

Sierra Leone's Action Plan to Reduce CO₂ Emission from International Aviation



Preface

Sierra Leone is a member State of ICAO and by extension obliged to abide with all ICAO General Assembly Resolutions for the safe operation of international aviation. ICAO Resolutions A37-19, A38-18 A39-2, A40-18 and A40-19 require states to develop their “National Action Plans for CO₂ Emission Reduction from International Aviation”.

This Action Plan provides an overview of the primary initiatives of the Ministry of Transport and Aviation, Ministry of Environment and relevant stakeholders in the Aviation industry to reduce Carbon Dioxide (CO₂) which is the main Greenhouse Gas (GHG) that is emitted from the Aviation Industry. From the various ICAO Resolutions and Sierra Leone’s Nationally Determined Contribution (NDC), the SLCAA is committed to managing the Carbon footprint of Sierra Leone’s Aviation Industry for the sustainable management of the environment as well as enhancing safety, security and efficiency of service delivery.

This plan is a strategic document and road map that has been develop to meet the requirements of relevant ICAO Resolutions for the reduction of CO₂ Emission from International Aviation. The actions proposed are to ensure that “Emission must drop 7.6% per year from 2020 to 2030 to keep temperature from exceeding 1.5° C and 2.7% per year to stay below 2° C goal”.

The Ministry is committed to providing the necessary leadership and will make available all necessary resources for the implementation of this plan.



Hon. Kabineh Kallon

Minister of Transport and Aviation

Introduction

This Action Plan to Reduce CO₂ Emission from International Aviation is in line with ICAO Resolution A40-19 and in fulfilment of the state's commitment to tackle environmental problems especially greenhouse gas Emission (Carbon Dioxide (CO₂)) from the Aviation Sector.

The state is committed to reducing CO₂ aviation Emission for meeting the ICAO's move to actualize the global inspirational goal of achieving Carbon-neutral growth by 2025.

For this reason, the SLCAA will provide the necessary leadership, support and guidance to partners and stakeholders where necessary and will factor in its annual budget respective contribution (co-funding) for each of the projects identified for the implementation of this action plan in accordance with all related ICAO Resolutions.

The Action Plan gives an executive summary of the policy framework, the State's other related obligations with the resource mobilisation, monitoring, reporting and verification strategy (new direction). It highlights its purpose, scope and implementation process of the activities including the mitigation measures and tools and how they could help reduce CO₂ emission.

The SLCAA is committed to ensuring implementation of this plan



Moses Tiffa Baio
Director-General
Sierra Leone Civil Aviation Authority

ACRONYMS

ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AF	Air France
AFTN	Aeronautical Fixed Telecommunications Network
AFS	Aeronautical Fixed service
RAM	Royal Air Morocco
ANS	Air Navigation Service
AIDPS	Aeronautical Information Data Processing System
ANSP	Air Navigation Service Provider
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
ATK	Available Tonne Kilometres
ASK	Available Seat-Kilometres
A-SMGCS	Advanced Surface Movement Guidance & Control System
AWOS	Automatic Weather Observing System
AWS	Automated Weather System
AEWG	Aviation Environmental Working Group
Baro-VNAV	Barometric Vertical Navigation
BAU	Business as Usual
CAEP	Committee on Aviation Environmental Protection
CFIT	Controlled Flight into Terrain
CIEWS	Climate Information Early Warning System
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
COP	Conference of Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPDLC	Controller Pilot Data Link Communications
CSO	Civil Society Organizations
CTA	Controlled Airspace
DDA	Drift Down Analysis
DME	Distance Measuring Equipment
EDP	Emission Development Pathways.
ETS	Emissions Trading Scheme
EPA-SL	Environment Protection Agency- Sierra Leone
EU	European Union
EVD	Ebola Virus diseases
FANS	Future Air Navigation System
FIR	Flight Information Region

FMS	Flight Management System
GHG	Greenhouse Gas
GNSS	Global Navigation Satellite System
GMDSAP	Guidance Material for the Development of States 'Action Plans
GoSL	Government of Sierra Leone
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IPCC	Governmental Panel on Climate Change
KP	Kyoto Protocol
KQ	Kenya Airways
LDCs	Least Developed Countries
MBM	Market-Based Measures
MDA	Ministries, Departments and Agencies
MET	Meteorological Services for Air Navigation
MRV	Measurement, Reporting and Verification
MTA	Ministry of Transport and Aviation
MSSR	Mono-pulse Secondary Surveillance Radar
NCCS	National Climate Change Secretariat
NDC	Nationally Determined Contribution
NDB	Non Directional Beacon
PA	Paris Agreement
PBN	Performance Based Navigation
PRSP	Poverty Reduction Strategy Paper
PSR	Primary Surveillance Radar
QMS	Quality Management Service
RCP	Required Communication Performance
RSP	Required Surveillance Performance
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance Authorisation Required
RTK	Revenue Tonne -Kilometre
SAP	State Action Plan on CO2 Emissions reduction
SID	Standard Instrument Departure
SN Brussels	Brussels Airlines
SLAA	Sierra Leone Airport Authority
SLCAA	Sierra Leone Civil Aviation Authority
SLMET	Sierra Leone Meteorological Agency
SSR	Secondary Surveillance Radar

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1. EXECUTIVE SUMMARY

1.1 Background

Sierra Leone lies between latitudes $6^{\circ}55'$ and $10^{\circ}00'$ North and longitudes $10^{\circ}14'$ and $13^{\circ}17'$ West with an area of 72,325 km². The coastal zone of Sierra Leone is nearly one third of the country's boarder and extends for a distance of about 465 km. The country is boarded by two other countries of Liberia in the south-east and Guinea in the North to North-west.



Figure 1.1 Location of Sierra Leone

As a tropical country, Sierra Leone has a tropical climate with two distinct seasons of wet and dry with approximately equal duration, but the present climate change and variability, renders this distinction almost irrelevant as each season now eats into the other from both ends.

The temperature is characterized by high temperatures with an average monthly temperature of between 26°C - 28°C from June to October with a maximum temperature of 32°C-34°C.

Temperatures of up to 36°C have been recorded during the month of March. The Freetown International Airport is located very close to the western coast and with the visibility generally obstructed by mist/fog and haze, especially from December to February during the Harmattan that poses another aviation challenge after thunder storm and heavy tropical rainfall.

“Sierra Leone’s Action Plan to Reduce CO₂ Emission from International Aviation” is developed to put mechanism in place for activities to address the reduction of CO₂ Emissions from international aviation.

The level of information contained in the Action Plan has been provided in order to demonstrate the effectiveness of State’s actions, and to ensure measurability of progress towards meeting the global goals set by ICAO Resolution A37-19 on CO₂ Emission reduction from International Aviation.

The Action Plan will provide a means through which SLCAA will communicate the states Aviation Emission reduction through the relevant ICAO channels. This National Action Plan for CO₂ Emission Reduction from International Aviation is a means by which the state takes into consideration the relevant ICAO Resolutions A37-19, A38-18, A39-2 and A40-18.

The state is also committed to other related obligations under the UNFCCC and IPCC to meet its target in Aviation Emission reduction based on the Nationally Determined Contribution (NDC) in particular and the Global goal in general.

The plan developed provides information on the following:

- Administrative and organizational arrangements and Identification of national conditions relating to CO₂ Emission and sinks.
- Identification of processes of estimation of historical National Emissions from Aviation.
- Identification of actions to mitigate CO₂ Emissions form Aviation.
- Means of monitoring progress based on the Measurement, Reporting and Verification (MRV) and transparency of action according to ICAO’s relevant Standards and CAEP Emission estimation models.
- Information on the available resources, needed resources, necessary capacity building and transfer of technology needs where the summary of possible projects that will address these issues forms parts the document.

Based on means and issues resulting in the achievement of the above goals, the necessary national legal frameworks were identified including formulated policies or laws.

This is why the relevant stakeholders’ engagement during the Action Plan development was very crucial. This final document therefore identified series of activities or projects whose implementation will help to meet the target set for Aviation Emission reduction and the corresponding mitigation actions.

1.2 National Climate Change Policy Framework

Climate Change is one of the emerging issues of this century that is threatening the very existence and developmental aspirations of some Least Developed Countries and Small Island

States. It is in recognition of this fact coupled with the IPCC classification in the Fourth Assessment that placed Sierra Leone as one of the most Vulnerable countries to Climate Change and by extension the one of the most vulnerable to food security, that the Government was proactive in developing the Climate Change Policy Framework document in 2017 after the twin challenges of the 2015 Ebola Virus diseases (EVD) and the 2017 Freetown Mudslide and the unprecedented Freetown flooding that claimed many lives.

1.3 Sierra Leone's Climate Change Strategy and Action Plan

This Action Plan is aligned with the Sierra Leone National Climate Change Policy Framework and hinges on low GHGs (especially CO₂) Emission Development Pathways (EDP). It incorporated Sierra Leone's Development Plan that was aligned to the Sustainable Development Goals of the Agenda for Prosperity (A4P) and the current "New Direction" where the President's special attention of Climate Change in Cluster 7 captures Environment, Disaster Management and Climate Change.

To give further prominence to the issue of climate change the government proposed that a special Ministry responsible for the Environment be created to address cluster 7 in the "New Direction" (PRSP4).

The document outlined ten Climate Change Projects that were expected to initially address some of the main hindrances for Sierra Leone in trickling Climate Change as shown below:

Project/Programme	Estimated Cost (US Dollars)
Strengthening the Environment Protection Agency to serve as Climate Change Secretariat for effective and efficient provision of technical and policy advice to the Government and people of Sierra Leone for relevant decision making in transitioning to green economic growth.	5,000,000
Transform the National Meteorological Services of Sierra Leone into an Agency.	3,000,000
Strengthening of Climate Change Early Warning System of Sierra Leone.	15,000,000
Promote Renewable (Solar, Wind, Hydro, Biomass) Energy based mini grids for productive uses in rural areas of Sierra Leone	58,000,000
Promote the use of energy-efficient cooking stoves to reduce greenhouse gas Emissions from fuel wood consumption	15,000,000

Reinforcement of transmission and distribution system to reduce losses to 45% between 2015 and 2030	25,000,000
Reduce methane Emissions through improved waste management by land filling, composting and recycling of waste in Freetown, and other cities and towns of Sierra Leone	168,000,000
Plan, develop and regulate a Green Technology Mass Transport System for the Urban and Rural Western Area of Sierra Leone	150,000,000
Promotion and adoption of roof-top and surface-runoff rainwater harvesting for 2000 households as climate change adaptation technologies for human consumption, animal watering and other livelihood uses.	5,500,000
National agricultural land and water management development for increased rice and vegetable production and for strengthened climate resilience.	25,000,000
TOTAL COST IN US DOLLARS	469,500,000

Table 1: Some actions taken by SL to address Climate Change

Source: Sierra Leone Climate Change Strategy and Action Plan Document: Courtesy; EPA-SL

Some of these projects were funded and their objectives achieved like the establishment of the Climate Change Secretariat unit at EPA-SL, the transformation of the Meteorological Department into an Agency and the implementation of the Climate Information Early Warning System (CIEWS) among others.

