ICAO ENVIRONMENT

CAPACITY BUILDING FOR CO_2 MITIGATION FROM INTERNATIONAL AVIATION

Eduardo Caldera-Petit

Programme Coordinator

A WINDOW FOR A GREENER FUTURE

PROJECT FUNDED BY European Union

AGENDA

01 Project **OVERVIEW**

02 Project **OUTCOMES**

03 **Oversight / Evaluation of Success**

04 **Next steps / Sustainability of results**

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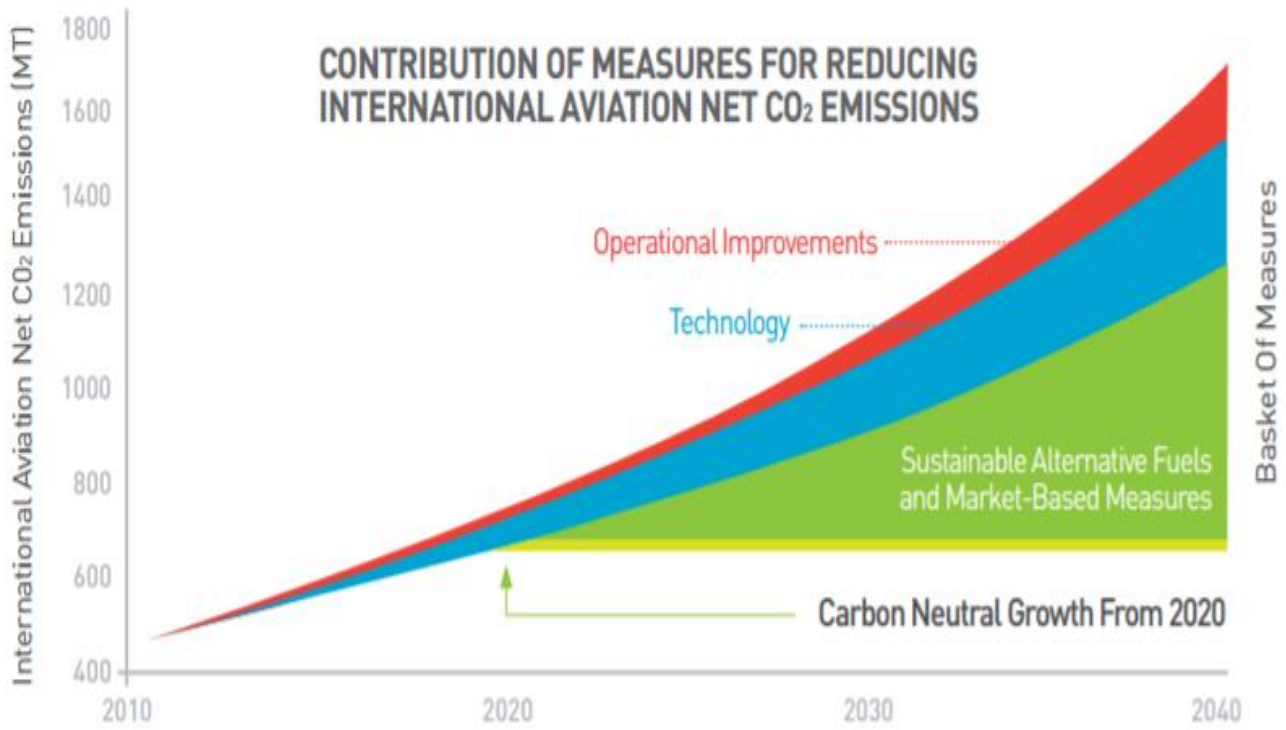
BACKGROUND / CONTEXT

