mitigation and adaptation actions in Mozambique's NDC lacking financial resources for the full implementation of adaptation and mitigation actions.

3.2 EMISSION DATA FROM INTERNATIONAL AVIATION

The baseline of CO_2 emissions up to 2050 is described in Table No. 1 attached and in Chart No 4, according to the results, in the absence of mitigation measures implemented by Mozambique, CO_2 emissions from international aviation will increase from 13,095.45 to 44,172.70 tons of CO_2 by the year 2050. Once according to this baseline scenario, with the implementation of the mitigation measures will reduce from 12,702.59 to -5,021.28 t CO_2 from international aviation in Mozambique in the years 2019 to 2050.

Chart No 4 – Baseline until 2050



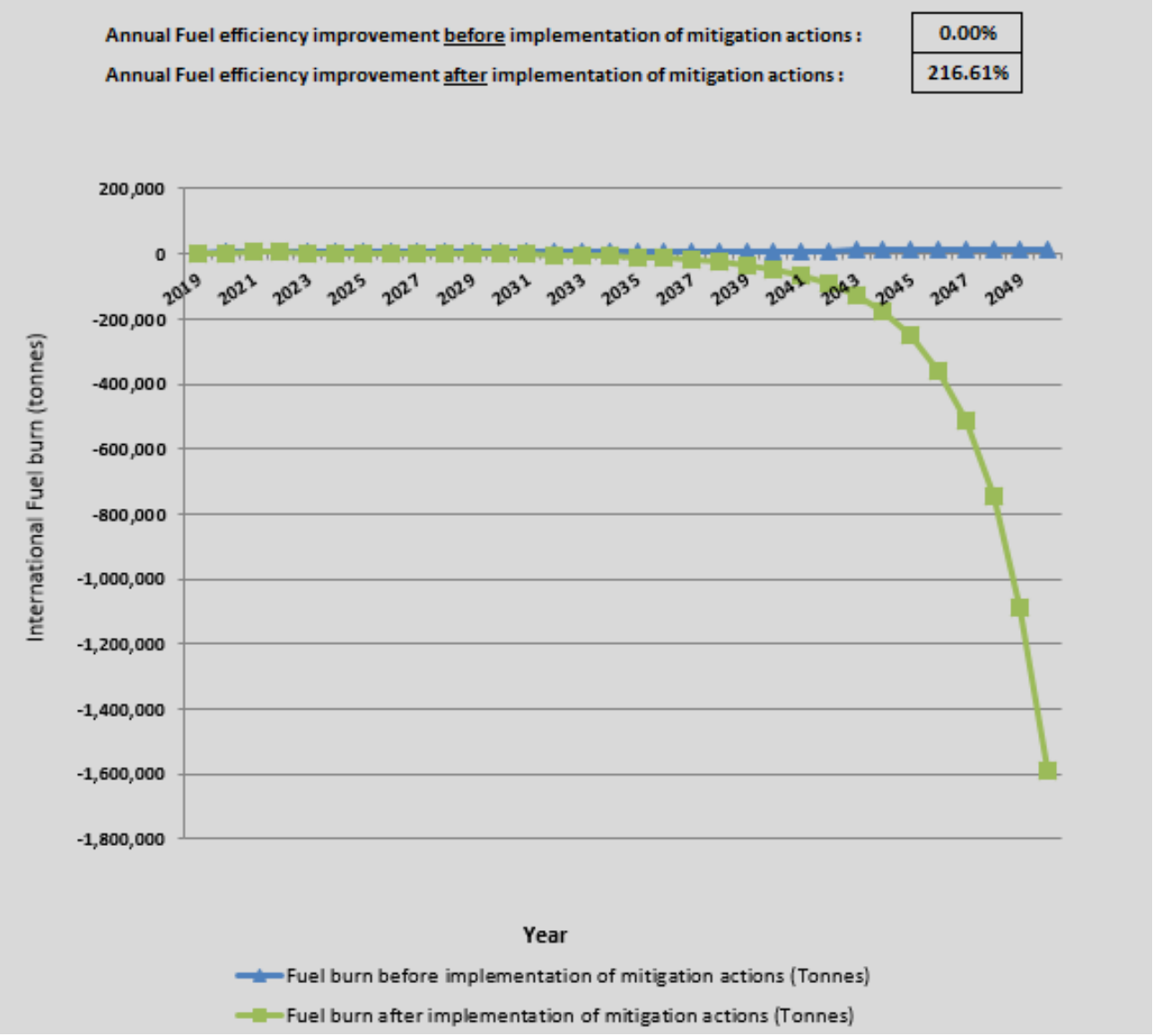
*Source of information: ICAO EBT.

