



GOVERNMENT OF MALAWI



ACTION PLAN FOR CO₂ EMISSIONS REDUCTION IN INTERNATIONAL AVIATION

MEASURES THAT WILL IMPROVE FUEL EFFICIENCY AND REDUCE EMISSIONS



08 September 2023
DEPARTMENT OF CIVIL AVIATION
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1. This Action Plan is divided into five sections:

Section 1 — Contact information

Section 2 — Baseline

Section 3 — Measures to mitigate CO₂ emissions

Section 4 — Expected results

Section 5 — Assistance needs

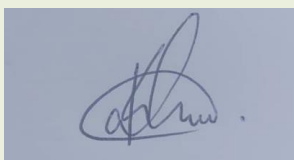
PREAMBLE

Air travel is paramount to Malawi's economy as it facilitates movement of people and goods (intra and cross borders) enabling activities in the trade and tourism sectors and most importantly, but equally, it connects Malawi to the region and the rest of the continent and beyond. The Government of Malawi recognises that despite the major role played by international aviation, in stimulating economic gains, it also acknowledges the effects on the environment by contribution of greenhouse gas emissions from the various activities associated in the industry. Hence, Malawi's has made efforts to voluntarily embark on developing an Action Plan for implementation on how the various players in the local industry intend to reduce greenhouse gas emissions from international aviation activities.

The Action Plan does not contain legal obligations of any sort or impose unreasonable expectations on any Party, or intend to negatively impact any operator's ability to do business in the land of Malawi.

The Government of Malawi reserves the right to develop and implement appropriate regulatory or other measures it deems necessary, whilst considering maintaining a conducive business environment, to achieve clean air and climate change goals. This Action Plan does not restrict the Parties from taking further actions relating to activities in an endeavour to reducing greenhouse gas emissions or fuel use.

Dated: 08 September 2023

A handwritten signature in blue ink, appearing to read 'SK', is placed over a light blue rectangular background.

Samuel Kalua
DIRECTOR

DEPARTMENT OF CIVIL AVIATION

EXECUTIVE SUMMARY

The Government of the Republic of Malawi (GOM) has the responsibility for the provision of Air Traffic Services over its sovereign territory provided through the Department of Civil Aviation (DCA) under the Ministry of Transport and Public Works.

In the past few years, Malawi has made efforts towards progress with the implementation of two initiatives to reduce the carbon dioxide (CO₂) emissions in aviation which are investment in the acquisition of new and modern aircraft fleets and airport infrastructure improvements.

One of the successes that the State has implemented as an appropriate mitigation measure was the installation of a solar farm at Lilongwe's Kamuzu International Airport in 2013 which provides clean energy at the airport and reinforces safety for the air transport system. This facility generates 830 kilowatts of power and supply the airport premises. The excess is added to the national grid system. This has led to the reduction of the airport's operating costs incurred from consuming electricity from the National electricity supply company by 30-40%.

The national airline, Malawi Airlines has implemented various initiatives in improving its fuel efficiency and reducing its carbon footprint by using modern aircraft which are fuel efficient.

The Government of the Republic of Malawi is committed to the sustainable development of the air transport sub sector and to the continued efforts to protect the environment of its territory.

INTRODUCTION

BACKGROUND


Malawi is a Land Locked Developing Country (LLDC) in southern Africa which shares its borders with Mozambique to the east and south, Tanzania to the North and Zambia to the west.



It consists of 3 regions with 28 districts and there is at least one aerodrome designated in each region. However, some aerodromes have been encroached by growing settlements and no longer used for air transport purposes.

The Ministry of Transport and Public Works through the Department of Civil Aviation (DCA) is responsible for the maintenance, rehabilitation and upgrading of all Government owned aerodromes across the country.

Figure 1: Country Profile & Map

Population- 17,563,749 ¹	
Area – 118, 484 sq. Meters	
Capital city – Lilongwe	
	Languages – English & Chichewa
Major religion – Christianity, Islam	
Currency – Malawi Kwacha (MWK)	
Major mode of transport – Road	

ASPIRATIONS TOWARDS SAFEGUARDING THE ENVIRONMENT FROM INTERNATIONAL AVIATION EMISSIONS

Malawi's Action Plan for CO₂ Emissions Reduction in the International Aviation Sector describes ongoing and planned activities to mitigate contributory factors that have an adverse effect on the environment from various activities emanating from Malawi's international aviation activities.

Through the implementation of these measures, the aviation sector, has set a target to achieve a reduction in greenhouse gases between 10% and 30% and improvement in fuel efficiency, respectively, by the end of 2035.

¹ 2018 Malawi Housing and Population census

This will involve Malawi reporting on international aviation CO₂ emissions to the International Civil Aviation Organisation (ICAO); reviewing and updating baseline emissions periodically; outlining respective policies and actions; and providing information on the basket measures considered and any assistance required by the State from ICAO.

