REPUBLIC OF KENYA

KENYA'S ACTION PLAN FOR THE REDUCTION OF CO_2 GAS EMISSIONS IN AVIATION SECTOR

KENYA CIVIL AVIATION AUTHORITY

DECEMBER 2015

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ACKNOWLEDGEMENT

Kenya Civil Aviation Authority (KCAA) would like to place on record the valuable contributions of individuals, corporate entities, Ministries, Departments and Agencies of the Government and indeed, the critical stakeholders leading to the final production of this Action plan. We wish to acknowledge the significant role and leadership working group team towards actualizing of this action plan.

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Finally, the steadfastness and commitment of staff, especially the focal points and indeed the whole KCAA, are much appreciated.

ACRONYMS

The following is a list of acronyms used in this document:

ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AFTN	Aeronautical Fixed Telecommunications Network
AFS	Aeronautical Fixed service
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
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CTA	Controlled Airspace
DME	Distance Measuring Equipment
ETS	Emissions Trading Scheme
EU	European Union
FANS	Future Air Navigation System
FMS	Flight Management System
GHG	Greenhouse Gas
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
KAA	Kenya Airports Authority
KCAA	Kenya Civil Aviation Authority
KAAO	Kenya Association of Air Operators
KMD	Kenya Meteorological Department
KQ	Kenya Airways

MET	Meteorological Services for Air Navigation
MOT	Ministry of Transport
MSSR	Mono-pulse Secondary Surveillance Radar
NEMA	National Environmental Management Authority
NDB	Non Directional Beacon
PBN	Performance Based Navigation
PSR	Primary Surveillance Radar
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
SID	Standard Instrument Departure
SSR	Secondary Surveillance Radar
STAR	Standard Instrument Arrival
VOR VHF	Omni-directional Radio-range
WAM	Wide Area Multilateration

CIVIL AVIATION COMPLEX

PREAMBLE

While air travel supports Kenya's economy, trade and tourism, and connects Kenya to different parts of the World, its aviation industry also contributes to greenhouse gas emissions. This voluntary Action Plan expresses how the parties, in good faith, intend to reduce greenhouse gas emissions from aviation activities.

It does not contain legal obligations of any kind or impose unreasonable expectations on any party, or intend to negatively impact any air carrier's ability to do business in Kenya.

The Government of Kenya reserves the right to develop and implement appropriate regulatory or other measures to achieve clean air and climate change goals. This Action Plan does not restrict the Parties from taking further actions relating to greenhouse gas emissions or fuel use.

Dated 24TH December 2015

Capt. Gilbert M. Kibe
DIRECTOR GENERAL

KENYA CIVIL AVIATION AUTHORITY

EXECUTIVE SUMMARY

Recognizing the importance of the global warming issue, Kenya has been sincerely making aggressive efforts to address Greenhouse Gas (GHG) Emissions from Aviation. Kenya has been taking a wide range of possible measures in various fields in aviation, including air traffic management improvements and airport initiatives as well as aircraft emission reduction measures.

Kenya has been upgrading its Air Navigation Systems, Airports facilities, operations and procedures to meet the dynamic changing aviation industry and global challenges. The upgrades have significantly resulted in a more efficient Flight Information Region. These upgrades include the installation of new and modern air navigation equipment, fleet renewal, implementation of performance based navigation, air traffic fully under radar surveillance and upgrade of Airports infrastructures.

Building on the success of the voluntary agreement to address greenhouse gas (GHG) emissions from aviation, the Kenya Civil Aviation Authority (KCAA) and the Kenyan aviation industry have developed Kenya's *Action Plan to Reduce Greenhouse Gas Emissions from Aviation.*

Taking into account achievements to date, Kenya has developed a National Climate Change Response Strategy (NCCRS 2010), National Climate Change Action Plan (NCCAP 2013), the aviation industry Action Plan sets an ambitious goal to reduce GHG emissions from both domestic and international

operations, which we expect to contribute to global efforts to minimize aviation's carbon footprint.

In line with the broad international consensus, the Action Plan 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 we reach this goal, the Action Plan identifies five key 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 Action Plan also highlights a second set of measures. The Kenyan Aviation industry expects these measures to have beneficial environmental results, but these results are not expressed in quantitative terms due to the nature or current stage of the activity. These include:

- Alternative fuels
- International Coordination;
- Afforestation programs;
- Flexible use of airspace allowing transgression into special airspace.

Kenya government (KCAA) will introduce the following initiatives:

- Encouraging investment in aircraft efficiency improvements and the development of sustainable biofuels policy;
- Monitoring and reporting Kenya's aviation carbon footprint;
- Working towards a multilateral approach through ICAO for managing the climate change impacts of international aviation;
- Establishment of an annual forum involving relevant Government agencies and industry to facilitate the exchange of information and ideas on mitigating actions and to discuss any obstacles to implementation.

The Action Plan is a living document that will evolve through:

- Quarterly meetings between KCAA officials and the Aviation Environmental Working Group;
- Annual reporting on the progress towards achievement of the Action Plan's fuel efficiency target;
- A review of the Action Plan, that will occur within three years; and

- An audit that will occur at least once over the next three years.

This Plan is focused on International and domestic Civil Aviation and is being supported by the ICAO-EU Assistance Project on Capacity Building for CO_2 Mitigation from International Aviation. The Government of Kenya is committed to continuing the implementation of concrete actions towards a greener aviation.

1. Introduction

1.1. Background

The International Civil Aviation Organization (ICAO) Assembly Resolutions A37-19 and A38-18 are key milestones in the global collective drive to minimize the impact of aviation on climate change. In addition to set global aspirational goals – carbon-neutral growth from 2020 and a 2 per cent annual increase in fuel efficiency up to 2050, the Assembly instituted the voluntary submission of States' Action Plans. They are tool for States to communicate on the progress toward the environmental goals set by the ICAO Assembly, and to the international community regarding their efforts to reduce CO2 emissions from international aviation and to request necessary assistance.

More precisely, ICAO resolution A38-18 required the following;

1. Collective global aspirational goals for the international aviation sector of improving 2% fuel efficiency per year and keeping net global CO_2 emissions from 2020 at the same levels, thus reaching carbon neutrality;
2. Further work to explore the feasibility of a long-term global aspirational goals for international aviation;
3. Development of a global CO_2 certification Standard for Aircraft, aiming for adoption by the ICAO Council in 2016;
4. Implementation of operational improvements (relating to aircraft and infrastructure) and further development and update of tools and guidance to assess environmental benefits;
5. Further facilitation of developing and deploying sustainable alternative fuels for aviation, including consideration of methodologies to account for life-cycle CO_2 benefits and projection of future production.
6. Development of a global market based measure (MBM) scheme for international aviation, which addresses key design elements, including means to take into account the special circumstances and respective capabilities of States, in particular developing States, as well as the implementation mechanisms from 2020, for decision by the 39th Assembly in 2016;
7. Voluntary preparations and updates of States' Action Plans on CO_2 emissions reduction activities, for submission to ICAO by June 2015, and make it available to the public;
8. Enhancement of ICAO strategy for capacity building and assistance (to States), including support for development and update of States' Action

Plans, as well as the mechanisms to facilitate access to financial resources.

From the foregoing Kenya has prepared an Action Plan as a tool that will be used to showcase and communicate both at the national and international levels, Kenya's efforts to address greenhouse gases (GHG) emissions from aircraft operating national and international air navigation. Through the Action Plan, Kenya has identified, quantified and is implementing the environmental mitigation measures that will contribute to the ICAO global aspirational goals for international aviation.

This Action Plan has identified appropriate future mitigation measures and activities, barriers and constraints in the implementation of future actions and how to overcome them. This includes access to financial resources, building national capacities and technology transfer, but also developing options to track the implementation of actions. The elaboration of this action plan has followed an inclusive process that has brought together all stakeholders involved.

1.2. Kenya's Aspirational Goals for Aviation

Kenya's *Action Plan to Reduce CO_2 Emissions from Aviation* describes ongoing and planned activities to reduce CO_2 emissions from Kenya's national and international aviation activities.

Kenya seeks to undertake an ambitious mitigation contribution towards the 2015 Agreement. Kenya therefore seeks to abate its GHG emissions by 30% by 2030 relative to the business as usual (BAU) scenario of 143 MtCO2eq; and in line with its sustainable development agenda.

Through the implementation of these measures, the aviation sector, has set a target to achieve an annual average fuel efficiency improvement of 2 per cent equivalent to 2.86 MtCO2eq until 2030 and an aspirational fuel efficiency improvement rate of 2 per cent per annum from 2031 to 2050, calculated on the basis of volume of fuel consumed per Revenue Tonne Kilometre (RTK).

The national goals, as well as the specific objectives were set by a broad range of stakeholders.

1.2.1 The short term

Kenya will have;

- To report on international aviation CO_2 emissions to ICAO;
- To review and update baseline emission data to reflect the current status of CO_2 emissions;
- To outline respective policies and actions;
- To provide information on the basket of measures considered, reflecting their respective national capacities and circumstances and information on any specific assistance needs.

1.2.2 The long term,

Kenya will;

- Identify barriers and constraints in the implementation of future actions and how they could be overcome, including through access to financial resources, building national capacities and technology transfer;
- Identify appropriate future mitigation measures and activities;
- Track the implementation of actions with an aim of continuous improvement;
- Maintain a national inventory of CO_2 emissions.

1.3. Strategic Approach and Guiding Principles

Multiple factors motivated the elaboration of the Action Plan:

1. The country did not have so far an integrated national strategy and action plan for the reduction of carbon dioxide emissions by Kenyan aircrafts operating national and international air navigation. This triggered the need to develop one.
2. Due to the lack of any nodal national reporting, it is difficult to assess the status and the impacts of the aviation emissions to the environment.
3. It is important to create national awareness to the stakeholders for the ownership of the activities, through adaptation of logical, objective, interactive and participatory methodologies.
4. In order to meet international requirements, it is essential that the process be guided by the principles already established by ICAO and guidelines from the relevant UN and other specialized organizations.

In developing this State Action Plan for the reduction of CO_2 emissions by Kenyan aviation operators, operating national and international air

navigation, the following principles were constantly relied on as a guide to selecting our actions:

- Fine tune actions that are already being implemented;
- Consider how it may voluntarily contribute to the ICAO global aspirational goals for international aviation;
- Identify appropriate future mitigation measures and activities;
- Identify barriers and constraints in the implementation of future actions and how they could be overcome, including through access to financial resources, building national capacities, and technology transfer;
- Consider options to track the implementation of actions; and
- Bring together all stakeholders involved in the design and implementation of actions, such as air carriers, air navigation service providers, airport operators, the relevant regulators, fuel providers and military representatives.

2. THE AVIATION SECTOR IN KENYA

2.1. Kenya's Economic Context

Kenya's economy is estimated to grow by 6.0% in 2015, compared to a growth of 5.3% in 2014.From the demand side, growth was mainly driven by an increase in private final consumption and a rapid growth in capital investment. From the supply side, the major drivers were agriculture, construction, education, finance and insurance. The country is generally perceived as Eastern and Central Africa's hub for financial, communication and transportation services.

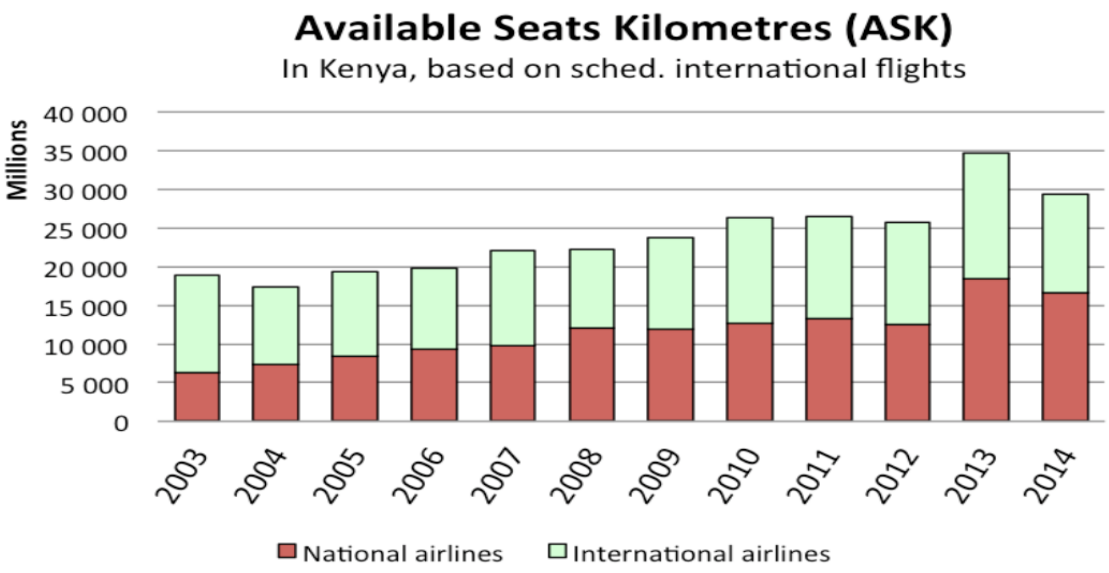
The tourism sector has exhibited steady growth in most years since independence and by the late 1980s had become the country's principal source of foreign exchange. In the late 1990s, tourism relinquished this position to tea exports, because of a terrorism-related downturn. In 2014 the tourism earnings decreased by 7.3% from Ksh 94 billion in 2013 to KSh 87.1 billion in 2014.

The aviation industry in Kenya has continued to expand with 8.89 million passengers and 264,314.5 tonnes of cargo being handled at Kenya's major airports as at June 2015. The frequency of services and the number of international and domestic destinations served by Kenyan air carriers have increased tremendously over the last one year. The number of passenger arrivals and departure were 4.47 million and 3.072 million respectively, while those in transit stood at 1.35 million in June 2015.

2.3. Kenya's Aviation Sector

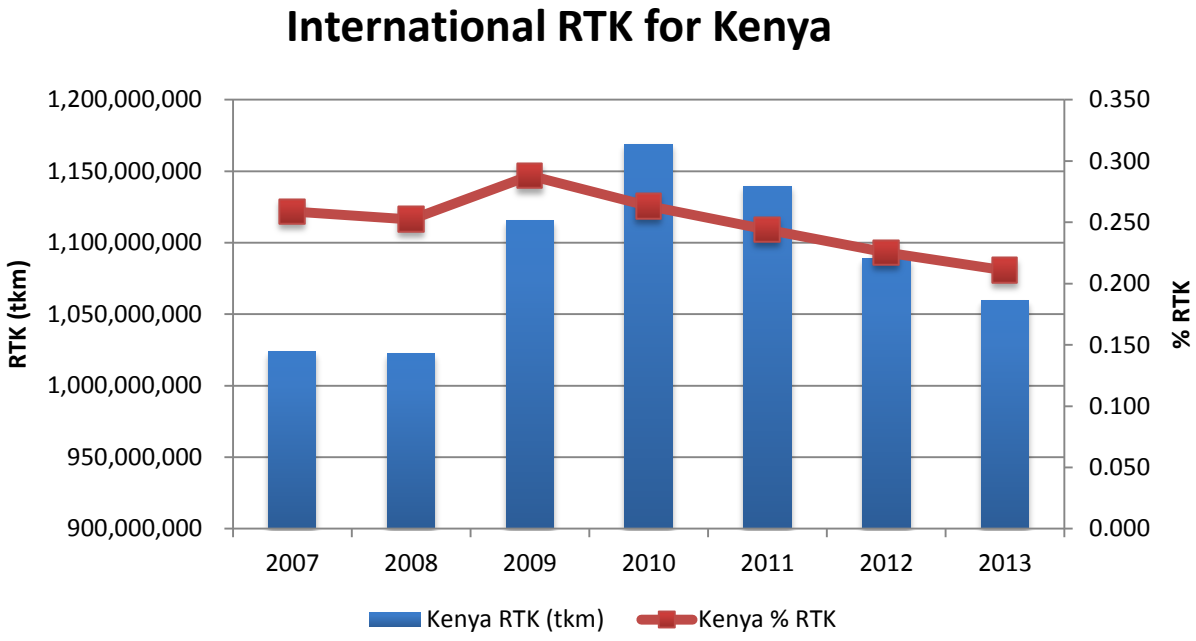
2.3.1. Capacity and traffic trends

As shown on the below figure, seats capacity has been increasing in Kenya over the last decade, both for national and international airlines.