3.3. EXPECTED RESULTS.

For the quantification and estimation of CO_2 emission reductions, the environmental benefit tool (EBT) was used.

According to the data generated by the EBT, we expect that on average annually approximately 468,912 tons of CO_2 will be mitigated per year as a result of implementing the measures in the range of measures implemented by Mozambique.

Chart No 5 - Baseline Results Expectations



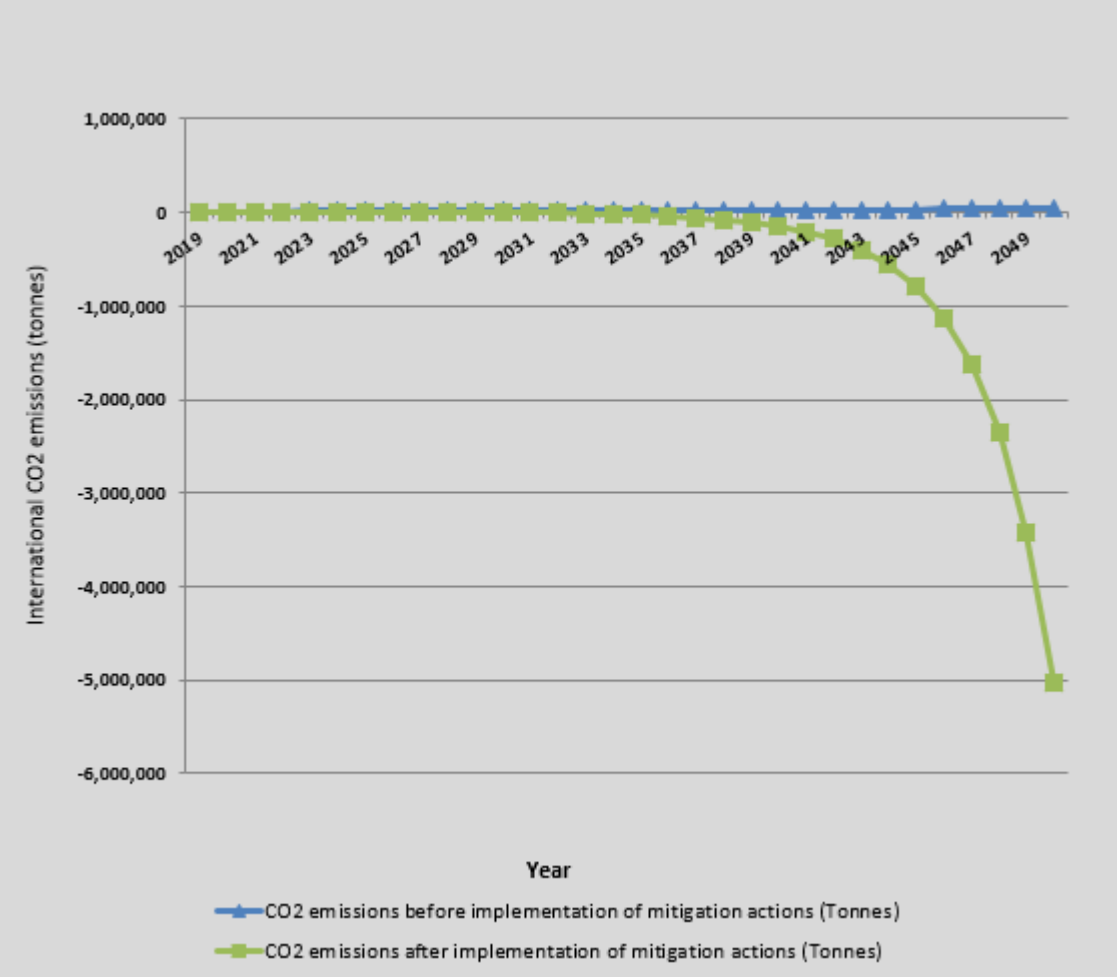
In the baseline scenario, the annual fuel efficiency improvement was 0%. With the implementation of the proposed measures, the annual fuel efficiency improvement rate is expected to grow to 216.61%. The expected results are described in Table No 2 attached to the document. Figure 5 provides a representation of the results compared to the CO_2 emission reduction and expected fuel efficiency improvements compared to the baseline scenario.