As Malawi did not have an aviation related action plan to reduce emissions by aircraft and other related activities and operations, it was imperative that stakeholders were sensitised on the drive to mitigate impacts to the environment from international aviation activities.

Furthermore, a committee was established to spearhead the implementation of this action plan, namely, an Aviation Emissions Working Group (AEWG).

AVIATION EMISSIONS WORKING GROUP (AEWG)

The Government of the Republic of Malawi (GOM) recognises the importance of climate change and global warming and has embarked on various initiatives to implement Greenhouse Gases (GHG) mitigation measures. The SAP for CO₂ Emissions Reduction in international aviation is one of the most important initiatives by GOM, in the bid to achieve a sustainable growing aviation system, in partnership with ICAO.

This SAP describes the civil aviation sector in Malawi and the main stakeholders in the AEWG for CO₂ emissions reduction in international aviation. The Action Plan also highlights the set of mitigation measures identified by the AEWG to address CO₂ emissions reduction in international aviation at the national level.

The forecast of the trends of CO₂ emissions with and without the implementation of these measures is also mentioned, reflecting the positive impacts of these initiatives on the carbon footprint of the international aviation sector in Malawi.

Environmental initiatives for international aviation in Malawi will be implemented by the AEWG. This working group consists of national level stakeholders and is chaired by the DCA. Representatives are: Malawi, Department of Civil Aviation (Airports, Air Traffic Management, Flight Safety Standards (Regulatory Division), Malawi Airlines, Ministry of Natural Resources, Energy and Environment.

DEPARTMENT OF CIVIL AVIATION (DCA)

The Department of Civil Aviation consist of two Divisions; Regulatory and Operations.

Regulatory	Operations
AIR TRANSPORT PLANNING	Aerodromes
AIRWORTHINESS	Aeronautical Information Services
FLIGHT OPERATIONS	Airport Operations
PERSONNEL LICENSING	Air Traffic Services
ENVIRONMENTAL PROTECTION	Aviation Security
	Telecommunication Engineering Services

In fulfilling its responsibilities, the DCA strives to assure a safe, orderly, regular and efficient civil aviation system. The DCA recognises the importance of its stakeholders and the role it has to play in the development of an efficient civil aviation system in Malawi. Whilst ensuring quality service, aviation safety and security remains its top priority.

The Cabinet approved in 2017, the establishment of an autonomous Civil Aviation Authority (CAA) which will be established on 1 October 2023. The DCA still remains regulator and operator resulting in operational efficiencies and with this development, this situation aims to be improved with the clear separation of regulatory and operation functions.

INTERNATIONAL AERODROMES IN MALAWI AND AIR NAVIGATION SERVICES

Kamuzu International Airport (FWKI) in Lilongwe and Chileka International Airport (FWCL) in Blantyre are the two main international airports. The two airports are owned and managed by the Government of Malawi.

All the entire Air Navigation Services (ANS) including Air Traffic Management (ATM) is done by the Department of Civil Aviation.

MALAWI AIRLINES

Malawi Airlines Limited is a proprietary limited company incorporated in accordance with the Company's Act. Malawi Airlines is the national airline of the Republic of Malawi, with the Government of Malawi and Ethiopian Airlines in a strategic partnership setup, Malawi Government with 51% shareholding position and Ethiopian Airlines with 49%.

The company's business operations commenced in 2014 following the insolvency of Air Malawi in 2011 and primarily involves provision of air transport services for passengers and cargo. The airline serves domestic points within Malawi, the immediate regional markets of Kenya, Zambia, Zimbabwe and South Africa, regularly.



Malawi Airlines' mandate was determined by its Shareholder, the Government of the Republic of Malawi represented by the Ministry of Transport and Public Works, to be a major contributor towards the stimulation of tourism, as well as promotion and facilitation of trade to Malawi by providing air and cargo transport services between Malawi and other countries, as well as by operating flights within the boundaries of Malawi.

Since its inception, Malawi Airlines makes a positive net economic (value) contribution to the national economy, in line with its mandate. Net economic gain is defined as the gross value that visitors carried into the country by the airline contribute to the economy, less the cost of Government support to the airline. Net economic gain also includes the impact that Malawi Airlines has on employment in Malawi. The value added is measured in terms of contribution to "Gross Domestic Product (GDP)" and employment.

Malawi Airlines operates a fleet carefully selected to meet expectations of its stakeholders. These expectations include performance, dependability and comfort. All aircraft in the fleet are all cabin pressurized, provide immense comfort offered by the generous legroom, modern interiors and trend setting features. These aircraft are subjected to high levels of safety ensured through the maintenance programmes, and highly trained flight deck and cabin crews.

Today's fleet comprises the following;

- 1 x Boeing 737-800 aircraft
- 1 x Bombardier Dash 8 –Q400 aircraft

An additional aircraft (B737-NG) is expected by the end of September 2023.