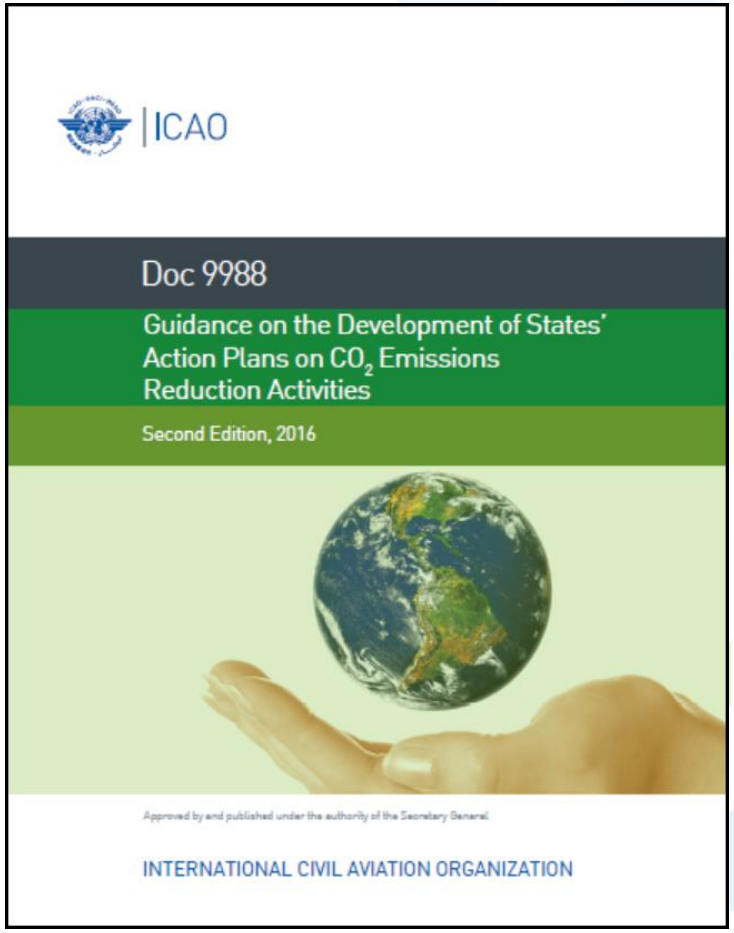
ICAO ASSEMBLY 2010

ICAO'S ASPIRATIONAL GOALS

2% ANNUAL FUEL EFFICIENCY IMPROVEMENT
CARBON NEUTRAL GROWTH FROM 2020



STATES' ACTION PLANS INITIATIVE



PROJECT FUNDED BY

BACKGROUND / CONTEXT

2013

ICAO / EU PARTNERSHIP

ENVIRONMENTAL PROTECTION

ICAO

European Union

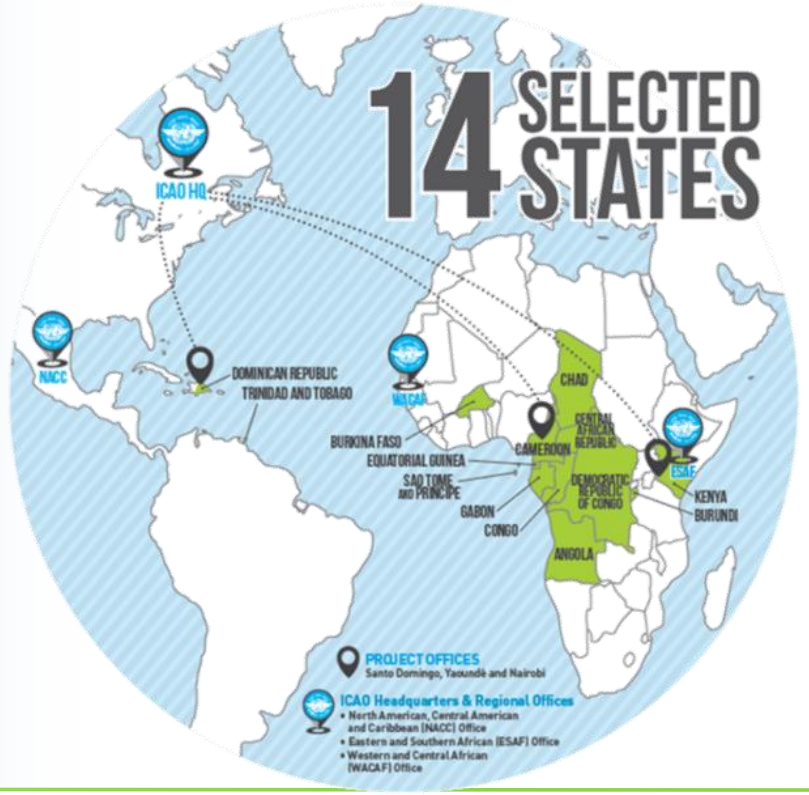
PROJECT FUNDED BY

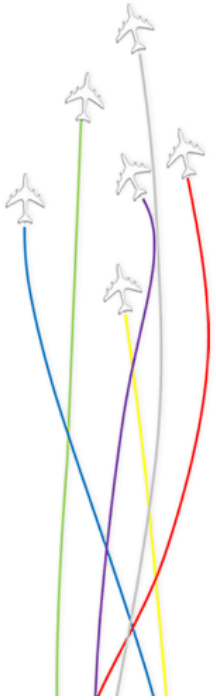
Project OVERVIEW

6.5 € MILLION BUDGET

CAPACITY BUILDING FOR CO_2 MITIGATION FROM INTERNATIONAL AVIATION

No Country Left-Behind





2014 - 2018

OBJECTIVE 1

ACTION PLANS DEVELOPMENT:

Improved capacity of the National Civil Aviation authorities to develop an Action Plan on CO_2 emissions reduction from international aviation in accordance with ICAO recommendations

OBJECTIVE 2

AVIATION ENVIRONMENTAL SYSTEMS (AES):

Efficient CO_2 emissions monitoring system for international aviation developed in each selected Member State

OBJECTIVE 3

IMPLEMENTATION OF MITIGATION MEASURES:

Priority mitigation measures identified, evaluated and partly implemented

PROJECT FUNDED BY

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PROJECT FUNDED BY

Project OUTCOMES

CAPACITY BUILDING
STATES' ACTION PLANS TO REDUCE CO_2 EMISSIONS

OBJECTIVE 1

ACTION PLANS DEVELOPMENT:

Improved capacity of the National Civil Aviation authorities to develop an Action Plan on CO_2 emissions reduction from international aviation in accordance with ICAO recommendations

PROJECT FUNDED BY

OBJECTIVE 1: ACTION PLANS DEVELOPMENT

NATIONAL ACTION PLAN TEAMS

- Civil Aviation Authorities
- Ministry of Environment
- Ministry of Transport
- Air Navigation Services
- Airlines
- Airports
- Ground Handling
- Fuel suppliers

