



ICAO

ENVIRONMENT

NO COUNTRY LEFT BEHIND

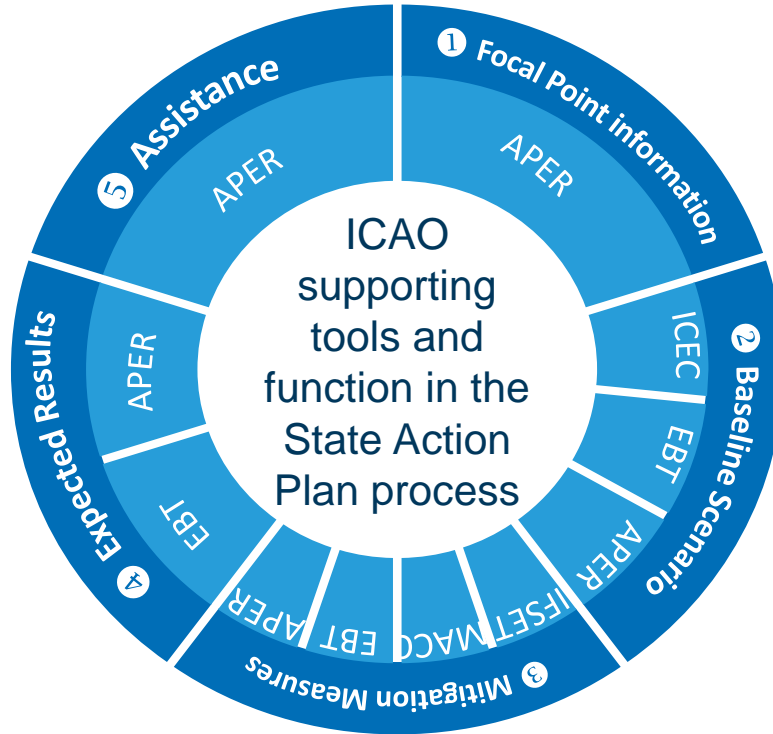


# ICAO Supporting Tools States' Action Plan





# ICAO Environmental Tools





## ICAO Environmental - ENV Tools Suite



### ICAO Carbon Emissions Calculator – for States

Allows passengers to estimate CO<sub>2</sub> emissions from their air travel



### ICAO Fuel Savings Estimation Tool (IFSET)

To assist States in estimating fuel savings from operational improvements



### ICAO CORSIA CO<sub>2</sub> Estimation and Reporting Tool (CERT)

To assist States and aeroplanes operators - monitoring and reporting requirements



### ICAO E-Learning Course – Module 1. State Action Plan



### ICAO Green Meetings Calculator

To support decision making in minimizing CO<sub>2</sub> emissions from air travel to attend meetings



### ICAO EBT – Environmental Benefit Tool



### ICAO MAC Curves



Baseline scenario

Mitigation Measures

Expected Results





# Action Plan Emissions Reduction (APER) Website

Action Plan on Emissions Reduction

[SUBMIT A STATE ACTION PLAN](#)

[CONTACT ICAO](#)

## Welcome to the Action Plan on Emissions Reduction (APER) Website



This website has been developed to assist States that want to prepare and submit their State Action Plan to ICAO. State Action Plans enable all ICAO Member States to establish a long-term strategy on climate change for the international aviation sector, involving all interested parties at national level. The level of detail submitted within a State Action Plan will ultimately enable ICAO to compile global progress towards meeting the goals set by Assembly Resolution A37-19, and reaffirmed by A38-18, A39-2, and A40-18. States are invited to update their State Action Plans every three years, so that ICAO can continue to compile the quantified information submitted.

on climate change for the  
ing the goals set by  
information submitted.

### UPCOMING EVENTS: State Action Plans – Online Regional Seminars 2020

- SAM/NACC - 27 to 28 July, starting at 13:00 Lima / 13:00 Mexico City time
- EUR/NAT - 29 to 30 July, starting at 14:00 Paris time
- ESAF/WACAF - 03 to 04 August, starting at 15:00 Nairobi / 12:00 Dakar time
- APAC - 05 to 06 August, starting at 08:00 Bangkok time
- MID - 25 to 26 August, starting at 13:00 Cairo time

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# Action Plan Emissions Reduction (APER) Website

- **Resources**

- Document 9988 - Guidance Material for the Development of States' Action Plans
- Document 10031 - Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes
- Transforming Global Aviation Collection
- Feasibility Studies



## Action Plan Emissions Reduction (APER) Website

- **Tool links & guidance**
  - Environmental Benefit Tool (EBT)
  - ICAO e-learning course on Action Plans
  - ICAO Carbon Emissions Calculator for States
  - Marginal Abatement Cost (MAC) Curve Tool
  - ICAO Fuel Savings Estimation Tool
  - Eco-Airport Toolkit e-collection



## Action Plan Emissions Reduction (APER) Website

- **Miscellaneous**

- Assembly Resolution A40-18 – Climate Change
- International RTK by State
- Fuel burn and RTK by State
- Form M
- Seminar Material





# Action Plan Emissions Reduction (APER) Website

APER

ICAO Secure Portal > APER > SUBMIT A STATE ACTION PLAN

Action Plan on Emissions Reduction

SUBMIT A STATE ACTION PLAN

CONTACT ICAO

## SUBMIT A STATE ACTION PLAN

Welcome to the Action Plan on Emissions Reduction (APER) Website



There are two ways to submit a State Action Plan through the APER.