1.4 Sierra Leone's Development plan 2019-2024 code named the "New Direction"

This document is in line with the gradual but continuous development progress slated for five year interval that is hoped to assist Sierra Leone in meeting the Sustainable Development Goals (SDGs). This particular document is unique in comparison to its previous three predecessors by specifically assigning one of its eight clusters to addressing Environment related issues of which climate change is an integral part. To match words with action, the Government created for the first time the "Ministry of Environment" to specifically address cluster 7 of its five years' Development trajectory; that is Environment, Climate Change, Disaster Management and related issues. For CO₂ Emission reduction the government is heavily investing in renewable energy to complement national demands. In 2016, the government commissioned the operation

of the newly constructed 6MW solar plant at Newton (some 32Km from Freetown) to serve the electrical power needs of the parts of Western Rural District settlement whose headquarter town of Waterloo is among the fastest growing settlement. The drive to also electrify the chiefdom headquarter town with solar power is well underway in the 59 pilot chiefdoms with only some household electrifying and distribution network remaining before the final commissioning in those towns lagging behind.

1.5 The Paris Agreement and Sierra Leone's Nationally Determined Contribution

Sierra Leone originally prepared its Intended Nationally Determined Contribution (INDC) that was submitted to the UNFCCC Secretariat before the Paris Agreement which automatically became Sierra Leone's NDC after its ratification.

Sierra Leone NDC outlined actions and measures ranging from legislation to implementation of actions that will reduce its national GHGs Emissions and/or enhance the removal by sink of CO₂ and other GHGs from the atmosphere, while at the same time encouraging actions to address climate change through adaptation, mitigation and transfer of appropriate technology.

One of the climate action points is the reduction of CO₂ Emission in all facets including CO₂ Emission Reduction from Aviation as this complementary document of the State Action Plan (SAP) developed by Sierra Leone to address the reduction of CO₂ Emission from International Aviation.

1.6 ICAO Annex 16 and Resolutions A37-19, A38-18, A39-2 and A40-18

The provisions in Resolution A37-19 and subsequent Resolutions along with Annex 16 build upon ICAO's past achievements to incorporate elements relating to international aviation and climate change specifically:

- (a) Endorsement of the global annual average fuel efficiency improvement of 2 per cent until 2020 and the global aspiration goal of 2 per cent annual fuel efficiency improvement from 2021 to 2050.
- (b) A medium-term global aspiration goal of keeping the global net Carbon Emissions from International Aviation from 2020 at the same level.
- (c) Explore the feasibility of a long-term global aspiration goal for International Aviation.
- (d) Development of a global CO₂ Standard for aircraft.
- (e) Facilitation of developing and deploying sustainable alternative fuels for aviation.
- (f) Development of a framework for Market-Based Measures (MBMs), including further elaboration of the guiding principles, and exploration of a global scheme for International Aviation.
- (g) Concrete steps to assist States to contribute to ICAO's global efforts.
- (h) *De minimis* provisions to ensure that States with small contributions to global air traffic are not burdened disproportionately; and

- (i) Action plans outlining States' policies and actions, annual reporting on International Aviation CO₂ Emissions, basket of measures and specific assistance needs. Coherent with the ICAO Assembly Resolutions on addressing Climate Change, state decided to develop its State Action Plan on CO₂ Emissions reduction from International Aviation. This document among others gives the blue print outline of:
 - (1) The Major elements of the various contextual issues and highlights rational for the policy.
 - (2) The second part of the Framework outlines the Vision, Mission and Strategic Objective of the National Climate Change Policy Response and Strategy Direction
 - (3) In the last section, it deals with responsibilities of various stakeholders including state and non-state actors for the necessary policy response approaches and actions that will reduce the impact and/mitigate climate change effect.

1.7 Guidance Material for the Development of States' Action Plans on CO₂ Emissions Reduction Activities (ICAO Doc 9988)

This action plan has been developed using the **ICAO Doc 9988** and was prepared towards the achievement of ICAO's Global Climate Change Goals.

The Sierra Leone's Action Plan is a means to communicate to ICAO information on the activities undertaken by SLCAA and the Aviation stakeholders to address CO₂ Emissions from International Aviation.

The ICAO guidance document is divided into five parts where each of the parts focuses on specific but different aspect of the plan.

This was therefore followed throughout the development of this document as addressed below in the respective chapters or sections.

1.8 Resource Mobilisation

Included in any good Action Plan is the special focus of how to meet the goals and objectives of the plan. This includes the brief outline of who does what and with what resources, ranging from human to technical/technology capacity building/technology transfer and the financial capability. Thus after highlighting the various perceived projects/action to implement the Action Plan, the perceived sources/tasks of resource mobilisation will be captured as action points for the implementation of the Action Plan.

1.9 Monitoring, Reporting and Verification

States' monitoring (through measurement), Reporting and Verification (MRV) are integral parts in meeting the transparency aspects of progress of the CO₂ Emissions Reduction. ICAO's CO₂ Emission Reduction Strategy requires the elaborate procedure of measuring progress and one of the mechanisms is through the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). This is one of the action points that this action plan hopes to flag under its identified projects and actions.

2. INTRODUCTION TO ACTION PLANS

2.1 Purpose and Scope of the action plan

Sierra Leone Action Plans on CO₂ Emissions Reduction is a strategic tool that helps to address CO₂ Emissions from International Aviation. It must be noted that at the moment there is very little international aviation traffic in the country that we can safely assume Emission in this sector is negligible for inclusion.

This National Action Plan is a state driven initiative that allows for voluntary submission to ICAO. The level of the information contained in this action plan will ultimately enable ICAO to assess the global progress towards meeting the environmental goals set by its member States.

Thus the present expansion of the Lungi International Airport with the building of a new terminal, the proposed Lungi Bridge amongst other developments will surely give a boost to the aviation industry. The consequent increase in CO₂ Emission as a result of the growth in air traffic will be addressed in this action plan

2.2 The planning process

There were series of consultation with various stakeholders including Ministries, Departments and Agencies (MDAs), the Airline Operators and other relevant non-state actors including the Civil Society and the media outlining Sierra Leone's obligation and ICAO requirement of States in the Global Emission Reduction in the Aviation Industry.

2.3 Monitoring of progress

The monitoring of progress made in states collective actions to reducing the CO₂ Emission from International Aviation will follow ICAO's methodology and guidelines in meeting the global goal already mentioned above.

The Parliamentary Oversight Committee on Ministry of Transport and Aviation, the SLCAA and SLAA were the key data base sources from their activities with the airline operators and the bridge for ICAO monitoring team for the quantification of such progress.

2.3.1 The primary Point of Contact (POC) for all ICAO CO₂ Emission related issues is the Director General of the Sierra Leone Civil Aviation Authority.

Address: 3rd and 4th Floor, NDB Building,
21/23 Siaka Stevens Street,
Freetown, Sierra Leone.

Email: info@slcaa.gov.sl

The Director General shall nominate CORSIA Focal Point for Sierra Leone as the second Point of Contact.

2.4 The Sierra Leone Civil Aviation Authority

The Sierra Leone Civil Aviation Authority was set up to replace Civil Aviation Department in the Ministry of Transport by an Act of Parliament in 2008 and amended in 2017 and 2019 in order to enhance autonomy, competitiveness and service delivery in the Aviation Industry. The Act established the Sierra Leone Civil Aviation Authority which is responsible for the safety and security oversight of all aviation activities in the state in accordance with ICAO standards and recommended practices.

SLCAA over the years initiated measures to improve Sierra Leone Aviation Industry by carrying out various ICAO recommendations from the AFI Regional Session ranging from:

- (a) The ICAO Security Audit of the state that were conducted in 2012 and 2019.
- (b) The introduction of the Quality Management System (QMS) for improved service provision for safe flight operations.
- (c) Acquisition of improved air navigation facility and training of personnel
- (d) Setting up of the Meteorological unit solely for the monitoring of the National Meteorological Services to the SLAA.
- (e) Improving airport infrastructure; the latest being the launching of the new Airport Terminal Building in November 2020.
- (f) Improving air navigation facilities and the Air Traffic Management System
- (g) Putting in place regulatory measures for better service delivery
- (h) Collaborating and coordinating with other states and International Organisations on the reduction of CO₂ Emission that this AP will be addressing
- (i) Encouraging Airline Operators to use more fuel efficient aircrafts.

Action Plans are never static, as emerging issues usually surface, it is recommended that the Plan shall be reviewed after every three to five years in order to capture emerging trends of Emission in International Aviation

2.5 Other Stakeholders

- 2.5.1 The Sierra Leone Meteorological Agency (SLMet) evolved from the Sierra Leone Meteorological Department (SLMD) which came into being when the country gained its independence on April 27, 1961 and was part of the British West African Meteorological Service established on May 29, 1927. It provides the necessary Meteorological Services needed for the safe operations of International Aviation.
- 2.5.2 Sierra Leone Airport Authority (SLAA) works with other organizations to provide needed services for Airlines including Air Navigation Services and airport safety among others.
- 2.5.3 The Airline Operators provide the needed operations including ticketing for ease of services for their passengers and cargo activities. The Airline Operators propels the growth of the Sierra Leone aviation industry in various sectors that depend on their services ranging from tourism to trade and investment. They are therefore integral components of the Action Plan since they are responsible for the Emission in the first place. The Emission Reduction strategy and action is therefore done with intensive consultation with them especially on their part and cooperation.