COORDINATION MECHANISM TO
DEVELOP AND IMPLEMENT THE ACTION PLAN

ESTABLISHED IN THE 14 STATES

PROJECT FUNDED BY

OBJECTIVE 1: ACTION PLANS DEVELOPMENT

8 CAPACITY BUILDING SEMINARS

PROJECT 'KICK-OFF' SEMINARS
DOMINICAN REPUBLIC 2014 / CAMEROON 2015

Preparation of the Action Plans

SECOND CAPACITY BUILDING SEMINARS
TRINIDAD AND TOBAGO 2015 / KENYA 2015

Collection and monitoring of CO_2 emissions - AES

THIRD CAPACITY BUILDING SEMINARS
GABON 2016 / DOMINICAN REPUBLIC 2016

Implementation of mitigation measures

FOURTH CAPACITY BUILDING SEMINARS
DOMINICAN REPUBLIC 2018 / KENYA 2018

Solar project inauguration, closure and next steps

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OBJECTIVE 1: ACTION PLANS DEVELOPMENT

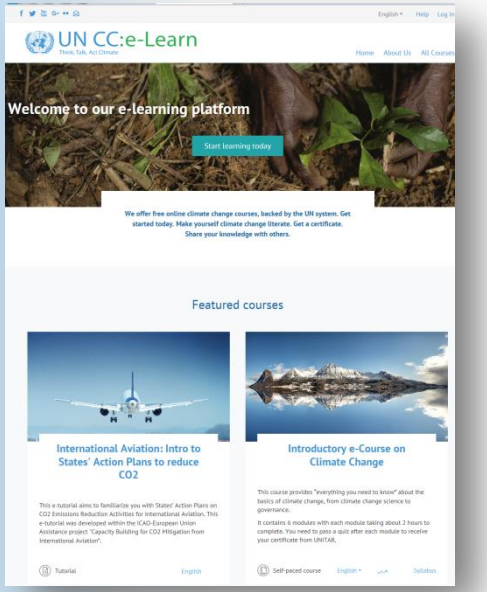
MODULE 1 — STATES' ACTION PLANS ON CO_2 EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION

MODULE 2 — BASELINE SCENARIO CALCULATION

MODULE 3 — MITIGATION MEASURES

MODULE 4 — SELECTION, PRIORITIZATION AND IMPLEMENTATION OF MITIGATION MEASURES

MODULE 5 — TOOLS AND EXPECTED RESULTS



unitar
United Nations Institute for Training and Research

Free registration for focal points

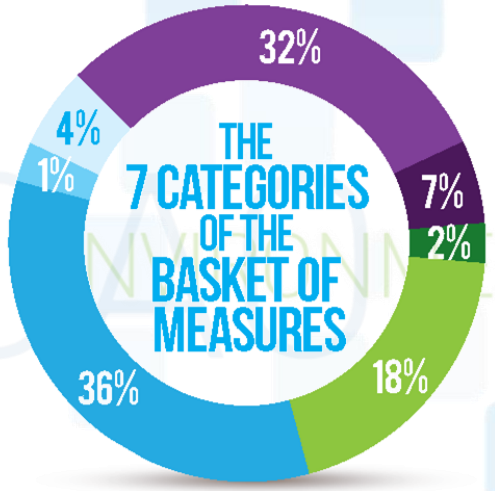
OBJECTIVE 1: ACTION PLANS DEVELOPMENT

14 ACTION PLANS DEVELOPED & SUBMITTED BY THE SELECTED STATES

218 POTENTIAL MEASURES IDENTIFIED

THE 218 MITIGATION MEASURES ARE DISTRIBUTED IN:

CAT 1	Aircraft related technology
CAT 2	Alternative fuels
CAT 3	Improved Air Traffic Management
CAT 4	More efficient operations
CAT 5	Economic/market based measures
CAT 6	Regulatory measures
CAT 7	Airports improvements



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Project OUTCOMES

THE AVIATION ENVIRONMENTAL SYSTEM

OBJECTIVE 2

AVIATION ENVIRONMENTAL SYSTEMS (AES):

Efficient CO_2 emissions monitoring system for international aviation developed in each selected Member State

PROJECT FUNDED BY

OBJECTIVE 2: AVIATION ENVIRONMENTAL SYSTEM

THE AVIATION ENVIRONMENTAL SYSTEM

MONITORING, REPORTING AND VERIFICATION (MRV) TOOL

AES – INSTALLED IN THE 14 STATES

1. A stand-alone application with a database back-end installed at the Civil Aviation Authority (CAA)
2. Facilitates the data collection and monitoring of CO_2 emissions from international aviation at the State level
3. Automatizes the data reporting to ICAO

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Aviation Environmental System | AES

Annual and Monthly CO_2 Reports

MONTHLY AVIATION CO_2 REPORT

Feb-18

Dominican Republic

State-level report 5 reporting airline(s)

ICAO definition for international flights

KEY METRICS FOR INTERNATIONAL AVIATION

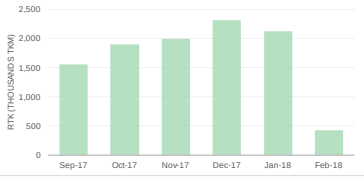
FLIGHTS	RTK (tkm)	FUEL BURN (L)	CO2 EMISSIONS (t)	FUEL EFFICIENCY (L/tkm)
523	433,949	551,512	1,393	2.813