MINISTRY OF NATURAL RESOURCES, ENERGY AND ENVIRONMENT

The Department of Environmental Affairs (DEA) under the Ministry of Natural Resources, Energy and Environment is a Government agency responsible for promoting environmental protection, environmental planning and environmental coordination. It manages a number of programmes which address priority environmental issues and challenges.

GOVERNMENT POLICY ON CLIMATE CHANGE

National Climate Change Management Policy (NCCMP)

The National Climate Change Management Policy (NCCMP) guides programming of interventions for reduction of greenhouse gas emissions in the atmosphere, as well as adapting to the adverse effects of climate change and climate variability. The development of this Policy is in tandem with national aspirations, as well as regional and international obligations. The Policy guides and coordinates implementation of relevant provisions enshrined in the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, and the Paris Agreement at the national level. The Policy is reviewed and updated every five years in order to incorporate emerging issues.

PURPOSE OF THE NCCMP

The Government of Malawi developed the NCCMP to assist the country to achieve its long-term goal for climate change management which is to reduce the socioeconomic impacts of adverse effects of climatic change. The medium-term outcome is improved community resilience to climate change through the development of sustainable livelihoods and reduced emissions of GHGs. Therefore, the Policy acts as a mechanism for harmonizing and enhancing the planning, development, coordination, financing and monitoring of climate change initiatives and programmes in Malawi. The Policy articulates the goals and objectives for climate change management in Malawi, as well as principles and strategies to guide implementation of activities aimed at reducing socio-economic impacts of adverse effects of climate change.

The Policy guides implementation of critical climate change issues and strategies, including capacity building; education, training & public awareness; the Clean Development Mechanism (CDM); Reducing Emissions from Deforestation and Forest Degradation (REDD+); adaptation and mitigation in Agriculture, Energy, Industrial processes, Waste management, Forestry, Water resources, and Wildlife sectors. In particular, the Policy builds on the National Environmental Policy (NEP) that deals with issues of air quality, reduction of GHG emissions and supplement several guiding principles. Recognizing the multiple dimensions and cross-cutting nature of climate change and the diversity in roles played by the various actors in climate change management, the NCCMP compliments other relevant policies such as those of energy, water, agriculture and forestry.

The Policy specifies strategies for each sector under the broader themes of climate change adaptation and mitigation. The NCCMP serves as an overarching reference document for policy makers in Government, the private sector, civil society, and donors concerning climate change as a priority development issue. It feeds into the Sector Wide Approaches (SWAPs) to inform strategic government programming, including programming for the achievement of the Sustainable Development Goals (SDGs). Nevertheless, it does not usurp powers and responsibilities of sectoral ministries, but instead reinforces them and highlights areas of high priority for the nation. The Ministry of Natural Resources, Energy and Mining plays a

facilitating, coordinating and advisory role in ensuring its implementation, setting and enforcement of relevant and acceptable standards.

The NCCMP objectives address the broad range of climate change problems facing Malawi at the present time and the projected future impacts. As such, the Policy addresses a number of challenges that have hitherto hindered the effective implementation of climate change actions in the country. These include inadequate financing towards climate change programmes and interventions from domestic budgetary allocations; and weak enforcement to minimize causes of climate change. It is envisaged that achievement of the objectives laid out in this Policy will lead to guided and harmonized implementation of programmes aimed at reducing GHGs; promoting adaptation actions; attainment of SDGs and low carbon emission development pathway; guided application of adaptation, mitigation, technology transfer and capacity building at the same time positioning the country to benefit from global climate change financial, technical and technological opportunities. For every development activity, there is need to assess impacts of climate change prior to implementation to ensure all activities are climate proofed.

SECTION 1 — CONTACT INFORMATION

1.1 Contact information

Name of the Authority	:	DEPARTMENT OF CIVIL AVIATION
Point of contact	:	MR. SIMPLEX SALIMA
Street address	:	ROBERT MUGABE CRESCENT CITY CENTRE
Country	:	MALAWI
State/Province	:	Malawi
City	:	LILONGWE
Telephone number	:	+265 888894065
Fax number	:	N/A
E-mail address	:	simplex.salima@dca.gov.mw

Alternative

Name of the Authority	:	DEPARTMENT OF CIVIL AVIATION
Point of contact	:	MR. MICHAEL E. MONONGA
Street address	:	ROBERT MUGABE CRESCENT CITY CENTRE
Country	:	MALAWI
State/Province	:	Malawi
City	:	LILONGWE
Telephone number	:	+265 884610075
Fax number	:	N/A
E-mail address	:	michael.mononga@dca.gov.mw

SECTION 2 — BASELINE

2.1 Baseline

The baseline for CO₂ emissions in international aviation represents the evolution of CO₂ emissions from international aviation in the future till the year 2050 in the absence of mitigation measures (business as usual scenario). A 1-year historical data (2019) and composition was used and projections have been made from 2019 onwards. Malawi Airlines is the only airline registered in Malawi that serves international flights. Only international flights according to the ICAO definition were considered for the baseline calculations.