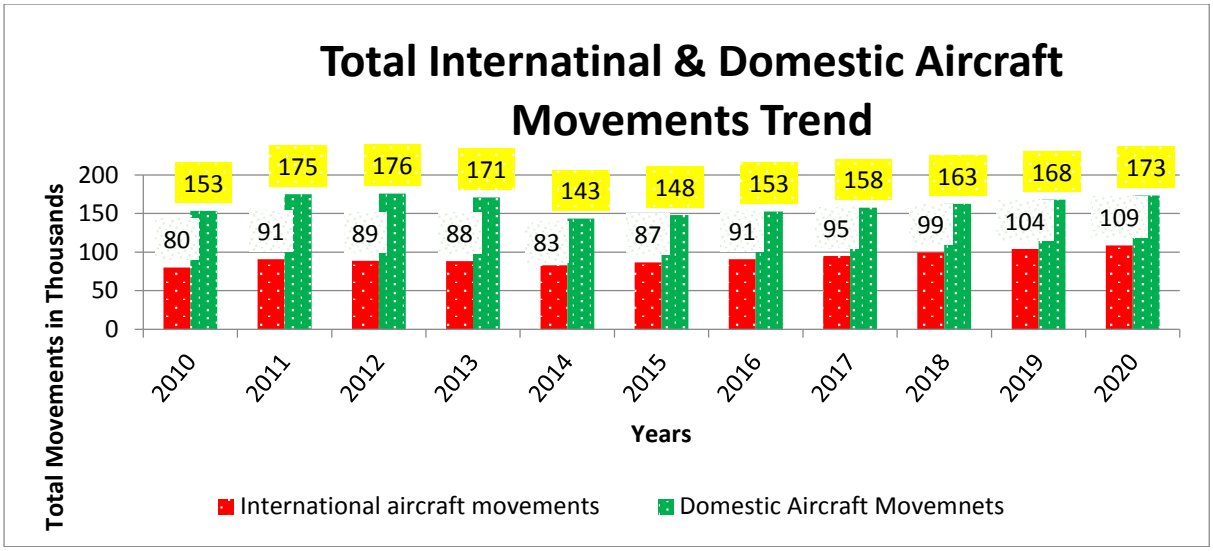


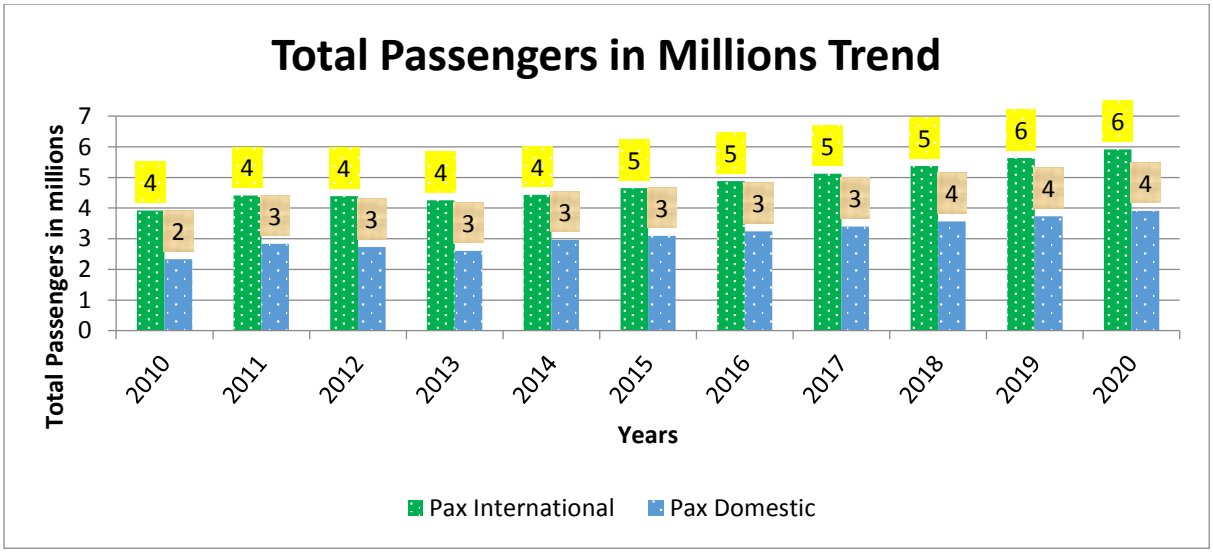
Source: OAG

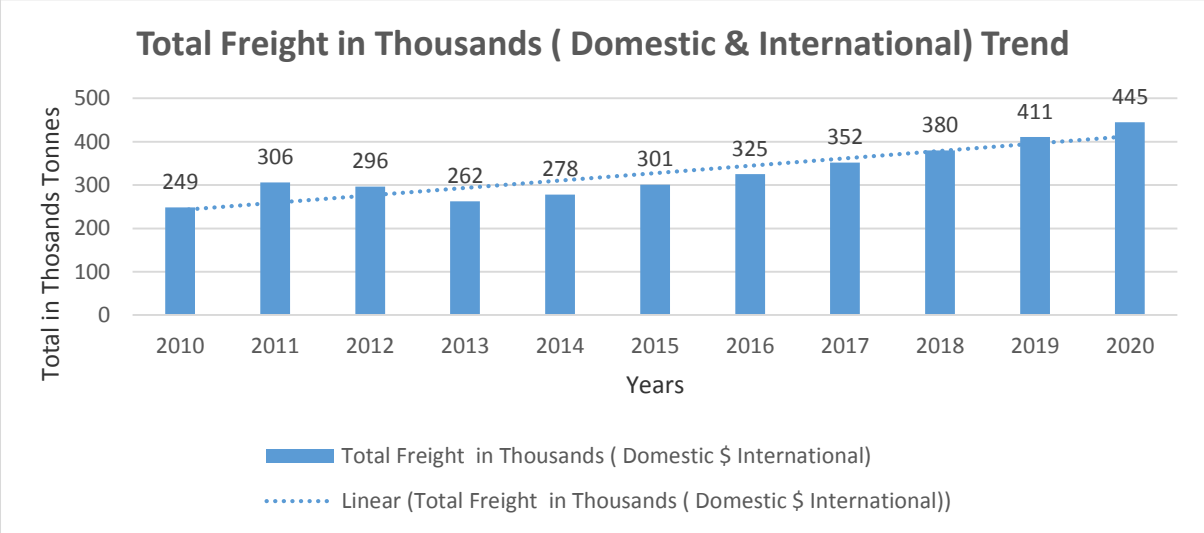
International Revenue Tonnes Kilometer (RTK) has been irregular since 2007, as described on the below figure. The RTK from Kenya represents between 0.2% and 0.3% of the world total international RTK.



The following graphs describe the overall traffic trends by national and foreign airlines from 2010 to 2020. More details are provided in Annex 1.


Total Internatinal & Domestic Aircraft Movements Trend
Total Movements in Thousands
200
150
100
50
0
80 153
91 175
89 176
88 171
83 143
87 148
91 153
95 158
99 163
104 168
109 173
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Years
International aircraft movements
Domestic Aircraft Movemnets


Total Passengers in Millions Trend
Total Passengers in millions
7
6
5
4
3
2
1
0
4 2
4 3
4 3
4 3
4 3
5 3
5 3
5 3
5 4
6 4
6 4
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Years
Pax International
Pax Domestic


Total Freight in Thousands (Domestic & International) Trend
Total in Thosands Tonnes
500
400
300
200
100
0
249
306
296
262
278
301
325
352
380
411
445
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Years
Total Freight in Thousands (Domestic $ International)
Linear (Total Freight in Thousands (Domestic $ International))

2.3.2. Kenya Civil Aviation Authority

The Kenya Civil Aviation Authority (KCAA) is a State Corporation, established on 24th October 2002, which exists to regulate the Civil Aviation industry and provide Civil Aviation services on behalf of the Government of Kenya. KCAA is composed of four Directorates which are:

- Aviation Safety and Security Standards and Regulations,
- Air Navigation Services (ANS),
- East African School of Aviation (EASA), and
- Corporate Services.

The ANS Directorate is responsible for providing Air Navigation Services within the Kenyan airspace and any other airspace delegated to Kenya by ICAO, which includes:

- Air Traffic Services (ATS),
- Aeronautical Information Services (AIS), and
- Engineering and Telecommunication Services (CNS).

Kenya Civil Aviation Authority (KCAA) which is the public corporation that owns and operates Kenya's civil air navigation service, has invested over Ksh 5 billion since 2008 to modernize Kenya's air navigation system. These investments have helped improve safety and operational efficiency for all customers, and have facilitated reductions in fuel burn and GHG emissions.

KCAA also involved in the INSPIRE collaborative initiatives that support the reduced impact of aviation on the environment

KCAA has made significant progress towards adopting performance based navigation (PBN), using existing specifications and instrument procedure design criteria. Furthermore, KCAA established a PBN Working Group with customers and stakeholders, which developed a PBN implementation framework and concept of operations for Kenya (see Annex 2- Subgroup 1)

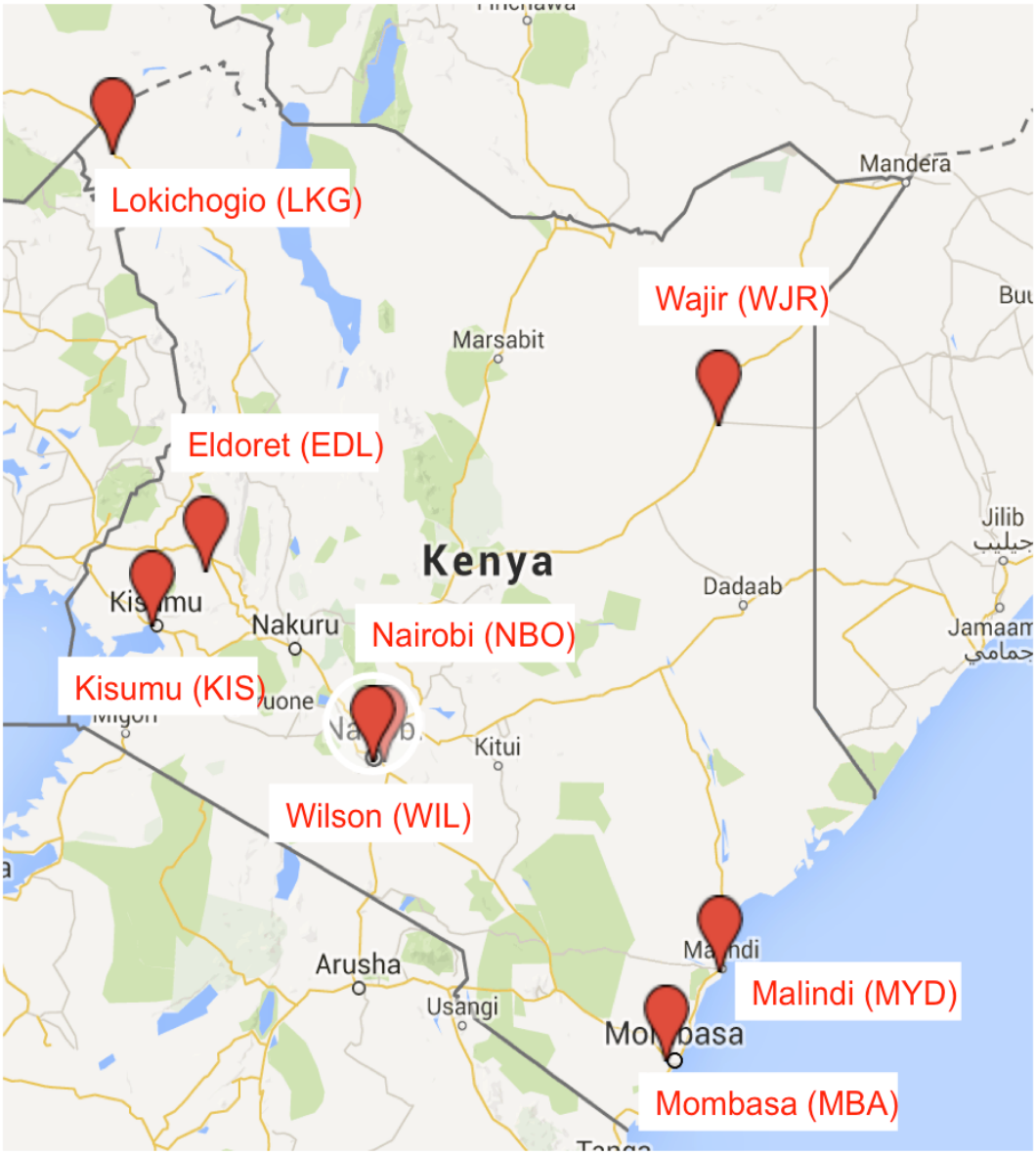
2.3.3. Airport Facilities and Management

2.3.3.1. Airports Infrastructure in Kenya

Kenya has international and domestic air transport facilities which are continuously being upgraded. There are eight international airports (Jomo Kenyatta, Moi, Eldoret, Kisumu, Wajir, Lokichoggio, Malindi and Wilson) and more than 500 airstrips around the country. Nairobi's Jomo Kenyatta International Airport serves more than 75 airlines providing direct scheduled services to major capitals in Africa, Europe, the Middle East and Asia. Wilson Airport, which is also in Nairobi, handles general aviation.

The following table and map give more details on the characteristics and location of the eight international airports in Kenya.

	ICAO	IATA	Airport Name	City
1	HKEL	EDL	Eldoret	Eldoret
2	HKKI	KIS	Kisumu	Kisumu
3	HKLK	LKG	Lokichogio	Lokichogio
4	HKMO	MBA	Moi	Mombasa
5	HKML	MYD	Malindi	Malindi
6	HKJK	NBO	Jomo Kenyatta	Nairobi
7	HKNW	WIL	Wilson	Nairobi
8	HKWJ	WJR	Wajir	Wajir



Jomo Kenyatta International Airport (JKIA) is Kenya's largest airport facility and the busiest airport in East and Central Africa and also serves as a major cargo centre for both inbound and outbound goods. JKIA is located in Embakasi, a suburb to the south-east of Nairobi, Kenya. Other than Kenya's leading airline, Kenya Airways, the airport serves as a hub for other major airlines including British Airways, Virgin Atlantic, KLM, Emirates, South African Airways, Egypt Air and other African airlines.

The initial design capacity of JKIA was to serve about 2.5 million passengers per year but over the years this capacity has been overshot to over 6.5 million passengers per year. The aircraft movement (ATM) has also increased to reach over 72,700 aircrafts per year and is predicted to reach over 195,000 aircrafts per year by the year 2030. The current cargo handling capacity is estimated at 252,000 tons having increased by over 50,000 tons over the last 7 years alone. The number of flights handled at the airport has also increased by almost 45% in 7 years.

2.3.2.2. Kenya Airports Authority (KAA)

The Kenya Airports Authority (KAA) was established in 1991 through an act of parliament (The Kenya Airport Authority Act, Cap. 395) and is charged with an umbrella responsibility of providing services and managing a coordinated system of all airports and aerodromes in the country. The KAA mandate includes the following;

- Coordinating operations in airports and aerodromes;
- Management of facilities within airports and aerodromes;

- Overall management and administration of airports and aerodromes;
- Provision of services and facilities necessary for aircraft operation;
- Ensure good environmental, health and safety status at all airports and aerodromes.

Aligned with the national focus of "The Kenya Vision 2030", KAA strives for environmental sustainability and has created in 2006 an environmental section with full-time trained personnel in charge of promoting integration of environmental considerations in all airport activities in compliance with environmental standards and legislations. In 2006, the Environment section had one environment personnel and two other officers were recruited in 2011.

Details on the initiatives already undertaken by KAA for the environment are described in section 4.2.5.

2.3.4. National Airlines

The following national airlines registered in Kenya are serving international flights.

	ICAO	IATA	Airline name
1	XAK	P2	Air Kenya
2	-	K4	Aircraft Leasing Services
3	ACP	8V	Astral Aviation
4	BBZ	-	Blue Bird Aviation
5	EC	EC	East African Airways
6	KQA	KQ	Kenya Airways
7	XLK	F2	Safari Link
8	FFV	5H	SAX/FLY 540

2.3.5. Kenya Airways

Kenya Airways is the National carrier for Kenya. It was established in January 1977 following the breakup of the East African Community and subsequent disbanding of the jointly-owned East African Airways. It contributes to 90% of the Kenya registered operators traffic; of this traffic, 72% of KQ flights are international while 28% is domestic. The airline has a fleet of 37 aircraft comprising of 9 B787, 8 737-800, 3 B737-700, 4 B737-300 and 15 Embraer 190. The average aircraft age for Kenya Airways is 4.93 years as at November 2015. It operates to 52 destinations.