- 1) Complete the step-by-step process of entering data directly on the site, with the option to upload supporting material; or
- 2) Upload a complete the State Action Plan as a PDF or Word document, along with any supporting material.

Please select the submission process that you would like to follow:

FOLLOW THE STEP-BY-STEP APER PROCESS

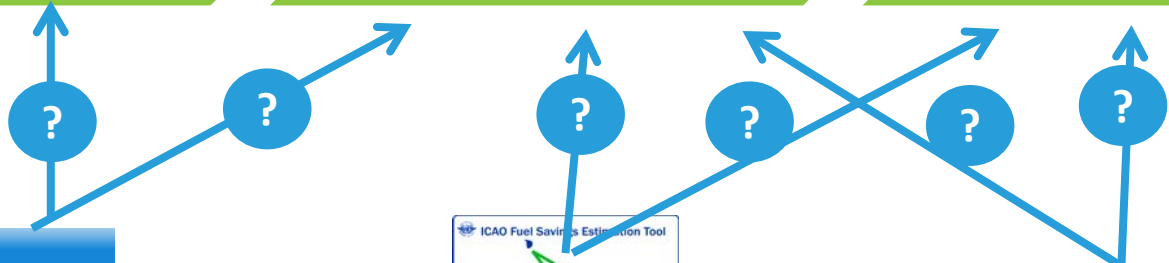
UPLOAD A COMPLETE STATE ACTION PLAN



Baseline scenario

Mitigation Measures

Expected Results





# ICAO E-Learning Training Tutorial





# ICAO UNITAR Online Training Tutorial



UN CC:e-Learn

Think, Talk, Act Climate

[www.icao.int/environmental-protection](http://www.icao.int/environmental-protection)

<https://unccelearn.org>



This e-tutorial aims to build an understanding of the importance of States' Action Plans in the civil aviation sector.

It shows how, by adopting the right "basket of measures" in the aviation sector, according to their own contexts, States can mitigate the Greenhouse Gas Emissions from international aviation .



## Tutorial



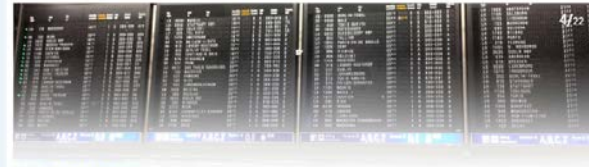
### WELCOME!

This e-tutorial aims to familiarize you with States' Action Plans on CO<sub>2</sub> Emissions Reduction from International Aviation. By the end of the tutorial, you should be able to:

1. Define the activities related to the development of a State Action Plan
2. Explain why it is important to develop a State Action Plan
3. Describe the main information which should be included in a State Action Plan

This e-tutorial was produced with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.

## Tutorial



### OVERVIEW



**SECTION 1:** Introduction



**SECTION 2:** What is a State Action Plan



**SECTION 3:** Elements of a State Action Plan



**SECTION 4:** Potential Mitigation Measures



**SECTION 5:** Assistance to States





# E-Learning Training Course on States Action Plan

## MODULE 1

### STATES' ACTION PLANS ON CO<sub>2</sub> EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION



This module describes the main components of the States' Action Plans on CO<sub>2</sub> Emissions Reduction from International Aviation. By the end of this module, you will be able to:

Define the activities to carry out for the development of a State Action Plan

Explain why it is important to develop a State Action Plan

Describe the main information which should be included in a State Action Plan

## MODULE 2

### BASELINE SCENARIO CALCULATION



This module aims to provide the necessary information to enable the States to calculate their baseline. By the end of this module, you will be able to:

Define the baseline scenario of CO<sub>2</sub> emissions from international aviation

Estimate international aviation fuel burnt, CO<sub>2</sub> emissions, and International Revenue Tonnes Kilometer (RTK)

Calculate the baseline using the ICAO Environment Benefits Tool (EBT)

## MODULE 3

### MITIGATION MEASURES



This module provides an overview of mitigation measures to limit or reduce CO<sub>2</sub> emissions from international aviation and case-studies of low emissions aviation measures implemented in States. By the end of this module, you will be able to:

Understand the elements of ICAO's Basket of Measures to reduce CO<sub>2</sub> emissions

Identify relevant measures that can be taken by a State to reduce CO<sub>2</sub> emissions from the international aviation sector