Following ICAO's methodology described in ICAO Doc 9988², and a growth rate of 4% per year in the African region, the baseline was calculated. Appendix 1 describes the estimated baseline of fuel consumption and CO₂ emissions for international aviation within Malawi.

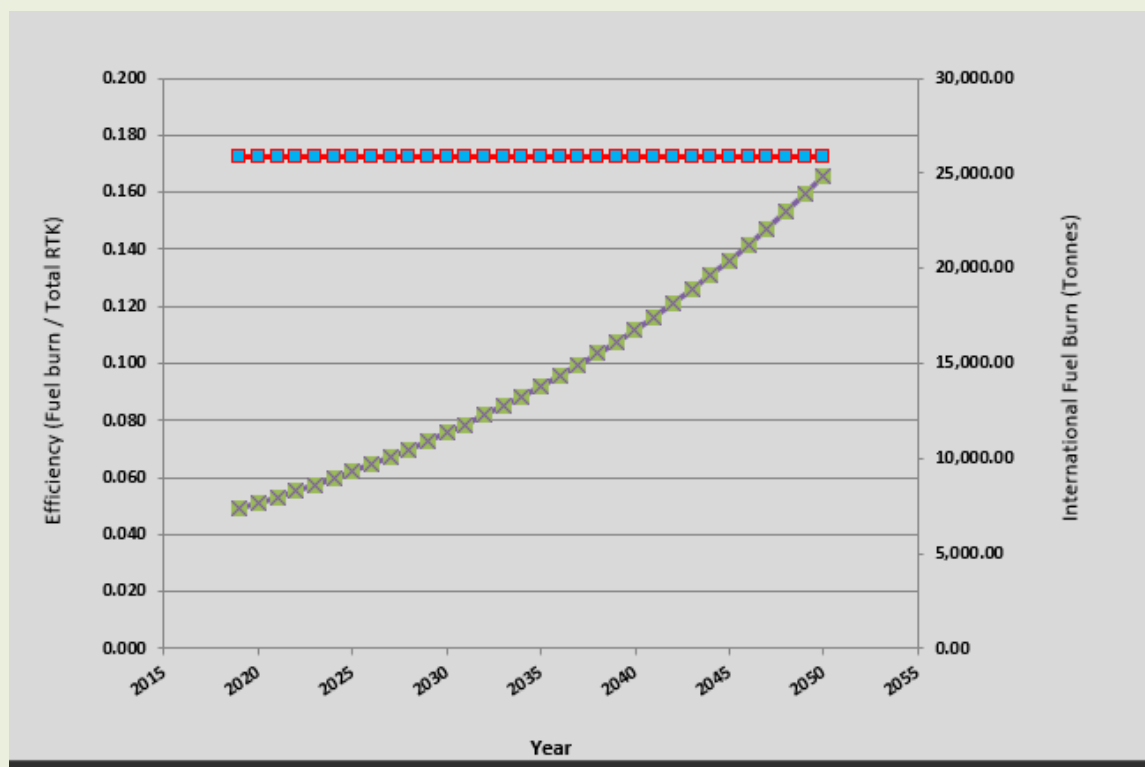


Figure 2.1: Baseline scenario

² Guidance on the Development of States' Action Plans on CO₂ Emissions Reduction Activities, Third Edition, 2019

According to these results, in the absence of mitigation measures, fuel burn from international aviation will grow from 7,359.78 tonnes in 2019 to 24,825.52 tonnes in 2050, which represents an increase of 237% in thirty-one years.

SECTION 3 — MEASURES TO MITIGATE CO₂ EMISSIONS

3.1 Measures

Various measures could be taken by States, air carriers, airports and air navigation service providers to reduce CO₂ emissions from international civil aviation. Different categories from the basket of measures have been identified for Malawi, including:

a) Airport Improvements;

i. Measures to reduce energy demand and preferred cleaner energy sources

The DCA has a solar farm, installed in 2013, located at one of the primary international airports and provides electrical power to the airport and excess to the national grid. Unfortunately, the solar infrastructure does not have storage capabilities meaning during the evening the infrastructure is rendered incapable to provide electrical power to the airport from solar stored power.

Title		Airport improvements
Description		Acquisition and Installation of batteries to incorporate in the solar farm system located at Lilongwe/Kamuzu International Airport
Category		Technological
Measure		reduce energy demand and preferred cleaner energy sources
Expected results reduced/year)	(tCO ₂	Reduce the amount of fuel burn by 50% of backup power generators
Action		Procure and install 80+ cells to enable the solar farm to store energy that can be utilised by the airport terminal building over a 24hr period
Start date		1 st October 2023
Date of full implementation		30 th September 2026
Implemented by		Department of Civil Aviation
Economic cost		1,000,000.00 (estimate)
Currency		USD
Reference to existing legislation		N/A
Legislation is proposed		N/A

Compliance	N/A
Assistance needed	Technical, Financial

b) **Sustainable Aviation Fuels**

In response to the 1970s energy crises and the higher costs of importing refined oil products in the landlocked country, Malawi has produced sugarcane ethanol and blended it at proportions of 10-25% with gasoline since the 1980s. This makes the Malawi the only African country to fully integrate biofuels into its energy system. Studies have been conducted on the potential use of jatropha as a feedstock.