TRENDS

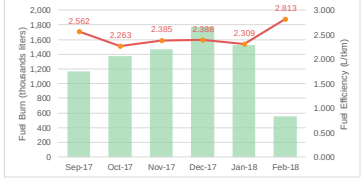
MONTH-TO-MONTH	Feb-18	Jan-18	% CHANGE	6 MONTHS TREND
RTK (tkm)	433,949	2,121,882	↓ -80%	
FUEL BURN (L)	551,512	1,527,272	↓ -64%	
CO2 EMISSIONS (kg)	1,393	3,860	↓ -64%	
FUEL EFFICIENCY (L/tkm)	2.813	2.309	↑ 22%	

YEAR-TO-YEAR	Feb-18	Feb-17	% CHANGE	1 YEAR TREND
RTK (tkm)	433,949	2,204,416	↓ -80%	
FUEL BURN (L)	551,512	2,238,844	↓ -75%	
CO2 EMISSIONS (T)	1,393	5,659	↓ -75%	
FUEL EFFICIENCY (L/tkm)	2.813	2.292	↑ 23%	

Revenue Tonnes Kilometers (RTK)



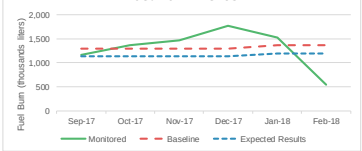
Fuel Burn and Efficiency



Efficiency of Mostly Used Aircrafts

	Aircrafts	Flights	Fuel Efficiency (L/tkm)
1	JS32	184	1.253
2	B190	90	2.402
3	SF34	63	2.599
4	JS31	52	1.303
5	C560	27	5.651

Fuel Burn Trends



Most Fuel Efficient Routes

	Routes*	Flights	Fuel Efficiency (L/tkm)
1		4	0.02
2	MUHG-MUVR	4	0.389
3	MDLR-TBPB	2	0.677
4	MDSD-TAPA	6	0.731
5	WMKE-TAPA	2	0.78

* Only routes with at least 2 flights were considered.

Least Fuel Efficient Routes

	Routes*	Flights	Fuel Efficiency (L/tkm)
1	SVMI-MDJB	3	14.424
2	TDPD-MDSD	2	9.089
3	TBPB-MDJB	2	8.349
4	KPBI-TAPA	2	7.224
5	MKJP-MDJB	2	6.091

* Only routes with at least 2 flights were considered.

Routes with Highest Load Factors**

	Routes*	Flights	Load Factor
1	MDSD-TDPD	2	0.974
2	MDJB-TNCM	2	0.967
3	MDSD-TNCM	14	0.955
4	MDSD-TAPA	6	0.877
5	MDSD-TQPF	9	0.865

* Only routes with at least 2 flights were considered.

** Only flights with at least 1 passenger were considered.

Routes with Lowest Load Factors**

	Routes*	Flights	Load Factor
1	TDPD-MDSD	2	0.132
2	TBPB-MDJB	2	0.222
3	MKJP-MDJB	2	0.278
4	MDJB-WMKE	2	0.278
5	SVMI-MDJB	3	0.281

* Only routes with at least 2 flights were considered.

** Only flights with at least 1 passenger were considered.

ANNUAL AVIATION CO_2 REPORT

2017

Kenya

State-level report - 1 reporting airline(s)

ICAO definition for international flights

MONTHLY REPORTS SUBMITTED

✓ Jan ✓ Feb ✓ Mar ✓ Apr ✓ May ✓ Jun ✓ Jul ✓ Aug ✓ Sep ✓ Oct ✓ Nov ✓ Dec

100% of the year covered

KEY METRICS FOR INTERNATIONAL AVIATION

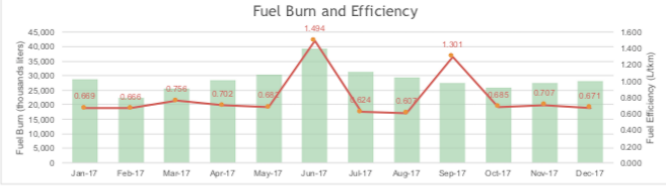
FLIGHTS	RTK (tkm)	FUEL BURN (L)	CO2 EMISSIONS (t)	FUEL EFFICIENCY (L/tkm)
31,694	1,005,964,260	344,557,408	871,041	0.796

TRENDS

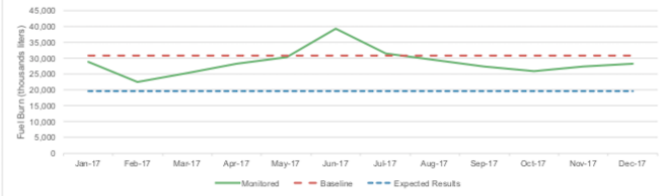
YEAR-TO-YEAR	2016	2017	TREND	% CHANGE
RTK (tkm)	931,600,992	1,005,964,260	↑	8%
FUEL BURN (L)	355,584,946	344,557,408	↓	-3%
CO2 EMISSIONS (T)	898,919	871,041	↓	-3%
FUEL EFFICIENCY (L/tkm)	2.403	0.796	↓	-67%

Revenue Tonnes Kilometers (RTK)

Fuel Burn and Efficiency



Fuel Burn Trends



Most Fuel Efficient Aircraft

	Aircraft	Number of flights*	Fuel efficiency (L/tkm)
1	788	4126	0.299
2	738	7163	0.691
3	E90	18848	0.85
4	73W	1256	1.33
5	73F	301	4.533

* Only aircraft with at least 2 flights were considered.

