

AVIATION INDUCED POLLUTION

AFRICA'S CONTRIBUTION TO REDUCING EMISSIONS

Presented at

*The 8th UTIAS International Workshop on Aviation
and Climate Change*



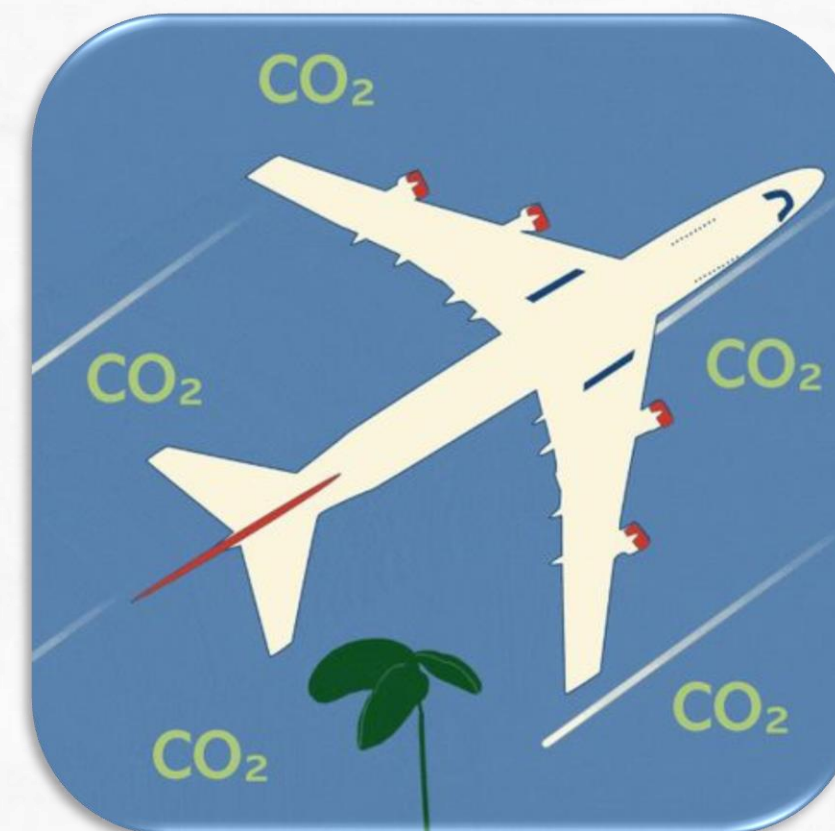
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June 2023



Presentation Outline

- **Introduction**
- **African Context** - Specific Initiatives, Contributions and limitations
- **The Way Forward**





INTRODUCTION

❖ Global aviation continue to play an important role in global economic, social interaction and development as the sector build back better.

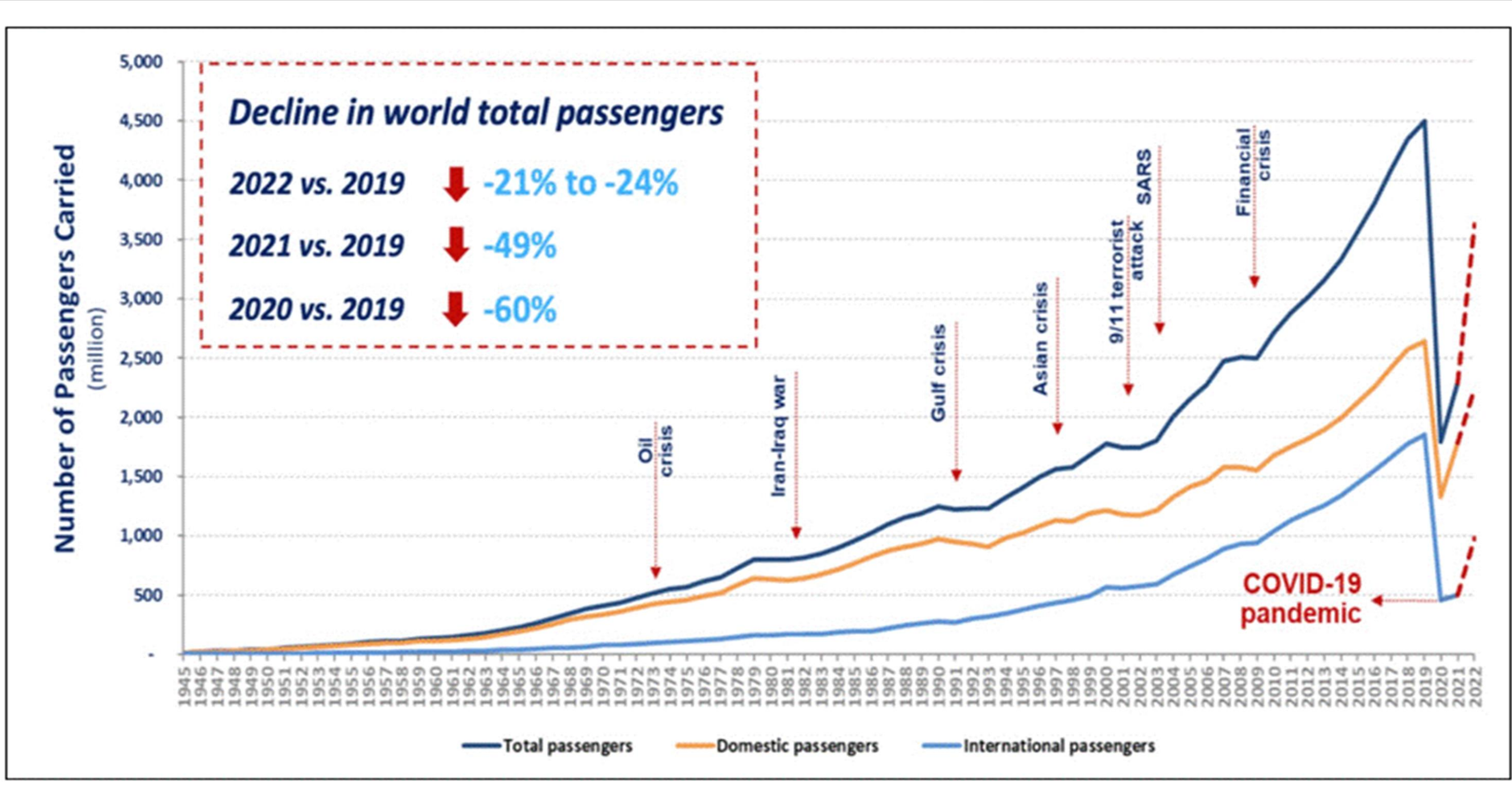
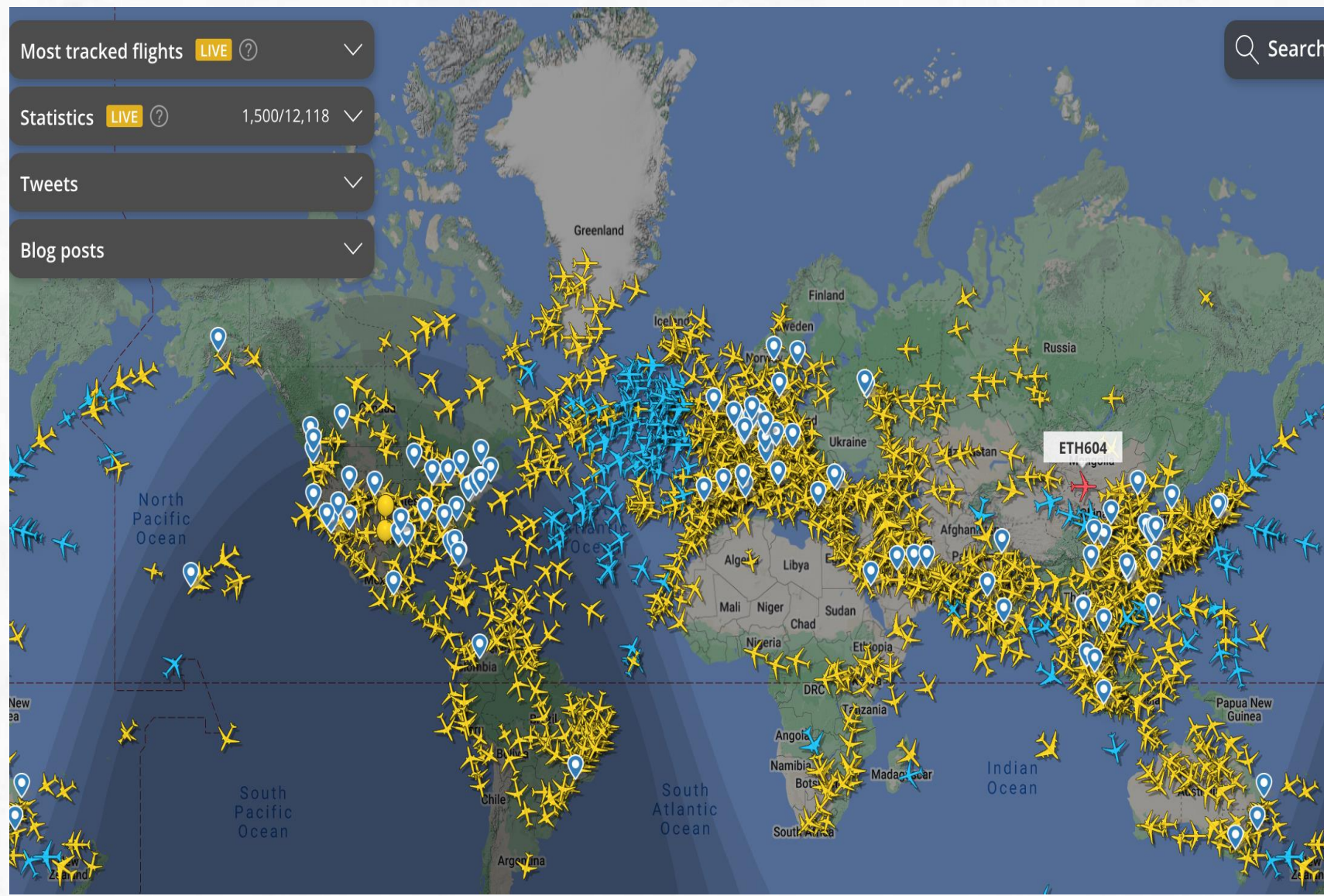