The Government of Malawi realises that industrial and socio-economic development of the country depends on access to modern, reliable and sufficient energy. In view of this, the Malawi National Energy Policy of 2003 has been revised in 2018 to provide a new policy direction and guidance to all stakeholders in the implementation of energy interventions.

The country, through the Department of Civil Aviation is committed to ensure that Standards/requirements for SAF are included in the Malawi National Energy Policy.

Benefits

Renewable hydrocarbon biofuels offer many benefits, including: Engine and infrastructure compatibility—SAF blended with conventional Jet A can be used in existing aircraft and infrastructure.

Fewer emissions— Compared with conventional jet fuel, 100% SAF has the potential to reduce greenhouse gas emissions by up to 94% depending on feedstock and technology pathway.

More flexibility—SAF is a replacement for conventional jet fuel, allowing for multiple products from various feedstocks and production technologies.

Title Sustainable Aviation Fuels	
Description	Development of Standards/ requirements for SAF use
Category	Sustainable Aviation Fuels (SAF)
Measure	Use of cleaner energy sources

Expected results reduced/year)	(tCO₂	Promote SAF development and deployment in Malawi
Action		Malawi National Energy Policy update to include SAF Feasibility study on SAF
Start date		1 st October 2023
Date of full implementation		30 th September 2026
Implemented by		Department of Civil Aviation
Economic cost		100,000.00 (estimate)
Currency		USD
Reference to existing legislation		N/A
Legislation is proposed		N/A
Compliance		N/A
Assistance needed		Technical, Financial

c) Improved Air Traffic Management and infrastructure use

i. measures to improve fuel efficient departure and approach procedures (PBN.)

ii. The DCA intends to fully implement the use of the ADS-B in Malawi airspace inorder to improve efficieny of flight movements thereby reducing fuel burn in each phase of flight

Title		Improved air traffic management and infrastructure use
Description		i. measures to improve fuel efficient departure and approach procedures (PBN STAR and SID) Ii. Use of ADS-B
Category		Technological
Measure		Reduce amount of fuel burn by shortening the flight route and reducing delays
Expected results (tCO₂ reduced/year)		Unknown, however aiming to achieve 10% reduction in fuel burn from total number of flights recorded to have been delayed or diverted.
Action		Implementing the use of PBN STAR , SID and ADS-B in all air traffic control operations
Start date		1st October, 2023
Date of full implementation		30th September 2026

Implemented by	Department of Civil Aviation
Economic cost	0
Currency	USD
Reference to existing legislation	N/A
Legislation is proposed	N/A
Compliance	Mandatory
Assistance needed	No

d) Technology and Standards- purchase of new aircraft

The Aircraft addition is to serve its scheduled routes across the region, for new routes embarked on a route network expansion drive.

The aircraft has a better cargo hold capacity and will serve the cargo market much better on the routes.

Title Technology and Standards	
Description	Purchase of new aircraft (B737-700)
Category	Technology and Standards
Measure	To serve its scheduled routes across the region, for new routes embarked on a route network expansion drive. The aircraft has a better cargo hold capacity and will serve the cargo market much better on the routes.
Expected results (tCO₂ reduced/year)	Reduction in fuel burn
Action	Aircraft addition
Start date	1 st October 2023
Date of full implementation	31st September 2026
Implemented by	Malawi Airlines
Economic cost	N/A
Currency	USD
Reference to existing legislation	N/A
Legislation is proposed	N/A
Compliance	Mandatory
Assistance needed	No

e) **Best practices in operations (single engine taxi) and optimized aircraft maintenance (engine wash)**

Engine wash will be done in closed hangar so this will be done in contracted maintenance organization (ET-MRO) and this will be done every 6 month.

taxi-in is considered easier to manage in single-engine operations than taxi-out, due to the less workload associated with monitoring the engine cooldown (with respect to warm up) and the higher predictability of taxiing duration

Title		More efficient operations
Description		Best practices in operations (single engine taxi) Optimized aircraft maintenance (engine wash)
Category		More efficient operations
Measure		It will help to improve engine's performance by removing dirt and grime that can cause it to run less efficiently. Helps to reduce fuel consumption, and emissions of Oxides of nitrogen (NOX), carbon monoxide (CO) and hydrocarbon (HC).
Expected results (tCO₂ reduced/year)		reduction in fuel burn
Action		
Start date		1 st October 2023
Date of full implementation		30 th September 2026
Implemented by		Malawian Airlines
Economic cost		NA
Currency		USD
Reference to existing legislation		N/A
Legislation is proposed		N/A
Compliance		Mandatory
Assistance needed		No

3.3 Additional information

Recognizing that efforts to address climate change are global and require coordination amongst States and ICAO, Malawi will embark to participate and maintain participation, through ICAO, on the implementation of global

approaches and standards to address climate change. This will include participation in international meetings and conferences such as the ICAO Assembly and will continue to engage and interact with the aviation industry and other key stakeholders as part of the international dialogue on market based measures.