Least Fuel Efficient Aircraft

	Aircraft	Number of flights*	Fuel efficiency (L/tkm)
1	73F	301	4.533
2	73W	1256	1.33
3	E90	18848	0.85
4	738	7163	0.691
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* Only aircraft with at least 2 flights were considered.

PROJECT FUNDED BY

Project OUTCOMES

PILOT MITIGATION MEASURES

OBJECTIVE 3

IMPLEMENTATION OF MITIGATION MEASURES:

Priority mitigation measures identified, evaluated and partly implemented

PROJECT FUNDED BY

OBJECTIVE 3: PILOT MITIGATION MEASURES

PILOT MITIGATION MEASURES
TO BE IMPLEMENTED WITH PROJECT FUNDING

The pilot mitigation measures, which will be completed by 2018, will showcase concrete actions that may be replicated by other Member States to contribute to the achievement of ICAO's aspirational goals for CO_2 emissions reduction from international aviation.

SOLAR PANELS
Provides clean power to the airport grid

GATE ELECTRIFICATION SYSTEM
Provides ground power and pre-conditioned air to the aircraft at the gate

- CAMEROON — DOUALA INTERNATIONAL AIRPORT
- KENYA — MOMBASA INTERNATIONAL AIRPORT

CO_2 REDUCTION **2408** TONNES/YEAR

IMPLEMENTATION OF CCO/CDO
Continuous Climb Operations (CCO) / Continuous Descent Operations (CDO)

- BURKINA FASO
- GABON

CO_2 REDUCTION **1266** TONNES/YEAR

FEASIBILITY STUDIES
TO BE DEVELOPED WITH PROJECT FUNDING

The feasibility studies will provide the governments of the selected States decision-making tools that may unveil new opportunities to get to the edge of innovations for a sustainable aviation sector.

FEASIBILITY STUDY
on the use of renewable energy to power airport operations
- TRINIDAD & TOBAGO

FEASIBILITY STUDY
on the development of sustainable alternative fuels
- DOMINICAN REPUBLIC
- TRINIDAD & TOBAGO
- BURKINA FASO
- KENYA

PROJECT FUNDED BY

OBJECTIVE 3: PILOT MITIGATION MEASURES

CAMEROON

DOUALA INTERNATIONAL AIRPORT

Capacity:	**1.2 MWp**
Solar modules:	**3,692 panels**
Price:	**1,432,340 USD**
Inauguration:	**10 January 19**

Benefits:

2,600 tonnes/year
14 flights per day
33% energy demand – solar!

An electrical Ground Power unit (GPU) and Pre-Conditioned Air unit (PCA) procured and installed by the airport

OBJECTIVE 3: PILOT MITIGATION MEASURES

KENYA

MOI INTERNATIONAL AIRPORT

Capacity:	502.92 kWp
Solar modules:	1,524 panels
Gate equip:	1 GPU + 1 PCA
Price:	1,422,314 USD
Inauguration:	12 December 18
Benefits:	1,300 tonnes/year 7 flights per day

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OBJECTIVE 3: PILOT MITIGATION MEASURES