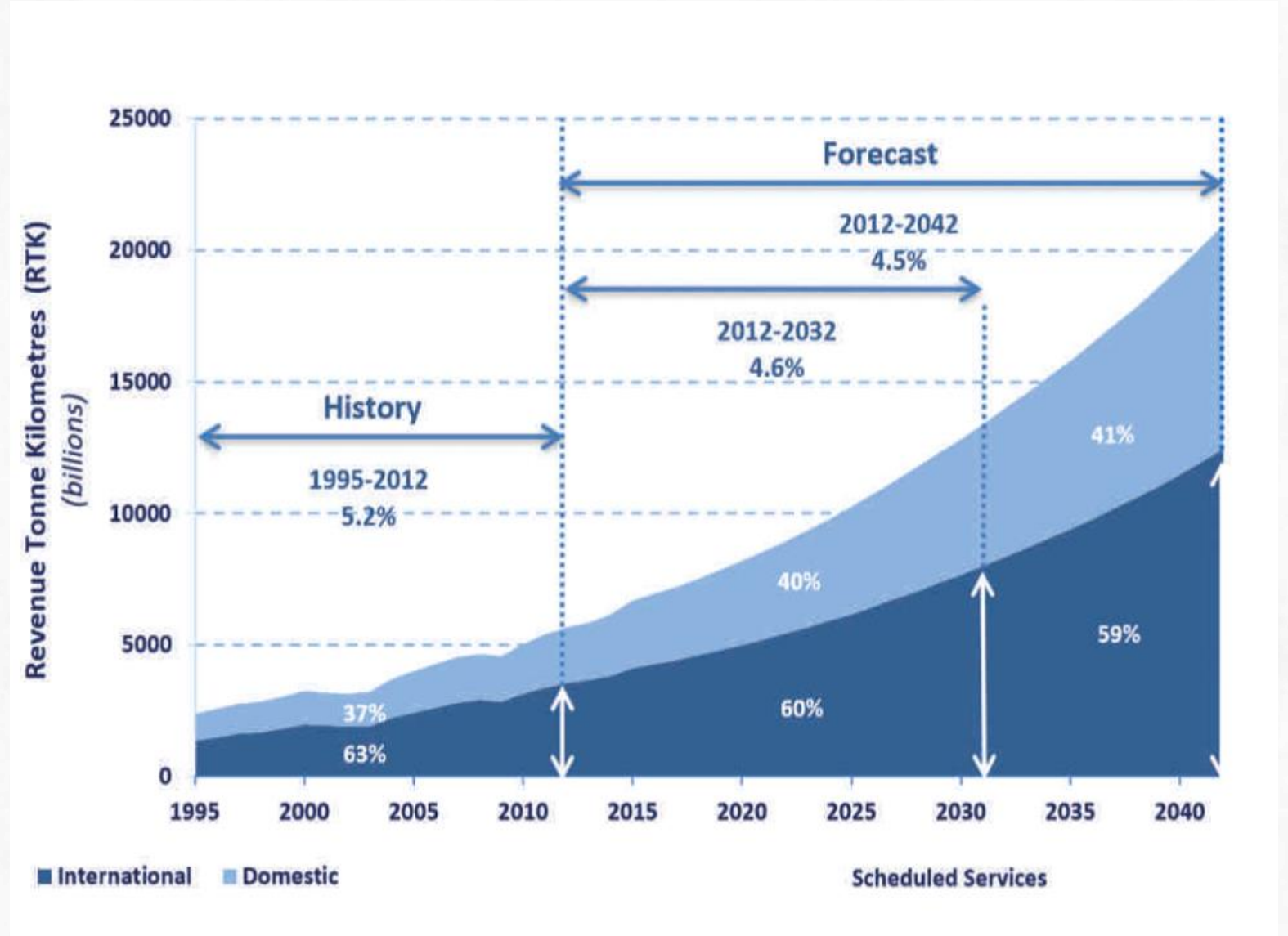
Figure 1: Air Transport, Passengers Traffic Evolution

(Source: ICAO, 2022)

- ❖ Global aviation is **building back back better** – No more travel restrictions worldwide
- ❖ The most recent estimates suggest that demand for air transport will increase by an average of 4.3% per annum over the next 20 years– (ICAO, IATA, ACI)



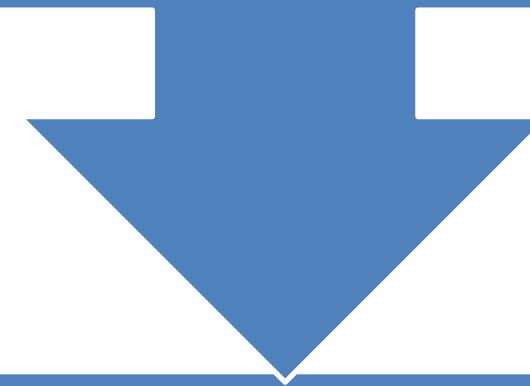
Global Air Traffic Display
Source: <https://www.flightradar24.com/-4.01,14.34/3>



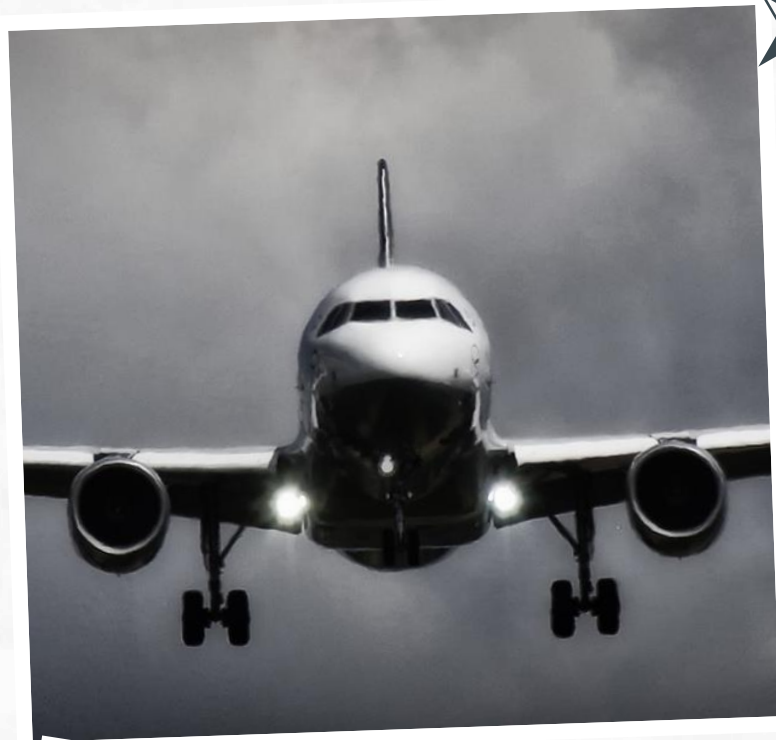
Future of Aviation – Passenger and Cargo Traffic
Source: ICAO



African aviation is growing and there is potential for continued growth.



By 2035, there are estimated to be 350 million airline passengers traveling through Africa, with demand expected to increase an average of 5.7% each year during the next 20 years (*IATA, 2017*).



➤ Global growth of air traffic comes with environmental and public health impacts and Africa is no exception.

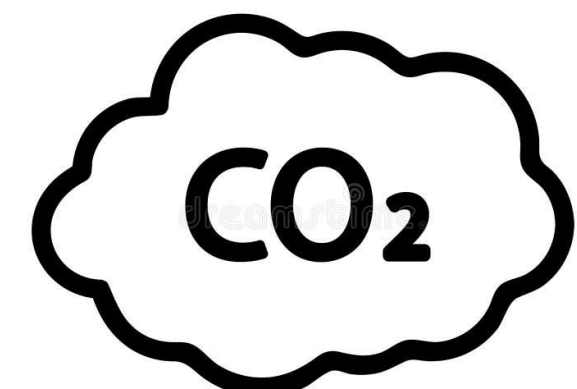
➤ Aviation pollution is the **environmental impact of various emissions and pollutants resulting from the operation of aircraft and the aviation industry as a whole.**

- ❖ *Impact of aviation noise on communities*
- ❖ *Impact of aviation emissions on local air quality*
- ❖ *Impact of greenhouse gas emissions on global climate*



❖ The major pollutants emitted by aircraft engines include:

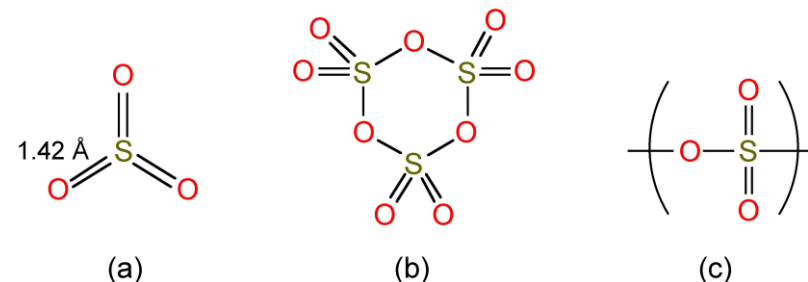
❖ *Carbon Dioxide*



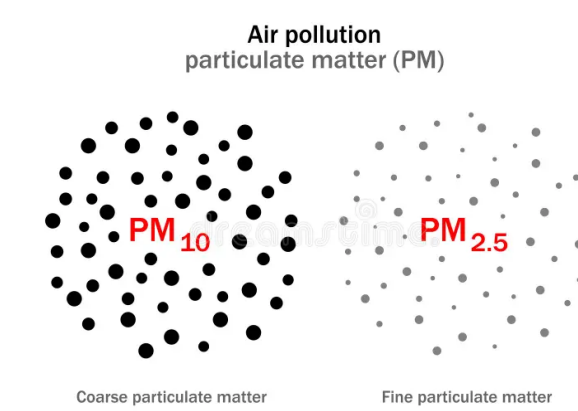
❖ *Nitrogen Oxides*



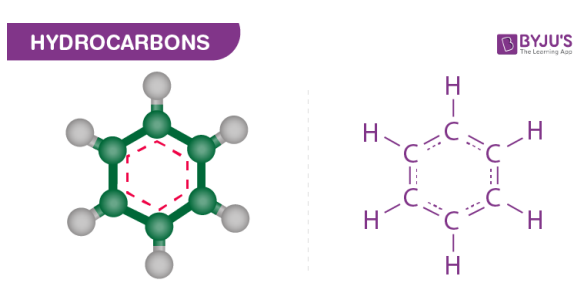
❖ *Sulfur Oxides (SOx)*



❖ *Particulate Matter (PM)*



❖ *Hydrocarbons (HCs)*



❖ Aircraft engines emit these pollutants throughout flight, affecting the atmosphere and air quality.