Kenya Airways is committed to the reduction of carbon emissions and has employed various fuel efficiency initiatives. Guided by IATA principles, the

initiatives are implemented during the day to day operations of the airline. They are categorized into 4 major areas of savings;

i) Flight Dispatch -43%
ii) Flight Operations – 33%
iii) Maintenance and Engineering – 14%
iv) Ground Operations and Commercial – 10%

2.3.5.1 Flight Dispatch

Fuel efficiency requires a coordinated effort between Flight Operations, Dispatch and Operations Control. Many opportunities for fuel savings and reduced emissions exist from the start of the planning process through the execution of the flight. With the help of a flight planning management system, Kenya Airways ensures fuel efficiency by;

- Optimizing cost index
- Flight Plan Optimization
- Fuel Bias
- Alternate Selection / No ALTN IFR
- Contingency Fuel reduction from 5% to 3%
- Reduction of Pilot / Dispatcher Additional Fuel
- Zero Fuel Weight Accuracy
- C of G Management
- Mission Management
- Excess Taxi Fuel Allowance

2.3.5.2 Flight Operations

The flight operations department is involved in delivering fuel savings. Some of the initiatives carried out include;

- APU Utilization
- Taxi
- Optimized Taxi Fuel
- Engine Out Taxi
- Reduced Flap Take off
- Reduced Acceleration Altitude
- Low Noise Low Drag Approaches
- Continuous Descent Approaches
- Reduced Flap Landing
- Idle Reverse on Landing
- Pilot Technique & Flight Management

2.3.5.3 Maintenance and Engineering

The Engineering department is involved in the following initiatives:

- Weight reduction
- Moisture in insulation blankets, fly-away kit
- On-board weight: dirt, dust, over-paint, etc.

- Drag Reduction through rigging of aircraft panels; Doors, seals
- Paint & cleanliness
- Engine Improvement
- Engine core wash, engine build for fuel efficiency

2.3.5.4 Ground Operations and Commercial

The Ground Operations and Commercial department is involved in the following initiatives:

- Aircraft Handling – how the aircraft is powered, air-conditioned, and moved while on the ground.
- Aircraft Servicing – the various services performed on the aircraft on the ground (excluding maintenance) such as fueling, cleaning, and loading/unloading.
- Aircraft Commercial (Discretionary) Weight – that weight added to required aircraft weight during ground servicing for customer comfort or service, as well as for commercial or competitive purposes.
- Portable Water
- On-board Weight Reduction ; Catering carts and galley equipment, Duty free carts , Cargo containers and pallets, magazines and newspapers

2.3.5.5 Carbon Offset Program

To ensure environmental sustainability and in an effort to attain carbon neutral growth by 2020, Kenya Airways is currently offsetting the carbon emissions produced from its flights by;

a) Implementing a voluntary carbon offsetting platform allowing guests to offset the carbon emitted from their booked flight; the monies collected from this program are used in the rehabilitation of the Kasigau Corridor REDD+ project in Voi.
b) Purchasing fuel efficient aircraft thus reducing the Carbon emissions.
c) Planting trees as a Corporate Social Responsibility (CSR) project, so far having planted approximately 750,000 indigenous trees in Ngong forest.

2.3.6. Air Navigation Service Providers

The Directorate of KCAA that is responsible for providing air navigation services within the Kenyan airspace and other airspaces delegated to Kenya by ICAO. In order to provide the required air navigation services for safe landings, take-offs and over flights, the Directorate has installed equipment in various parts of the country. Due to the heavy capital investment made in the past few years through acquisition of ANS equipment which comprises of ATS facilities, AIS facilities, CNS facilities and SAR facilities., Kenya currently benefits from some of the most modern air navigation infrastructure in Africa.

2.3.7. Kenya Meteorology Department

Kenya Meteorological Department (KMD) started as a small colonial service for East Africa way back in 1929, called the British East African Meteorological Service (BEAMS), to provide meteorological and climatological services to various sectors of the economy.

KMD became a Department of the Government of Kenya in 1977 from the previous East African Meteorological Department (EAMD) after the collapse of the East African Community (EAC).

As stated in the World Meteorological Organization (WMO) Convention, the purpose of a National Meteorological and Hydrological Services (NMHS), like KMD, is in observing and understanding weather and climate and in providing meteorological, hydrological and related services in support of relevant national needs, which include the following areas:

- Safety of life and protection of property;
- Safeguarding the environment;
- Contributing to sustainable development;
- Promoting long-term observation and collection of meteorological, hydrological and climatological data, including related environmental data;
- Meeting international commitments;,
- Contributing to international cooperation.
- KMD issues 24-hour, 5-day, monthly (30-day), and seasonal (90-day) forecasts.

KMD also provides specialised services to other sectors of the economy including; Aviation, Agriculture, Energy, Health, Insurance, Water Resources, Forestry and Wildlife, Tourism, Disaster Management, Marine and the environment, among others.

KMD not only offers Aviation Meteorological Services in all the major airports in Kenya including JKIA, MIA, EIA, Wilson Airport, Malindi Airport, Wajir Airport and Kisumu Airport but also to the Kenya Airforce airfields. The type of service depends on the size of the airports and their operational needs.

2.4. Aviation Environmental Working Group

The Aviation Environmental Working Group was officially created in 2012.

The following table describes the participating stakeholders and the positions of their representatives within the group.

Organization	Category	Position of representative
Kenya Civil Aviation Authority (KCAA)	Government	National Focal Point
		Alternate National Focal Point
		Chief Air Traffic control officer
		Senior aeronautical information officer
		Chief inspector ground operations
		Chief inspector Air traffic Management
		Legal Officer
Kenya Airports Authority (KAA)	Government	Manager Environment
		Quality Manager
		Environment Officer
National Environmental Management Authority (NEMA)	Government	Compliance & enforcement Officer
		Chief Research Officer
		Principal Compliance & enforcement Officer
Kenya Meteorological Department	Government	Senior Assistant Director
Ministry of Transport and Infrastructure	Government	Director Air Transport
Ministry of Environment and Mineral Resources	Government	*National Climate Change Secretariat*
Ministry of Defence	Government	Environment Coordinator
Kenya Airways	National Airlines	Environment Coordinator
		Fuel Analyst
Kenya Association of Air Operators (KAAO)	National Airlines	Executive Secretary
African Express Airways	National Airlines	Manager Ramp Services
SAX/540		Chairman
Kenya Aerotech	Ground Handling	Manager Ramp Services

3. BASELINE FOR CO_2 EMISSIONS IN INTERNATIONAL AVIATION

3.1. Data collection

Historical data on fuel burnt and RTK for the years 2010 to 2014 (five years) were obtained from the main national airline Kenya Airways (KQ). While other national air carriers serve international flights in Kenya as well, KQ represents more than 80% of the international traffic. Due to the challenges met by other national airlines to provide similar historical data, the baseline was calculated based on KQ data only. Future updates of the Action Plan will take as far as possible account of the other national airlines as well.

The historical data that was used to calculate the baseline is detailed in the following table.

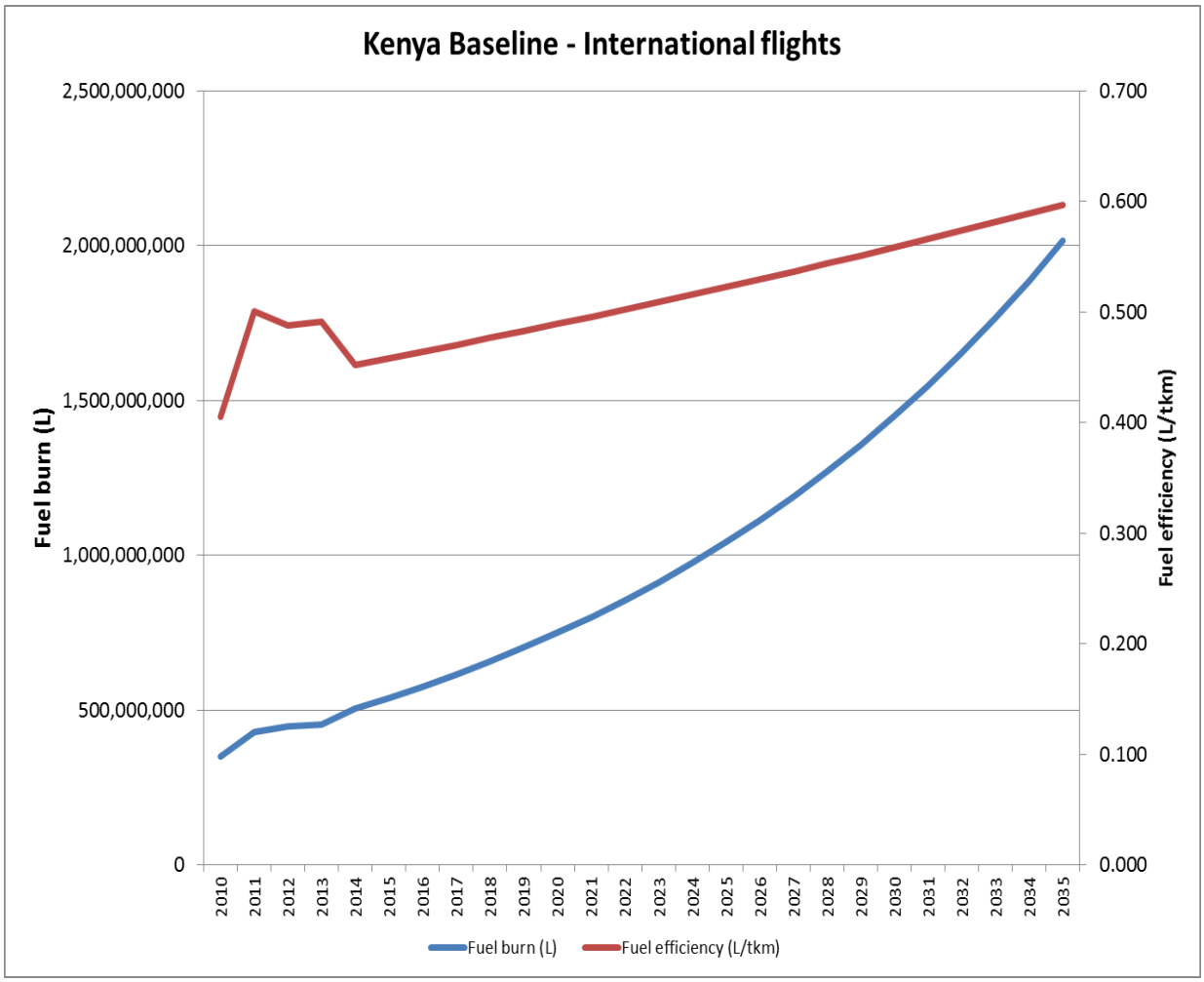
Year	Fuel Burn (in tonnes)	RTK (tkm)	Fuel efficiency (in litre sper RTK)
2010	281,092	867,615,649	0.404977849
2011	343,546	857,415,984	0.500845124
2012	356,956	915,134,999	0.487573547
2013	362,144	921,665,778	0.491155376
2014	404,242	1,118,515,206	0.451762914

3.2. Baseline calculation

The ICAO methodology for 5 years of historical data was used to calculate the baseline for Kenya. The following table and figure illustrate the results of the projection up to the horizon of 2035.

BASELINE					EXPECTED RESULTS		
Year	International RTK (tkm)	International Fuel burn (L)	International CO2 emissions (kg)	Fuel efficiency	International Fuel burn (L)	International CO2 emissions (kg)	Fuel efficiency
2010	867,615,649	351,365,119	888,251,021	0.405	351,365,119	888,251,021	0.405
2011	857,415,984	429,432,615	1,085,605,651	0.501	429,432,615	1,085,605,651	0.501
2012	915,134,999	446,195,617	1,127,982,520	0.488	446,195,617	1,127,982,520	0.488
2013	921,665,778	452,681,102	1,144,377,826	0.491	452,681,102	1,144,377,826	0.491
2014	1,118,515,206	505,303,689	1,277,407,725	0.452	505,303,689	1,277,407,725	0.452
2015	1,178,915,027	539,699,923	1,364,361,405	0.458	454,835,208	1,149,823,405	0.386
2016	1,242,576,439	576,437,523	1,457,234,059	0.464	468,324,828	1,183,925,165	0.377
2017	1,309,675,566	615,675,867	1,556,428,593	0.470	506,072,115	1,279,350,306	0.386

BASELINE					EXPECTED RESULTS		
2018	1,380,398,047	657,585,182	1,662,375,340	0.476	546,388,876	1,381,271,077	0.396
2019	1,454,939,541	702,347,282	1,775,533,928	0.483	589,450,015	1,490,129,638	0.405
2020	1,533,506,277	750,156,356	1,896,395,267	0.489	635,442,345	1,606,398,247	0.414
2021	1,616,315,616	801,219,814	2,025,483,689	0.496	684,565,391	1,730,581,309	0.424
2022	1,703,596,659	855,759,183	2,163,359,214	0.502	737,032,264	1,863,217,564	0.433
2023	1,795,590,878	914,011,070	2,310,619,984	0.509	793,070,579	2,004,882,425	0.442
2024	1,892,552,786	976,228,187	2,467,904,856	0.516	852,923,446	2,156,190,472	0.451
2025	1,994,750,636	1,042,680,449	2,635,896,176	0.523	916,850,523	2,317,798,121	0.460
2026	2,102,467,171	1,113,656,145	2,815,322,735	0.530	985,129,142	2,490,406,471	0.469
2027	2,216,000,398	1,189,463,186	3,006,962,935	0.537	1,058,055,516	2,674,764,343	0.477
2028	2,335,664,419	1,270,430,445	3,211,648,164	0.544	1,135,946,018	2,871,671,534	0.486
2029	2,461,790,298	1,356,909,178	3,430,266,403	0.551	1,219,138,560	3,081,982,279	0.495
2030	2,594,726,974	1,449,274,556	3,663,766,077	0.559	1,307,994,053	3,306,608,966	0.504
2031	2,734,842,231	1,547,927,283	3,913,160,171	0.566	1,402,897,977	3,546,526,085	0.513
2032	2,882,523,711	1,653,295,343	4,179,530,627	0.574	1,504,262,050	3,802,774,463	0.522
2033	3,038,179,991	1,765,835,851	4,464,033,031	0.581	1,612,526,019	4,076,465,776	0.531
2034	3,202,241,711	1,886,037,038	4,767,901,633	0.589	1,728,159,561	4,368,787,371	0.540
2035	3,375,162,763	2,014,420,371	5,092,454,699	0.597	1,851,664,328	4,681,007,420	0.549



4. MITIGATION MEASURES FOR CO_2 EMISSIONS REDUCTION IN AVIATION

4.1. Past and ongoing initiatives

In the recent past, Kenya like other states have being developing some initiatives that will have positive impact to reduce greenhouse gases (GHS) emitted from Kenyan aviation, mainly CO_2 gas emissions.

4.2. Selected mitigation measures for the Action Plan

In this section, mitigation measures selected for the Action Plan are presented according to the seven categories of the *basket of measures* defined by ICAO in its Doc 9988.

To build on the aviation sector's fuel efficiency advances, the Kenyan aviation industry together with the Government of Kenya must address a number of challenges and explore new opportunities. Subsequently, the Action Plan takes a sustainable development approach by taking into account the environmental, social and economic impacts of each measure.

4.2.1. Aircraft-related Technology Development

Background

Kenya Civil Aviation Authority forecasts that the air traffic will grow at an average annual rate of 5 percent until 2030 for both domestic and international air traffic (Annex 1). Kenya's forecast is largely in line with the air traffic forecasts produced by the aviation industry

In response to changing markets, Kenyan aviation industry continually modernizes their fleets, infrastructure and technology. The aviation industry plans to invest over $2.99328 billion more between 2011 and 2020.

The fleet renewal efficiency gains are dependent on two assumptions:

i. New aircraft being delivered on schedule. Delays in aircraft delivery may impact anticipated fuel efficiency improvements;
ii. All replaced aircraft will be retired from service. However, if these aircraft remain in or return to service, this could impact fuel efficiency improvements.