SECTION 4 — EXPECTED RESULTS

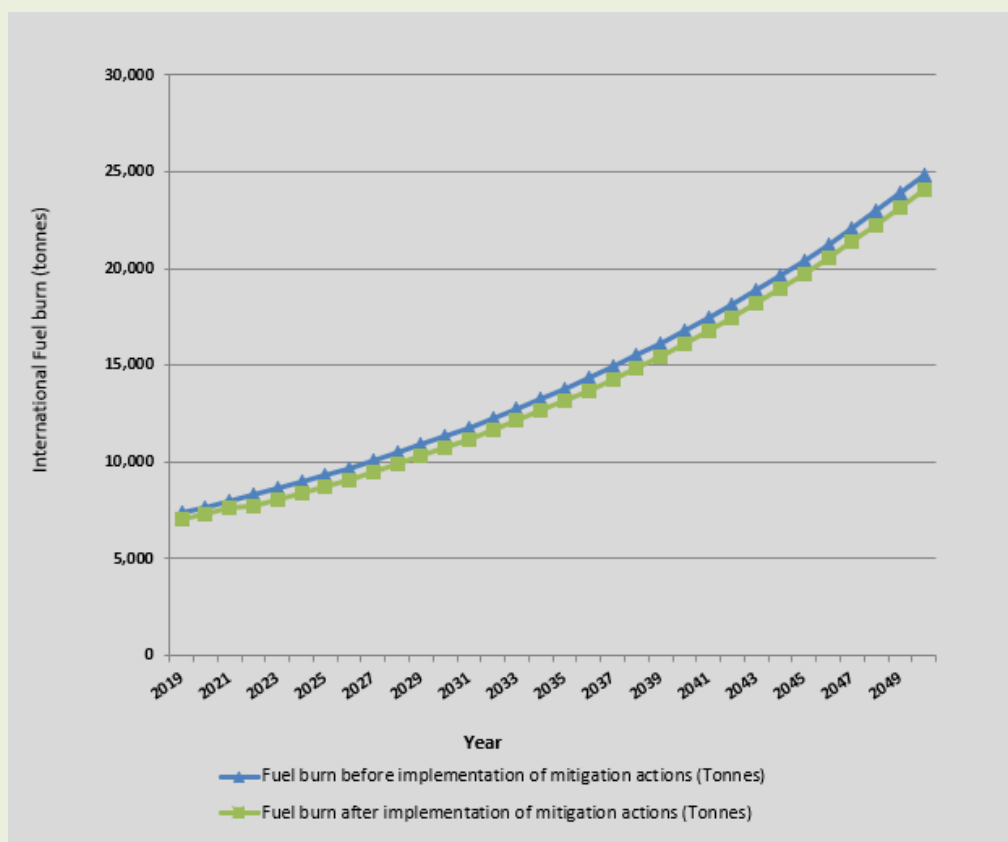


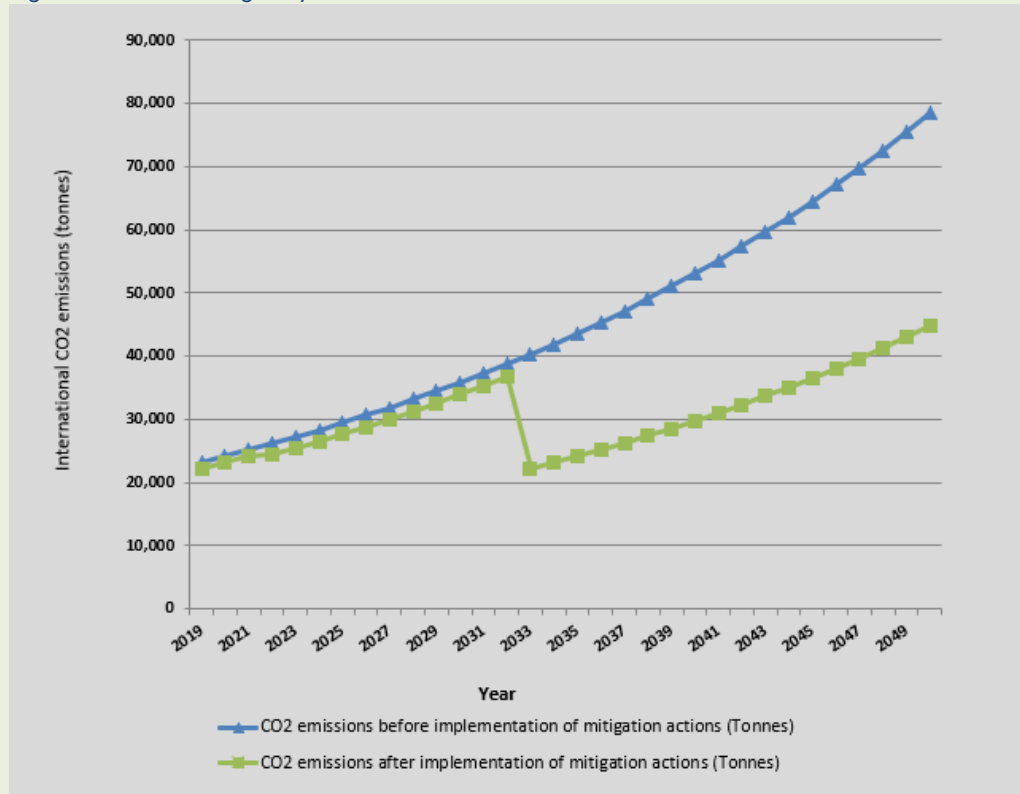
Figure 4.1: Fuel Savings

Figure 4.1 shows the fuel burn (before implementation of mitigation measures) and (after implementation of mitigation measures identified in Section 3). The Table below show the details of the fuel burn data:

Table 4.1: Fuel burn data

Year	Fuel burn <u>before</u> (tonnes)	Fuel burn <u>after</u> (tonnes)
2019 (historic data)	7,359.78	7,033.54
2040	16,771.23	16,112.97
2050	24,825.52	24,086.72

Figure 4.2: CO₂ Savings Expected Results



It is noted in the graph above that there is a big dip in 2033 in CO₂ emissions due to the implementation of Sustainable Aviation Fuels (SAF) as a mitigation action. SAF is one of the measures identified in Section 3. Malawi will undertake to work between now and 2033 to promote the development and deployment of SAF from 2033.

SECTION 5 — ASSISTANCE NEEDS

Malawi, as earlier indicated, is committed to participate in the global effort towards addressing climate change issues in the aviation sector. However, its efforts are limited due to varying factors and challenges mainly in the following key areas;

- a. Technical
- b. Financial

The assistance needed to develop and implement activities in an effort to reduce CO₂ are the following;

- Support in implementing the identified measures which include the use of SAF
- Support in the development of technical capacity;
- Support in financial capacity for acquisition and installation of cells for the solar farm;

Figure 2: Aerial view of solar farm south of Kamuzu International Airport terminal building



- Support in establishing monitoring systems of emissions in the Malawi FIR, national airline and airports

SECTION 6 — GOVERNANCE OF ACTION PLAN

6.1 Reporting

6.1.1 Governance

The Working Group on Aviation Emissions will oversee this Action Plan. The Working Group will meet biannually, to monitor individual and collective progress made towards achieving efficiency targets.