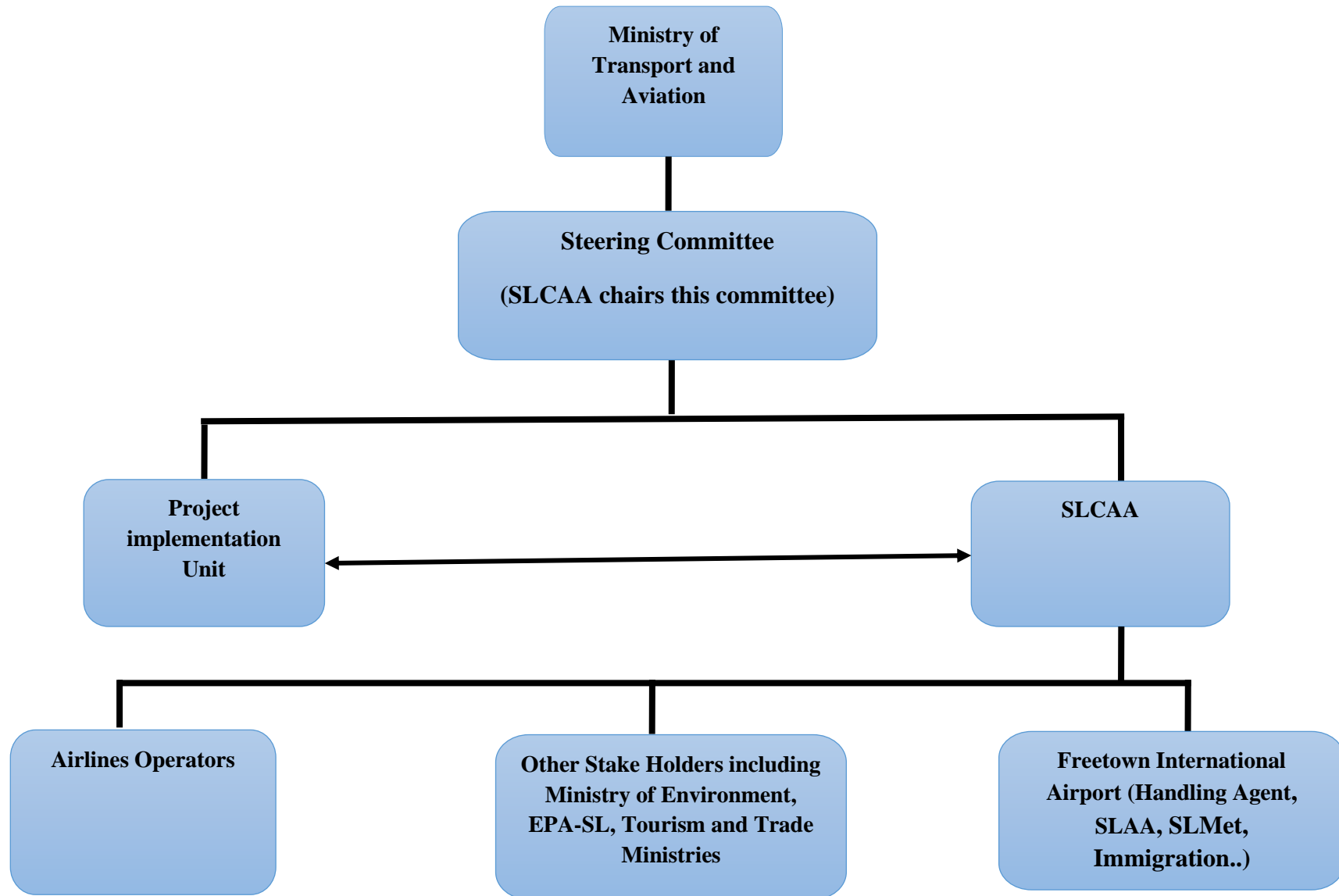
They are included in the needed training that will enhance their efficiency in CO₂ Emission Reduction from International Aviation.

- 2.5.4 Various stakeholders that are either directly or indirectly connected with International Aviation including Sky handling and partners, NRA, Sierra Leone Immigration Department etc. were also consulted and they are included as part of the institutional arrangement for this action plan.

2.6 Institutional Arrangement for the implementation of the Action Plan

SLCAA will be directly responsible for the implementation of the action plan under the policy directive of the Ministry of Transport and Aviation as illustrated below with the different stakeholders also included.

Figure 1.2: Institutional Arrangement/Management Structure for implementing the Action Plan



The Steering Committee will be meeting and reporting the achievement done in the implementation of the Action Plan quarterly and will prepare an annual report that will summarize the progress that has been made in meeting CO₂ gas Emission reduction goals together with other activities of the AP . The first Annual Report is expected to be published by the end of December 2022 subject to the availability of funding.

3. ESTIMATION, REPORTING AND VERIFICATION OF CO₂ EMISSIONS

3.1 Introduction

The object of the Sierra Leone Civil Aviation Authority is to promote safety, security efficiency of civil aviation in Sierra Leone by licensing and regulating civil aviation in accordance with the obligations of Sierra Leone under the Chicago Convention and other applicable international agreements in order to:

- (a) Meet international and domestic demands for air transportation and cargo services in Sierra Leone
- (b) Provide oversight in the operation and maintenance of aerodromes and related facilities for aviation
- (c) Advise Government on the efficient development of the aviation industry

In fulfilment of the above objective, SLCAA performs the following key functions among many others equally important Aviation related functions:

- (1) Promotion and development of safety and security in aviation, including oversight in aircraft operation, airport operation, air navigation facilities and services, air traffic control, meteorological services and facilities to combat hazards to air navigation;
- (2) Ensure due compliance with the conventions, annexes, protocols, standards and recommended practices of the International Civil Aviation Organisation;
- (3) Develop guidelines and guidance for the implementation of a safety management system that requires operators and stakeholders in the aviation sector to incorporate safety management systems in their operational activities.

This Action Plan is in conformity of the role of SLCAA in ensuring Sierra Leone's compliance with ICAO Resolutions A37-19, A38-18, A39-2 and A40-18

The Sierra Leone Aviation activity is small but notwithstanding, there have been a steady growth especially in 2013-2018 where some four regular scheduled flights were added to those already operating in the country. This trend was expected to continue if not for the global COVID-19. However the current stride by the Sierra Leone Government in improving the Freetown International Airport Facilities as well as the proposed bridge that will link Lungi and Freetown is expected to attract the necessary transits hub that the country is strategically located for in comparison with its sub regional neighbours

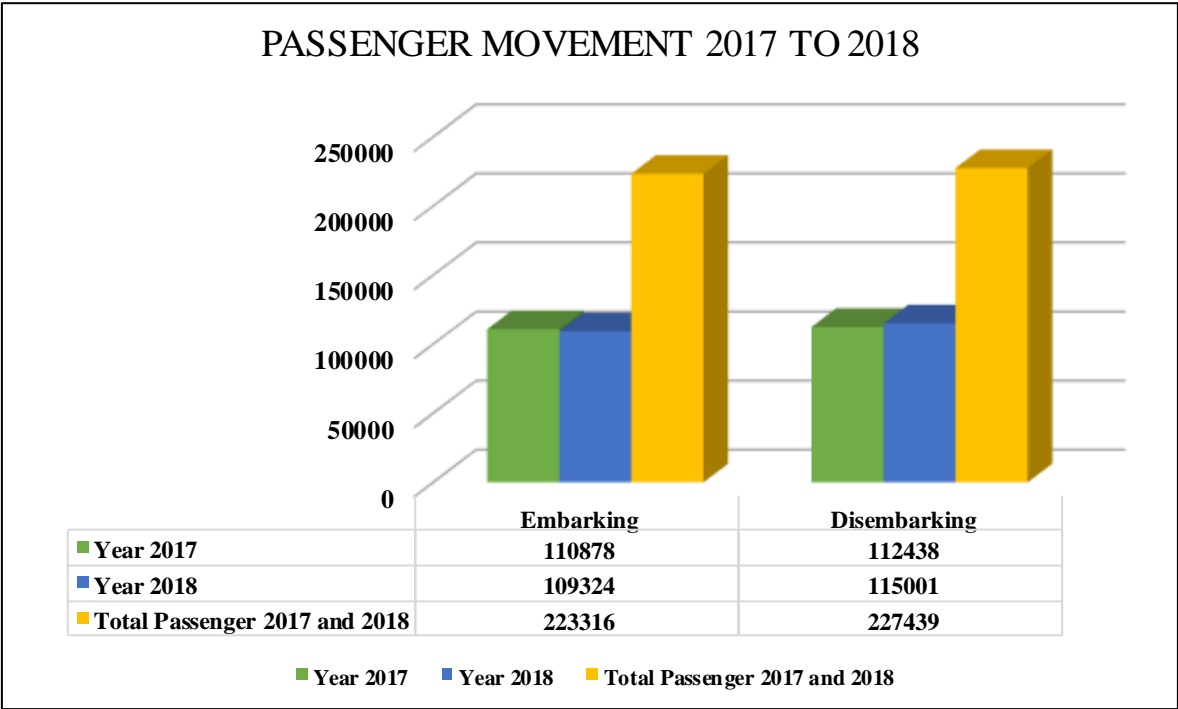
3.2 Background

3.2.1 Domestic and International Emissions

Carbon Dioxide (CO₂) Emission from domestic flights cannot be referenced as local or internal air transportation had long been in comatose.