In the last years, the national airline Kenya Airways (KQ) has initiated an important fleet renewal, mainly to replace the old fleet of six B767 aircrafts into a new fleet of six B787 (Dreamliners). In order to address the traffic increase, three B787 and 15 E-190 were purchased in addition, that are all operational.

Mitigation measures selected for the Action Plan

The mitigation measure considered in the Action Plan includes the replacement of six B767 by six B787. Further changes in the fleet as well as new aircrafts may lead to additional impacts on the overall fuel efficiency of KQ fleet that will be reflected in the CO_2 emissions monitoring conducted during the implementation of the Action Plan. These evolutions may be taken into account in the future in the upcoming updates of the Action Plan.

Overall, national airlines of Kenya expect to achieve an average annual fuel efficiency improvement of **0.7 percent** for both domestic and international flights between 2010 and 2020 through further fleet changes.

4.2.2. Alternative fuel

Background

Moving forward, development of **sustainable alternative aviation fuels** will be a key initiative required by the aviation industry to meet the global aspirational goal of carbon neutral growth from 2020. Substantial advances in developing and commercializing sustainable alternative aviation fuels will be needed in light of the key issues related to limited fuel options and availability of supply for aviation.

Kenya Government is developing a comprehensive renewable fuels strategy primarily focused on on-road transportation with five key elements:

i) A regulation to establish minimum bio fuels content for ethanol and diesel;
ii) Programs to support farmer participation in the industry;
iii) A production incentive to stimulate domestic production;
iv) Encourage the use of ethanol from the sugar industries ;and
v) Initiatives to support next generation technologies.

The Government of Kenya will continue to assess the effectiveness of the renewable fuels strategy and analyze areas for future policy development. In particular, the Government of Kenya and the aviation industry will work

collaboratively to discuss the potential benefits and barriers to alternative aviation fuel production and use in Kenya.

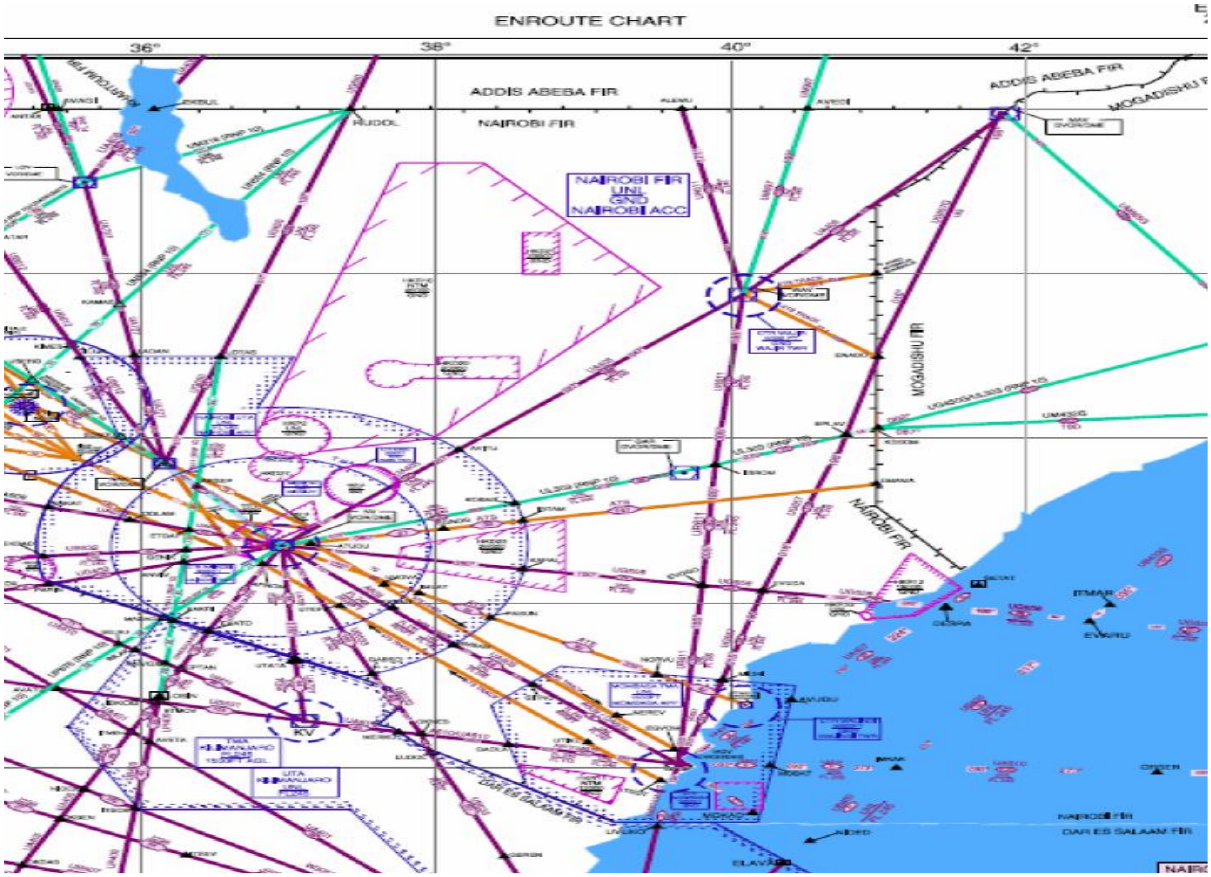
Mitigation measures selected for the Action Plan

The government of Kenya will set a taskforce to develop a policy framework for support and promote the production, storage and distribution of sustainably produced drop-in biofuels for use in aviation.

4.2.3. Improved ATM and infrastructure use

Background

Kenya's **Air Traffic Management** system and airport facilities have been greatly improved over the past one decade. While real environmental benefits have been realized, the expected growth in air traffic will require the Kenyan aviation industry to continue to make further advances.



Mitigation measures selected for the Action Plan

Performance-based Navigation (PBN) — Shifting from ground based to sensor-based navigation which will enable more efficient en route and airport operations for equipped aircraft, reducing fuel burned and associated CO_2 gas emissions. Building on existing PBN activities and further implementation could improve average annual fuel efficiency by 1 to 2 percent between 2010 and 2020. The benefits are being realized within the current PBN stage as per the National PBN plan.

KCAA and the Kenyan aviation industry will work together to develop and put in place an ICAO State PBN Implementation Plan for Kenya.

- KCAA will continue to move short- and medium-term solutions forward to advance PBN in Kenya. These measures include:
  1. Incorporating new PBN-based Kenyan air navigation procedures, aligned with those of East Africa; and
  2. Continuing to work with ICAO to develop and incorporate new international procedures for Kenya's air navigation system.

- The Kenyan PBN Working Group, which includes representatives from KCAA, and the Kenyan aviation industry, will identify, within the next two years, the regulatory requirements and any other non-regulatory mechanisms to help determine short-, medium-, and long-term opportunities for adopting PBN. The work of the PBN Working Group began in 2009.

Surveillance—KCAA has and will continue to use technologies that increase surveillance capability and coverage to maximize benefits and minimize costs. Increased surveillance capability, both airborne and on the ground, will result in more efficient air operations.
Benefits include:

a) Increased airspace capacity;
b) Faster response times to pilot requests;
c) More flexible routing; and
d) Fewer ground delays.

KCAA will also continue to use existing mechanisms to engage customers and stakeholders who may be affected by any changes to the Air Navigation System.

Reducing GHG Emissions at the Gate and on the Ground — Airlines and airports are working together to reduce emissions from APUs and ground support equipment (such as baggage tugs and tractors). For example, Kenya Airport Authority (KAA) is in the process of constructing a green terminal at Jomo Kenyatta airport, which will help to minimize the use of APUs. Airlines and Airport Authority will also collaborate to develop an effective way to track how these efforts reduce emissions from these sources.

Taxi Operations—The Kenyan aviation industry (airports, airlines, and KCAA) will continue to work together to reduce GHG emissions by reducing airport aircraft ground emissions through improved taxi and queuing procedures. KCAA and KAA will establish slot time allocation. This Taxi times will then be monitored. Other tools to assist in reducing this time e.g. AMAN & DMAN will also be employed together with infrastructure improvements.

GHG Emission Inventories— KCAA will be receiving and arching data from Kenyan airlines to refine and improve data quality and explore opportunities to adopt emission reductions strategies.

4.2.4. More efficient operations

Background

Kenya airlines expect to achieve an average annual fuel efficiency improvement of 0.7 percent for both domestic and international flights between 2010 and 2020 through improved operations.

- Kenya Association of Air Operators (KAAO) will encourage its members to continue to adopt operational improvements to reduce emissions.
- KCAA will continue to work through ICAO to help prepare, provide guidance, to encourage technology and operational improvements. This includes updating ICAO Circular 303 *Operational Opportunities to Minimize Fuel Use and Reduce Emissions*.

Mitigation measures selected for the Action Plan

The measures will mainly aim at enforcing further best practices in operations, such as minimizing weight, in compliance with KCAA AIC NO. 8/15 of 2015 (see Annex 4).

The national airline Kenya Airways is also considering the opportunity to acquire a Fuel Management System that would contribute to a reduction of

the fuel consumed. According to their initial analysis, an improvement of 5% of the fuel efficiency could be obtained with this system. Annex 7 provides more details on the cost-benefits of this measure.

Selecting aircrafts best suited for the mission and optimizing aircrafts maintenance (engine or aircraft wash) are additional measures considered in this category.

4.2.5. Airport improvements

Background

KAA has already undertaken significant initiatives for the environment, including:

- Undertaking environmental impact assessments for construction of KAA large projects and implementation of subsequent environmental management plans together with engineering contractors. Emission reduction from machines and equipment is one of the key issues address.
- Undertaking environmental audits which involved evaluation of airport activities and processes of ongoing projects to determine how far they conform to sound environmental requirements.
- Development of waste Audits and prepared waste management plans in accordance with national regulations.
- KAA has also embarked on preparation of Noise Maps and Noise mitigation action plans for JKIA, MIA, EIA, KIA and soon Wilson Airport. KAA is the first institution to achieve this in the country.
- KAA has successfully planted and maintained trees in various airports to promote ecological restoration. The number of trees planted per airport include;
    - ✓ 600,000 trees in Eldoret Airport,
    - ✓ 150,000 trees in JKIA,
    - ✓ 6000 trees in Kitale airstrip,
    - ✓ 3000 trees in Isiolo Airport,
    - ✓ 3000 trees in Nyaribo Airstrip,

  All these trees were planted as a carbon sink.

Other projects include;

- Replacement of indoor lighting for JKIA terminal building lighting to LED
- Replacement of current streetlights with LED in JKIA

- Replacement of Air conditioning systems with CFC free ones in All Airports
- There is proposal to Switch to renewable sources of energy (Solar Power that can generate 6MW)

Thanks to a US$2M loan from the World Bank and the French Development Agency (AFD), KAA has also embarked in a set of activities for improved environmental management and monitoring at JKIA and other major airports by the year 2018, this project aims at achieving the following:

- Capacity building for Environmental officers in the following areas (environment and aviation, Noise and air monitoring, Strategic Environment assessment, benchmarking with good airport practices)
- Installation of Solid waste management infrastructure
- Purchase and installation of Noise and Air Monitoring equipments
- Environmental management Systems (ISO14001)
- Climate Change Mitigation

Other major "green" projects are planned in the coming years, as described in the following paragraphs.

The Green Terminal Project

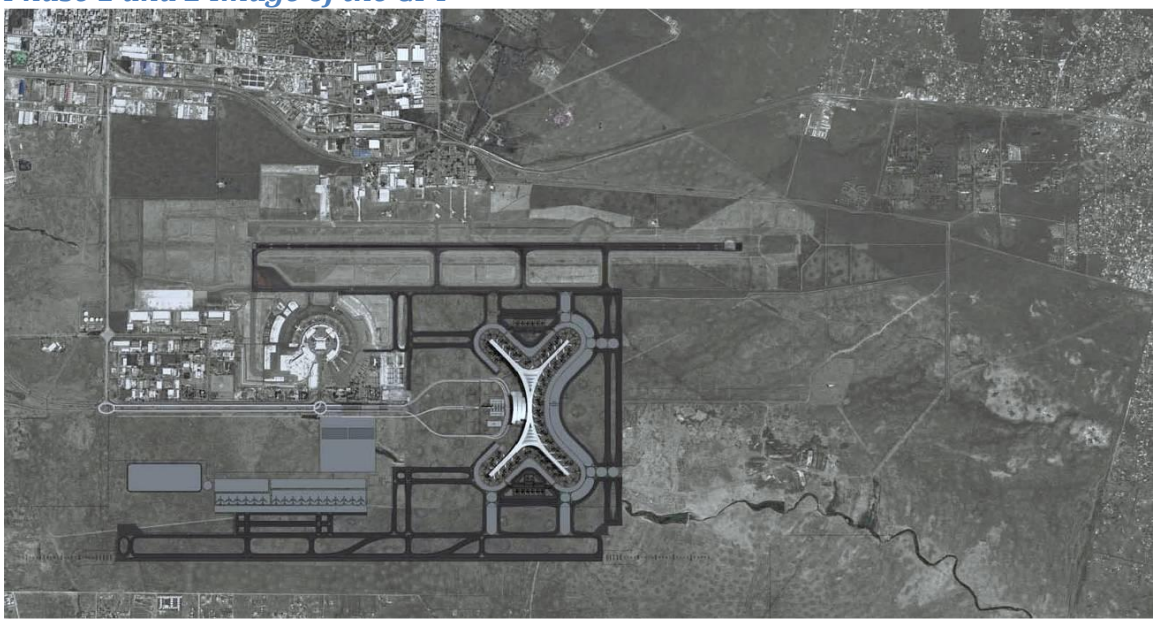
The passenger traffic at the Jomo Kenyatta Airport is expected to grow by the year 2020 to 12.7 million passengers per annum (3,339 passengers in the planning peak hour) and to 28.8 million passengers per annum by the year 2030. The Government of Kenya, through KAA, has embarked on a plan to expand JKIA by building the new Green Fields Terminal (GFT, also referred to as Terminal 3) and associated aircraft pavements (aprons and access roads) to handle the expected increased traffic flow.

The GFT is designed to meet world class standards and best practices in environment, social and economic terms. On the environmental front, the project is geared towards energy use reduction, water saving, natural lighting, natural aeration, waste reduction and safety focus. The ESMP has been developed under this report to provide a tool for ensuring integration of environmental and social recommendations into the project implementation and operations thereafter.