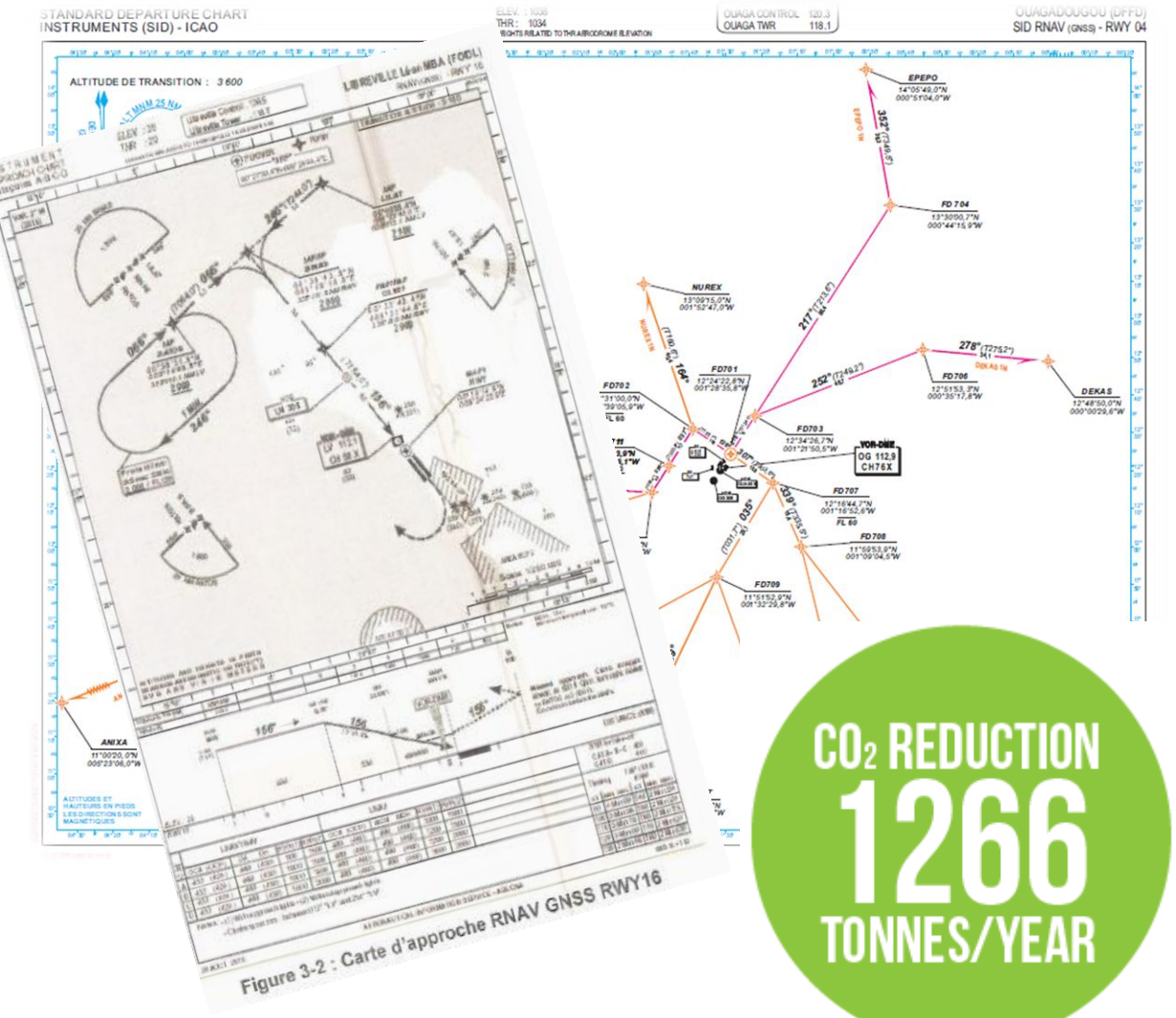


Figure 3-2 : Carte d'approche RNAV GNSS RWY16

CO_2 REDUCTION
1266
TONNES/YEAR

OPERATIONAL MEASURES
BURKINA FASO AND GABON

CONTINUOUS CLIMB AND DESCENT OPERATIONS (CCO/CDO PROCEDURES)