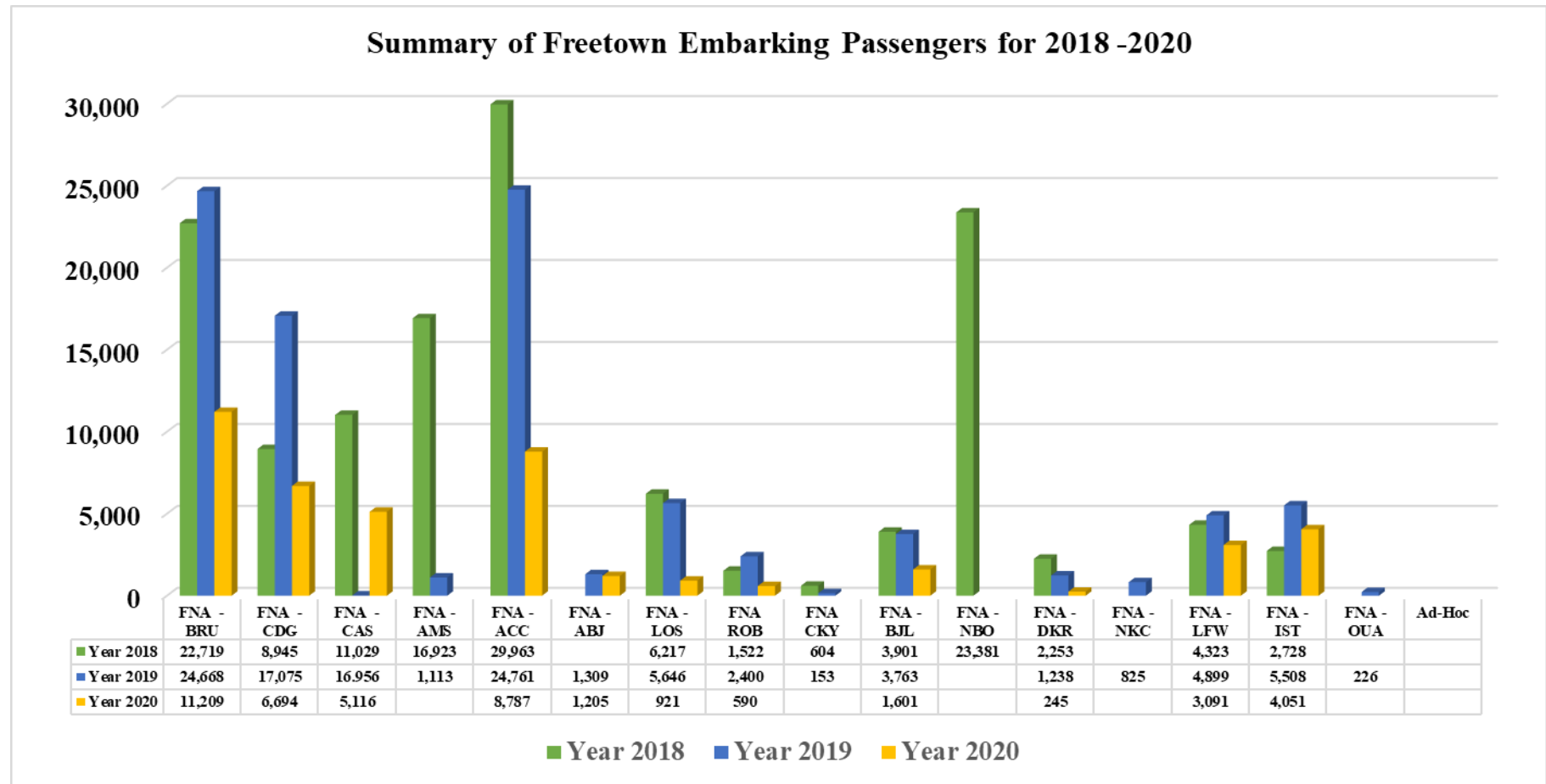
Emissions for international flights can be traced to airlines operating into the country. The table below shows information on Airlines type of Aircraft with fuel consumption that are operated into Sierra Leone.

Figure 3.1 International Traffic Movement by Passenger to and from Freetown International Airport for 2017 and 2018



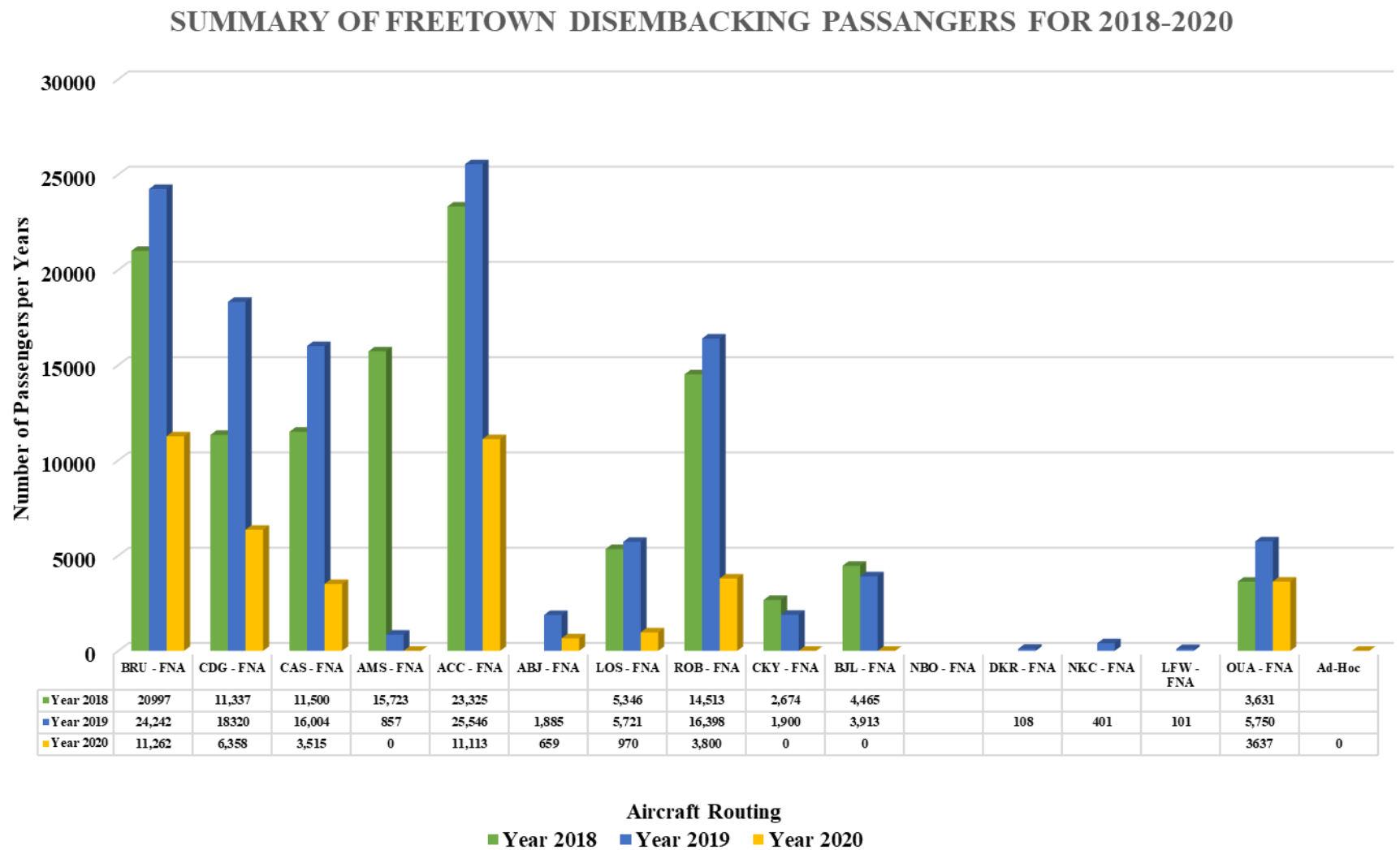
The following charts in figure 3.2 and 3.3 shows records of the International passenger movement for 2018 to 2020 without disaggregating.

Figure 3.2 Summary of Freetown Embarking passengers for 2018-2020



With the accompanying summary of airline-route disembarking passenger statistics as follows:

Figure 3.3 Summary of Freetown Disembacking passengers for 2018-2020



Legend:

BRU – Brussels

CDG - France

CAS - Casablanca

AMS- Amsterdam

ACC - Accra

ABJ - Abidjan

LOS - Lagos

ROB - Roberts

CKY - Conakry

BJL - Banjul

NBO - Nairobi

DKR - Dakar

NKC - Nouakchott

LFW - Lomé

OUA – Ouagadougou

IST - Istanbul

Ad-Hoc

3.2.2 Estimation of Emissions and methodological issues

Over the years, one of the major challenges facing the aviation industry has been reaching and maintaining the necessary balance between its growth and environmental protection. Series of initiatives and models have been developed by various interest groups, however international air travel has increased since it makes travel faster and safer in comparison to other means of transportation.

One of the problems encountered in accounting for aviation Emission has been the burning issue of ascribing the Emission to flights traversing beyond national borders, which has been elaborated upon in successive ICAO resolutions/sessions.

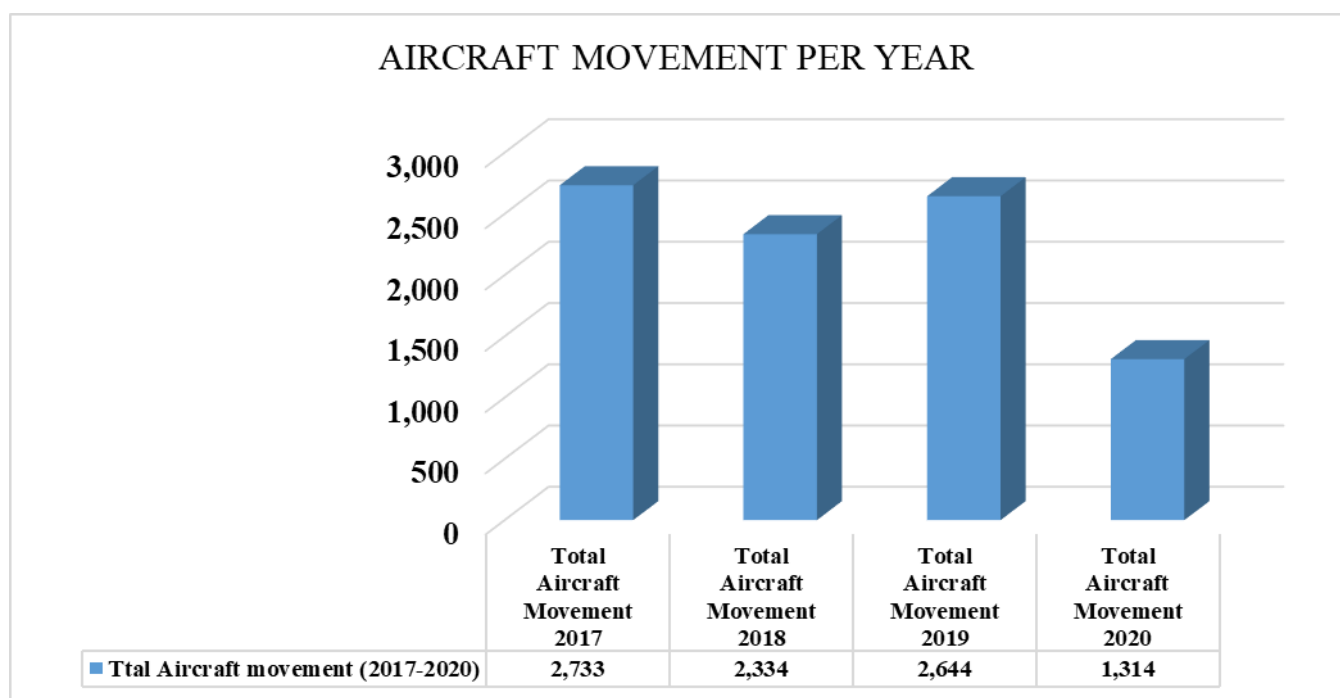
During the 37th Assembly Session, ICAO adopted a “global aspirational goals of 2 per cent annual fuel efficiency improvement” for the medium-term and general stabilization of CO₂ Emissions.