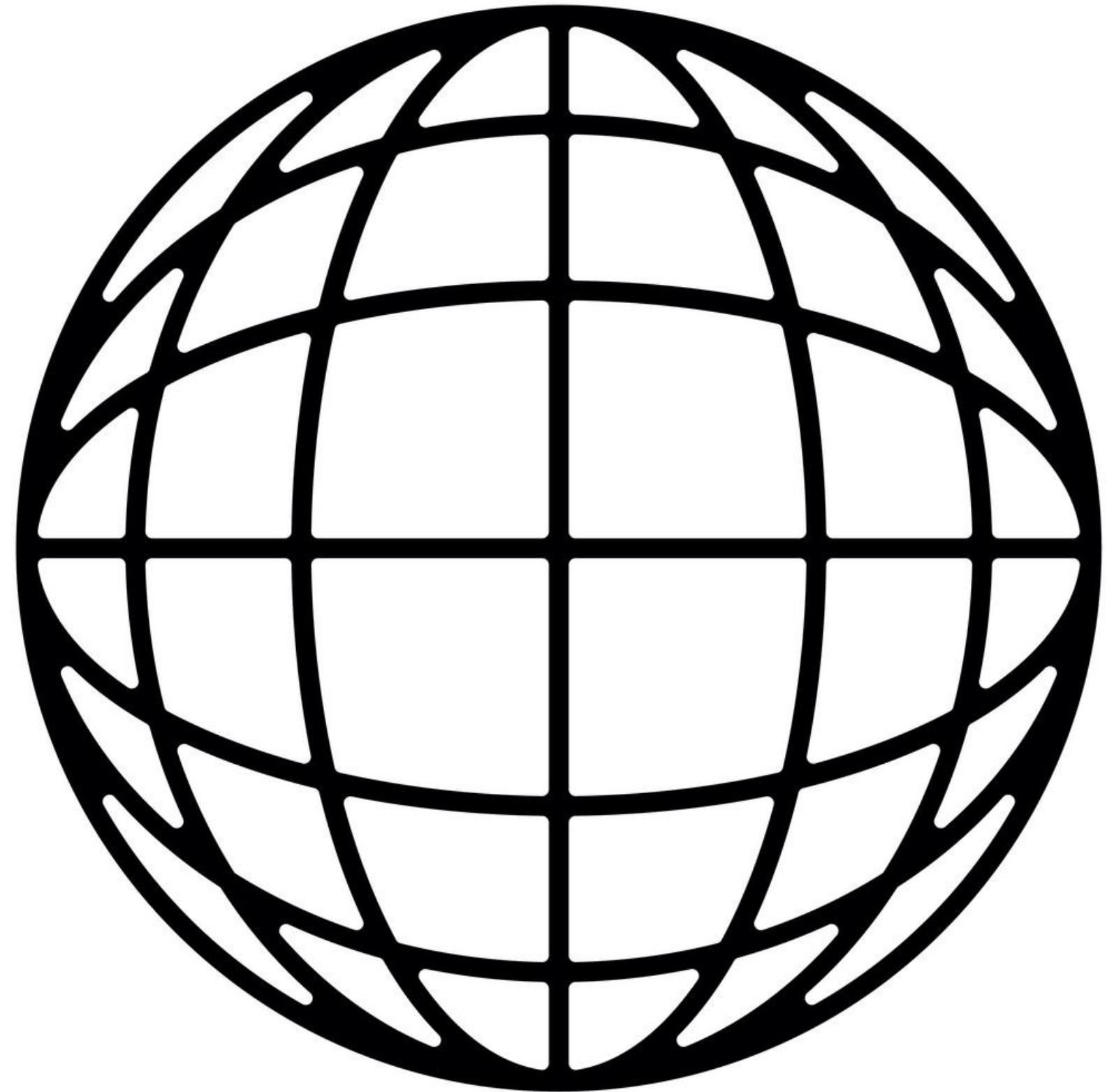
❖ Global Aviation industry is continually making efforts in addressing **aviation-induced pollution** concerns for several reasons:

- ❖ Climate Change Mitigation
- ❖ Air Quality Improvement
- ❖ Sustainable Development
- ❖ Technological Advancements
- ❖ Environmental Stewardship
- ❖ International Collaboration





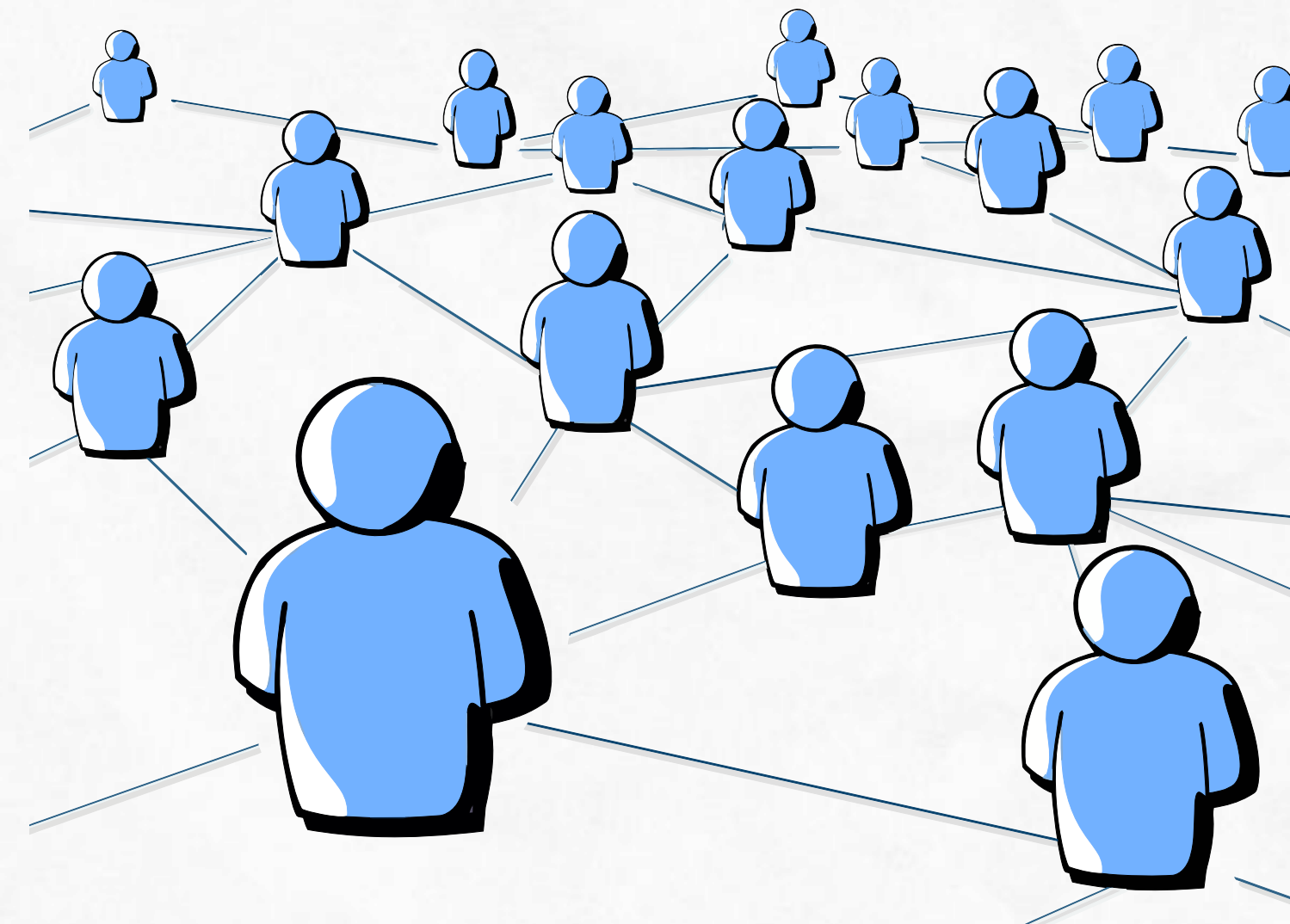
Global efforts to mitigate aviation pollution



ICAO Policies and Practices related to Environmental Protection – Annex 16 volumes and Documents

1. Carbon Offsetting and Reduction Scheme for International Aviation (CORSIIA)

- global Market-based Measure (MBM)



2. Sustainable Aviation Fuel (SAF) Initiatives

- Sustainable aviation fuels (SAF) as a means to reduce emissions.
- Sustainable Biomaterials and other certification schemes provide sustainability standards for the production of SAF, ensuring that they are produced from sustainable sources.



3. Emission Standards and Technology

- ICAO has established standards for aircraft engine emissions
- IATA has set voluntary goals for improving fuel efficiency and reducing emissions.
- ACI airport carbon accreditation – reducing carbon and increasing airport sustainability



4. National and Regional Initiatives

- Many countries have implemented their own regulations and initiatives to reduce aviation emissions with support and assistance from ICAO and Regional organizations.
 - ❖ AFCAC State's Authorities capacity building initiatives in collaboration with ICAO/ EU EASA / US FAA.



5. Research and Development

- Governments, industry stakeholders and research institutions are actively involved in research and development efforts to advance aviation technologies and explore sustainable alternatives.



African Context

Africa's role and contribution to reducing aviation emissions -

Specific Initiatives, Contributions and limitations



Overview of Institutional Landscape for Emission Reduction

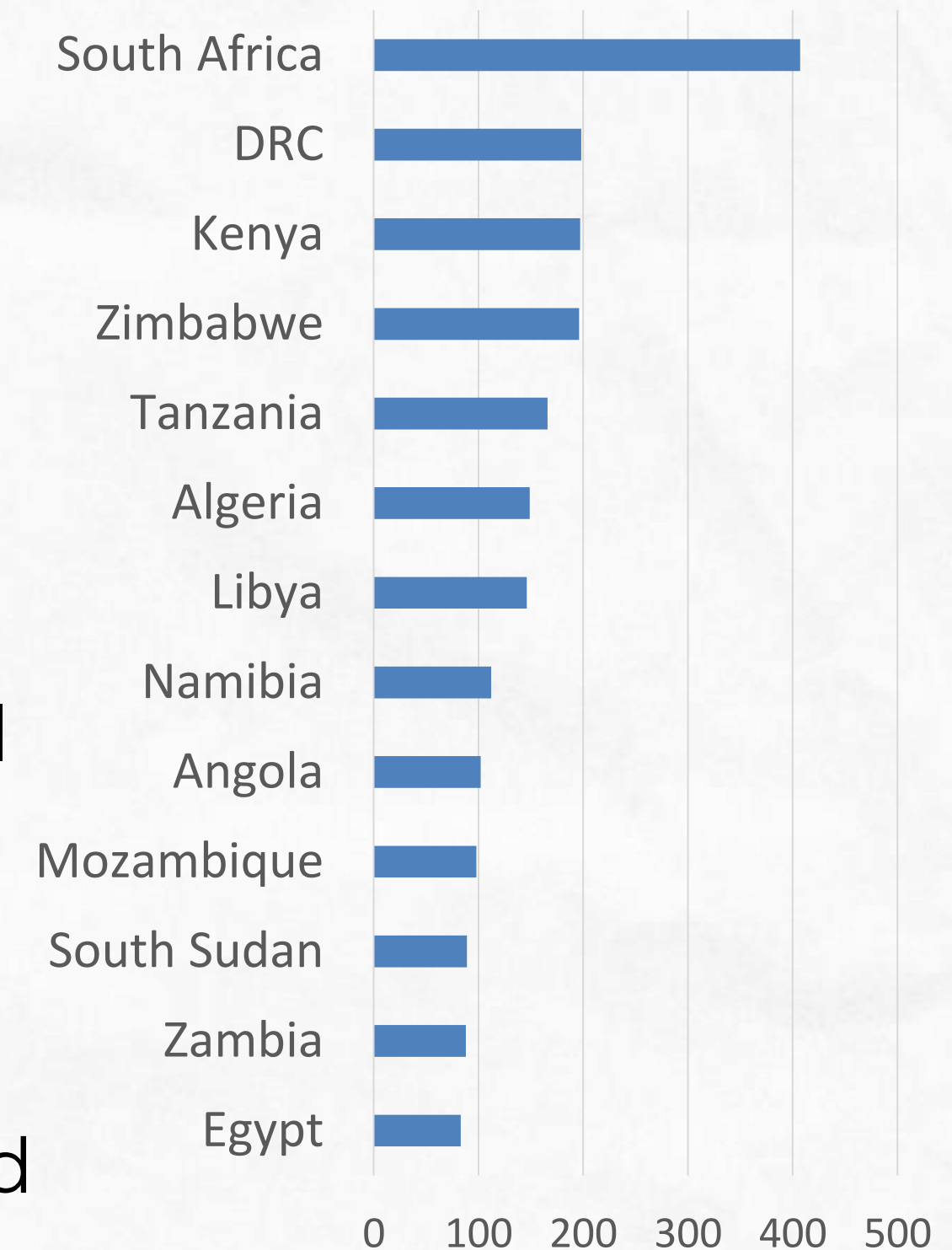
- African Union's Agenda 2063 –
 - ❖ African Civil Aviation Commission (**AFCAC**) - Specialized agency of the African Union responsible for Civil Aviation matters in Africa
 - ❖ African Regional Economic Communities
- African Airlines Association (AFRAA)
- African Carbon Market Initiative (ACMI)
- International Civil Aviation Organization (ICAO) Regional Offices
- Industry Partnerships on Sustainable Aviation Fuel (SAF) Initiatives