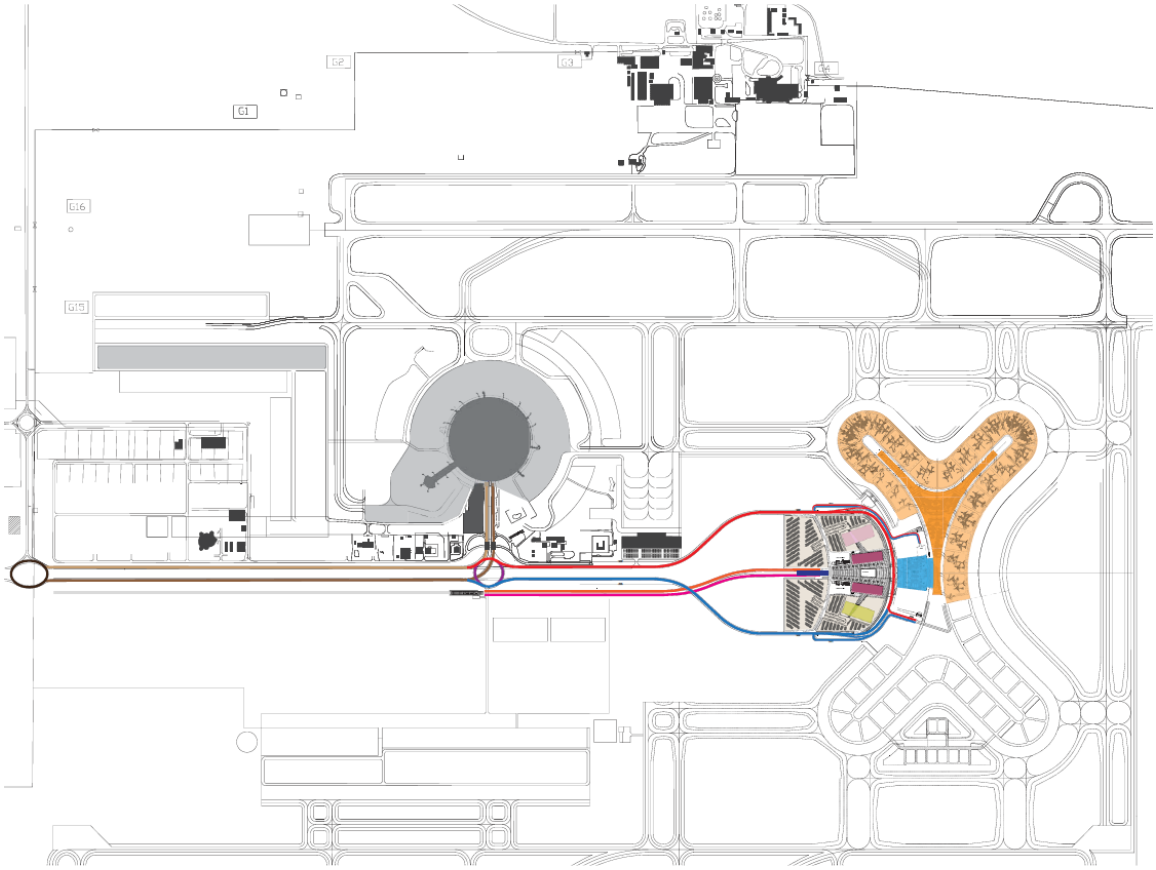
The current aerial view of the Airport

Source: Google Earth

Phase 1 and 2 Image of the GFT



Phase 1 Image of the GFT



The first phase of the GFT is expected to be complete by year 2020

A set of additional developments and reconfigurations at JKIA are under consideration to increase operations efficiency, and will be closely related to the progress of the GFT. This includes e.g.:

- A second runway parallel to the existing one
- New taxiways for rapid exit
- Remote stands comprising the construction of passenger apron and remote aircraft parking spaces

Improved energy use at international airports

Following an energy audit initiated by KAA in 2011, a set of initiatives have been planned to improve the energy use in 4 major international airports: Jomo Kenyatta, Moi in Mombasa, Eldoret and Wajir.

Through an integrated approach, this project aims at reducing the energy demand, improving energy efficiency and increasing the use of renewable energy in the selected facilities.

More details on these measures and their expected results are provided in Annex 6.

Carbon offset project

Under the World Bank funded projects, KAA has planned to undertake carbon foot print assessment for JKIA. This will form part of KAA commitment to Environment sustainability effort towards climate change mitigation.

Phase 1 of this assessment will be to acquire data on the sources and establish the amount of CO_2 emitted from JKIA operations. The output of this exercise will be a map of CO_2 emissions for the airport.

Phase 2 of this assignment will be development of reduction measures for JKIA. This will eventually help JKIA apply for Airport Carbon accreditation status, for both Phase 1 and 2. Only two African Airports currently hold this status.

This assignment will also provide a Carbon Neutralization strategy for JKIA. One of the proposed neutralization strategy KAA will plant One Million trees in a span of 5 years.

Mitigation measures selected for the Action Plan

The mitigation measures related to Airports improvements and selected for the Action Plan are focused, first, on reducing the use of APU by installing fixed electrical GPU and PCA. This measure, when applied to aircrafts performing international flights, contributes directly to reducing CO_2 emissions from international aviation.

In addition, initiatives are also planned to reduce energy demand at the main international airports and to switch to renewable energy to power Ground Support Equipment (GSE).

More details on these initiatives are provided in the list of measures (Annex 5) as well as in the Annex 6.

4.3. Additional Measures

This Action Plan contains other measures whose expected results are not expressed in quantitative terms due to the nature of the activity or their current

stage of implementation. These measures will be essential to achieving the long-term aspirational goals of the aviation industry.

4.3.1. Regulatory Measures

Development of CO_2 Emissions Standard

KCAA will continue to support in the development of a CO_2 standard for air transport, through ICAO's Committee on Aviation Environmental Protection (CAEP). This standard is targeted for completion by the year 2016. Once completed and adopted by ICAO, KCAA, NEMA and KEBS will adopt the standard domestically under Kenya Civil Aviation Act, EMCA, and Kenya Standard CAP 496.

Enhancing weather observation/forecasting services

The government of Kenya will enhance the weather forecasting services by implementing the following items;

- Weather Radar and a wind profiler for Jomo Kenyatta International Airport
- Wind profiler for Kisumu International Airport
- Upgrading of AWOS for Jomo Kenyatta International Airport &Eldoret International Airport
- Upgrading of forecasters systems at Moi International Airport
- Stand alone wind systems (mid runway for all the airports)
- Forecasters work stations for Eldoret International Airport and Kisumu Airport
- Enhanced training for aero-met staff

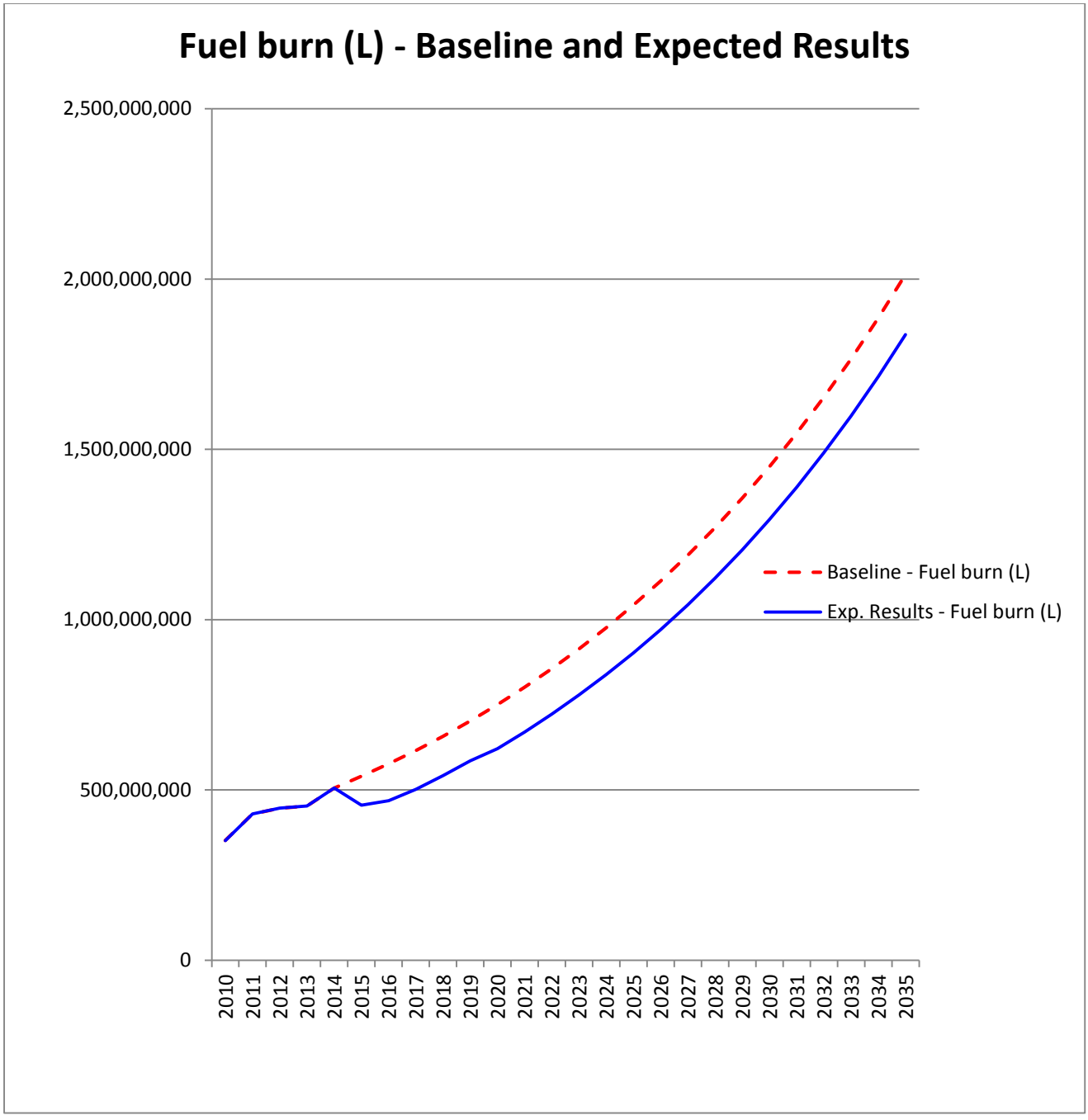
4.3.2. International Coordination

Recognizing that efforts to address climate change require international action and coordination, Kenya will continue to actively participate, through ICAO, on the implementation of global approaches and standards to address climate change. This will include participation in international meetings and conferences. Kenya will continue to engage the aviation industry and other stakeholders as part of the international dialogue on market based measures.

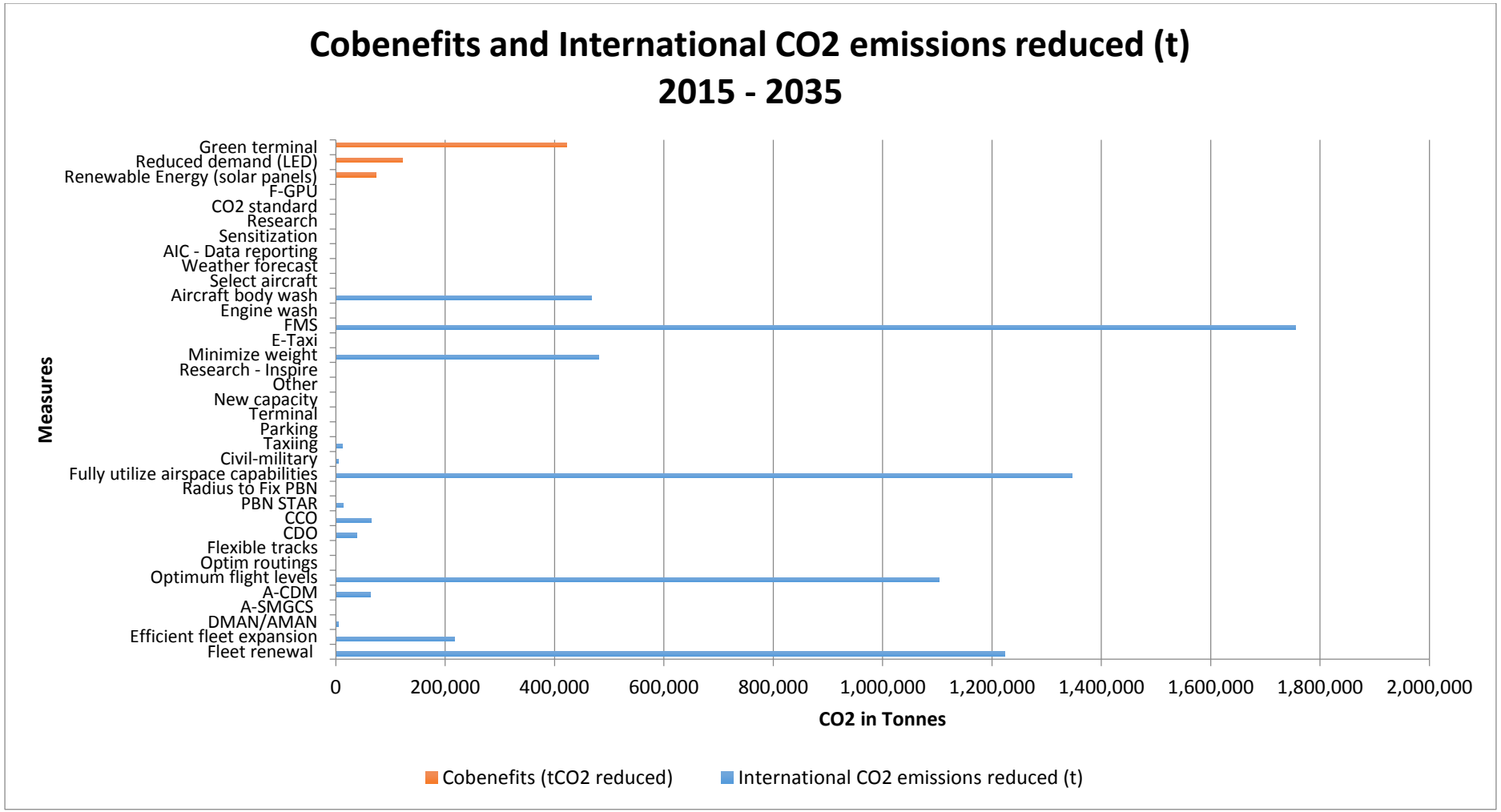
Kenya will continue to actively participate in other international forum e.g. United Nation Framework Convention on Climate Change (UNFCCC).

4.4. Expected results

The graph below shows the baseline and the expected results as a result of Implementation of the measures in the action plan



The graph below shows the Contribution of each selected measures in CO2 Emission reduction from internation aviation and the other Cobenefits.



5. ASSISTANCE REQUIRED

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

Kenya is particularly looking for assistance in the following areas:

1) Support in updating the present Action Plan;
2) Support in the development of technical capacity;
3) Support in financial capacity in the implementation of mitigation measures;
4) Support in the development / update of the baseline;
5) Assistance to set up systems for the monitoring of emissions in the Nairobi FIR, the national airlines and the airports;
6) Support in supply and installation of CO_2 gas monitoring system
7) Support in collaborate research endeavor's
8) Support in installation of fuel management systems for airlines
9) Support in modernization of weather observing equipment and capacity building
10) Support in supply and installation of complete solar unit
11) Support in construction of greenfield terminal and second runways at JKIA (note the Design are ready and complete)
12) Support in the development of a pilot project for alternative fuels for aircraft and ground based vehicles in Kenya.

The details on the assistance that may be solicited for each measure is described in Annex 5.

6. GOVERNANCE OF THE ACTION PLAN AND REPORTING

6.1. Governance

The Working Group on Aviation Emissions will oversee Kenya's Action Plan.

The Working Group will meet quarterly from October 2016, to monitor individual and collective progress made towards achieving Kenya's fuel efficiency target.

6.2. Quarterly meeting and Annual Reporting

The working group will be meeting and reporting the achievement quarterly. Annual Report will prepare to summarize the progress that has been made in meeting CO_2 gas emission reduction goals and other Action Plan activities. The first Annual Report will be published by December 31, 2016 on the KCAA website.

Kenya government (KCAA) will introduce an annual forum involving relevant Government agencies and industry to facilitate the exchange of information and ideas on mitigating actions and to discuss any obstacles to implementation.

The Annual Reports will include:

- A quantitative description of achievements (including relevant indicators such as litres of fuel consumed per Revenue Tonne Kilometre);
- KCAA will collect all of the information necessary to report on the fuel efficiency improvements achieved;
- A list of member companies reporting; and
- A quantitative and/or qualitative description of the actions taken by all Working Group members to achieve progress on the measures identified in the Action Plan. The aviation activity and emission data reported in the Annual Reports will be aggregated for domestic and international aviation

6.3. Review

The Working Group will conduct a review of the Action Plan within three years from the date of approval to assess progress towards the environmental goals and commitments and update the Action Plan.

6.4. Auditing and Monitoring

To ensure continued confidence in the reliability of the reports, a qualified auditor together with Working Group, will be given access at least once over the next five years of the Action Plan, to audit the reports, processes, and supporting documentation that pertain to the Action Plan.

7. ANNEXES

7.1 Annex 1: Traffic trends for the years 2010 to 2020

The statistics below capture the flights from national and foreign airlines serving Kenya.

Flights from 2010 to 2014 reflect historical data. Data from 2015 to 2020 are based on projections.