## MODULE 4

### SELECTION, PRIORITIZATION AND IMPLEMENTATION OF MITIGATION MEASURES



This module aims to provide the necessary information to enable States to select, prioritize and implement mitigation measures. By the end of this module, you will be able to:

Analyse the benefits and effectiveness of mitigation measures in relation to the costs involved

Analyse the additionality of projects

Carry out a risk analysis in the process of implementing mitigation measures

## MODULE 5

### TOOLS AND EXPECTED RESULTS



This module presents the tools that allow the Civil Aviation Authorities (CAA) to calculate, as well as to monitor CO<sub>2</sub> emissions from international aviation at the State level. By the end of this module, you will be able to:

Use the ICAO tools to calculate CO<sub>2</sub> emissions reduction and fuel savings

Use the ICAO Environmental Benefits Tool (EBT) to calculate the expected results from the selected mitigation measures

Use the Aviation Environmental System (AES) to monitor CO<sub>2</sub> emissions from the aviation sector, if available in the State



UN CC:e-Learn

Think, Talk, Act Climate





## E-Learning Training Course on States Action Plan

ICAO PROJECT FUNDED BY European Union UNITAR United Nations Institute for Training and Research

### MODULE 1: STATES' ACTION PLANS ON CO<sub>2</sub> EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION

**INTERNATIONAL AVIATION CO<sub>2</sub> EMISSIONS REDUCTION STATES' ACTION PLANS**  
E-LEARNING COURSE

**LEARNING OBJECTIVES**

By the end of this module, you should be able to:

- Define the activities related to the development of a State Action Plan;
- Explain why it is important to develop a State Action Plan;
- Describe the main information which should be included in a State Action Plan.

This e-book was produced with the financial assistance of the European Union. The views expressed herein are only those of the author(s) and do not represent those of the ICAO.

ICAO PROJECT FUNDED BY European Union UNITAR United Nations Institute for Training and Research

### MODULE 2: STATES' ACTION PLANS: BASELINE CALCULATION

**INTERNATIONAL AVIATION CO<sub>2</sub> EMISSIONS REDUCTION STATES' ACTION PLANS**  
E-LEARNING COURSE

**LEARNING OBJECTIVES**

By the end of this module, you should be able to:

- Define the Baseline;
- Estimate international aviation fuel burn, CO<sub>2</sub> emissions, and International Revenue Times Kilometer (IRK);
- Calculate the baseline using the Environmental Benefit Tool (EBT).

This e-book aims to familiarize you with the methodology to develop the Baseline in the process of developing a State Action Plan on CO<sub>2</sub> Emissions Reduction Activities for International Aviation.

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### MODULE 3 STATES' ACTION PLANS: MITIGATION MEASURES

**INTERNATIONAL AVIATION CO<sub>2</sub> EMISSIONS REDUCTION STATES' ACTION PLANS**  
E-LEARNING COURSE

**LEARNING OBJECTIVES**

By the end of this module, you should be able to:

- Identify measures that can be taken by a State to reduce the CO<sub>2</sub> emissions from the international aviation sector.

This e-book provides information on the various measures that can be taken by a State to reduce the CO<sub>2</sub> emissions from the international aviation sector.

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### MODULE 4 STATES' ACTION PLANS: SELECTION, PRIORITIZATION AND IMPLEMENTATION OF MITIGATION MEASURES

**INTERNATIONAL AVIATION CO<sub>2</sub> EMISSIONS REDUCTION STATES' ACTION PLANS**  
E-LEARNING COURSE

**LEARNING OBJECTIVES**

By the end of this module, you should be able to:

- Analyze the benefits and effectiveness in relation to the costs involved;
- Analyze the additivity of projects;
- Carry out a risk analysis in the process of implementing mitigation measures.

This e-book aims to provide the necessary information to enable States to select, prioritize and implement mitigation measures.

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### MODULE 5: STATES' ACTION PLANS: TOOLS AND EXPECTED RESULTS

**INTERNATIONAL AVIATION CO<sub>2</sub> EMISSIONS REDUCTION STATES' ACTION PLANS**  
E-LEARNING COURSE

**LEARNING OBJECTIVES**

By the end of this module, you should be able to:

- Use the ICAO tools to calculate CO<sub>2</sub> emissions and fuel savings;
- Use the Environmental Benefit Tool (EBT) to calculate the expected results from the selected mitigation measures;
- Use the Aviation Environmental System (AES) to monitor CO<sub>2</sub> emissions from international aviation, if installed in the State.

This e-book aims to present the various ICAO tools which can be used to support the development of a State Action Plan.

This e-book was produced with the financial assistance of the European Union. The views expressed herein are only those of the author(s) and do not represent those of the ICAO.