NEW DEPARTURE AND ARRIVAL PROCEDURES

1. Ouagadougou International Airport
2. Libreville MBA International Airport

In cooperation with

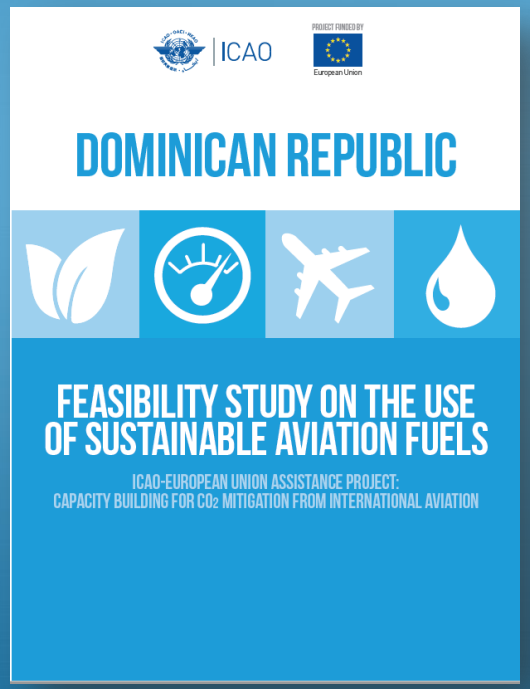
PROJECT FUNDED BY

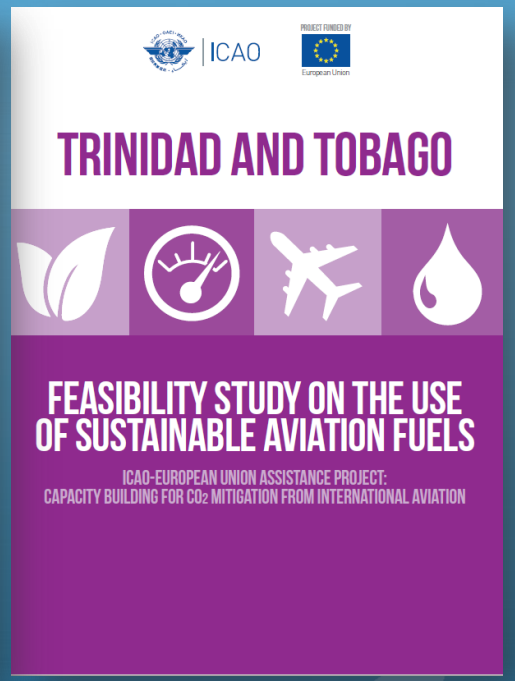
OBJECTIVE 3: PILOT MITIGATION MEASURES

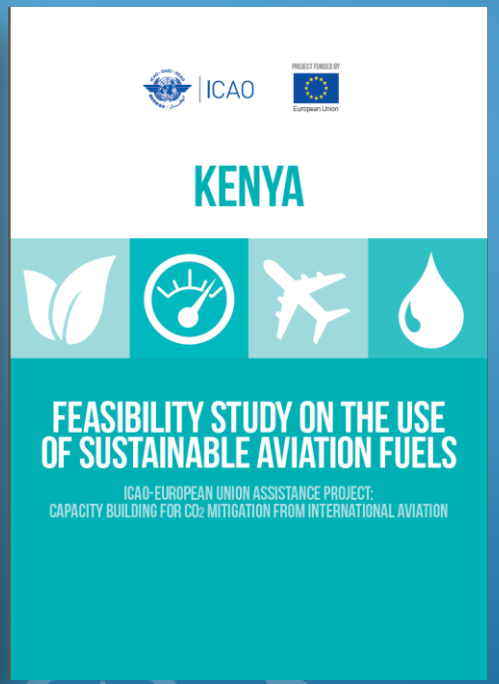
FIVE FEASIBILITY STUDIES

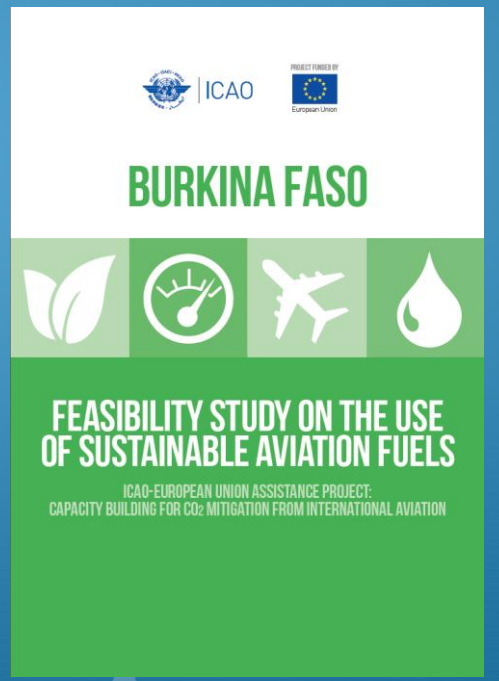
SUSTAINABLE AVIATION FUELS

SOLAR ENERGY AT AIRPORTS









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OVERSIGHT / EVALUATION OF SUCCESS

Key Results

	Indicators	Project Target	Achieved to-date	Target exceeded
OBJECTIVE 1	NATIONAL ACTION PLAN TEAMS ESTABLISHED	10 States	14 States	**4 States**
OBJECTIVE 1	STATES TRAINED ON ACTION PLAN DEVELOPMENT	10 States	14 States	**4 States**
OBJECTIVE 1	STATES' ACTION PLANS DEVELOPED AND SUBMITTED	5 States	14 States	**9 States**
OBJECTIVE 2	AVIATION ENVIRONMENTAL SYSTEM FOR CO2 MONITORING INSTALLED	5 States	14 States	**9 States**
OBJECTIVE 2	STATES TRAINED TO USE THE AES AND REPORT ON AVIATION EMISSIONS	10 States	14 States	**4 States**
OBJECTIVE 3	FEASIBILITY STUDIES FOR THE MITIGATION MEASURES INCLUDED IN THE ACTION PLANS	5 Studies	5 Studies	-
OBJECTIVE 3	MEASURES TO IMPROVE ENVIRONMENTAL BENEFITS AND REDUCE FUEL CONSUMPTION IMPLEMENTED	5 States	14 States	**9 States**

7 expected results were completed and exceeding the targets

PROJECT FUNDED BY

OVERSIGHT / EVALUATION OF SUCCESS

NETWORK OF ENVIRONMENT AND AVIATION EXPERTS IN THE AFRICAN REGION

ABILITY TO **MONITOR AND REPORT CO_2 EMISSIONS** FROM AVIATION

ESTABLISHMENT OF ENV UNITS AT THE CAAs in 7 STATES

6 STATES VOLUNTARILY JOINED CORSIA FROM THE PILOT PHASE

PROJECT FUNDED BY

Results-Oriented Monitoring (ROM) 2016 - 2017

Relevance, Efficiency, Effectiveness and Sustainability

Highlights

- Increased relevance of the project
- Objective 1 and Objective 2 completed with exceeding targets
- More awareness and commitment from beneficiary States
- Exit strategy in place which will support sustainability of results
- Most of the recommendations from previous review were addressed