The adopted Resolution contains guiding principles for the design and implementation of market based measures for reduction of Emissions in International Aviation.

ICAO has also concluded agreement on a global framework for the development and deployment of sustainable alternative fuels for aviation. As already stated, fuel efficiency requires a coordinated effort between multiple players within the aviation industry. Therefore series of chances exist for fuel savings and the consequent CO₂ Emissions reduction from the start of the flight planning process through the execution of the flight plan.

To get the CO₂ Emission for a particular place, there is a correlation between the total number and frequency of flights to the distance and time covered. Figure 3.4 gives the Total Aircraft movement for 2018-2020 for the routing that were quoted in figures 3.2 and 3.3 above.

Figure 3.4: Total Aircraft Movement for 2018-2020 at the Freetown Int. Airport



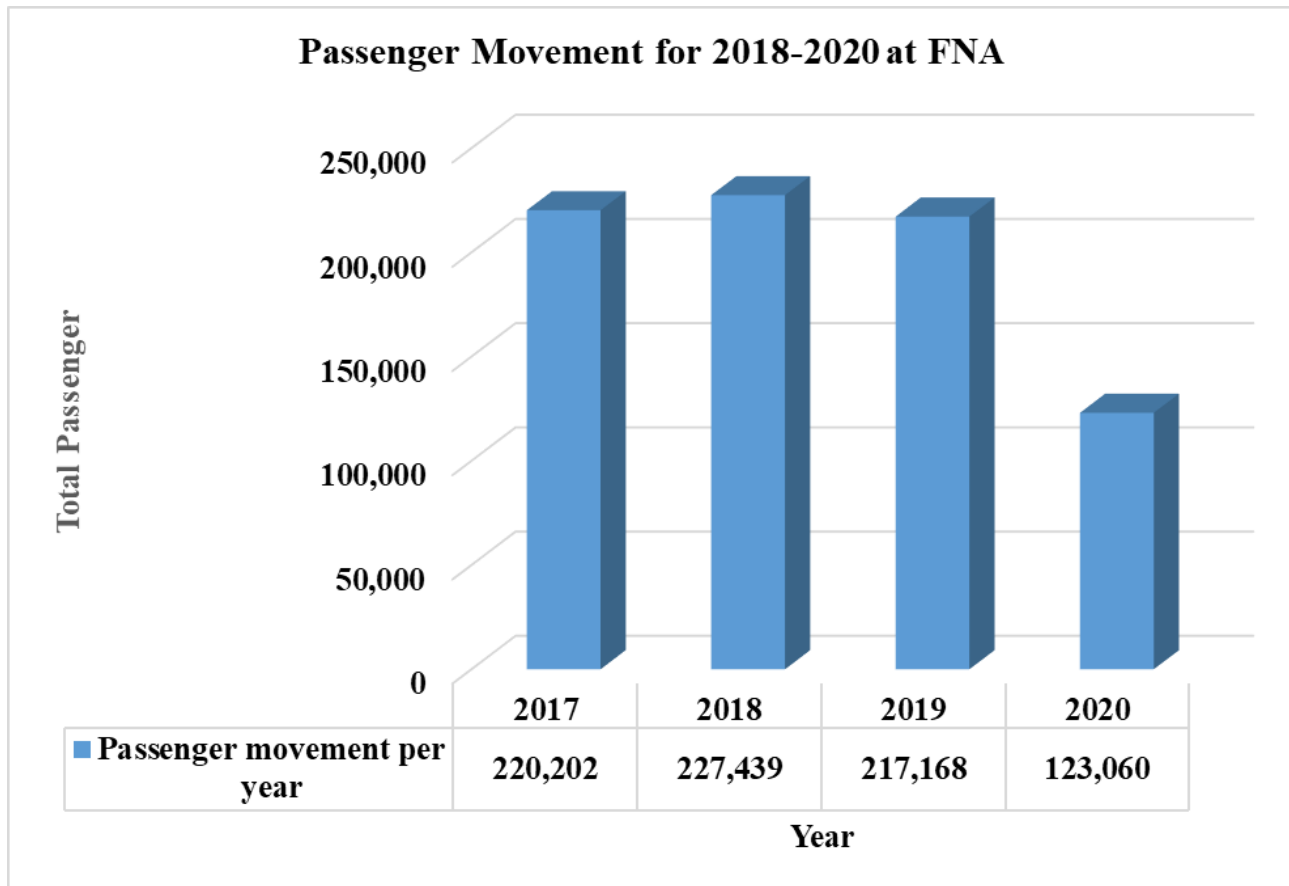
3.2.3 Use of Climate Models for Emission projection

Various fuel efficiency models for Aircraft and fuel additives have been developed since engine life is crucial to *aircraft*. It has been established that there is a correlation between the aircraft age and efficiency. The Drift Down Analysis (DDA) model is widely used and is easily available, it plots the aircraft trajectory by the optimal route calculations provided by flight planning organizations and the fuel consumed is calculated for approximate aircraft weight loss across the flight path. The analysis can be calculated with either actual or forecasted atmospheric conditions of temperature, pressure, or obstacle height. Such and other models shall be parts of the training component for the implementation of this Action Plan. In this regard, the ICAO recommendation requires strong commitment from all stakeholders to work together through the four pillars of the aviation industry strategy;

- (a) Improving technology, including the deployment of sustainable low-Carbon fuels.
- (b) Airlines operators using more efficient aircraft operational methods.
- (c) Infrastructure improvements, including modernized air traffic management systems.
- (d) A single global market-based measure, to fill the remaining Emissions gap.

Under Cluster 7 of the “Sierra Leone Midterm Development plan 2018-2023”, SLCAA is required to work with stakeholders to provide the relevant capacity building of required personnel for meeting the above targets

Figure 3.5: Total Passenger movement for 2018-2020 at the Freetown Int. Airport



3.2.4 Verification of Emissions estimates

The estimation of CO₂ Emission from international aviation relies on multiple stakeholders ranging from the Airline operators to the fuel suppliers. SLCAA monitoring and verification is recommended to include all stakeholders and their operational record for aircraft. For CO₂ mitigation, ICAO recognizes the need to address the global challenge of climate change and adopted a set of targets Emissions reduction from air transport:

- (a) An average **improvement in fuel efficiency** of 2% per year from 2009 to 2020.
- (b) A cap on Net aviation CO₂ Emissions from 2020 (**Carbon-neutral growth**)

These shall all be action points that the verification will focus on for meeting the transparency element of the process.

3.3 Reporting additional information on Emissions estimates

Estimation of airport machines especially the ground support equipment are not included as they are accounted for in the relevant GHGs inventory under the transport sector.

At the moment, there is no domestic flight in the country. Information in this subcategory shall be provided in subsequent editions where available.

4. SELECTION OF MITIGATION MEASURES

4.1 Objective

The objective is to provide Sierra Leone with the ability to assess her contribution of CO₂ Emission reduction to the global goals and to identify whether or not the planned actions are “additional”.

4.2 Overview

The measures will include the selection of appropriate baseline and necessary scenarios for adequate forecast of future Emission with the corresponding measures of its reduction. The main source of data collection here is from the SLCAA, SLAA and the Airline Operators. The measures taken are in line with SLCAA mission of providing services that promotes International Aviation in line with Sierra Leone’s obligation to ICAO for the safe operation of aircraft.

4.3 Establishment of the baseline

In this action plan, SLCAA will follow the 2006 IPCC Guidelines for National Greenhouse Gas Inventories in its CO₂ Emission calculation.

The baseline year was selected for the period before the COVID-19 pandemic since this pandemic severely affected the country’s aviation industry just like all other states that encountered similar challenges.

During the data collection, the historical data that was used for calculations has been provided by SLCAA, SLAA and Roberts’ FIR. The structure, units of measurement and fuel consumption are in accordance with ICAO Form M (Aircraft Fuel Consumption and Traffic — Commercial Air Carriers). Data for RTKs from international flights and Total Services ranging from revenue and non-revenue for International flights were also assessed.

The aggregated data covering a 3-year period from 2018-2020 for all international flight operations during the above period was used for the baseline calculation.

4.4 Forecast of air transport activity

The forecast of growth in the air transport industry is bright despite the present pandemic of COVID-19, due to the fact that there is a coordinated international effort to bring it under control; there is expectation for the state to return to normalcy.