# Estimating aircraft fuel burn and CO<sub>2</sub> emissions:

## ICAO Carbon Emissions Calculator





# ICAO Carbon Emissions Calculator

## Description:

ICAO has developed a methodology to calculate the carbon dioxide emissions from air travel for use in offset programmes.



One Way/Round Trip	Cabin Class	Number of Passengers
One Way	Economy	1

Leg	From City/Airport	To City/Airport
1	GVA	YUL

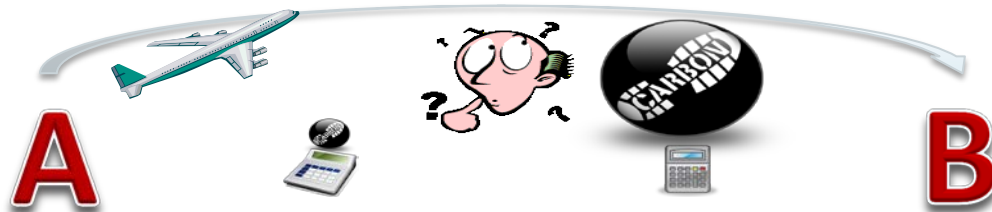
Metric (KG / KM)		Standard (LBS / MI)		Total		
Dep Airport	Arr Airport	Number of passengers	Cabin Class	Trip	Aircraft Fuel Burn/journey (KG) <sup>ab</sup>	Total passengers' CO <sub>2</sub> /journey (KG) <sup>c</sup>
GVA	YUL	1	Economy	One Way	46048.4	318.2

Flight Stage Detail					
Dep Airport	Arr Airport	Distance (KM)	Aircraft	Aircraft Fuel Burn/leg (KG) <sup>a</sup>	Passenger CO <sub>2</sub> /pax/leg (KG)
GVA	YUL	5901.0	333	46048.4	318.2



## ICAO Carbon Emissions Calculator Background

- Proliferation of tools for calculating “carbon footprint” from aviation
  - Results differ by factor of 4 or more!
  - Unknown data sources and methodologies (black box)
  - Inconsistent basis for offsetting





# ICAO Carbon Emissions Calculator Methodology

- **Objectives**

- User-friendly, unbiased, tool to compute carbon emissions from air travel
- Suitable for use with voluntary offsetting programmes
- Best publicly available data (**transparency**)
- Fully documented



## ICAO Carbon Emissions Calculator Methodology (cont.)

- Methodology Developed through CAEP
- Expert input provided from
  - ICAO Secretariat
  - ICAO Member States
  - Universities
  - NGOs
  - International Air Transport Association – IATA (Airlines)
  - International Coordinating Council of Aerospace Industries Associations – ICCAIA (Manufacturers)
- Methodology is internationally recognized and accepted
- All UN air travel GHG inventories are prepared using the ICAO Calculator

Available on the  
public website

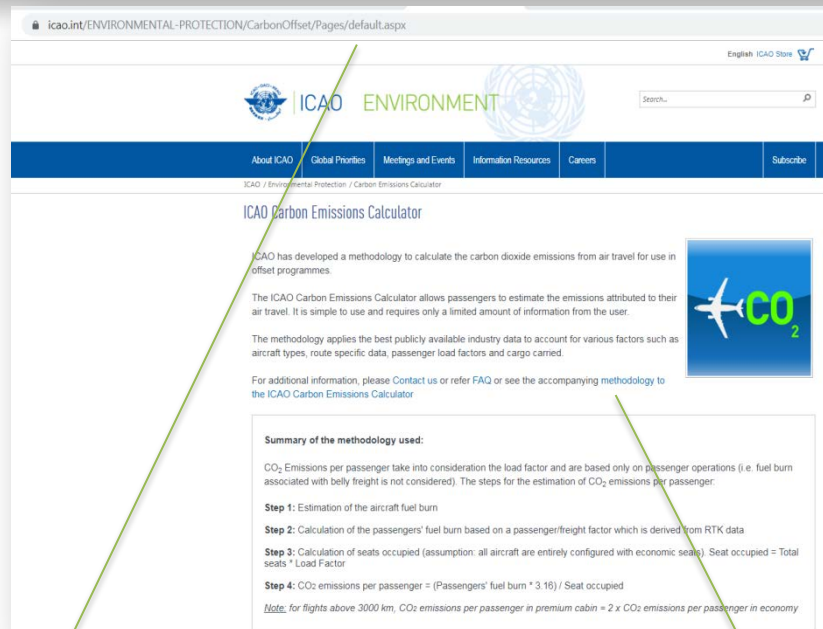






# ICAO Carbon Emissions Calculator - Public Interface

- Transparent
- Easy-to-use
- Publicly available
- Delivers consistent estimates of CO<sub>2</sub> – suitable for use with offset programs
- Available since June 2008



The screenshot shows the ICAO Carbon Emissions Calculator public interface. The page title is "ICAO Carbon Emissions Calculator". The main content area contains the following text:

ICAO has developed a methodology to calculate the carbon dioxide emissions from air travel for use in offset programmes.