6.1.2 Bi-annual meeting and Annual Reporting

The working group will be meeting and reporting the achievement twice a year. Annual Reports will summarise the progress that has been made in meeting the CO₂ gas emission reduction goals and other Action Plan activities.

The Annual Reports will include:

- A quantitative description of achievements (including relevant indicators such as litres of fuel consumed per Revenue Tonne Kilometre and CO₂ emissions);
- The DCA will collect all of the information necessary to report on the fuel efficiency improvements and CO₂ savings achieved; and

6.1.3 Review

The Working Group will review of the Action Plan every three years from the date of approval as requested by ICAO Resolution A41-21.

Appendix 1: Baseline scenario

BASELINE

Year	International RTK (¹ 000)	International Fuel burn (Tonnes)	Efficiency (Fuel burn / RTK)
2019	42,640.40	7,359.78	0.173
2020	44,346.02	7,654.17	0.173
2021	46,119.86	7,960.34	0.173
2022	47,964.65	8,278.75	0.173
2023	49,883.24	8,609.90	0.173
2024	51,878.57	8,954.30	0.173
2025	53,953.71	9,312.47	0.173
2026	56,111.86	9,684.97	0.173
2027	58,356.33	10,072.37	0.173
2028	60,690.59	10,475.26	0.173
2029	63,118.21	10,894.27	0.173
2030	65,642.94	11,330.04	0.173
2031	68,268.66	11,783.24	0.173
2032	70,999.40	12,254.57	0.173
2033	73,839.38	12,744.76	0.173
2034	76,792.95	13,254.55	0.173
2035	79,864.67	13,784.73	0.173
2036	83,059.26	14,336.12	0.173
2037	86,381.63	14,909.56	0.173
2038	89,836.89	15,505.94	0.173
2039	93,430.37	16,126.18	0.173
2040	97,167.58	16,771.23	0.173
2041	101,054.29	17,442.08	0.173
2042	105,096.46	18,139.76	0.173
2043	109,300.32	18,865.35	0.173
2044	113,672.33	19,619.97	0.173
2045	118,219.22	20,404.76	0.173
2046	122,947.99	21,220.96	0.173
2047	127,865.91	22,069.79	0.173
2048	132,980.55	22,952.59	0.173
2049	138,299.77	23,870.69	0.173
2050	143,831.76	24,825.52	0.173