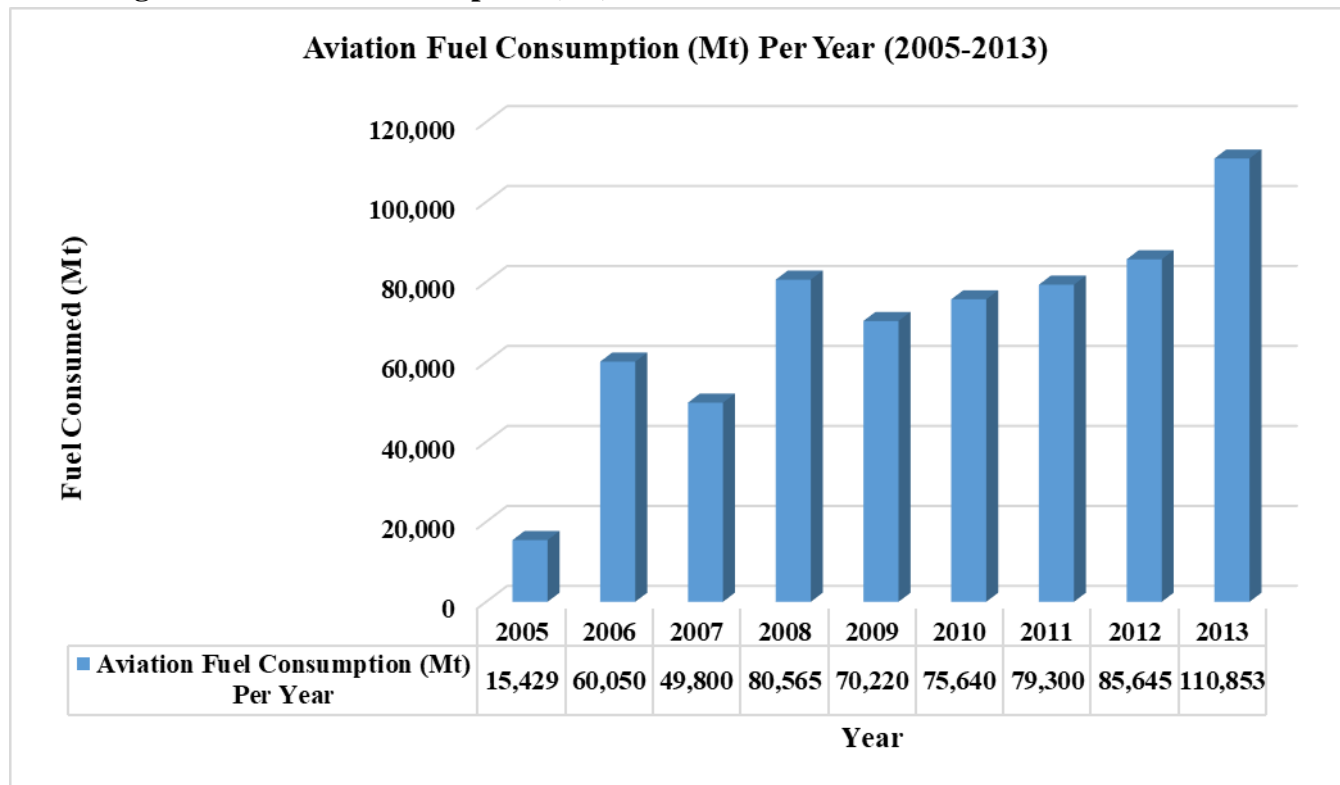
4.5 Emissions forecast

CO₂ Emission is calculated in accordance with ICAO Doc 9988, 2006 IPCC guidelines and ICAO CAEP recommendations as:

CO₂ Emission in tonnes = Fuel Consumption in tonnes x 3.157

The CO₂ Emission and fuel efficiency data for International flights for the State are given for the period 2005-2013 per aircraft for the same period mentioned in figure 4.1 as follows:
The fuel consumption (Mt) by International flight is given in figure 4.1 below for the period 2005-2013.

Figure 4.1: Fuel consumption (Mt) for 2005-2013



The fuel efficiency is correlated against the linear efficiency.

The SLCAA captured Revenue Tonne-Kilometres (RTK) values for Scheduled International flight for 2011 and 2012 as 3952060.84 and 4071281.175 respectively.

Thus one of the action points for this Action Plan is to restart the annual computation of the RTK per aircraft operating at the Freetown International Airport as was done for 2011 and 2012.

Review of the basket of measures, their feasibility and Emissions reduction potential

Sierra Leone's development direction is following a green development trajectory where issues addressing Climate Change are pivotal especially CO₂ Emissions from aviation. The creation of the new Ministry of Environment is a show of the Government's commitment. This ministry is busy working with stakeholders to follow government's Emission reduction pathways. The SLCAA is working with all aviation stakeholders in line with the government commitment.



Figure 4.2: *Efficient ground service reduce flight on ground Emission*

4.6 Prioritization and selection of mitigation measures

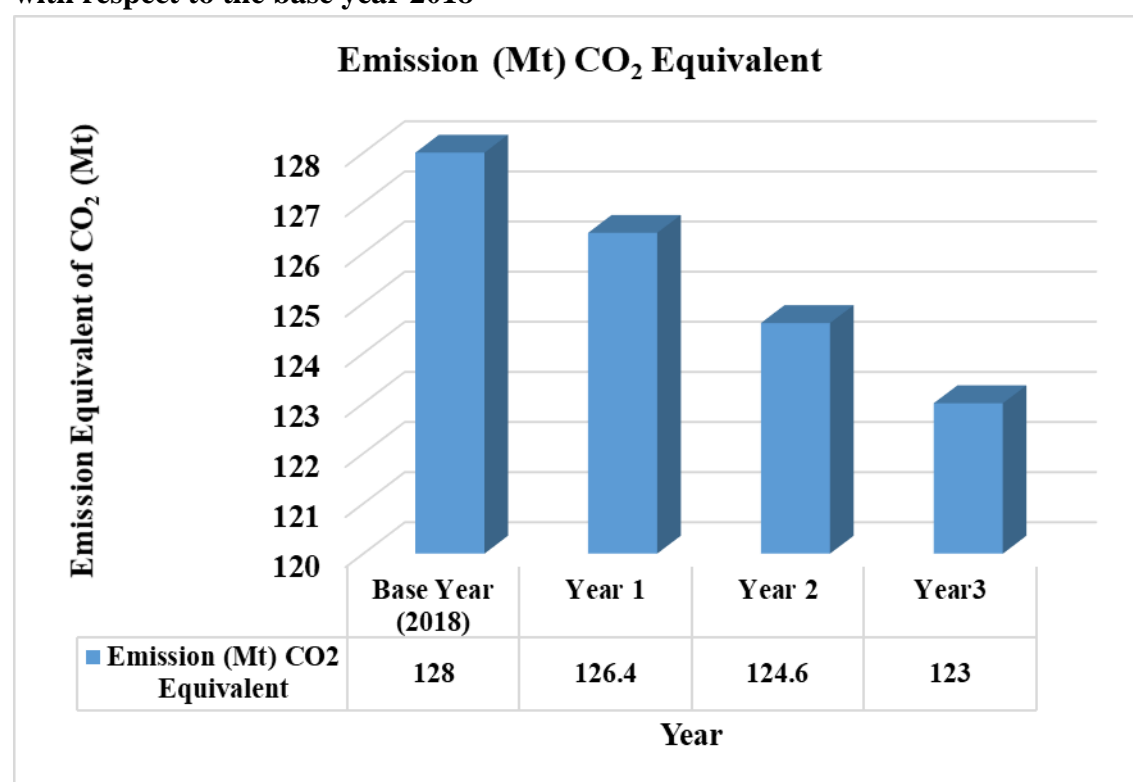
SLCAA in collaboration with relevant stakeholders and in keeping with the Government CO₂ Emission reduction achievement in all MDAs, the following table defines current measures being implemented.

Table 4.1 Aviation Emission Reduction Mitigation Measures

Emission and related issues	Measures and actions	Proposed CO ₂ Emission Reduction (kg CO ₂ Eq) per year	Remarks
Emission Reduction Category	Improvement in air traffic management (capacity building training for Air traffic management staff) and provision of relevant instruments and infrastructure.	12.5	This will reduce Aircraft flying/landing time as well as time on the ground since all international flights do not make overnight stops at the Lungi International Airport.
	SLCAA working with Roberts FIR for proper management of the State's airspace.	350.8	Especially for special/unscheduled flights and: To manage traffic allocation for different level
	Airport stakeholders collaborative decision making that will minimise fuel use	250.6	Fast and efficient ground service, cabin cleaning and quick passenger embarkation/disembarkation

	Improvement in the Performance Based Navigation (PBN). Continuous decent operations and Continuous climb operations.	180.5	To reduce fuel usage with Effective implementation of Performance Based Navigation
	Provision of accurate meteorological information/forecast to avoid unnecessary flight diversion or hold.	125.0	As a tropical country with frequent thunderstorm the proper forecasting of these events reduces unnecessary flight diversion or hold
	Fly the most fuel efficient aircraft type for the sector	250.0	To cut down on fuel wastage
	Fly the most fuel efficient direct route and Fly at the most fuel-efficient speed	111.5	Experience and well trained pilots to be employed
	Maximize the aircraft's load factor	80.0	To reduce fuel usage
	Maintain a clean and efficient airframe and engines.	240.0	For unnecessary fuel wastage
	Load the minimum fuel to safely complete the flight	54.0	The lighter the aircraft the less fuel it will use over a specific distance
Operational controls	More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities	Not Evaluated	To optimize use of runway and departure process from push back to take off and to optimize arrival process from touchdown to chocks on.

Figure 4.3 Projection of Progressive Emission Reduction of the AP implementation with respect to the base year 2018



Over the years the Sierra Leone Government undertook series of measures to improve the SLCAA and relative services ranging from ICAO Compliance in the Security Sector and improvement in ground handling management to the necessary infrastructure and human development.

Below is a list of projects implemented and in progress in order to improve service delivery for economic return including fuel reduction.