The ICAO Carbon Emissions Calculator allows passengers to estimate the emissions attributed to their air travel. It is simple to use and requires only a limited amount of information from the user.

The methodology applies the best publicly available industry data to account for various factors such as aircraft types, route specific data, passenger load factors and cargo carried.

For additional information, please [Contact us](#) or refer [FAQ](#) or see the accompanying methodology to the ICAO Carbon Emissions Calculator

**Summary of the methodology used:**

CO<sub>2</sub> Emissions per passenger take into consideration the load factor and are based only on passenger operations (i.e. fuel burn associated with belly freight is not considered). The steps for the estimation of CO<sub>2</sub> emissions per passenger:

**Step 1:** Estimation of the aircraft fuel burn

**Step 2:** Calculation of the passengers' fuel burn based on a passenger/freight factor which is derived from RTK data

**Step 3:** Calculation of seats occupied (assumption: all aircraft are entirely configured with economic seats). Seat occupied = Total seats \* Load Factor

**Step 4:** CO<sub>2</sub> emissions per passenger = (Passengers' fuel burn \* 3.16) / Seat occupied

*Note:* for flights above 3000 km, CO<sub>2</sub> emissions per passenger in premium cabin = 2 x CO<sub>2</sub> emissions per passenger in economy

The interface also features a navigation menu with links for "About ICAO", "Global Priorities", "Meetings and Events", "Information Resources", "Careers", and "Subscribe". A search bar and a language selector are also visible.

<http://www.icao.int/ENVIRONMENTAL-PROTECTION/CarbonOffset/Pages/default.aspx>

[Link to Methodology](#)



# ICAO Carbon Emissions Calculator User Interface for Action Plans



Available on the  
APER Website

The screenshot shows the Microsoft Excel interface for the 'ICAO Carbon Emissions Calculator (Entire Flight) Version 2.6'. The spreadsheet is divided into several sections:

- Header Section (Rows 1-4):** Contains the ICAO logo, title 'ICAO Carbon Emissions Calculator (Entire Flight) Version 2.6', and copyright information '© ICAO 2016'.
- Results Section (Rows 5-7):** A table with the following structure:

Results	
Total CO <sub>2</sub> (tonnes):	
Total flights:	
Remarks:	
- Input Section (Row 14):** A header row for flight schedule data with columns: 'Airport Pair or Distance in km', 'Number of Flights', 'Aircraft Code', 'CO<sub>2</sub> (kg)', and 'Messages'. A yellow bar above this row says 'Insert schedule data below this row'.
- Buttons:** A 'Click to Compute CO<sub>2</sub>' button is located below the header row.

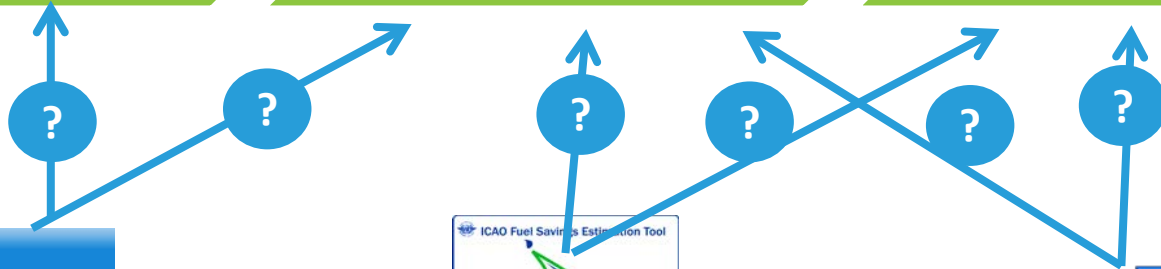
Simply enter the flight schedule for the State



Baseline scenario

Mitigation Measures

Expected Results





# Estimating Fuel Savings from Operational Changes:

## ICAO Fuel Savings Estimation Tool (IFSET)





# ICAO Fuel Savings Estimation Tool

## Description:

Operational measures are one of the instruments available to States to improve fuel efficiency and reduce CO<sub>2</sub> emissions.

The ICAO Fuel Savings Estimation Tool (IFSET) has been developed by the Secretariat with support from States and international organizations to assist the States to estimate fuel savings in a manner consistent with the models approved by CAEP and aligned with the Global Air Navigation Plan.