	2010	2011	2012	2013	2014
Flights International	79,967	90,837	88,618	88,463	83,030
Flights Domestic	153,276	174,882	176,046	170,941	143,375
Passengers International	3,924,771	4,409,638	4,392,273	4,258,770	4,431,209
Passengers Domestic	2,330,009	2,832,753	2,734,163	2,604,414	2,954,916
Freight International	246,507,663	303,697,967	294,606,752	260,356,610	274,359,208
Freight Domestic	2,276,562	2,288,567	1,788,823	2,123,936	3,738,728
Total Freight (Domestic and International)	248,784,225	305,986,534	296,395,575	262,480,546	278,097,936

	2015	2016	2017	2018	2019	2020
Flights International	86,816	90,785	94,945	99,307	103,879	108,673
Flights Domestic	147,941	152,670	157,568	162,642	167,898	173,344
Passengers International	4,649,833	4,879,262	5,120,031	5,372,702	5,637,862	5,916,131
Passengers Domestic	3,096,652	3,245,216	3,400,938	3,564,166	3,735,262	3,914,607
Freight International	296,654,588	320,767,951	346,848,142	375,056,250	405,566,624	438,567,968
Freight Domestic	4,047,506	4,381,925	4,744,125	5,136,430	5,561,358	6,021,637
Total Freight (Domestic and International)	300,702,094	325,149,876	351,592,267	380,192,680	411,127,982	444,589,605

7.2 Annex 2: Working Subgroups of the National Action Plan Team

The five following subgroups were created in order to focus on specific areas with the relevant key stakeholders:

1. Performance-based Navigation;
2. Surveillance;
3. Auxiliary Power Units (APU) and Ground Support Equipment (GSE);
4. Taxi in and out operations;
5. Fuel management system.

Subgroup 1: Performance-Based Navigation (PBN)

Description and Scope

Performance-Based Navigation (PBN) will provide benefits to equipped aircraft operators by allowing more efficient and flexible enroute and terminal (airport) operations than existing ground-based navigation. PBN includes both Area Navigation (RNAV) and Required Navigation Performance (RNP). The PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for States and operators. The PBN concept specifies that aircraft RNAV system performance requirements be defined in terms of the accuracy, integrity, availability, continuity and functionality, which are needed for the proposed operations in the context of a particular airspace concept.

Members of the Subgroup

Main manager: KCAA
Other members: KAA, Aircraft Operators and Kenya Association of Air Operators (KAAO)

Strategic Goals

Improved Air Navigation Services (ANS) and air operator efficiency.

Past and Current Progress

- KCAA developed its State PBN plan, in accordance with ICAO resolution A36-23
- The PBN regulations have been developed and advisory circular published
- The AIC is awaiting publication by December 2015

Timelines

• Short-Term (2008–2012)—Short-term implementation objectives are based on projects that have begun or are identified in KCAA's business plans as well as those that use PBN specifications that currently exist and are approved in Kenya.

• Medium-Term (2013–2016)—Transition from ground based to sensor-based environment.

• Long-Term (2017 and beyond)—KCAA will implement PBN as primary mode of navigation and encompassing new development e.g 4D RNP operations which are expected to be available to support a full gate-to-gate flight management environment.

Targets and Performance Measurement

To implement PBN, KCAA will transition on a schedule dictated mostly by customer needs, levels of equipage, and positive business cases.

To this purpose, KCAA commenced transitioning with the implementation of WGS084 and implementation of GNSS procedures, in line with the KCAA master plan and the AFI plan. Culmination of implementation will be marked by the release of AICs specifying the use of PBN within the airspace.

Reporting Schedule

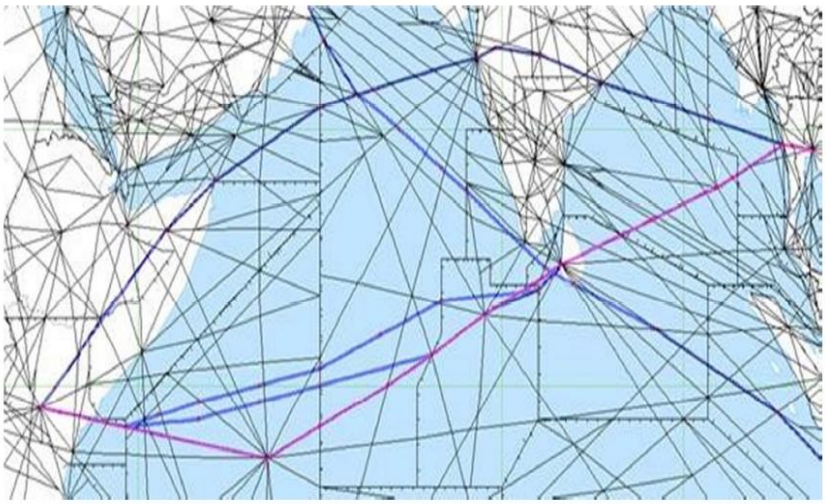
Quarterly

Example: UPR OPS Trials Phase 1 (28th June to 19th July 2012)

Figure 5. Nairobi Bangkok Routes

UPR track is depicted in cobalt blue.

Maximum flights using conventional routes use the northern route depicted in dark blue via Mumbai but the other possible southern route is also shown in pink.



Sr No.	Date	Aircraft Call sign	City Pair	Fuel Saved (kg)
1	18-Jul-12	KQ860	NBO - BKK	1745
2	19-Jul-12	KQ861	BKK - NBO	2214
Total Fuel Savings (kg)				**3959**
Total CO_2 Emissions Reduced (kg)				**12510**

Subgroup 2: Surveillance

Description and Scope

Increased airborne and surface (airport) surveillance capability will make ground and air operations more efficient. This means increased airspace capacity, faster response times to pilot requests, more flexible routing and less ground delays.

There are various technologies that can enhance surveillance capability and coverage in the current radar environment. KCAA will use a mix of surveillance technologies to maximize benefits and minimize costs, using a business case process.

Members of the Subgroup

Main manager: KCAA
Other members: KAA, Aircraft Operators and Kenya Association of Air Operators (KAAO) and Military

Strategic Goals

Improved Air Navigation Services (ANS), airports, and air operator efficiency

Past and Current Progress

- ADS-B Surveillance
- ADS-C Surveillance
- Controller Pilot Data Link Communications (CPDLC)
- A-SMGCS
- Wide Area Multilateration (WAM)
- Multilateration—Surface Detection
- Warning System—Radar Integration

Subgroup 3: Auxiliary Power Units (APU) and Ground Support Equipment (GSE)

Description and Scope

Airlines and airports have been working closely together to identify ways to reduce emissions from the use of auxiliary power units (APUs) and ground support equipment (GSE).

Emissions from an aircraft's APUs can be greatly reduced if ground-based alternatives are available and used. GSE is either owned directly by airlines or contracted by airlines from third-party providers and is a major part of airport ground operations. Airlines and airports are:

- Working to improve on their operational efficiency.
- Working to improve technology;
- Adding fixed ground power unit and air start unit infrastructure;

- Developing and adopting operating procedures to more effectively use the infrastructure.

These emission reduction opportunities support the Action Plan's targets. The range of potential CO_2 gas emissions reduction from these opportunities will be quantified as appropriate and feasible. The Working Group understands that these targets are intensity-based and will take into account an increase in flight schedules and equipment inventory.

Members of the Subgroup

Kenya airport authority, Kenya airlines, Kenya Association of Air Operators (KAAO), KCAA, ground handlers, NEMA.

Strategic Goals

Identify and implement opportunities to reduce emissions from APUs and GSE.

Past and Current Progress

The partners mentioned above have agreed to:
• Collect data on inventory of GSE and their fuel burn;
• Collect data on auxiliary power use, use of pre-conditioned air and ground power units
• Take inventory of gate infrastructure.

Targets and Performance Measurement

- Specific targets and performance measures will be determined from individual initiatives. Performance will be measured based on the amount of fuel saved by the airlines and ground handlers.

Reporting Schedule

- Responsibility of Reporting will be Ground Handler, Airlines, KAA and KCAA
- Through AIC for ENV1, the data will be reported quarterly

Subgroup 4: Taxi in and out operations

Description and Scope

The importance of managing aircraft taxi times increases with the increased number of aircraft ground movements (the busier the airport the more important this initiative becomes). Opportunities to reduce GHG emissions through improved taxiing and queuing procedures at all airports and reduce overall taxi times have been identified. The goal is to limit aircraft main engine run time on the ground.

Members of the Subgroup

KCAA, KAA, Kenyan airlines, Kenya Association of Air Operators(KAAO) and other stakeholders.

Strategic Goals

There are six areas targeted:

1. Data collection on various elements of airport taxiing and queuing operations;
2. Push-back operations;
3. Ground crew availability;
4. Ground surveillance improvements; and
5. Taxi infrastructure improvements.
6. E-taxiing

Past and Current Progress

- All of the initiatives above except e-taxiing are underway, as they generally provide improvements to efficiency, safety and reduce fuel costs and CO_2 gas emission.
- Assistance will be required to implement E-Taxiing

The partners mentioned above have agreed to advance the data on the airport taxiing and queuing operations, push-back operations, ground Crew availability, ground surveillance improvements, taxi infrastructure improvements.

Identification and addition of new taxiways and runways are an ongoing.

Targets and Performance Measurement

- Airside taxi out times can be reduced by an estimated 20 percent;
- Emission reductions and benefits will be measured based on fuel consumption of aircraft.

Reporting Schedule

Responsibility of Reporting will be Ground Handler, Airlines, KAA and KCAA

Subgroup 5: Fuel Management System

Description and Scope

This measure aims at installing a Fuel Management System at Kenya Airways, the main national airline representing more than 80% of the international traffic in Kenya.

Members of the Subgroup

Kenya Airways and other Airlines and KCAA

Strategic Goals

International emissions reduction and co-benefits as follows:

- To efficiently manage initiatives in order to maximize carbon emission reduction;
- To monitor fuel consumption hence establish where fuel savings can be made;
- To have 100% accuracy and completeness in reporting of carbon emissions;
- To have timely reports;
- To extract reports compatible with the ENV1 format used to report to the regulator.

Timelines

2016

Targets and Performance Measurement

Kenya Airways understands the need to reduce fuel consumption and carbon emissions and has embarked on implementation of various initiatives as well as an automation project to capture fuel data electronically (ACARS). Despite these efforts, the company is experiencing challenges in realizing the full potential of the fuel savings because it lacks a robust fuel management system. Acquisition of this system is not attainable given the current financial position of the company therefore seeking assistance on the same.

7.3 Annex 3: The National Strategy

Constitution of Kenya

The constitution of Kenya recognizes the need to protect the environment. Chapter Five Part 2 Section 69 and 70 says;

69. (1) The State shall—

(d) encourage public participation in the management, protection and conservation of the environment;
(f) establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
(g) eliminate processes and activities that are likely to endanger the environment; and
(*h*) utilise the environment and natural resources for the benefit of the people of Kenya.

(2) Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

70. (1) If a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter.

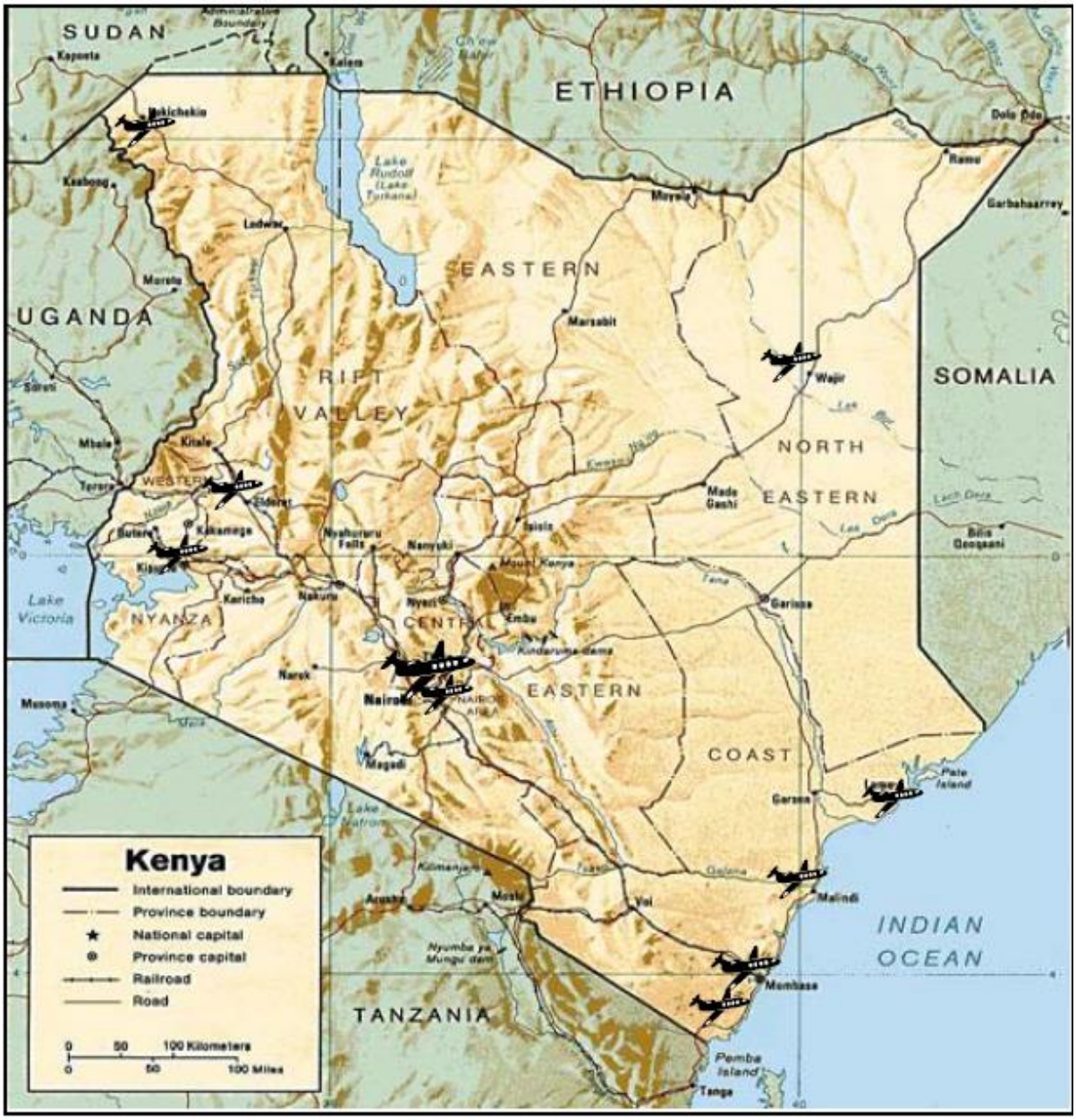
(2) On application under clause (1), the court may make any order, or give any directions, it considers appropriate—

(a) to prevent, stop or discontinue any act or omission that is harmful to the environment;
(b) to compel any public officer to take measures to prevent or discontinue any act or omission that is harmful to the environment; or

Legislation

All the emissions are covered by the Environmental Management and Co-Ordination Act, 1999.
Part VII Section 78 Subsection (d) state that;
78. (1) the standards and enforcement review committee shall, in consultation with the relevant lead agencies:

(d) recommend to the authority guidelines to minimize emissions of green houses gases and identify suitable technologies to minimize air pollution;
(e) advise the authority on emissions concentration and nature of pollutants emitted;
(f) recommend to the authority the best practicable technology available in controlling pollutants during the emission process.



7.4 Annex 4: AIC 8/15 for Data Collection

KENYA CIVIL AVIATION AUTHORITY
AERONAUTICAL INFORMATION SERVICES
P.O BOX 30163- 00100
NAIROBI

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AIC
8/15
(White 146)
21 JUL 2015

The following circular is hereby promulgated for information, guidance and necessary action.

Capt. Gilbert M. Kibe
DIRECTOR GENERAL

MEASURES FOR OVERALL IMPROVEMENT IN FUEL EFFICIENCY WITH CO-BENEFIT OF REDUCTION OFCARBON DIOXIDE (CO_2) GAS EMISSIONS IN THE KENYAN AVIATION SECTOR

1. PURPOSE

The objective of this circular is to improve the overall fuel efficiency by all stakeholders in aviation sector and as co-benefit to reduce emissions of carbon dioxide (CO_2) by adopting simple but effective measures to meet a specific goal.

The goal is annual improvement in Fuel Efficiency i.e Fuel/Revenue Tonne Kilometer (RTK) above the current scenario over a 5-year period from 2015-2020.

RTK has been chosen as the preferred metric based on the metric adopted by International Air Transport Association (IATA) for calculating fuel efficiency. This metric provides a better indication of the actual social-economic performance of the sector in combination with fuel data.

Achievements can be evaluated against a baseline of actual past emissions or a projection of baseline forecasted emissions depending upon the current growth.