Table 4.2 Sierra Leone Government's improvement to facilitate enhanced International Aviation service delivery

No	Project	Phase / Period	Components	Progress/Results
1	Freetown International Airport security audit	2012 2019	ICAO Compliance	The state demonstrated 72% Effective implementation of ICAO standards and recommended practices.
2	Climate Information and Early Warning Service	2014/17	Transformation of the SLMD to an agency (SLMet)	Capacitated the Sierra Leone Meteorological Agency to enhance service delivery for air navigation services.
3	Installation of	2018/2020	To save on reduce CO ₂	On-going by replacing

	Solar powered street and airport area lights		Emission from the Airport power generation	some with new and more efficient ones
4	The New Terminal Building and terminal expansion at Lungi Airport	2020/2022	To match with the increasing passenger and aircraft traffic.	In progress

Special flights/unscheduled flights are all on average captured in the action plan. The base line Emission as given above can be represented as follow:

Figure 4.4 CO₂ emissions for 2005-2013 (Base line emission)

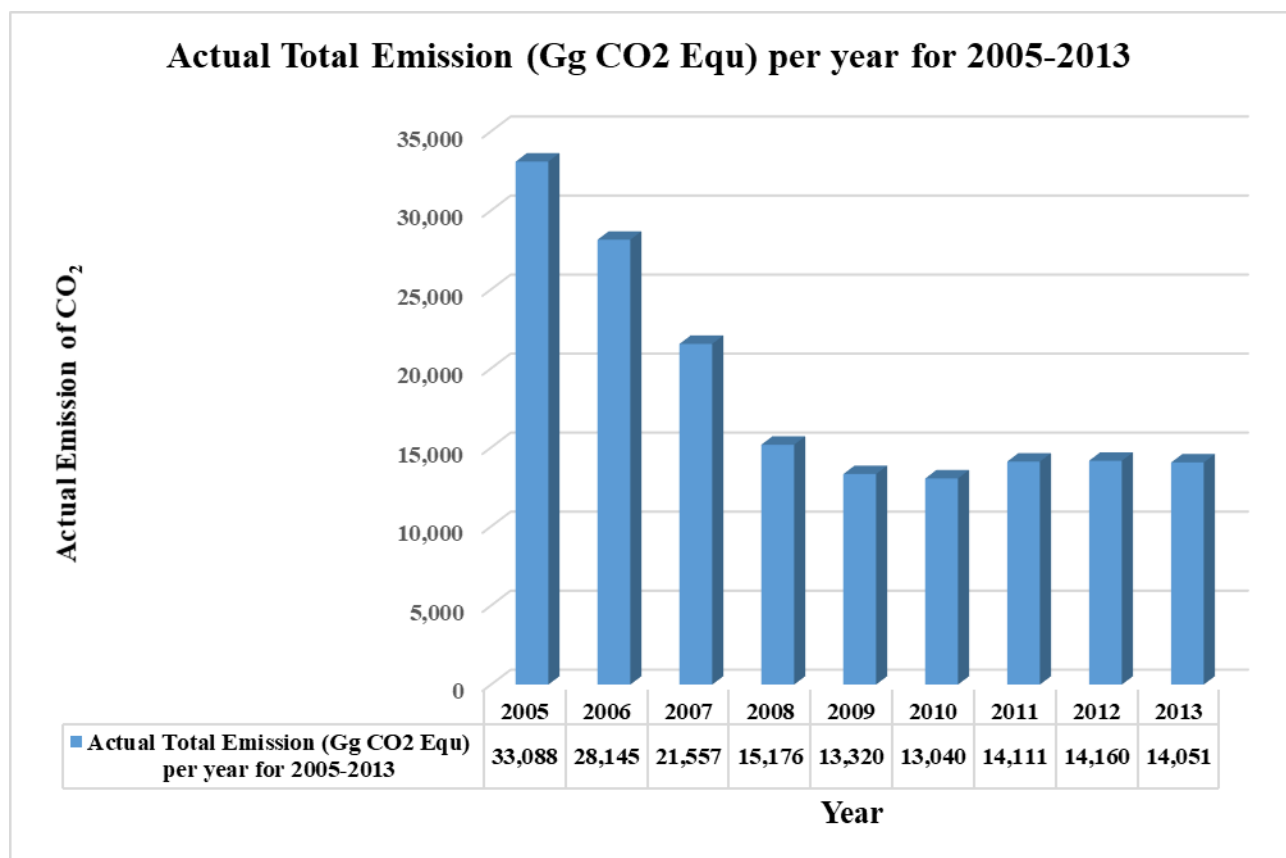
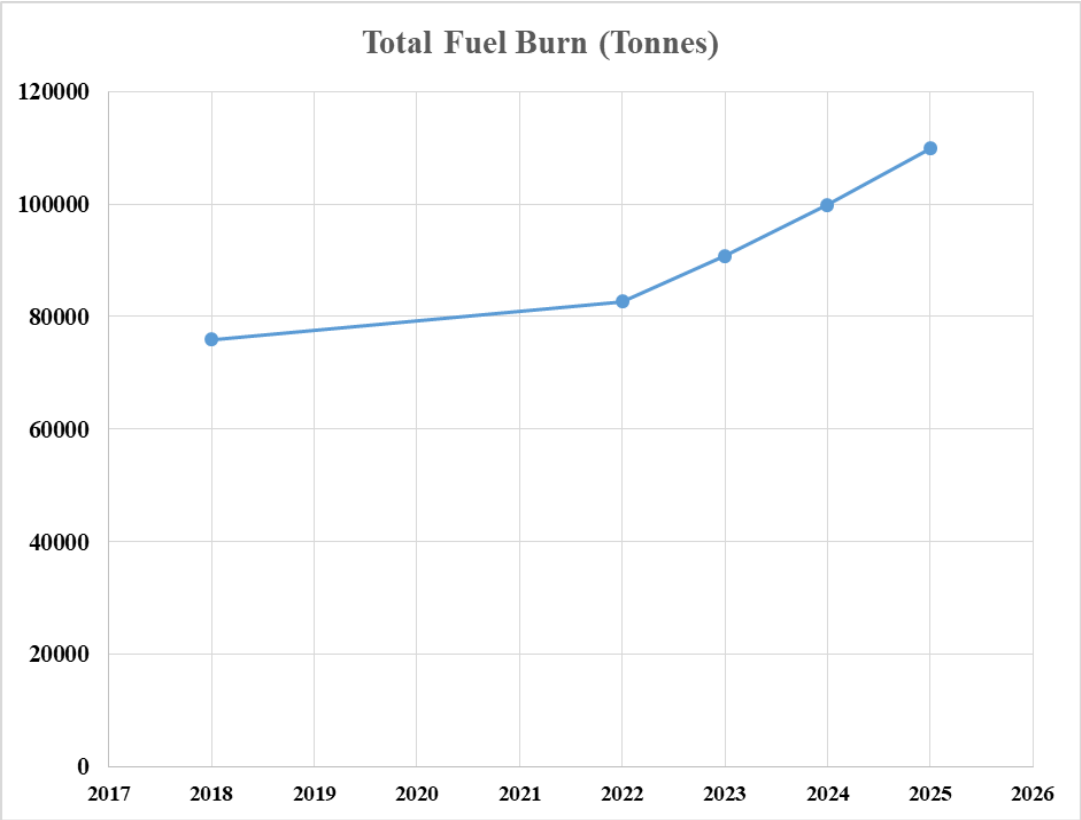
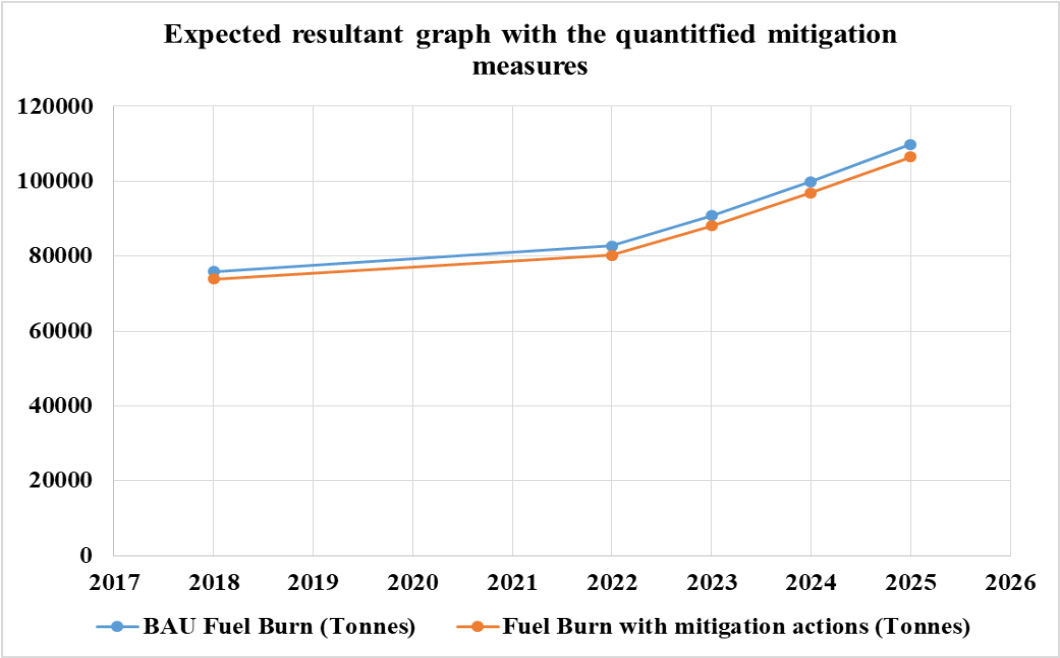


Figure 4.5: Total fuel Burn (Tonnes) taking the Base Year is 2018



Note that 1 Tonne Fuel= 1250 Litres

Figure 4.6: Expected resultant graph with the quantified mitigation measures



4.8 Implementation

Refer to the measures above in table 4.1.

For the implementation of this action plan the following governance structure shall be established:

The Steering Committee of the action Plan to be established at the SLCAA with other main members from the Airline Operators, SLAA, SLMet, the Ministry of Environment, ground handling service provider and other stakeholders

Table 4.3 Base Year 2018 Calculation of Fuel Consumption by Aircraft per Route for 2018

Flight FREETOWN TO:	Distance (KM)	Flight Duration	Flight Duration in Min	Fuel Consumption per min (Litres)	Total fuel per leg (Litres)	Total Fuel per week (Litres)	2018 Total Fuel per year (Litres)	2019 Total Fuel per year (Litres)	2020 Total Fuel per year (Litres)	Total Distance Travelled (Km) 2018	Total Distance Travelled (KM) 2019	Total Travelled (KM) 2020
BRUSSELS	4985	6hr 40 min	400	240	96000	288000	15264000	12720000	3816000	777660	777660	398800
PARIS	4724	6hr 22min	382	240	91680	275040	14577120	12147600	3644280	736944	736944	377920
CASSABLANCA	2814	3hr 50min	230	50	11500	34500	1828500	1523750	457125	438984	438984	225120
ACCRA	1477	2hr 39min	159	240	38160	114480	6067440	5056200	1516860	230412	230412	118160
LAGOS	1847	2hr 45min	165	240	39600	118800	6296400	5247000	1574100	288132	288132	147760
MONROVIA	409	1hr	60	50	3000	9000	477000	397500	119250	63804	63804	32720
CONAKRY	116	35min	35	50	1750	5250	278250	231875	69562.5	18096	18096	9280
BANJUL	647	1hr 15min	75	50	3750	11250	596250	496875	149062.5	100932	100932	51760
DAKAR	823	2hr 5min	125	50	6250	18750	993750	828125	248437.5	128388	128388	65840
NOUAKCHOT	1109	1hr 53min	113	240	27120	81360	4312080	3593400	1078020	0	110900	88720
LOME	1618	2hr 30min	150	50	7500	22500	1192500	993750	298125	252408	252408	129440
OUAGADOUGOU	1351	2hr 5min	125	240	30000	90000	4770000	3975000	1192500	210756	210756	108080
NAIROBI	5656	7hr 32min	452	240	108480	325440	17248320	14373600	4312080	882336	882336	452480
ISTAMBUL	5482	7hr 20min	440	240	105600	316800	16790400	13992000	4197600	855192	855192	438560
ABIDJAN	1088	1hr 50min	110	240	26400	79200	4197600	3498000	1049400	169728	169728	87040
Total	34146	50hr 35 min	3021	2460	596790	1790370	94889610	79074675	23722403	5153772	5264672	2731680