3.4. EXPECTED CO_2 REDUCTION IN EMISSIONS FROM INTERNATIONAL AVIATION

For the quantification and estimation of CO_2 emission reduction, the environmental benefit tool (EBT) was used.

According to the data generated by the EBT, reflected in table No 3, attached to the document we expect that on average annually approximately 468,912 tons of CO_2 will be mitigated per year as a result of the implementation of the measures provided in the range of measures implemented by Mozambique.

Chart No 6 - Expected CO_2 reduction in emissions from international aviation



*Source of Information: ICAO EBT.

4. ASSISTANCE AND SUPPORT NEEDS

- ✓ The Mozambique Civil Aviation has faced difficulties regarding the scarcity of financial resources for the full implementation of the mitigation action plan for the reduction of international CO_2. For the implementation of the plan, it resorts to the State Budget, which is scarce to cover the needs of the sector;
- ✓ The Aviation of Mozambique has made efforts to implement the plan, using its own resources, which in turn are scarce, so there is a need for financial support to address environmental issues;
- ✓ On the other hand, Mozambique is not subscribed to certified environmental projects, making projects illegible to be chosen for state compensation even though the state has higher levels of international CO_2 emissions;
- ✓ Sector-specific trainings to respond to the implementation of the Plan's actions.

CONCLUSION

The Action Plan for the reduction of CO_2 and other greenhouse gases in Mozambican civil aviation is a commitment made from the various ratifications for the country such as the Paris agreement - on climate change and with ICAO.

Aviation in Mozambique has taken qualitative steps in terms of concern for the improvement of the quality of ecosystems, nationally, regionally, as well as internationally. And, on the other hand, it plays an important role in the development of the country's economy, in terms of international business, trade, and tourism. International aviation has been growing in recent years, as well as domestic aviation in Mozambique.

The Government of Mozambique has supported the growth of the sector as an important vector for the national integration and international connection of the country, which in a sustainable way has taken into consideration the need to minimize the impact on climate change, adverse to the activities of the sector.

This document presents some of the actions adopted by the aviation related sectors that contribute significantly to the reduction of GHG emissions. The aeronautical industry, has advanced in the operational development of aircraft that contributed to the efficiency in fuel consumption and reduced the emissions intensity of the sector.

Air Operators in Mozambique have implemented measures to improve the efficiency of their operations and methodologies to calculate their GHG emissions. Airports in Mozambique have also sought to develop infrastructure improvements in order to increase the operational efficiency of airports and adopt other measures that contribute to the growth of airport infrastructure in a sustainable manner.

Mozambique has adopted in recent years an Economic Regulation with broad freedom to act according to the market (both with free determination of tariffs and routes), which contributes to the efficiency of the sector, considering that civil aviation is a highly interconnected sector, in view of the fundamental harmonization of rules, standards and procedures for its effective development.