2. BACKGROUND

ICAO Circular 303 on "Operational Opportunities to Minimize Fuel Use and Reduce Emissions" focuses on a compilation of operational measures that achieve near-term reductions in aircraft emissions, and in supporting ground operations. The circular is based on the understanding that the most effective way to minimize aircraft emissions is to minimize the fuel used in operating each flight. It identifies areas where improvements can be made. According to the *Circular 303,* the operational opportunities and techniques to minimize aircraft fuel use can be categorized as follows:

a) Fly the most fuel efficient aircraft type for the sector;
b) Fly the most fuel efficient route;
c) Fly at the most fuel-efficient speed;
d) Operate at the most economical altitude;
e) Maximize the aircraft's load factor;
f) Minimize the empty weight of the aircraft;
g) Load the minimum fuel to safely complete the flight;
h) Minimize the number of non-revenue flights; and
i) Maintain a clean and efficient airframe and engines.

There are other options to reduce aerodynamic drag through efficient distribution of load and technological options that may be considered as well. Clearly, all these options may not necessarily be practicable or cost effective, but some may offer fuel reduction. Technological options include;

a) Installation of winglets on aircraft
b) Engine retrofits and/or upgrades
c) Re-engining aircraft
d) Use of aerodynamically clean aircraft surface
e) Regular maintenance to correct aerodynamic deterioration.

3. Reporting on Fuel Efficiency and Emissions

The stakeholders shall report the progress towards achieving the goal on a quarterly basis. Many airlines collect data regarding environmental performance for their internal business planning purposes and some publishes detailed data as part of their annual reports. Generally, data collection should be a by-product of good environmental and management practices. Appropriate procedures and practices for data collection improve reporting and can be used to evaluate progress. The airline community itself will also have an interest in reviewing this information.

4. Interim Progress

The stakeholders may publish reports on a regular basis detailing the progress made toward achieving the goal. The aim of these reviews should be to assess progress and to determine further actions necessary for reduction in emissions. However, if fundamental changes have occurred, these reviews may also provide an opportunity for the stakeholders to assess possible changes in the goal.

The outcome of interim progress could be used by Kenya Civil Aviation Authority and other aviation stakeholders for planning purposes. It will also be a tool that will be used to showcase and communicate both at the national and international levels Kenya's efforts to address CO_2 gas emissions from Kenya's aviation industry.

5. Format for Reporting Fuel Efficiency Improvement and Co-benefits of CO_2 Gas Emission reduction by stakeholders

The airlines shall be required to submit traffic statistics with fuel consumption data and Revenue Tonne Kilometer (RTK) values in a prescribed format as given in appendix 1. The data shall be submitted on quarterly basis starting from July 2015. The report for the previous quarter should reach KCAA office latest by 10th of the first month of next quarter.

Additionally data for January 2010 to June 2015 should be submitted by September 2015.

The data received by KCAA will be handled and kept in confidential manner.

The email for submission is stats@kcaa.or.ke

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APPENDIX 1: AVIATION DATA COLLECTION FORM FOR ENVIRONMENTAL CO2 EMISSION

KENYA CIVIL AVIATION AUTHORITY
OFFICE OF DIRECTOR GEN ERAL
JOMO KENYATTA INTERNATIONAL AIRPORT

Date:	
Last name:	
First name:	
Email:	
Data provider:	
IATA CODE	

Flight no	Date of Dep	Airline	Origin	Destination	Aircraft	Seats available	Pax carried	Payload available	Freight carried (incl. express)	Mail carried	Scheduled	Fuel consumed	APU usage time	Taxi time
								(Kilogrammes)	(Kilogrammes)	(Kilogrammes)		(Litres)	(Minutes)	(Minutes)

3

Details on the form fields:

Flight No	Unique Identifying flight Number
Date Dep	Date of departure in the format of DD/MM/YYYY (for example 15/03/2015)
Airline	IATA Code for Airline
Origin	IATA code of airport of departure
Destination	IATA code of airport of arrival
Aircraft	Type of Aircraft
Seats	Number of available seats for passengers
Pax	Number of passengers carried
Max Freight	Maximum Weight of freight in kgs (including express)
Freight	Weight of freight in kgs (including express)
Max Mail	Maximum Weight of mail in kgs
Mail	Weight of mail in kgs
Scheduled/Non scheduled	Type of air service whether scheduled or non-scheduled
Fuel	Quantity of fuel consumed in litres

Note: Kindly List the voluntary measures adopted by your organization

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7.5.0 Annex 5: List of Selected Measures

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
	1. Aircraft Related Technology Development										
		c) Purchase of new aircraft									
M1				Investment in Fuel efficient engines/aircrafts Increased propulsive efficiency (higher bypass ratio delivering higher thrust at lower fuel consumption)	2011	2020	Target: Purchase of: * 3 B777-300, * 9 B787, * 5 B737-800, * 15 E-190 to replace the old fleet.	So far purchased: * 3 B777-300 * 9 B787 * 5 B737-800 * 15 E-190	* Replacement of 6 B767 by 6 B787: 58302 tCO2 per year * Fleet expansion with more efficient aircrafts (3 B787): 10364 tCO2 per year	USD 1.1 billion from 2011 to 2020	KQ KCAA KAA
	3. Improved ATM and infrastructure use										
		a) More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities									
M2				i) Measures to improve pre-departure planning (DMAN) and arrival planning (AMAN)	2016	2017	To optimize use of runway and departure process from push back to take off To optimize arrival process from touch down to chocks on	To Start 2016	* Rule of thumbs: 240 tCO2 per year	USD 0.2 Million	1. ANSP 2. KAA & KCAA

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
			ii) Measures to improve ground operations								
M3				A-SMGCS (SURF) during peak periods	2010	2010	To optimize use of runway by generating additional movements during peak times	Full implemented	Included in the quantification for A-CDM.	USD 1 Million	ANSP and KCAA
M4				A-SMGCS (SURF) during periods of Low visibility	2010	2010	To optimize use of runway during adverse weather conditions e.g Low Visibility and Wind change	Full implemented	Included in the quantification for A-CDM.		ANSP and KCAA
M5				A-SMGCS (SURF) during night operations	2010	2010	To reduce ATC workload and improve safety and efficiency	Full implemented	Included in the quantification for A-CDM.		ANSP and KCAA
			iii) Measures to improve collaborative decision making (A-CDM)								
M6				A-CDM (non-US version)	2016	2017	To Lower flight level separations	In Progress	Rule of thumbs: 3156 tCO2 per year	USD 0.2 Million	Airlines Airport ANSP and KCAA
M7			iv) Measures to improve the use of optimum flight levels		2009	Continuous	To manage traffic allocation for different level To minimize time required before correct flight level allocation that saves fuel	In Progress	Rule of thumbs: 52560 tCO2 per year	USD 1.5 Millions (cost for infrastructure , capacity building and documentation)	ANSPS Airlines Military Airports
M8			v) Measures to improve the use of optimum routings		2009	Continuous	To generate shorter routes or direct routes that saves fuel	In Progress	Included in the quantification for optimum flight levels.		

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M9			vi) Measures to improve flexible tracks		2009	Continuous	To have flexible tracts for delay reduction	In Progress	Included in the quantification for optimum flight levels.		
			vii) Measures to improve fuel efficient departure and approach procedures								
M10				CDO	2010	Continuous	Improve Flexibility & Efficiency in Descent Profiles.	In Progress	1839 tCO2 per year		
M11				CCO	2010	Continuous	Enabling the execution of a flight profile optimized to the performance of the aircraft.	In Progress	3068 tCO2 per year		
M12				PBN STAR	2010	Continuous	To achieve minimum internal times between flights	In Progress	613 tCO2 per year		
M13				Radius to Fix PBN procedure	2016	Continuous	Provide a predictable & repeatable ground track during a turn.	In Progress	Not quantified		
M14			viii) Measures to fully utilize airspace capabilities (en-route PBN, en-route RNAV/RNP, ADS-B, etc.)		2009	Continuous	To Achieve delay reduction as results of maximization of flight level and routes	In Progress	64097 tCO2 per year		
M15			ix) Measures to improve flexible use of civil-military airspace		1977	Continuous	To Achive shorter routes by overflying military airspace	In Progress	252 tCO2 per year		
		b) More efficient use and planning of airport capacities;									
M16			i) Measures to improve taxiing		2015	2017	To have reduced taxi times by having rapid exit taxiways and construction of a continuous taxiway linking end of RWY 06 and RWY 24	In Progress	565 tCO2 per year	USD 120 million cost of runway rehabilitation ,rapid exit and the continuous taxiway to link RWY 24 and RWY 06. This will improve RWY	KAA

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
										efficiency by 40%	
M17			ii) Measures to improve parking		2009	Continuous	To allocate parking bays in conjunction with slot as a result of quick sequencing of traffic' additional parking slots fom 20 to 34.	In Progress	Not quantifiable.	No cost as initiatives pre-existng establishments	KAA, Airlines
M18			iii) Measures to enhance terminal support facilities		2009	Continuous	Achieve less turn around time, additional airbridges and airport transport buses.	In Progress	Not quantifiable	No cost as initiatives pre-existng establishments	KAA, Airlines and ground handler
M19			iv) Measures to plan new capacity when bottlenecks cause environmental problems		1978	Continuous	Alternate airport - Moi international airport	Full implemented	Not quantifiable	No cost as initiatives preexisting establishments	KAA, KCAA
M20			v) Other		2014	Continuous	To continually improve the airport operational by involving all stakeholders - Airport CDM	In Progress	Not quantifiable	No cost as initiatives are as a result of change in operations	Airlines, KAA, KCAA
		c) Collaborative research endeavours.									
M21			ii) Inspire- Indian Ocean strategic Partnership to reduce emissions.		2012	Continuous	To benchmark the country CO2 emissions. Develop and Implemental procedures To reduce emission for all phases of flight Gate to Gate- The perfect flight Facilitate world-wide interoperability of environmentally friendly	in progress	Not quantifiable	USD 20,000- documentation, sensitize, research No cost as initiatives are as a result of change in operations	KCAA,research institutes KCAA,AIRLINES ,KAA, MET, and NEMA
	4. More efficient operations										
		a) Best practices in operations – ICAO Doc 10013									
			i) Minimising weight								

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M22				Minimising weight	2009	2015	To have unwanted weight removed from aircraft before comencing flight e.g Fly withou flight kit, less portable water, no life raft in the flying over water	Started on Jan 2009 (On-going initiatives monitored annually)	22878 tCO2 per year	No cost as initiatives are as a result of change in operations	Kenyan Airlines
			v) E-Taxi (only for A320 and B737)								
M23				E-Taxi	TBA	TBA	To achieve low fuel burn during taxiing e.g Aircraft to taxi using a motor and reduce APU fuel burn	Under scrutiny. The wheel tag provider shares 50% of the net savings from its customers. The idea is under research	Not quantified yet.	New technology in the market and cost of implementation is yet to be defined. This is Under scrutiny. The wheel tag provider shares 50% of the net savings from its customers. The idea is under research	Kenyan Airlines using B737 Aircraft
			x) Other								

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M24				Installation of fuel management system	2016	2020	The system will take complex fuel data and turn it into meaningful information that will: •Assist to Identify, Drive and Manage initiatives that will ensure a positive impact to the airline and environment. •Provide reports compatible with ENV1 carbon emissions reporting template •Enable confident and effective decision making •Increase data accuracy and consistency of data used in the airline and submitted to the authority for monitoring •Enable scaling and building for the future (More information on attached annex 7)	To start 2016	3% reduction fuel per year --> based on baseline	250,000 USD installation, training and purchase cost for the Fuel Management system.	Kenyan Airlines
		b) Optimized aircraft maintenance									
			i) Engine wash								
M25				Engine core wash	1977	Continuous	To achieve high passration making engines more efficient	Implemented	Not quantifiable	N/A	Kenyan Airlines
			ii) Aircraft wash								
M26				Aircraft body wash (exterior wash) Rigging of flaps and slat Aircraft reliability	1977	Continuous	To reduce drag during flight profile because the higher the drag the higher the fuelburn To improve the mainstream flow increasing lift and generating speed	Implemented	0.8% reduction fuel per year --> based on baseline	Maintenance costs	Kenyan Airlines
		c) Selecting aircraft best suited to the mission									
M27				Route Scheduling, Slot, Ground Handling, Cost index, Optimal flight level	1977	Continuous	To maximise aircraft capacity by improving RPK and RTK	Implemented	Not quantifiable.	No cost; Involves change of procedures	Kenyan Airlines
	6. Regulatory measures										
		b) enhancing weather forecasting services									

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M28				Infrastructure Modernization of weather observing equipment and Capacity building	2008	Continuous	To have an efficient and modern aviation weather forecasting systems including enhanced personnel training that enables airlines to plan safe, reliable routings and flight levels in order to minimize delay and diversions due weather Climate resilience can be improved through up-to-date weather observations systems, which also improves airline safety and provide access to safe air transportation	To Start 2016	Not quantifiable	USD 12 million (Cost of capacity development and procuring of facilities and equipment's)	KCAA, KAA, Airlines Air operators KMD
		c) requiring transparent carbon reporting									
M29				Publishing of AIC for aviation CO2 emission data collection	Aug-15	Sep-15	Guidance material on ENV data collection and reporting to KCAA	Implemented	Legal requirements for stakeholders	USD 30,000	KCAA, AIP Subscribers
		d) conferences/workshops									
M30				Active participationin International forum & capacity buildings/seminar on implementation of global approaches and standard to address the impact of the Climate change. Sensitizing stakeholders &	2015	Continuous	To keep stakeholders informed and Improve on capacity buildings in aviation environment	Implemented	Increased awareness to stakeholders	USD 150,000 annually -Organizing workshops quarterly for sensitization of stakeholders -Attending environmental meetings, seminars and International forum on climate change	All stakeholders
		e) other									

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M31				Conducting aviation research on environment	2016	Continuous	For continuos improvement and maintenance of global standards	To Start 2016	Not quantifiable	USD 500,000 annually KCAA will collaborate with Universities/Research Institutes and ICAO in conducting research.	KCAA and Other Stakeholders
M32				Through ICAO , develop a new CO2 standard for new airplanes and adopt the new standard domestically	2017	2020	To improve on Legal requirements for stakeholders by ensuring there is aviation environmental legislation	To start 2017	Not quantifiable	USD 20,000 annually -Enforce the legislation and build consensus as well as oversight activitities.	KCAA/NEMA MOT,KCAA, Kenyan aviation industry stakeholder
	7. Airport Improvements										
		a) Airfield improvements									
			v) Installation of fixed electrical ground power and pre-conditioned air allow aircraft APU switch-off								
M33				Installation of GPU to save on APU fuels	2013	2020	To reduce fuel consumed by during the aircraft servicing	under implementation	Not quantified yet.	USD 6.54M (cost of infrastructure, installation and training)	KAA, KCAA, Kenya Airlines, GHAs
		b) Reduced energy demand and preferred cleaner energy sources									
			i) use cleaner alternative sources of power generation (photovoltaic panels, wind generators)								

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M34				Use of alternative sources of power generation(Solar Power)	2017	2020	To reduce emission to global standards JKIA - (3MW) MIA - 2 MW, Wajir - 0.5 MW EIA-1MW	Under implementation	3861 tCO2 per year (cobenefits)	USD 2,500,000 Budget is as follows ; Supply and installation of complete solar unit and accessories (JKIA +MIA+EIA+Wajir) = USD 2.3M + Training personnel and purchase of maintenance tools = 200 000 USD	KAA and other stakeholders
			iii) reduce electrical demand (switch off unnecessary lights, promote stairs instead of lifts, etc.)								
M35				Reduce electrical demand (switch off unnecessary lights, promote stairs instead of lifts, etc	JKIA - 2015, MIA - 2015, EIA - 2017, Wajir - 2017	2020	Installation of LED lightng on land side and solar street lighting	In Progress	6389 tCO2 per year (cobenefits)	Sensitization USD 20,000 Cost is for: • Sensitization workshops • Stakeholder	KAA & other Stakeholders
		c) Enhanced GSE (Ground Support Equipment) management									
			i) Reduce distance travelled								
M36				Reduce distance travelled	2015	Continuous	To reduce distance travelled by contruction of second runway at JKIA and green greenfield terminal	In Progress	26,388 tCo2per year (Cobenetits)	USD 550,000,000 for greenfield terminal and 2nd runway.	KAA, Airlines and ground handler
		d) Conversion of GSE to cleaner fuels									
			i) Electrical operated ground vehicles								

Measure nb	Category	Measure	Action	Description	Start date	End date	Objectives	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Economic Cost (USD)	Stakeholders
M37				Approval of green ground-handling operators by; i. Electrical operated ground vehicles	2016	2020	To have efficiency that results in fuel reduction	To start 2016	Not quantified yet.	Sensitization USD 20,000 Cost is for: • Sensitization workshops and Policy formulation • Stakeholder	KAA, Airlines and ground handler
M38			ii) Gas operated ground vehicles		2016	2020	To have GSE that are fully Gas/ electrical or hybrid systems.	To start 2016	Not quantified yet.	N/A	KAA, Airlines and ground handler
M39			iii) biofuel operated ground vehicles		2020	2035	To have all vehicles and GSE fitted with catalytic converter To have GSE Pooling or have FGPU/FASU at all gates	To start 2020	Not quantified yet.	N/A	KAA, Airlines and ground handler

7.5.1 Annex 5: List of Selected Assistance Needs

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
	3. Improved ATM and infrastructure use										
		a) More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities									
M2			i) Measures to improve pre-departure planning (DMAN) and arrival planning (AMAN)		2016	2017	To Start 2016	* Rule of thumbs: 240 tCO2 per year	1. ANSP 2. KAA & KCAA	Capacity building in airspace planning methodology, air traffic flow management & slot time management this will entail training 12 staff members at Cost of USD 0.2 million in a reputable institution (Singapore/ EASA/ATNS)	0.2
			ii) Measures to improve ground operations								
M7			iv) Measures to improve the use of optimum flight levels		2009	Continuous	In Progress	Rule of thumbs: 52560 tCO2 per year	ANSPS Airlines Military Airports	Capacity building in airspace management and organization at cost of USD 140,000 for 10 staff member to be trained in	0.14
M8			v) Measures to improve the use of optimum routings		2009	Continuous	In Progress	Included in the quantification for optimum flight levels.			