Input

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Taxi				1200
2	Climb	3000	20000	37	
3	Level	20000	20000	20	
4	Climb	20000	25000	20	

Add
Delete

---

New Procedure Definition

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Taxi				1000
2	Climb	3000	25000	57	
3	Level	25000	25000	20	

Add
Delete

Output

Estimated Fuel Changes Report

Scenario Name	Old Fuel Consumption (KG)	New Fuel Consumption (KG)	Savings (KG)	Savings (%)
Example	1337600	1283000	-54500	-4.10

Estimated Detailed Fuel Changes Report

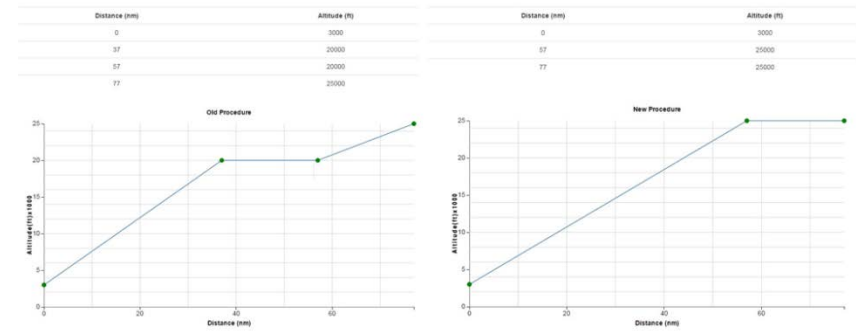
Old Climb Fuel (KG)	New Climb Fuel (KG)	Climb Savings (KG)
523000	521000	-2100

Old Descent Fuel (KG)	New Descent Fuel (KG)	Descent Savings (KG)
0	0	0

Old Level Fuel (KG)	New Level Fuel (KG)	Level Savings (KG)
155800	145400	-9400

Old Taxi Fuel (KG)	New Taxi Fuel (KG)	Taxi Savings (KG)
258800	215600	-43100

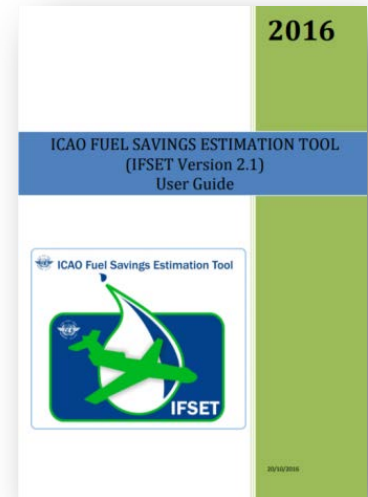
Graphics





## The tool can estimate:

- Effects of shortening / eliminating level segments on departure and approach
- Effects of shorter routes (either in time or distance)
- Effects of cruising at different altitudes
- Effects of reduced taxi times







- The tool **does not**:
  - Replace detailed modelling or measurement of fuel consumption
  - Estimate fuel consumption from airborne holding
  - Compute other elements than fuel consumption / CO<sub>2</sub> emissions



## IFSET

### How it Works: User Input

- Fleet mix defined for baseline and post-implementation scenario
  - Aircraft category
  - Aircraft remaining trip distance (optional parameter that will increase accuracy for departures)
- User selects “elements” to define the baseline and “new” procedure
- Tool estimates the change in total fuel consumption between the 2 scenarios



## IFSET Example

### Objective

Operational measures are one of the instruments available to States to improve fuel efficiency and reduce CO2 emissions. The ICAO Fuel Savings Estimation Tool (IFSET) has been developed by the Secretariat with support from States and international organizations to assist the States to estimate fuel savings in a manner consistent with the models approved by CAEP and aligned with the Global Air Navigation Plan.

The ICAO Fuel Savings Estimation Tool (IFSET) is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States without such facilities to estimate the benefits from operational improvements in a harmonized way.

User Guide: [IFSET Ver 2.1 User Guide](#)

**Please note that all the information saved in this web tool can be seen by the public. Therefore you should delete the event when you have finished using the tool.**

New Scenario

Saved Scenario

## Step 1 - Define New Scenario

Scenario Name

ID	Aircraft	Base Flights	New Flights	Continuing Old Flights	Remaining Trip (nm)
1	Single Aisle Jet ▼	1000	1000	0	1160
2	Turboprop ▼	500	500	0	740

[Back](#) [Aircraft Category Map](#) [Add](#) [Delete](#) [Save](#) [Next Step](#)

Save any change on the page by clicking "Save" before clicking "Next Step".



Step 2 - Saved Old/New Procedure Definition

Scenario Name:

Old Procedure Definition

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Taxi				1200
2	Climb	3000	20000	37	
3	Level	20000	20000	20	
4	Climb	20000	25000	20	

New Procedure Definition

ID	Action	From Alt (ft)	To Alt (ft)	Distance (nm)	Time (sec)
1	Taxi				1000
2	Climb	3000	25000	57	
3	Level	25000	25000	20	