This document is part of the contribution of the Government of Mozambique in the ICAO's efforts to reduce the impact of international aviation on climate change. It is the result of a joint work of various sectors linked to the themes of fuel efficiency, environmental management and reduction of GHG emissions in the various segments that make up the national civil aviation system, of which: Government Agencies, Airports, Aircraft Operators and the aeronautical industry.

The partnership between public and private entities is fundamental for the effective implementation of the mitigation measures described throughout the document. One of the challenges that remains is the measurement of the impact of mitigation measures on GHG emissions. Some sectors have calculated this impact and presented the figures in tons of CO_2, as well as the methodologies adopted. This result represents an evolution in relation to the 1st edition of the Action Plan, in which we obtained reduced or almost scarce data on emission reductions associated with mitigation measures. However, there is a need to establish harmonized methodologies, concepts and basic performance indicators that allow the appropriate monitoring of the impact of the measures.

This Action Plan provides a general framework on greenhouse gas emissions from domestic and international aviation in Mozambique. The Government of Mozambique intends to monitor these indicators and update the data presented every 3 years, as requested by ICAO.

It is understood that this process of periodic update of the Action Plan provides an important articulation between the sector stakeholders involved in the task of seeking the sustainable development of Mozambique's Aviation, with reduction of its impact on climate change.

TECHNICAL TEAM

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ANNEXES

ANNEX 1 - Baseline Table (2019-2050 Data)

BASELINE

Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Fuel burn / RTK)
2019	9,140.00	4,144.13	0.453
2020	9,505.60	4,309.90	0.453
2021	9,885.82	4,482.29	0.453
2022	10,281.26	4,661.58	0.453
2023	10,692.51	4,848.05	0.453
2024	11,120.21	5,041.97	0.453
2025	11,565.02	5,243.65	0.453
2026	12,027.62	5,453.39	0.453
2027	12,508.72	5,671.53	0.453
2028	13,009.07	5,898.39	0.453
2029	13,529.43	6,134.32	0.453
2030	14,070.61	6,379.70	0.453
2031	14,633.43	6,634.89	0.453
2032	15,218.77	6,900.28	0.453
2033	15,827.52	7,176.29	0.453
2034	16,460.62	7,463.34	0.453
2035	17,119.05	7,761.88	0.453
2036	17,803.81	8,072.35	0.453
2037	18,515.96	8,395.25	0.453
2038	19,256.60	8,731.06	0.453
2039	20,026.87	9,080.30	0.453
2040	20,827.94	9,443.51	0.453
2041	21,661.06	9,821.25	0.453
2042	22,527.50	10,214.10	0.453
2043	23,428.60	10,622.67	0.453
2044	24,365.74	11,047.57	0.453
2045	25,340.37	11,489.48	0.453
2046	26,353.99	11,949.05	0.453
2047	27,408.15	12,427.02	0.453
2048	28,504.47	12,924.10	0.453
2049	29,644.65	13,441.06	0.453
2050	30,830.44	13,978.70	0.453

ANNEX 2- Baseline Results Expectation Table (2019-2050)