Overview of Africa aviation industry

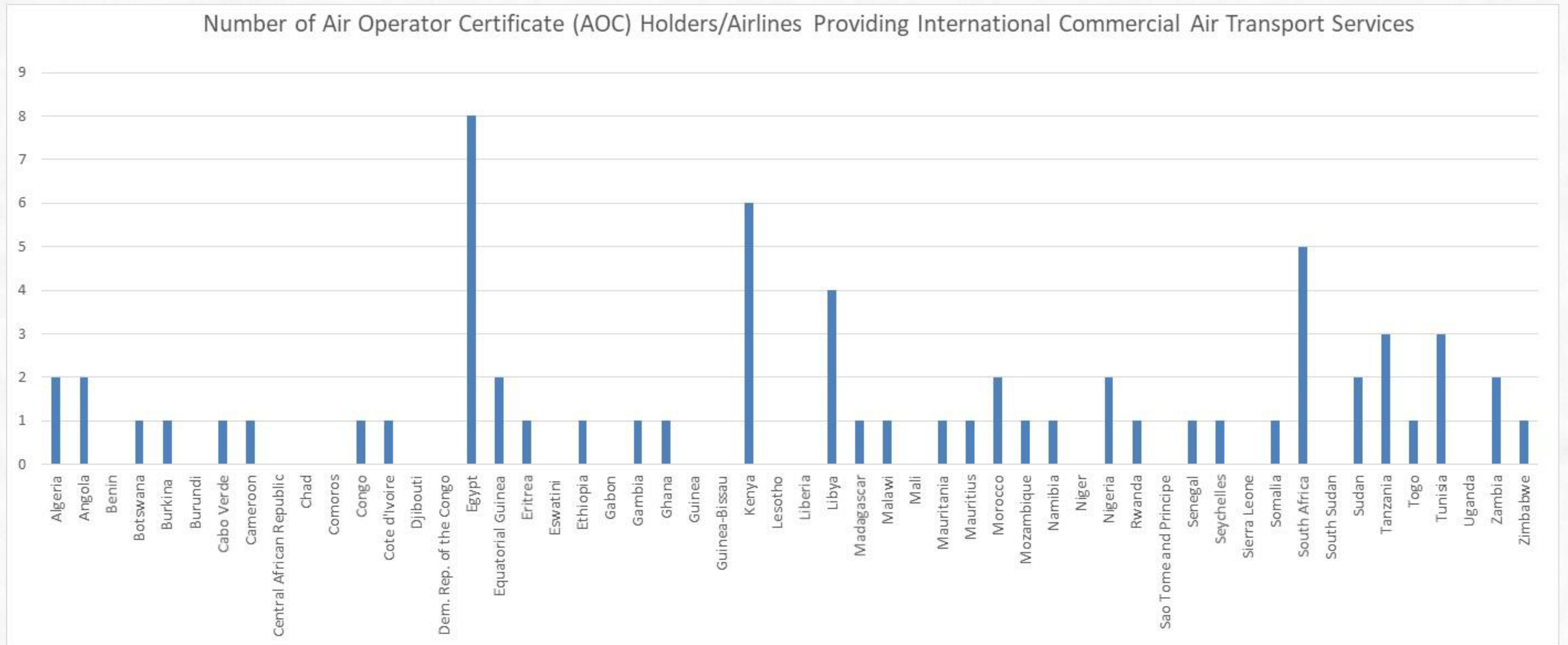
- Africa contains 57 countries and 2102 airports.
- There are 46 large airports, 431 medium airports and 1625 small airports.
- 477 airports has scheduled flight connections.
- The largest airport in Africa is OR Tambo International Airport, located in South Africa.
- Africa accounts for 18% of the global population, but just 2.1% of air transport activities (combined cargo and passenger) -Willie Walsh, IATA's Director General.

Top 13 countries with the highest number of airports



Overview of Africa aviation industry

Number of international airlines by State (2017)



Overview of Africa aviation industry

- Passenger traffic growth of African carriers has been volatile and consistently lower than the world average growth.
- Top 10 States in Africa accounted for the majority of the international passenger traffic carried by African carriers
- Top international destination region from Africa is to Europe (41%), followed by Intra Africa (27%) and to the Middle East (19%)

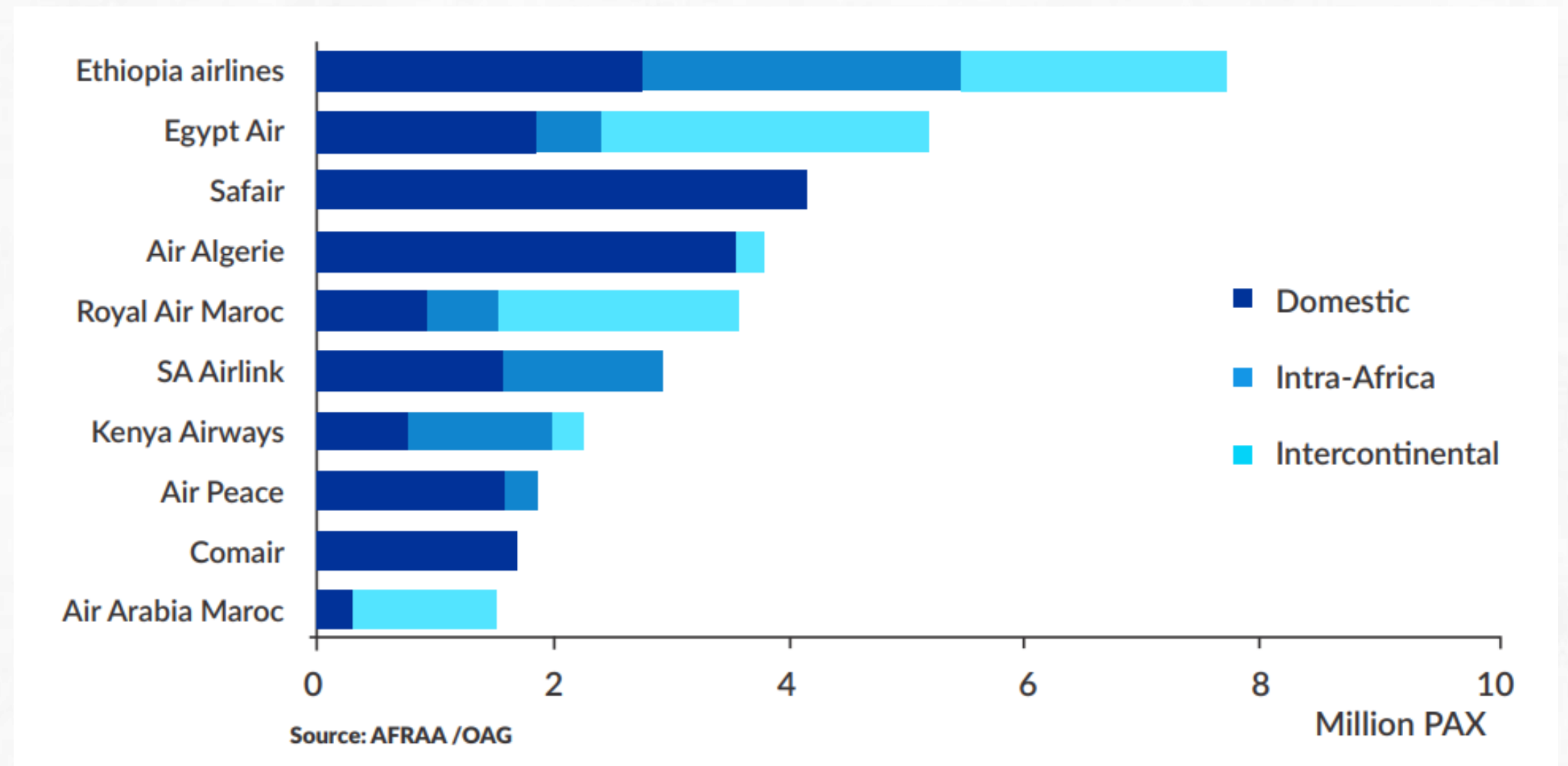
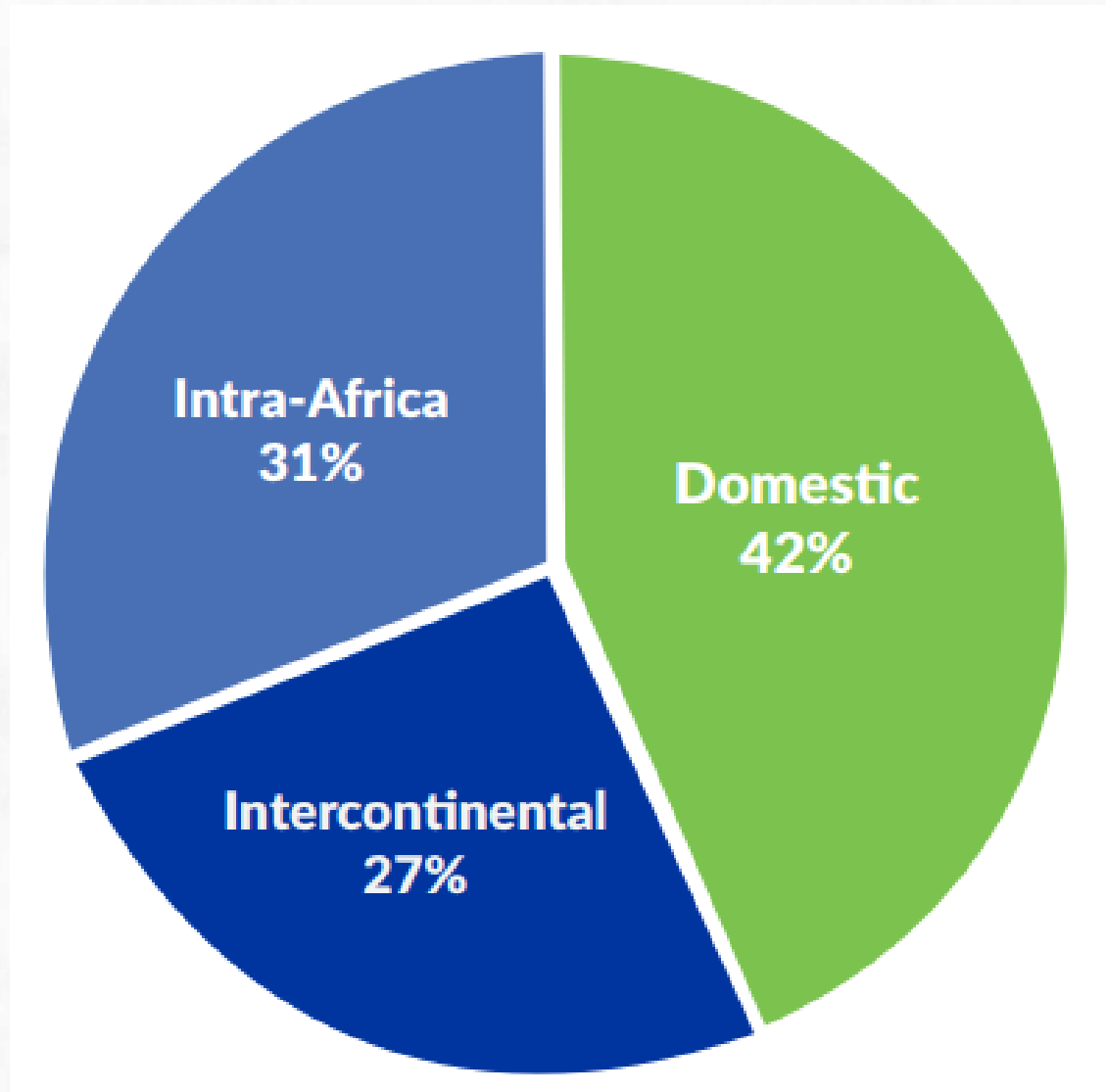
Overview of Africa aviation industry