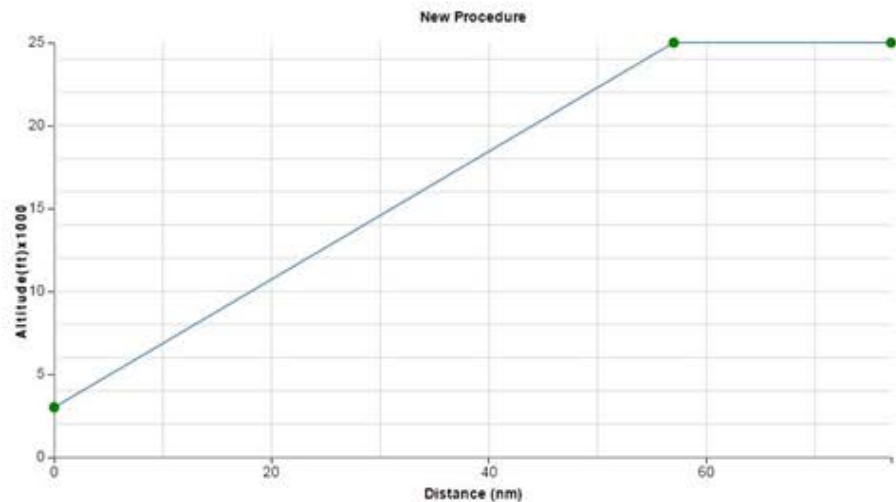
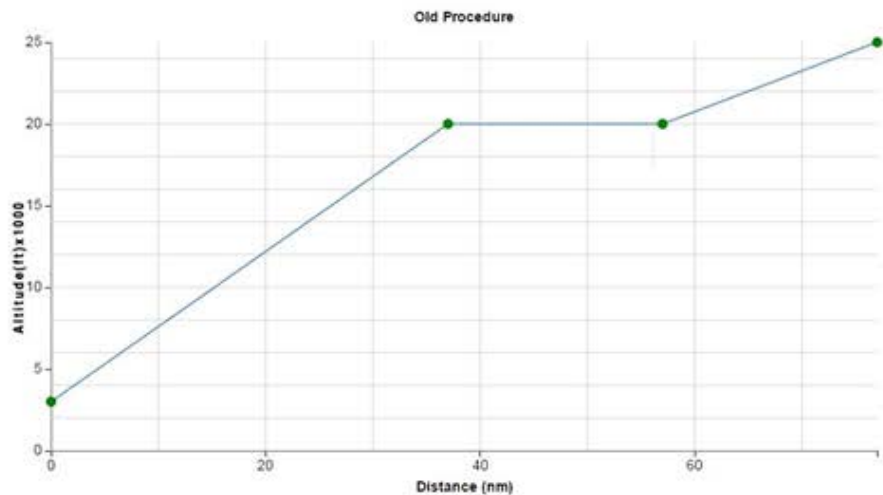


### Step 3 - Estimated Fuel Changes Report

Scenario Name:

Distance (nm)	Altitude (ft)
0	3000
37	20000
57	20000
77	25000

Distance (nm)	Altitude (ft)
0	3000
57	25000
77	25000







Estimated Fuel Changes Report

Scenario Name	Old Fuel Consumption (KG)	New Fuel Consumption (KG)	Savings (KG)	Savings (%)
Example	1337600	1283000	-54500	-4.10

Estimated Detailed Fuel Changes Report

Old Climb Fuel (KG)	New Climb Fuel (KG)	Climb Savings (KG)
923000	921000	-2100

Old Descent Fuel (KG)	New Descent Fuel (KG)	Descent Savings (KG)
0	0	0

Old Level Fuel (KG)	New Level Fuel (KG)	Level Savings (KG)
155800	146400	-9400

Old Taxi Fuel (KG)	New Taxi Fuel (KG)	Taxi Savings (KG)
258800	215600	-43100

Back

Export to Excel



# IFSET - In Summary

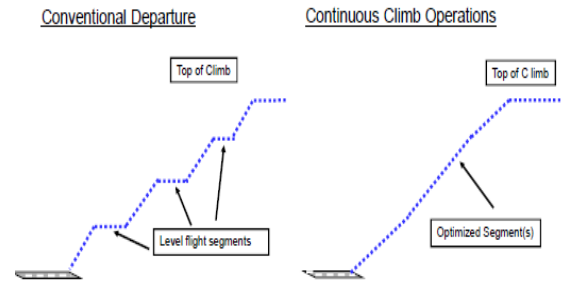
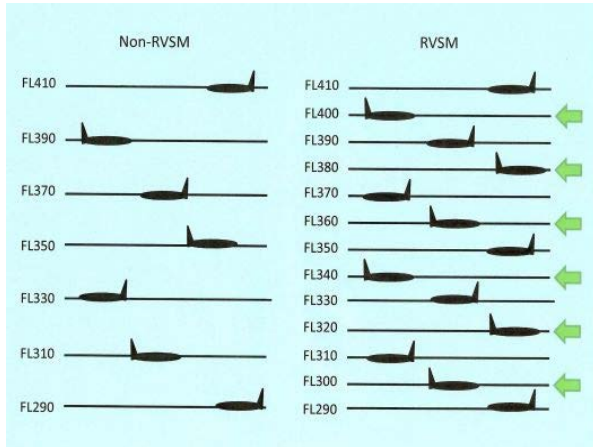
Operational Measure  
Implementation (planned or  
post)

+

Need to quantify change in  
fuel consumption, but don't  
have the tools?