The Fuel Consumption for 2018 is used to calculate the corresponding CO₂ Emission for International Aviation in Metric Tonnes as follows:

Table 4.4: Table showing expected result when Mitigation measures are taken

Year	Fuel Used (Litres)	Year	Fuel (Tonnes)	Emission (Metric Tonnes)	Expected Result After Measures (Metric Tonnes)
2015	7,947,676	2015	6358.41	2013.9819	2013.9819
2016	4850378	2016	3880.30	12250.1147	12250.1147
2017	5335121	2017	4265.70	13466.8048	13466.8048
2018	6295150	2018	5036.13	15899.0536	15422.08
2019	4814950	2019	3851.96	12160.6377	11431.00
2020	2,174,659	2020	1739.73	5492.3276	273.11
2022	7058713	2022	5646.97	20668.7696	19015.27
2023	1188883	2023	9511.06	26869.4005	24182.46
2024	13839463	2024	11064.37	34930.2207	30389.29
2025	17979600	2025	14383.68	45409.2869	38143.80

Figure 4.7: Expected result when mitigation measures are taken

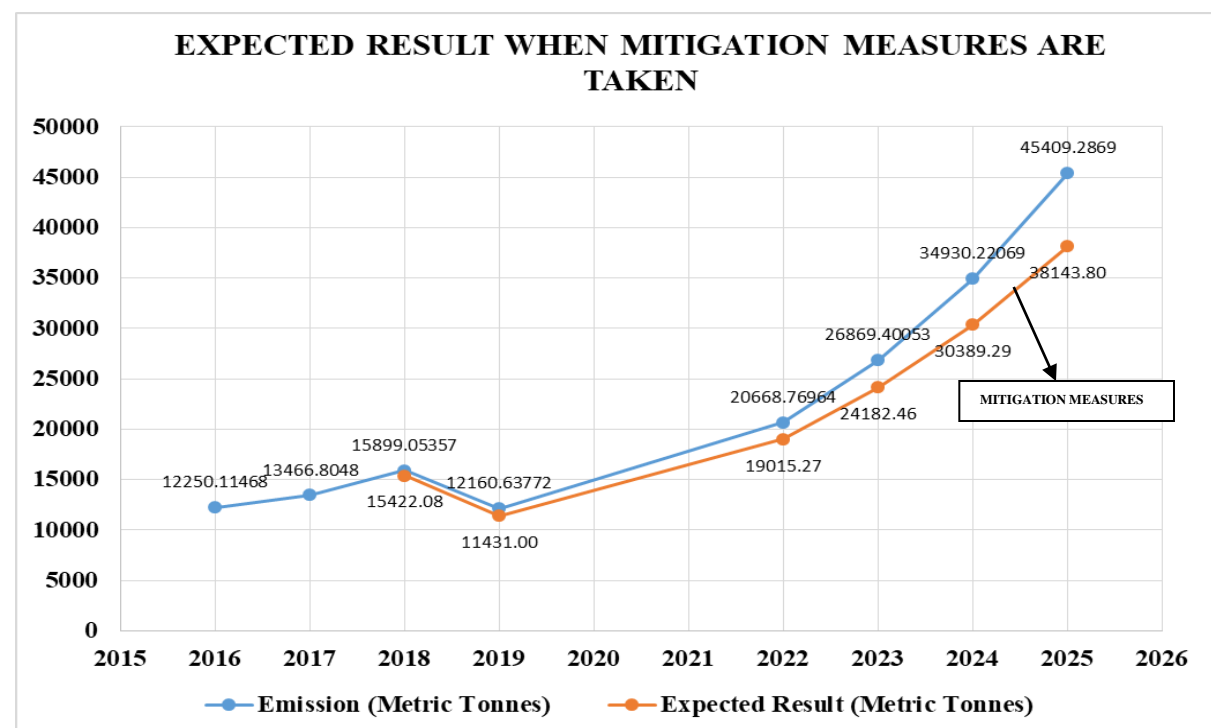


Table 4.5: Support needed and funding gaps

No	Support Needed	Identified Funders	% of funding gap
1	Technical Capacity Building needs for all stakeholders	GoSL and Airline Operators	70
2	The development / update of the baseline	GoSL	10
3	Purchase and installation of CO ₂ gas monitoring system	GoSL	90
4	Financial capacity in the implementation of mitigation measures	GoSL, SLAA and Airline Operators	70
5	Provision of state of the arts aviation weather observation equipment and operational logistics for the Aviation wing of SLMet	GoSL and SLMet	60
6	Research activities to enhance the action plan	Universities within and outside Sierra Leone	90
7	Purchase and installation of fuel management system for airlines	The Airline operators and Manufacturers	20
8	Regular update of the action plan	GoSL	0

To achieve the above target for the proposed CO₂ Emission reduction the following projects are expected to be implemented. Some activities within some of these projects are already in progress.

Project 1: Installation of Solar Panel to provide lighting facilities at various places of the airport to support International Aviation.

In this project some solar panel lighting facilities will be provided for the comfort of incoming passengers away from the terminal building such as the parking spaces and the baggage and passenger route on the tarmac from the terminal building to the aircraft. It must be noted that there are at the moment no Aviobridge entrance from the terminal building to the aircraft for the passengers. They either walk from the terminal building or go by bus to the parking aircraft. These solar lighting facilities that are independent of the general grid are very useful for night flights.

In the present Action Plan, it is expected to have a special Solar Power off grid facility to power the runway lights in order to reduce the CO₂ Emission.

Project 2: Performance Based Navigation (PBN) Training for staff of SLCAA, SLAA and other stakeholders to enhance their service delivery for CO₂ Emission reduction from international aviation.

“The continuing growth in aviation increases demands on airspace capacity therefore emphasizing the need for optimum utilization of available airspace. Improved operational efficiency derived from the application of area navigation (RNAV) techniques has resulted in the development of navigation applications in various regions worldwide and for all phases of flight. These applications could potentially be expanded to provide guidance for ground movement operations. Requirements for navigation applications on specific routes or within a specific airspace must be defined in a clear and concise manner. This is to ensure that the flight crew and the air traffic controllers (ATCs) are aware of the on-board RNAV system capabilities in order to determine if the performance of the RNAV system is appropriate for the specific airspace requirements.”

To achieve this, PBN training is therefore necessary for the relevant operators in this sector. The training will help build the capacity of personnel to effectively manage the Air Navigation for Aircraft.

In its bid to enhance service delivery, the SLCAA has started training its personnel on PBN Procedures and is instrumental in assisting the SLAA and Roberts FIR in training their own staff.

Project 3: Tree Planting by Airline Operators to Carbon-trade Aviation CO₂ Emission

One way to mitigate CO₂ Emission is by planting trees to absorb the emitted CO₂. Some Airlines especially the European Airlines have introduced the voluntary passenger Carbon tax. Part of this money is used to support the REDD⁺ projects of (especially the LDCs).

Global reforestation is an important environmental issue of growing concern. International programmes like the United Nations Initiative for Reducing Emissions from Deforestation and forest Degradation (UN-REDD) are key for implementing global programmes for reducing deforestation, Emissions through reforestation and afforestation projects.

Efforts to restore and establish global forest coverage have many benefits on a chemical, social and biological level. When deforestation rates decline it is often not clear whether this has happened because of government policies or it is due to economic factors.

In this project, some Airline operators will sponsor with credible CSOs to plant trees in degraded lands as a means of enhancing CO₂ removal from the atmosphere. In such a project the Airlines will state the relative target of CO₂ Emission reduction that their intervention will achieve. In this way SLCAA will use this in its subsequent Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Project 4: Training of SLCAA staff and other stakeholders in the relevant technical capacity building for enhance implementation of the action plan

Climate Change is a relatively new phenomenon in most disciplines in Least Developed Countries especially in the aviation industry where their focus is more on air travel services and its associated logistics. Thus the concept of Green House Gases especially CO₂ Emission from aircraft operation is almost abstract to most players in the industry. It is therefore necessary that key players in the aviation industry and other relevant stakeholders are made aware, sensitized

and trained on the issues of climate change and aviation CO₂ Emission contribution. They will be taught on the various ICAO Resolutions and sessions including the accompanying documents for their work in the implementation of this action plan.

The goal of this project/activity is to train Aviation and other relevant stakeholders on ICAO requirement for the reduction of CO₂ Emission.

5. ANALYSIS, METHODS AND TOOLS

5.1 Objective

The objective of analysis, methods and tools is to give a uniform and clear means of data collection, presentation, analysis and means of evaluation and verification. For the Sierra Leone Action Plan for CO₂ Emission reduction from international aviation, the relevant data collected by the SLCAA from Airline operators and other relevant stakeholders were used as previously demonstrated.

5.2 CONCLUSION

The Sierra Leone's Action Plan for CO₂ Emission Reduction from International Aviation that was validated by all stakeholders shows the importance that each of their parent organisations attached to the adverse effect of increasing accumulation of CO₂ Emissions in the atmosphere that is responsible for global warming and its end result of climate change. Sierra Leone is a victim of climate change related disasters. As such, the government is expected to give the necessary support to institutions that are tackling climate change. The implementation of this action plan will not only show the State's willingness and effort to address Aviation CO₂ Emission reduction, but would encourage environmental activists who support states that demonstrate commitment in addressing the growing GHG Emission in the aviation sector and other sectors. The AP implementation result will definitely speak for themselves in the not too distance future.

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Approved By
Moses Tiffa Baio

A handwritten signature in blue ink, appearing to read 'M Baio', enclosed within a blue oval.

Director-General, SLCAA