- Currently in Africa, 19 States have no international airlines, 22 States have only 1 international airlines, and 4 States have more than 3 international airlines.
- The 230 airlines operating in Africa (over 46 African Owned) only operate around 5% of the world's commercial passenger and cargo aircraft; the average age of the African airline fleet is the highest of all regions in the world (17 years compared to the world average which is around 12 years - use of older, less fuel-efficient aircraft types in their fleet of flights).

Overview of Africa aviation industry

African airlines Passenger distribution in 2021

Source: AFRAA/OAG



African airlines ranking by traffic 2021

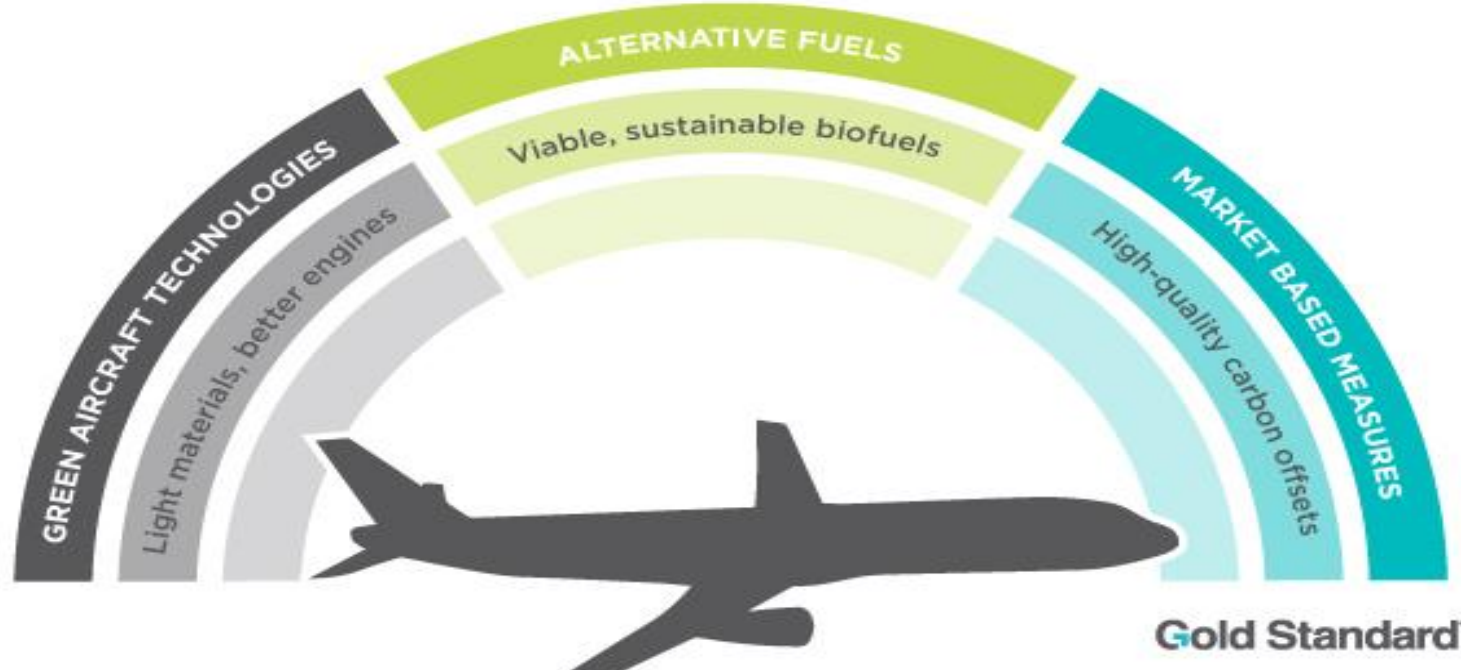
Case studies of ICAO SAP - Africa

A State Action Plan on CO₂ Emissions Reduction Activities from International Aviation is a **planning and communications tool** from a State that identifies the CO₂ emissions mitigation measures the Civil Aviation Authority and national aviation stakeholders intend to take over a given time period to achieve the desired CO₂ emissions reduction objectives.



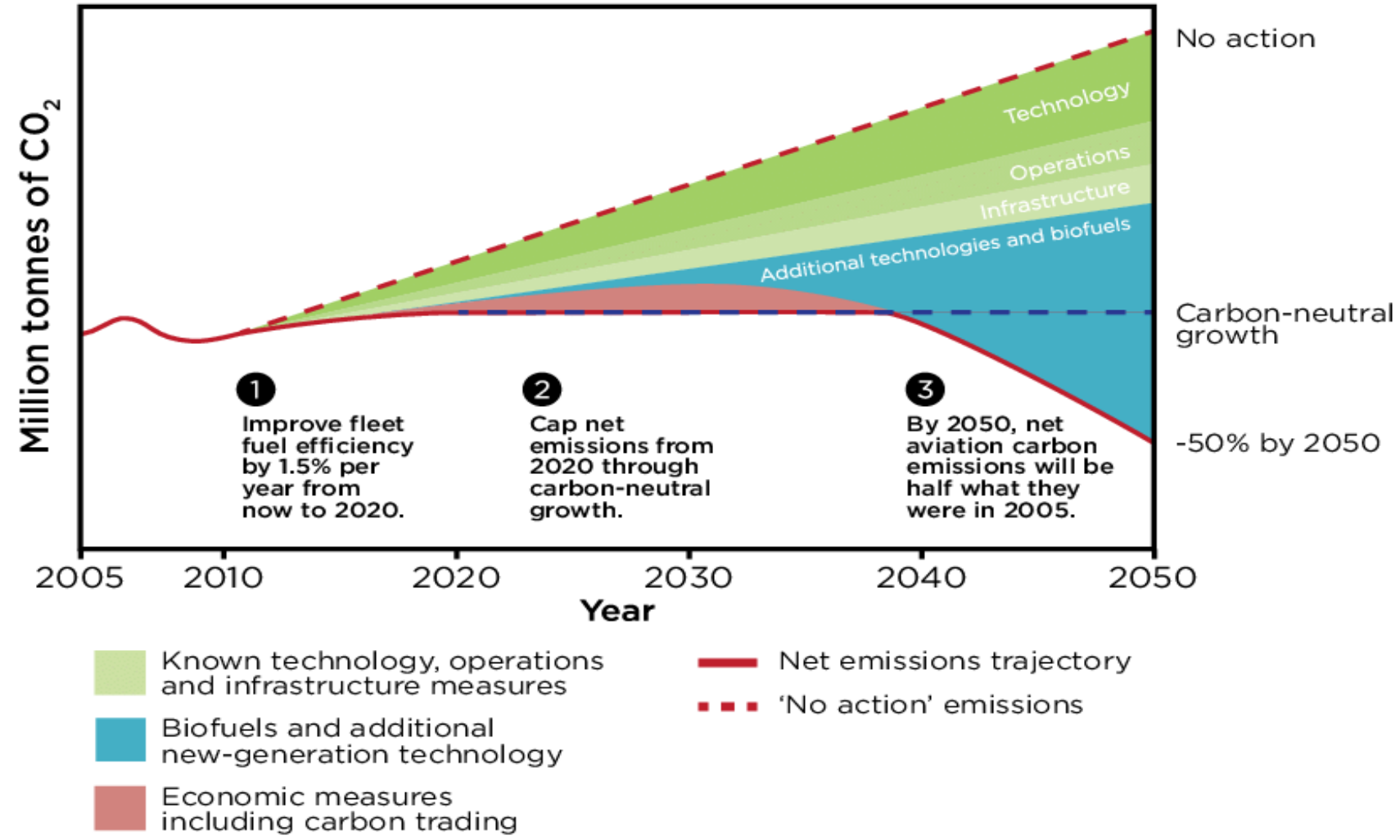
**ICAO'S ANATOMY
FOR A SUSTAINABLE AVIATION INDUSTRY**

source: www.icao.int/environmental-protection



Basket of Measures

- Aircraft- related Technology development
- Sustainable Aviation Fuel
- Improved Air Traffic Management
- Airport Improvements
- More Efficient Operations
- Regulatory Measures/Others





Case Studies of State Action Plans-ICAO LED Assistance

Case studies of SAP

Case study: Kenya

[Kenya State Action Plan](#)

The Action Plan of Kenya, submitted in 2015 with the support of the ICAO-European Union project, sets an aspirational goal to improve fuel efficiency from a 2010 baseline by an average annual rate of at least 2 percent per year until 2020. To help ensure reaching this goal, the Action Plan identifies five key categories of measures that are expected to have the greatest environmental impact:

- Aircraft Related Technology Development
- Improved ATM and infrastructure use
- More efficient Air operations
- Regulatory measures
- Airport Improvements

The assistance needed to implement the Action Plan is multi-fold and includes requests for mostly technical as well as financial support from external stakeholders.

The Action Plan of Kenya includes all the required elements of an Action Plan, according to ICAO Doc 9988 and its implementation is supported by the ICAO - European Union Assistance Project, including feasibility studies and the installation of a solar power and gate electrification system at the Mombasa International Airport.