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
M9			vi) Measures to improve flexible tracks		2009	Continuous	In Progress	Included in the quantification for optimum flight levels.		France/Singapore	
			vii) Measures to improve fuel efficient departure and approach procedures							Funding for capacity building in procedure design at cost USD 280,000 for 10 staff to be trained in ENAC France	0.28
M10				CDO	2010	Continuous	In Progress	1839 tCO2 per year			
M11				CCO	2010	Continuous	In Progress	3068 tCO2 per year			
M12				PBN STAR	2010	Continuous	In Progress	613 tCO2 per year			
M13				Radius to Fix PBN procedure	2016	Continuous	In Progress	Not quantified			
M14			viii) Measures to fully utilize airspace capabilities (en-route PBN, en-route RNAV/RNP, ADS-B, etc.)		2009	Continuous	In Progress	64097 tCO2 per year		Awareness training/ workshop for KCAA staff at cost of USD 50,000 facilitation for 300 staff members at EASA.	0.05
M15			ix) Measures to improve flexible use of civil-military airspace		1977	Continuous	In Progress	252 tCO2 per year			
		b) More efficient use and planning of airport capacities;									
M16			i) Measures to improve taxiing		2015	2017	In Progress	565 tCO2 per year	KAA	Capacity building in Aerodrome systems and Planning/design at cost of USD 163,000 for 10 staff members	0.163

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
										to be trained in Singapore	
M17			ii) Measures to improve parking		2009	Continuous	In Progress	Not quantifiable.	KAA, Airlines	Supply and Installation of CO2 gas Monitoring System and capacity building at cost of USD 200,000 at MIA and JKIA	0.2
M18			iii) Measures to enhance terminal support facilities		2009	Continuous	In Progress	Not quantifiable	KAA, Airlines and ground handler		
		c) Collaborative research endeavours.									
M21			ii) Inspire- Indian Ocean strategic Partnership to reduce emissions.		2012	Continuous	in progress	Not quantifiable	KCAA,research institutes KCAA,AIRLINES,KAA, MET, and NEMA	Funding required for documentation, sensitization and research at cost of USD 20,000	0.02
	4. More efficient operations										
		a) Best practices in operations – ICAO Doc 10013									
			x) Other								
M24				Installation of fuel management system	2016	2020	To start 2016	3% reduction fuel per year --> based on baseline	Kenyan Airlines	Kenya Airways requested financial assistance of 250,000 USD to train users, purchase, install and implement a fuel management system.	0.25
		b) Optimized aircraft maintenance									
			ii) Aircraft wash								

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
M26				Aircraft body wash (exterior wash) Rigging of flaps and slat Aircraft reliability	1977	Continuous	Implemented	0.8% reduction fuel per year --> based on baseline	Kenyan Airlines	Capacity building in fuel efficiency maintenance procedure at cost of USD 150,000 for 25 staff member to be trained in Nairobi	0.15
	6. Regulatory measures										
		b) enhancing weather forecasting services									
M28				Infrastructure Modernization of weather observing equipment and Capacity building	2008	Continuous	To Start 2016	Not quantifiable	KCAA, KAA, Airlines Air operators KMD	Funding for Assistance of 12 Million for Acquisition of wind profiler for JKIA & KSM Airport Upgrading of AWOS for JKIA and ELD and Capacity development at KMD	12
		c) requiring transparent carbon reporting									
M29				Publishing of AIC for aviation CO2 emission data collection	Aug-15	Sep-15	Implemented	Legal requirements for stakeholders	KCAA, AIP Subscribers	Capacity building in carbon reporting, monitoring and verification at Cost of USD 30,000	0.03
		d) conferences/workshops									

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
M30				Active participationin International forum & capacity buildings/seminar on implementation of global approaches and standard to address the impact of the Climate change. Sensitizing stakeholders &	2015	Continuous	Implemented	Increased awareness to stakeholders	All stakeholders	Capacity buildings in aviation environment at cost of USD 30,000 Active participation through capacity buiding in aviation environment seminar/meetings at USD 120,000	0.15
		e) other									
M31				Conducting aviation research on environment	2016	Continuous	To Start 2016	Not quantifiable	KCAA and Other Stakeholders	Training in Aviation environment, Purchase of Statistical systems and Conducting aviation research at cost of USD 500,000	0.5
M32				Through ICAO , develop a new CO2 standard for new airplanes and adopt the new standard domestically	2017	2020	To start 2017	Not quantifiable	KCAA/NEMA MOT,KCAA, Kenyan aviation industry stakeholder	Active participation through capacity buiding in aviation environment seminar/meetings at cost USD 20,000	0.02
	7. Airport Improvements										
		b) Reduced energy demand and preferred cleaner energy sources									
			i) use cleaner alternative sources of power generation (photovoltaic panels, wind generators)								

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
M34				Use of alternative sources of power generation(Solar Power)	2017	2020	Under implementation	3861 tCO2 per year (cobenefits)	KAA and other stakeholders	USD 2,500,000 Budget is as follows ;Supply and installation of complete solar unit and accessories (JKIA +MIA+EIA+Wajir) = USD 2.3M + Training personnel and purchase of maintenance tools = 200 000 USD	2.5
			iii) reduce electrical demand (switch off unnecessary lights, promote stairs instead of lifts, etc.)								
M35				Reduce electrical demand (switch off unnecessary lights, promote stairs instead of lifts, etc	JKIA - 2015, MIA - 2015, EIA - 2017, Wajir - 2017	2020	In Progress	6389 tCO2 per year (cobenefits)	KAA & other Stakeholders	Sensitization USD 20,000 Cost is for: • Sensitization workshops • Stakeholder	0.02
		c) Enhanced GSE (Ground Support Equipment) management									
			i) Reduce distance travelled								
M36				Reduce distance travelled	2015	Continuous	In Progress	26,388 tCo2per year (Cobenetits)	KAA, Airlines and ground handler	Funding for Construction of greenfield terminal and 2nd runway at cost ofUSD 550,000,000 and design are ready Funding for Carbon	550.15

Measure nb	Category	Measure	Action	Description	Start date	End date	Current status	GHG/Fuel Efficiency Impact (EBT)/ Expected Results	Stakeholders	Assistance needs	Amount in USD Million
										footprint mapping for KAA at a cost of USD 50,000 Funding for AIC certification for KAA at a cost of USD 100,000	
		d) Conversion of GSE to cleaner fuels									
			i) Electrical operated ground vehicles								
M37				Approval of green ground-handling operators by; i. Electrical operated ground vehicles	2016	2020	To start 2016	Not quantified yet.	KAA, Airlines and ground handler	Sensitization USD 20,000 Cost is for: • Sensitization workshops and Policy formulation • Stakeholder	0.02
TOTAL ESTIMATED COST IN USD MILLIONS											**566.83**

7.6 Annex 6: Detailed Measure - Improved Energy Use at Airports

PHASE 1 INSTALLATION OF LED ON THE LAND SIDE STREET LIGHTING

Total CO2 = power in MWh X grid emission factor for Kenya (0.5793) X 12hrs X 365days

Assumption light are on 12 hours per day for 365 days per year

Approximately 50% of power goes to lighting

Average reduction of usage for LED vs incandescent lighting is 60% - very conservative estimates some manufacturers claim up to 80%

Note for power in the building the figure is multiplied by 24 hours instead of 12 hours

International Airports	Power Consumption in kW/h per month	Power Consumption in kW/h per Year	kgCO2 from lighting	tCO2 from lighting
1. Jomo Kenyatta International Airport (JKIA)	2,600,000	2,600	6,597,068.40	6,597.07
2. Moi International Airport (MIA)	350,000	350	888,066.90	888.07
3. Wajir International Airport (WIA)	12,000	12	30,448.00	30.45
4. Eldoret International Airport (EIA)	60,000	60	152,240.04	152.24
			7,667,823.34	7,667.83

- JKIA, MIA, WIA and EIA produce approximately 7,667.83 mtCO2 or 7,667,823.34 kgCO2 from lighting
- Use of LED will cut down the emission by 60% = (100/60) (7,667.83/2) = 6,389.60 mtCO2
- Approximately = 6,389,600 kgCO2
- Cost of implementation USD 30M
- When we install LED at JKIA and MIA we will save 50% and 30% respectively in terms of revenue expenditure on electricity

PHASE 2 - INSTALLATION OF THE SOLAR PANEL MEANING 100% CONVERSION TO RENEWABLE ENERGY WITH ZERO EMISSIONS

Total CO2 = Amount of annual power generated from solar or replaced by solar X national grid factor

Assumptions - all emissions emitted in the process of the manufacture of the solar is not part of the emissions.

International Airports	Power Consumption in kW/h per month	Power Consumption in kW/h per Year	Expected solar power generation (mw)
1. Jomo Kenyatta International Airport (JKIA)	2,600,000	2,600	3.00
2. Moi International Airport (MIA)	350,000	350	2.00
3. Wajir International Airport (WIA)	12,000	12	0.50
4. Eldoret International Airport (EIA)	60,000	60	1.00
			6.50

- JKIA, MIA, WIA and EIA produce approximately 7,667.83 mtCO2 or 7,667,823.34 kgCO2 from lighting
- Total power generated = 6.50 MW
- Solar energy would be used mainly of lighting, hence 100% offset of 50% CO2 generated in total = (7,667.83/2) mtCO2 = 3,833.92 mtCO2
- In addition in EIA, the current electricity water pump will be replaced with a solar water pump hence saving an additional = offset of approx. 900kwh per month = 10,800 kWh per year = 27,403.21 kgCO2 per year
- Cost of implementation USD 170,000
- When we install solar power plant at JKIA we will save 25% in terms of revenue expenditure on electricity

7.7 Annex 7: Detailed Measure – Installation of a Fuel Management System

Category 4: More efficient operations
Measure a: Best practices in operations – ICAO Doc 10013
- Action x: Others

SUMMARY

Description	This measure aims at installing a Fuel Management System at Kenya Airways, the main national airline representing more than 80% of the international traffic in Kenya.		
Start date	2016	**End date**	2016
CO2 emisssions reduced (t)	• International emissions: **63,223,650** • Cobenefits (domestic flights): **16,786,350**		
Costs (USD)	250,000		
Stakeholders	Kenya Airways		

BACKGROUND

Kenya as a State has set 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, in line with the broad international consensus. Kenyan registered airlines have therefore set various initiatives to ensure reduction of carbon emissions, such as idle reverse landing, continuous descent operations, Zero Fuel Weight Accuracy, Single Engine Taxi, etc. To be able to gain the most fuel efficiency from these initiatives, data analysis is required to measure achievement of set targets. A fuel management information system (FMIS) is therefore important to achieve total efficiency and reduce carbon emissions.

Currently, Kenyan airlines have set more focus on simple initiatives that are easily measurable from simple tools such as excel. Data required to analyze these initiatives is collected manually. This manual data collection results to reduced accuracy and completeness of data as well as delayed reports due to the time it takes to compile the data.

In order to improve the data collection process, one of the airlines, Kenya Airways which contributes over 80% of the international aviation traffic has invested in equipping its fleet with an Aircraft Communications Addressing and Reporting System (ACARS), which enables electronic transfer of the required fuel data to the ground. Full implementation of automated data collection is scheduled for the end of 2015. Despite this effort, fuel efficiency initiatives are still not being fully realized due to the lack of a robust system that can accurately analyze this data.

The measure aims at addressing following main issues met by the airline:
- Data collection is manual – Only 1 fleet's data is collected via ACARS before complete role out of ACARS data collection by the end of 2015;
- Data is not 100% compatible with the reporting format (ENV1) required by the regulator;
- Required reports are not timely due to the manual data capture;
- Different airlines have different formats of data capture, it is important to standardize the process;
- There is a lack of a platform to measure initiative benefits, which prevents initiatives from being realized at their full potential;

- A lot of resources are spent in data collection as opposed to data analysis and management of fuel efficiency;
- Fuel inefficiency brings high costs that would otherwise be avoided if more efficient methods were measured and implemented.

OBJECTIVES, EXPECTED RESULTS AND COSTS

Through the implementation of the FMIS, the airline aims at achieving the 5 following main objectives:

1) To efficiently manage initiatives in order to maximize carbon emission reduction;
2) To monitor fuel consumption hence establish where fuel savings can be made;
3) To have 100% accuracy and completeness in reporting of carbon emissions;
4) To have timely reports;
5) To extract reports compatible with the ENV1 format used to report to the regulator.

The existing initiatives undertaken by the airline so far are able to achieve more than 68,000 tones carbon emissions reduction. A robust fuel management system would improve fuel efficiency by **5-6%** and provide more guidance on new areas where fuel efficiency can be achieved. For the airline, this increased fuel efficiency is also expected to bring 1 to 5% costs savings.

INTERNATIONAL EMISSIONS REDUCTION AND COBENEFITS

The IATA fuel initiative calculator has been used to derive savings achievable by the airline considering the fleet type and the size. The table below shows the projected savings (total of **80,000 tons** of CO2) which have been calculated based on a 5% fuel saving on existing initiatives. Much more can be achieved with the inclusion of more initiatives. 2014 data has been used to project an annual saving that can be realized by installation of a FMIS.

	Total Fuel Savings (KG)	Domestic		International	
		Fuel (KG)	CO2 (KG)	Fuel (KG)	CO2 (KG)
B777-300	6,900,000	69,000	217,350	6,831,000	21,517,650
B787-800	3,400,000	860,000	2,709,000	2,540,000	8,001,000
B737	8,000,000	2,400,000	7,560,000	5,600,000	17,640,000
E190	7,100,000	2,000,000	6,300,000	5,100,000	16,065,000
Total	**25,400,000**	**5,329,000**	**16,786,350**	**20,071,000**	**63,223,650**

ADDITIONALITY

Kenya Airways understands the need to reduce fuel consumption and carbon emissions and has embarked on implementation of various initiatives as well as an automation project to capture fuel data electronically (ACARS). Despite these efforts, the company is experiencing challenges in realizing the full potential of the fuel savings because it lacks a robust fuel management system. Acquisition of this system is not attainable given the current financial position of the company therefore seeking assistance on the same.

The anticipated fuel savings brought about by the system will enable payment of subsequent maintenance and annual license fees therefore ensuring sustainability.

Additionally, the airline will be better placed to assist other Kenyan carriers to reduce their carbon emissions by providing a benchmarking platform and guidance to the airlines. As a result, Kenya as a state will be able to accurately collect, measure, report and reduce carbon emissions.

ASSISTANCE NEEDS

Kenya Airways requested financial assistance of 250,000 USD to train users, purchase and implement a fuel management system.