Results

Very good

AGENDA

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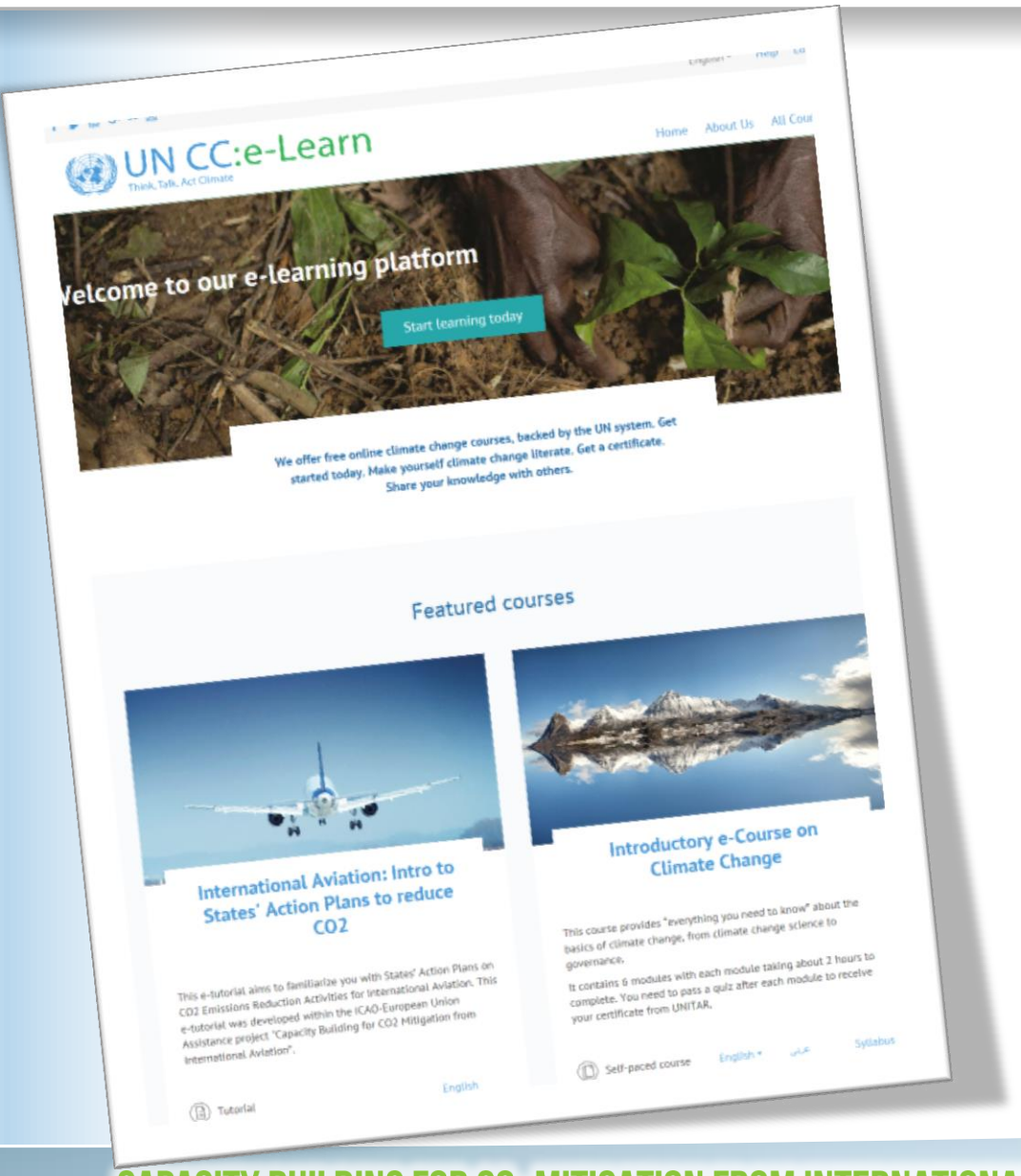
This journey towards the sustainability of air transport still continue……

The **ICAO-EU project** has been completed but **ICAO will continue supporting the States** through the regular programme from Headquarters and the Regional Offices.

NEXT STEPS / SUSTAINABILITY OF RESULTS



ONLINE TRAINING COURSE

INTERNATIONAL AVIATION: STATES' ACTION PLANS TO REDUCE CO_2 EMISSIONS

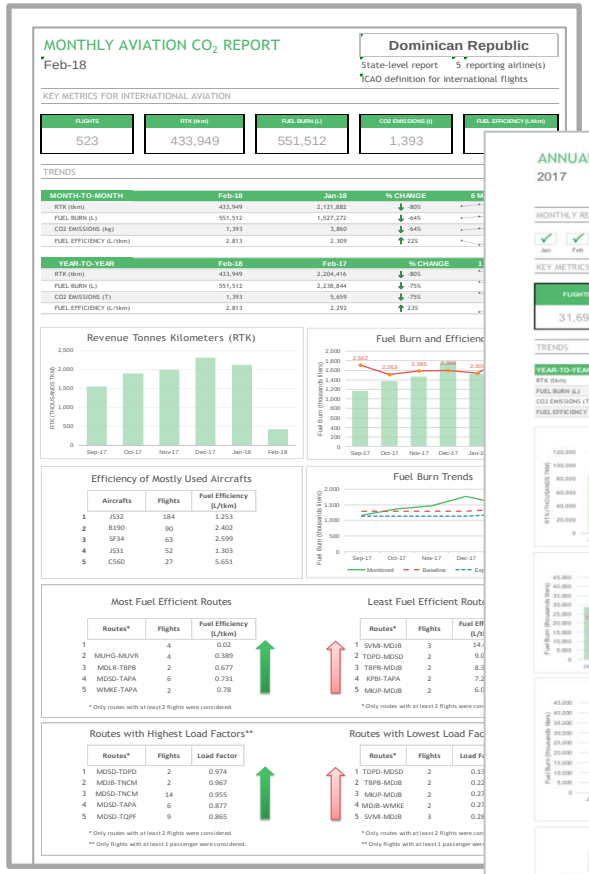
- Further training to new members/focal points
- Refresh knowledge and practice exercises
- Update the Action Plans for the next triennium
- Raise awareness

PROJECT FUNDED BY

NEXT STEPS / SUSTAINABILITY OF RESULTS

THE AVIATION ENVIRONMENTAL SYSTEM

Monthly reporting to ICAO



NEXT STEPS / SUSTAINABILITY OF RESULTS

THE AVIATION ENVIRONMENTAL SYSTEM

AES 2.0

CORSIA compatible

REPLICATION OF PILOT PROJECTS

PROJECT FUNDED BY

Upcoming activities

1

INAUGURATION OF SOLAR PROJECT IN CAMEROON

JANUARY 2019

2

COMISSIONING OF SOLAR FACILITIES TO CAMEROON AND KENYA

JANUARY 2019

3

AES 2.0 TESTING IN A PILOT STATE

FEBRUARY 2019

4

PROJECT AUDIT AND EVALUATION

MARCH 2019

5

PROJECT CLOSURE

JUNE 2019

A WINDOW FOR A GREENER FUTURE

ICAO

European Union