The Action Plan of Kenya is the result of an inclusive process which involved the main stakeholders of the aviation sector in Kenya, gathered in a National Action Plan Team (NAPT). The National Action Plan Team was created in 2010 and enhanced in 2015 following the start of the ICAO-European Union Project. A two-day workshop with the NAPT was organized mid-2015 by the Kenya Civil Aviation Authority to work intensively on the preparation of the Action Plan. This initiative proved to be decisive for the successful completion and submission of the Action Plan.



Case studies of SAP

Case study: Cameroon

In October 2014, with the support of the ICAO-European Union Assistance Project, the National Action Plan Team was established. Its mission is to develop an Action Plan to reduce CO₂ emissions from international aviation, supervise the implementation of the Plan and update the Plan every three years. The National Action Plan Team is coordinated by the Civil Aviation Authority of Cameroon (CCAA), which also chairs it and the Technical Secretariat is composed of representatives of each of the following administrations and organizations:

Aviation authorities: Ministry of Transport, Civil Aviation Authority of Cameroon

Environmental authorities: Ministry of Environment, Nature Conservation and Sustainable Development,

Airports: ADC - Airports of Cameroon

Airline: CAMAIR-Co

Air Navigation Service Providers (ANSP): ASECNA

Fuel providers: TOTAL

Starting project: 29 January 2015

The variety of measures selected from ICAO's "basket of measures" were included in the Action Plan of Cameroon, across the seven administrations and organizations mentioned above in an inclusive manner. The creation of a National Action Plan Team, was key for this achievement. Additionally, the implementation of the Action Plan was supported by the ICAO - European Union Assistance Project, through the installation of a solar power and gate electrification system at the Douala international airport.



Case studies of SAP

x

Measure: Aircraft-related Technology Development -
Purchase of New Aircraft

State: Burkina Faso

Description: The company Air Burkina has renewed its fleet by buying the new generation of EMBRAER 170 aircraft and decommissioning MD87 and CRJ200 aircraft.

Start date: January 2015

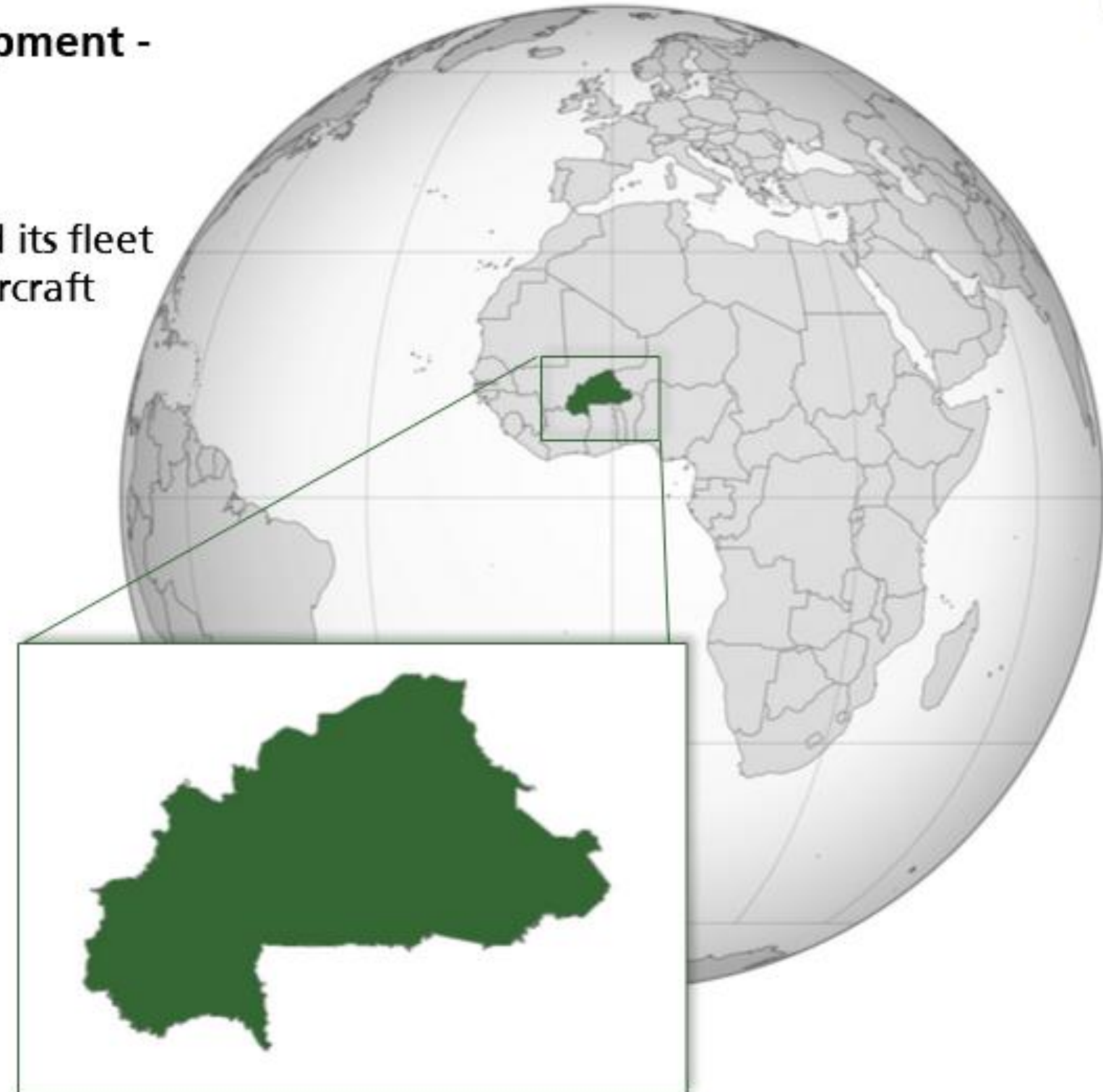
Completion date: April 2015

Expected results: 4,475 tones CO₂ reduced/year



Stakeholders involved:

Airlines: Air Burkina

Engine Manufacturer: EMBRAER



Case studies of SAP



Measure: Improved Air Traffic Management - Continuous Climb Operations
State: Central African Republic

Description: Implementing Continuous Climb Operations at Bagui Airport. Continuous Climb Operation (CCO) is an aircraft operating technique. A Continuous Climb Operations (CCO) enable the aircraft to attain initial cruise flight level at optimum air and speed and engine thrust settings set throughout climb, thereby reducing total fuel burn and emissions.

Number of take-offs of international flights per year will be affected by this measure: 104 flights of the Karinou Airlines

Start date: August 2016
Completion date: 2017
Expected results: 32.8 tones CO₂ reduced/ year
Co-benefits: 263 tonnes CO₂ reduced/year
Stakeholders involved: Aviation Authorities: Civil Aviation Authority; Air Navigation Service Providers: ASECNA; Airlines: Karinou
Assistance Needed: Personal/staff training

Case studies of SAP

Measure: Improved Air Traffic Management - Performance Based Navigation (PBN) Standard Arrival (STAR)

State: Gabon

Description: Implement more efficient air traffic management procedures based on Performance Based Navigation and Standard Arrival Procedures at international airports which will reduce fuel consumption during the take-off and approach phases by aircraft operators.

Following an international effort and in the scope of the Africa/Indian Ocean (AFI) roadmap for the implementation of Performance-Based Navigation (PBN), Gabon develops and implements Standard Instrument Departures (SIDs) and Standard Terminal Arrival Routes (STARs) based on PBN criteria on all its international airports. Routes optimization through the conception of shorter and more direct routes added to more efficient departures and arrivals will bring benefits in terms of reduced fuel consumption and CO₂ emissions.

Start date: 2016

Completion date: 2019

Expected results: 221.7 tons CO₂ reduced/year

Stakeholders involved:



Case studies of SAP

Measure: More Efficient Operations - Single Engine taxi

State: Angola

Description: All aircraft utilize the thrust that is produced by their engines to taxi to or from the runway for takeoffs and landings. That leads to burning jet fuel and creating emissions. However, shutting down one engine while taxiing can reduce the ground-level fuel burn and carbon dioxide emissions.

One engine is shut down (or not started) while taxiing for departure or after landing while taxiing to the terminal.

Apply : Engine Out - Taxi In; Engine Out - Taxi Out

Start date: 2016

Completion date: end 2016

Expected results: 1,331 tones CO₂ reduced/ year

Stakeholders involved: Air Navigation Service Provider: ENANA-EP; Airlines: TAAG Angola Airlines

Estimated costs savings: 678,550 USD/year



Case studies of SAP

Measure: Regulatory Measures/Other - Rising Public Awareness

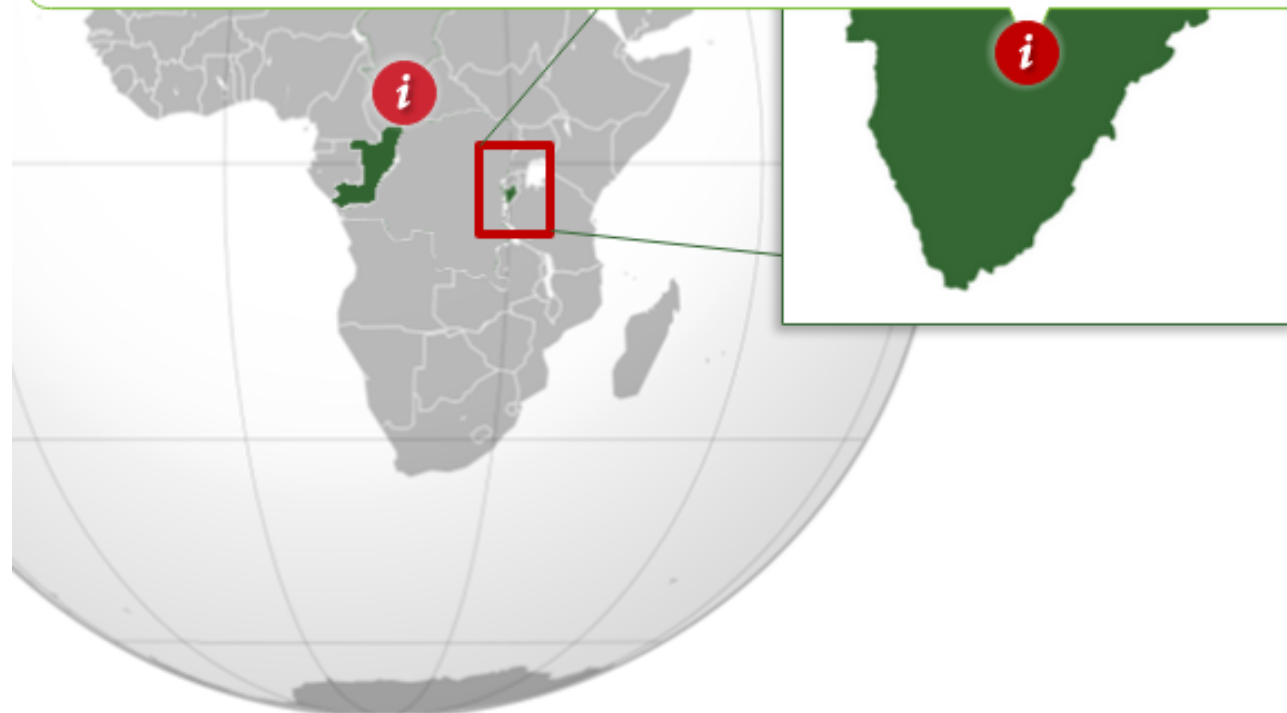
State: Burundi

Description: This measure aims to increase the air operators' awareness on environmental issues related to international aviation through the presentation and explanation on the national action plan of Burundi, including on the potential environmental benefits from the implementation of operational measures. The selected action will not directly generate CO₂ emissions reductions per se but will have a positive impact on the stakeholder's awareness to make them more familiarized with the operational measures selected by Burundi to reduce CO₂ emissions. The measure consists in organizing one meeting per trimester for all the staff involved in the management and implementation of operational measures.