EXPECTED RESULTS : FUEL SAVINGS

Year	Annual Fuel burn before implementation of mitigation actions (Tonnes)	Annual Fuel burn after implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2019	4,144.13	4,019.81	124.32	-3.00
2020	4,309.90	4,180.60	129.30	-3.00
2021	4,482.29	4,347.82	134.47	-3.00
2022	4,661.58	4,521.74	139.85	-3.00
2023	4,848.05	2,491.25	2,356.80	-48.61
2024	5,041.97	2,402.85	2,639.12	-52.34
2025	5,243.65	2,262.93	2,980.72	-56.84
2026	5,453.39	2,058.10	3,395.30	-62.26
2027	5,671.53	1,771.31	3,900.22	-68.77
2028	5,898.39	1,380.65	4,517.74	-76.59
2029	6,134.32	857.67	5,276.65	-86.02
2030	6,379.70	165.00	6,214.70	-97.41
2031	6,634.89	-747.00	7,381.89	-111.26
2032	6,900.28	-1,945.08	8,845.36	-128.19
2033	7,176.29	-3,520.07	10,696.37	-149.05
2034	7,463.34	-5,597.06	13,060.41	-174.99
2035	7,761.88	-8,350.25	16,112.13	-207.58
2036	8,072.35	-12,024.77	20,097.12	-248.96
2037	8,395.25	-16,968.92	25,364.17	-302.13
2038	8,731.06	-23,681.85	32,412.91	-371.24
2039	9,080.30	-32,884.21	41,964.51	-462.15
2040	9,443.51	-45,623.35	55,066.86	-583.12
2041	9,821.25	-63,429.84	73,251.09	-745.84
2042	10,214.10	-88,550.99	98,765.09	-966.95
2043	10,622.67	-124,299.42	134,922.09	-1,270.13
2044	11,047.57	-175,574.10	186,621.67	-1,689.26
2045	11,489.48	-249,639.37	261,128.84	-2,272.77
2046	11,949.05	-357,290.84	369,239.90	-3,090.12
2047	12,427.02	-514,600.80	527,027.81	-4,240.98
2048	12,924.10	-745,532.20	758,456.30	-5,868.54
2049	13,441.06	-1,085,854.95	1,099,296.01	-8,178.64
2050	13,978.70	-1,589,014.36	1,602,993.07	-11,467.39

ANNEX 3- Table of Expected CO_2 Results in International Aviation Emissions

EXPECTED RESULTS : CO_2 SAVINGS

Year	Annual CO_2 emissions before implementation of mitigation actions (Tonnes)	Annual CO2 emissions after implementation of mitigation actions (Tonnes)	Annual CO_2 savings (Tonnes)	Change CO_2 savings (%)
2019	13,095.45	12,702.59	392.86	-3.00
2020	13,619.27	13,210.69	408.58	-3.00
2021	14,164.04	13,739.12	424.92	-3.00
2022	14,730.60	14,288.68	441.92	-3.00
2023	15,319.83	7,872.34	7,447.49	-48.61
2024	15,932.62	7,593.01	8,339.61	-52.34
2025	16,569.92	7,150.85	9,419.07	-56.84
2026	17,232.72	6,503.59	10,729.13	-62.26
2027	17,922.03	5,597.34	12,324.69	-68.77
2028	18,638.91	4,362.86	14,276.05	-76.59
2029	19,384.47	2,710.24	16,674.22	-86.02
2030	20,159.84	521.40	19,638.44	-97.41
2031	20,966.24	-2,360.52	23,326.76	-111.26
2032	21,804.89	-6,146.45	27,951.34	-128.19
2033	22,677.08	-11,123.43	33,800.52	-149.05
2034	23,584.17	-17,686.72	41,270.89	-174.99
2035	24,527.53	-26,386.78	50,914.32	-207.58
2036	25,508.64	-37,998.26	63,506.90	-248.96
2037	26,528.98	-53,621.80	80,150.78	-302.13
2038	27,590.14	-74,834.64	102,424.78	-371.24
2039	28,693.75	-103,914.11	132,607.85	-462.15
2040	29,841.50	-144,169.79	174,011.28	-583.12
2041	31,035.15	-200,438.30	231,473.45	-745.84
2042	32,276.56	-279,821.11	312,097.68	-966.95
2043	33,567.62	-392,786.18	426,353.80	-1,270.13
2044	34,910.33	-554,814.15	589,724.48	-1,689.26
2045	36,306.74	-788,860.41	825,167.15	-2,272.77
2046	37,759.01	-1,129,039.07	1,166,798.08	-3,090.12
2047	39,269.37	-1,626,138.52	1,665,407.89	-4,240.98
2048	40,840.15	-2,355,881.75	2,396,721.89	-5,868.54
2049	42,473.75	-3,431,301.64	3,473,775.39	-8,178.64
2050	44,172.70	-5,021,285.38	5,065,458.09	-11,467.39