Appendix 2: Expected results

EXPECTED RESULTS: FUEL SAVINGS

Year	Annual Fuel burn <u>before</u> implementation of mitigation actions (Tonnes)	Annual Fuel burn <u>after</u> implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2019	7,359.78	7,033.54	326.24	-4.43
2020	7,654.17	7,324.98	329.19	-4.30
2021	7,960.34	7,628.09	332.25	-4.17
2022	8,278.75	7,705.42	573.33	-6.93
2023	8,609.90	8,033.26	576.64	-6.70
2024	8,954.30	8,374.21	580.09	-6.48
2025	9,312.47	8,728.80	583.67	-6.27
2026	9,684.97	9,097.57	587.39	-6.06
2027	10,072.37	9,481.10	591.27	-5.87
2028	10,475.26	9,879.96	595.30	-5.68
2029	10,894.27	10,294.79	599.49	-5.50
2030	11,330.04	10,726.20	603.84	-5.33
2031	11,783.24	11,174.87	608.38	-5.16
2032	12,254.57	11,641.48	613.09	-5.00
2033	12,744.76	12,126.77	617.99	-4.85
2034	13,254.55	12,631.46	623.09	-4.70
2035	13,784.73	13,156.34	628.39	-4.56
2036	14,336.12	13,702.21	633.90	-4.42
2037	14,909.56	14,269.92	639.64	-4.29
2038	15,505.94	14,860.34	645.60	-4.16
2039	16,126.18	15,474.38	651.80	-4.04
2040	16,771.23	16,112.97	658.26	-3.92
2041	17,442.08	16,777.11	664.96	-3.81
2042	18,139.76	17,467.82	671.94	-3.70
2043	18,865.35	18,186.16	679.20	-3.60
2044	19,619.97	18,933.22	686.74	-3.50
2045	20,404.76	19,710.17	694.59	-3.40
2046	21,220.96	20,518.20	702.75	-3.31

2047	22,069.79	21,358.55	711.24	-3.22
2048	22,952.59	22,232.52	720.07	-3.14
2049	23,870.69	23,141.44	729.25	-3.06
2050	24,825.52	24,086.72	738.80	-2.98

EXPECTED RESULTS : CO₂ SAVINGS

EXPECTED RESULTS : CO₂ SAVINGS				
Year	Annual CO₂ emissions before implementation of mitigation actions (Tonnes)	Annual CO₂ emissions after implementation of mitigation actions (Tonnes)	Annual CO₂ savings (Tonnes)	Change CO₂ savings (%)
2019	23,256.90	22,225.97	1,030.93	-4.43
2020	24,187.18	23,146.94	1,040.23	-4.30
2021	25,154.66	24,104.76	1,049.91	-4.17
2022	26,160.85	24,349.13	1,811.72	-6.93
2023	27,207.29	25,385.10	1,822.19	-6.70
2024	28,295.58	26,462.51	1,833.07	-6.48
2025	29,427.40	27,583.01	1,844.39	-6.27
2026	30,604.50	28,748.34	1,856.16	-6.06
2027	31,828.68	29,960.27	1,868.40	-5.87
2028	33,101.82	31,220.69	1,881.13	-5.68
2029	34,425.90	32,531.52	1,894.37	-5.50
2030	35,802.93	33,894.79	1,908.15	-5.33
2031	37,235.05	35,312.58	1,922.47	-5.16
2032	38,724.45	36,787.09	1,937.36	-5.00
2033	40,273.43	22,211.21	18,062.22	-44.85
2034	41,864.37	23,161.66	18,722.71	-44.70
2035	43,559.74	24,150.13	19,409.61	-44.56
2036	45,302.13	25,178.14	20,123.99	-44.42
2037	47,114.22	26,247.27	20,866.94	-44.29
2038	48,998.78	27,359.17	21,639.62	-44.16
2039	50,958.74	28,515.54	22,443.20	-44.04
2040	52,997.08	29,718.16	23,278.92	-43.92
2041	55,116.97	30,968.90	24,148.07	-43.81
2042	57,321.65	32,269.66	25,051.99	-43.70
2043	59,614.51	33,622.45	25,992.07	-43.60
2044	61,999.09	35,029.35	26,969.74	-43.50
2045	64,479.06	36,492.53	27,986.53	-43.40
2046	67,058.22	38,014.23	29,043.99	-43.31
2047	69,740.55	39,596.81	30,143.74	-43.22
2048	72,530.17	41,242.68	31,287.49	-43.14
2049	75,431.38	42,954.40	32,476.98	-43.06
2050	78,448.63	44,734.58	33,714.05	-42.98

Appendix 3: Malawi's Scenery and Attractions



Resort along Likoma Island



Commercial City of Blantyre



Nyika National Park



Stretch of Mt. Mulanje far from Zomba City



Zomba Plateau, Zomba City



Wildlife from Majete Wildlife Reserve