The objective is to enable all air operator's staff to learn about the State Action Plan and the impact of reducing the CO₂ from the international aviation sector at global and regional context.

Start date: 2016

Completion date: 2017



Case studies of SAP

Measure: Regulatory Measures/Other - Enhancing weather forecasting services

State: Congo

Description: Acquisition of now casting weather support tool who will have the advantage of strengthening the capacity of forecasters to observe and predict certain phenomena such as active thunderstorm areas, severe turbulence areas, severe icing levels etc.

Start date: 2017

Completion date: 2018

Expected results: 28.4 tones CO2 reduced/ year

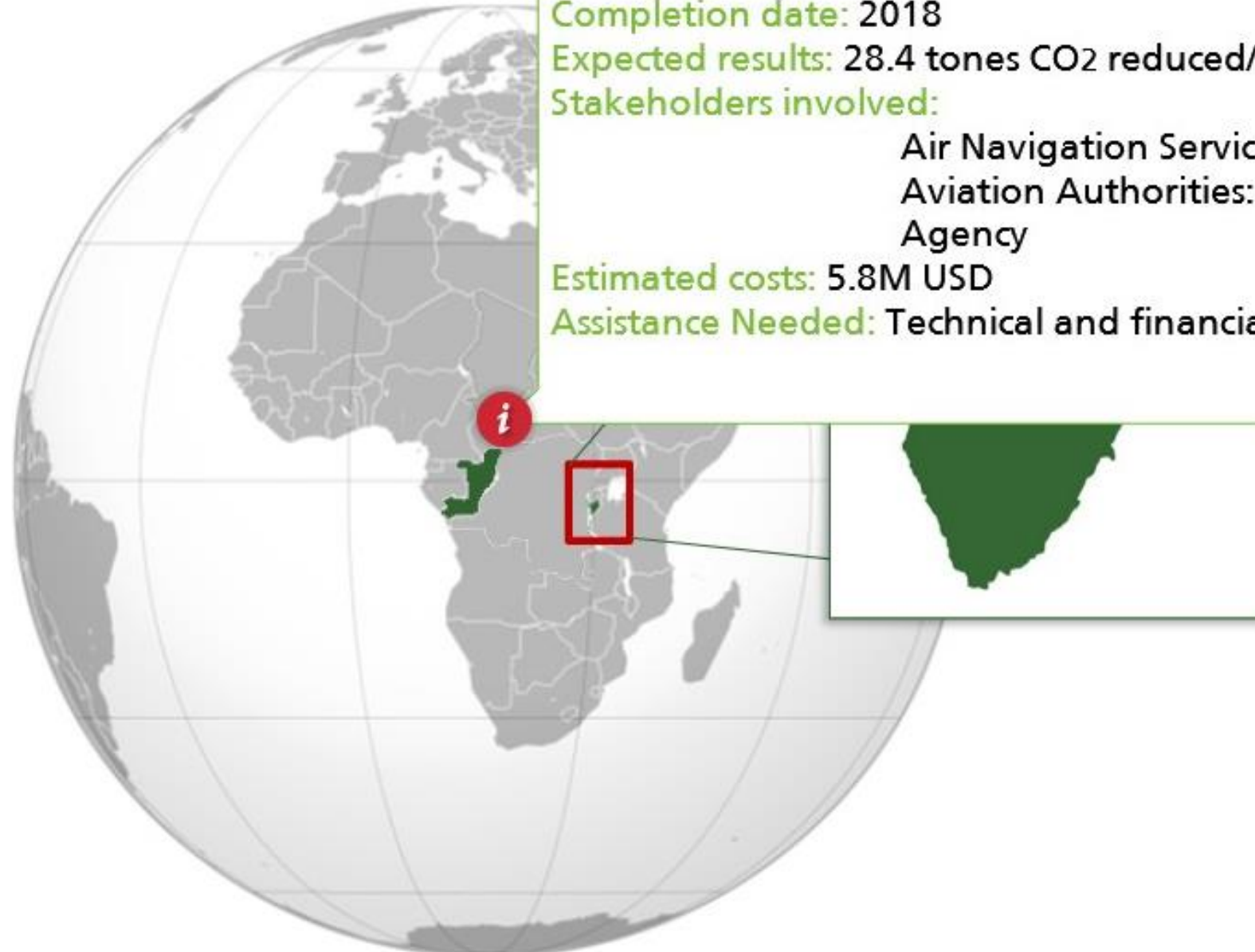
Stakeholders involved:

Air Navigation Service Provider: ASECNA

Aviation Authorities: ANAC - National Civil Aviation Agency

Estimated costs: 5.8M USD

Assistance Needed: Technical and financial assistance required



Case studies of SAP

State which has included its Assistance needs as integrated part in their Action Plan

X

State: Chad

Description

In developing the Action Plan the National Action Plan Team identified several areas where assistance is needed and highlighted them as follows:

Funding needed for the measures selected:

The civil aviation sector in Chad will need adequate financial resources to implement a range of selected mitigation measures that will contribute to both domestic and international emissions. The lack of resources will constitute a serious obstacle in the implementation of these projects, such as:

- The construction of a ramp at N'Djamena Airport
- The acquisition of an additional push back and three tie bars
- The acquisition of ground power units and air conditioning units and ground support equipment
- Replacing conventional bulbs with LEDs

Technical assistance

Technical assistance is requested for the implementation and optimization of operational procedures and for the feasibility studies for the following measures:

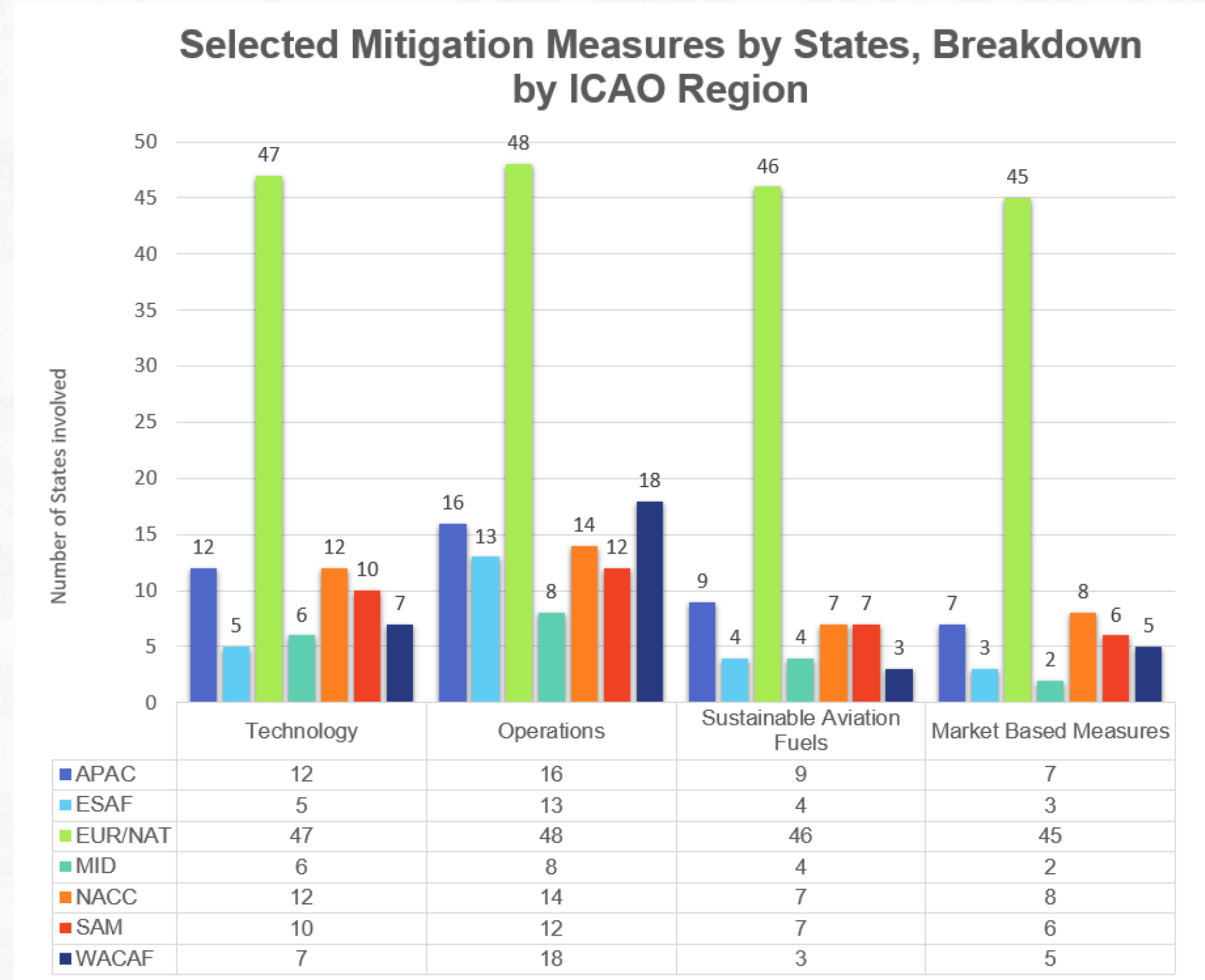
- The creation of increasingly direct trajectories in order to favor the optimal itineraries
- Improving the use of optimal flight levels
- Optimize and streamline more economical arrival procedures
- Improvement of the runway connection at the N'Djamena Airport

Training support

Capacity building in varied areas such as: the design and development of procedures, New Air Navigation Procedures



Current state action plan for Emission and noise reduction



- European and North Atlantic (EUR/NAT)
- Eastern and Southern Africa (ESAF)
- North and Central America, Caribbean (NACC)
- South America Office (SAM)
- West and Central Africa (WACAF)
- Middle East (MID)
- Asia and Pacific (APAC)

Source: ICAO, 2023


African Current carbon reduction measures

Measure	Activities
Aircraft-related technology development	Purchase of new fleet by major African airlines
Alternative fuels	SAF feasibility studies in Burkina Faso and Kenya
Improved air traffic management and infrastructure use	continuous climb operations (CCO) and continuous descent operations (CDO) in Burkina Faso and Gabon Solar at-gate demonstration projects in Cameroon and Kenya
Economic/market-based measures	Over 15 Africa countries participating in CORSIA

Airlines in Africa

From sources across the web

 Ethiopian Airlines ▼

 Royal Air Maroc ▼


 TAAG Angola Airlines ▼


 Fastjet ▼

 Air Tanzania ▼


 Air Namibia ▼


 Air Côte d'Ivoire ▼

 Asky Airlines ▼

 Kenya Airways ▼

 Air Mauritius ▼

 RwandAir ▼

 Kulula ▼

 Comair ▼

 Arik Air ▼

 Sudan Airways ▼

 Fly540 ▼


 Egyptair ▼

 Mango ▼


 Airlink ▼

 Air Algérie ▼

 Tunisair ▼

 Air Seychelles ▼

 CemAir ▼

 Air Senegal ▼

Case studies of successful emission reduction initiatives in African Airlines - Ethiopian Airlines, Royal Air Maroc & Kenya Airways

Examples of successful emission reduction initiatives in African aviation, focusing on Ethiopian Airlines, Kenya Airways and Royal Air Maroc:

Ethiopian Airlines

- Fleet Modernization
- Sustainable Aviation Fuel (SAF) Adoption
- Operational Efficiency



Royal Air Maroc

- Fleet Optimization
- Sustainable Aviation Fuel (SAF) Trials
- Efficient Operations



Kenya Airways

- On May 25, 2023 Kenya Airways (KQ) operated possibly the most **sustainable commercial long-haul flight between Africa and Europe as part of The Sustainable Flight Challenge (TSFC) by SkyTeam.**
- The flight was operated on KQ's Boeing 787 Dreamliner, departing Nairobi Jomo Kenyatta Airport (NBO) at 08:40 and arriving at Amsterdam Schiphol Airport (AMS) at 16:40.



New Airport Infrastructure Projects in Africa – Deployment of Renewable Energy Initiatives and Technologies



1,023 x 575

AIRPORT PROJECTS IN AFRICA

INTERACTIVE PROJECT MAP
Hover over the icon and see the detailed information

MODERN AIRPORTS AFRICA 2019

28-30 August 2019 | Nairobi, Kenya

FOR MORE INFORMATION OR TO REGISTER:
INQUIRY@IQPC.AE
+971 4 364 2975
modernairportsafrica.iqpc.com

Country	Project Name
MOROCCO	RABAT-SALÉ AIRPORT
TUNISIA	CONSTRUCTION OF NEW AIRPORT BIZERTE AIRPORT
ALGERIA	ALGIERS' HOUMR BOUMEDIENE AIRPORT
EGYPT	BORG EL ARAB INTERNATIONAL AIRPORT
GHANA	KUMASI AIRPORT
UGANDA	ENTEBBE INTERNATIONAL AIRPORT
UGANDA	KABALE AIRPORT
ZIMBABWE	ROSEBUD GABRIEL MUKACHE AIRPORT
MADAGASCAR	ANTANANARIVO INTERNATIONAL AIRPORT AND FA SINDRE

- Solar
- GSE
- Electrical vehicles
- LEDs
- Embracing Adaptation measures and Just transition etc

➤ African Airports with ACI Airport Carbon Accreditation certificates at different levels.



Accredited Airports across the world



Africa

There are currently 13 accredited airports in 8 countries at Level 1 'Mapping', representing 12.0% of African air passenger traffic.

Airports Company South Africa

- Cape Town International Airport
- King Shaka International Airport
- Chief Dawid Stuurman International Airport
- O.R. Tambo International Airport



Airports of Mauritius Co Ltd

- Mauritius Sir Seewoosagur Ramgoolam Airport



Le Syndicat Mixte de Pierrefonds

- Saint-Pierre Pierrefonds Airport



Moroccan Airports Authority (ONDA)

- Marrakech Menara Airport
- Casablanca Mohammed V International Airport



TAV Airports Holding

- Monastir Habib Bourguiba International Airport - Tunisia



EDEIS Group

- Dzaoudzi Pamandzi International Airport



Limak-Aibd-Summa (LAS)

- Dakar Blaise Diagne International Airport



S.A. Aéroport de la Réunion Roland Garros

- La Réunion Roland Garros Airport



TAV Airports Holding

- Enfidha Hammamet International Airport - Tunisia



AERIA

- Félix-Houphouët-Boigny Abidjan International Airport



GSEZ-Airport

- Libreville Leon Mba International Airport



Airport Carbon Accreditation supports the UNFCCC "Climate Neutral Now" campaign

CLIMATE NEUTRAL NOW

Airports Company South Africa

- George Airport
- Bram Fischer International Airport



Federal Airports Authority of Nigeria

- Murtala Muhammed Airport, Lagos



Kenya Airports Authority

- Jomo Kenyatta International Airport
- Moi International Airport
- Kisumu International Airport
- Eldoret International Airport



Moroccan Airports Authority (ONDA)

- Rabat-Salé Airport
- Fès Saïss Airport



- Nosy Be Airport
- Antananarivo Airport



St Helena Airport Limited

- St Helena Airport



The Société Aéroportuaire de Lomé Tokoin - SALT

- Aéroport International Gnassingbe Eyadema



Challenges and opportunities for Africa in terms of Regional disparities in infrastructural development, limited investment and financing and opportunities for market growth

1. Regional Disparities in Infrastructural Development

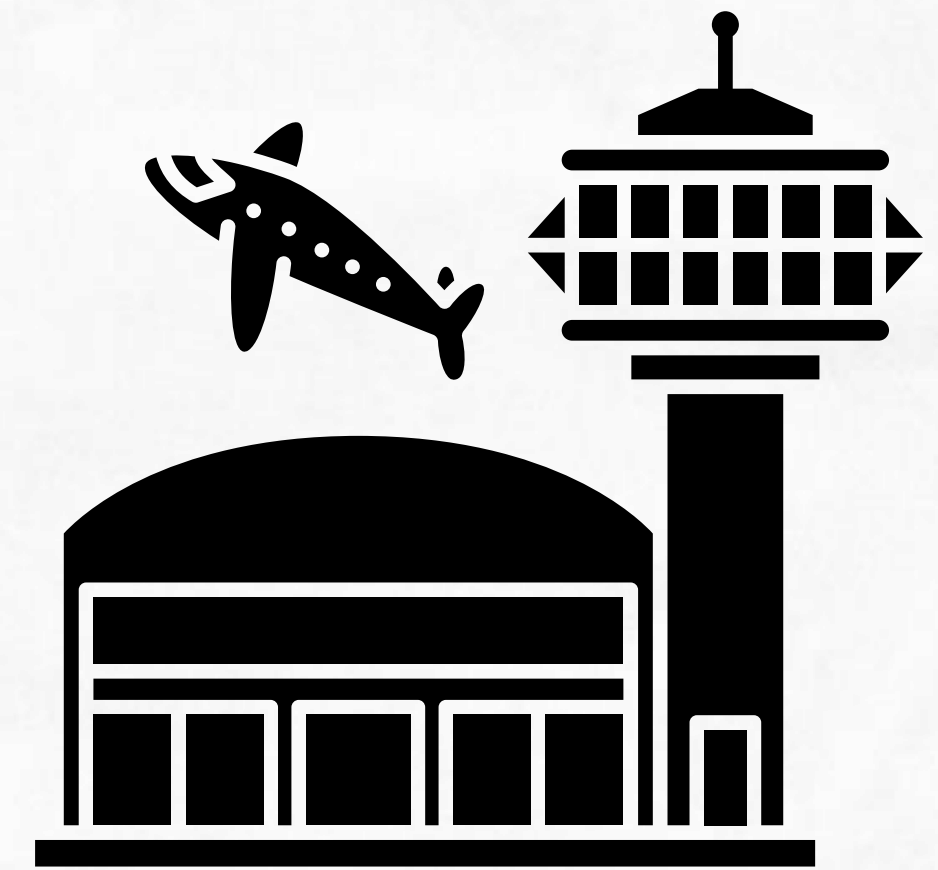
Challenge: There are significant disparities in aviation infrastructure across different regions in Africa.

Opportunity: Addressing regional disparities presents an opportunity for infrastructure development and investment.



2. Limited Investment and Financing

- **Challenge:** Limited investment and financing pose challenges for the development and expansion of aviation in Africa.
- **Opportunity:** Mobilizing investment and financing is crucial to unlock the potential of the African aviation industry.



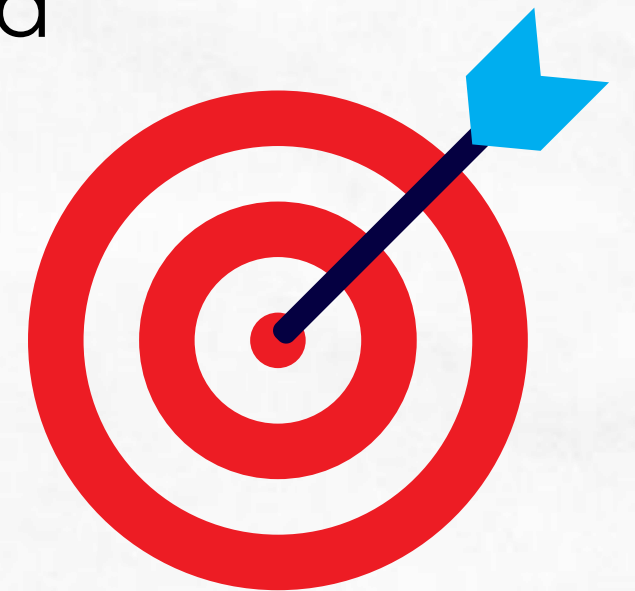
3. Opportunities for Market Growth

- Growing Middle Class and Economic Potential
- Tourism and Business Travel:
- Intra-African Connectivity



Addressing these challenges and seizing opportunities require concerted efforts from governments, industry stakeholders, and international organizations.

The aviation industry in Africa is challenged but presents good opportunities.



The image features a minimalist design with several overlapping triangles in shades of green, orange, and grey. The text 'The way forward' is centered in a bold, dark grey font. The background is white, and the geometric shapes are arranged in a way that suggests movement and progress.

The way forward

➤ To ensure a prosperous future for the aviation industry in Africa, a call to action is needed – (**Global Partnership and Collaboration (States, Governments, Industries and Academia)**):

- ❖ Enhance Infrastructure
- ❖ Mobilize Investment
- ❖ Foster Collaboration
- ❖ Promote Sustainability (**Development & Deployment SAF**)
- ❖ Research and development on emissions and community health
- ❖ Improvement capacity building, data collections and innovation



➤ The future prospects for the aviation industry in Africa are promising:

- ❖ Economic Growth
- ❖ Regional Integration
- ❖ Technological Advancements
- ❖ Human Capital Development



➤ In conclusion, by embracing these opportunities, addressing challenges, and taking proactive measures, **the aviation industry in Africa can contribute significantly to economic growth, job creation, and sustainable development across the continent.**



THANK YOU

ADDITIONAL INFORMATION

www.icao.int

www.au.int/agenda2063/sdgs

www.afcac.org

www.seforall.org/our-work/initiatives-projects/ACMI

www.iata.org

www.aci.aero