=

**USE  
IFSET**





# ICAO CO<sub>2</sub> Estimation and Reporting Tool CERT

© ICAO 2019

**CORSIA** | CO<sub>2</sub> Estimation & Reporting Tool (CERT) Version 2019

**Step 2. CO<sub>2</sub> emissions estimation**  
 Summary of assessment of applicability of CORSIA and eligibility to use the ICAO CORSIA CERT in 2020

← Back Home Next →

Steps:

- 2.a Collect flight information (aircraft type, aerodromes of origin and destination) for all flights during the relevant time period.
- 2.b Enter the information for all flights by double clicking on the green cells below.  
*Note: For a given aerodrome pair flown by a particular aircraft type, all flights can be entered as a single entry by entering total number of flights during the relevant time period.*  
*Note: Data can also be copied and pasted across input cells as needed.*  
*Note: Data can also be imported from a csv file, structured to match the contents under the INPUT section below.*
- 2.c After entering input, compute CO<sub>2</sub> emissions. Click on →
- 2.d After computing CO<sub>2</sub> emissions, generate a summary assessment of applicability of CORSIA and eligibility to use the ICAO CORSIA CERT in 2019. Click on →

Import Input File (.csv)

Estimate CO<sub>2</sub> Emissions

3. Generate Summary Assessment

INPUT					OUTPUT			
Date (Optional)	Flight ID (Optional)	ICAO Aircraft Type Designator Search Aircraft Code Custom AC	Origin Aerodrome Search Aerodrome Custom AP	Destination Aerodrome Search Aerodrome Custom AP	Number of Flights	Great Circle Distance (in km)	CO <sub>2</sub> Emissions (in tonnes of CO <sub>2</sub> )	Flight(s) subject to Scope of Applicability of CORSIA



# ICAO CORSIA CO<sub>2</sub> Estimation and Reporting Tool (CERT)

## Description:

The ICAO CORSIA CERT is one of the five ICAO CORSIA Implementation Elements and is reflected in the ICAO document entitled "ICAO CORSIA CO<sub>2</sub> Estimation and Reporting Tool", referenced in Annex 16, Volume IV.

The ICAO CORSIA CERT supports aeroplane operators in fulfilling their monitoring and reporting requirements in CORSIA by populating the standardized Emissions Monitoring Plan and Emissions Report templates.

© ICAO 2019



**CORSIA** | CO<sub>2</sub> Estimation & Reporting Tool (CERT) Version 2019

**Step 2. CO<sub>2</sub> emissions estimation**  
Summary of assessment of applicability of CORSIA and eligibility to use the ICAO CORSIA CERT in 2020

Back Home Next

Steps:

- 2.a Collect flight information (aircraft type, aerodromes of origin and destination) for all flights during the relevant time period.
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- 2.d After computing CO<sub>2</sub> emissions, generate a summary assessment of applicability of CORSIA and eligibility to use the ICAO CORSIA CERT in 2019. Click on →

Import Input File (.csv)

Estimate CO<sub>2</sub> Emissions

3. Generate Summary Assessment

INPUT					OUTPUT			
Date (Optional)	Flight ID (Optional)	ICAO Aircraft Type Designator	Origin Aerodrome	Destination Aerodrome	Number of Flights	Great Circle Distance (in km)	CO <sub>2</sub> Emissions (in tonnes of CO <sub>2</sub> )	Flight(s) subject to Scope of Applicability of CORSIA
		<input type="text" value="Search Aircraft Code"/> Custom AC	<input type="text" value="Search Aerodrome"/> Custom AP					



Baseline scenario

Mitigation Measures

Expected Results





## Environmental Benefit Tool (EBT)

- Background

- Guidance Document for the Development of States' Action Plans (Doc 9988)



EBT

A large, light grey arrow pointing from the bottom left towards the top right. It contains three blue circular markers. The first marker is positioned above the text 'Guidance Document for the Development of States' Action Plans (Doc 9988)'. The second marker is in the middle of the arrow. The third marker is positioned above the text 'EBT'.

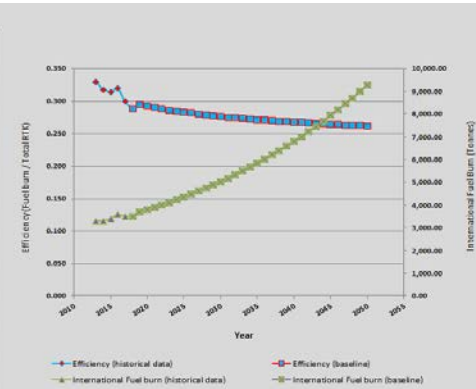
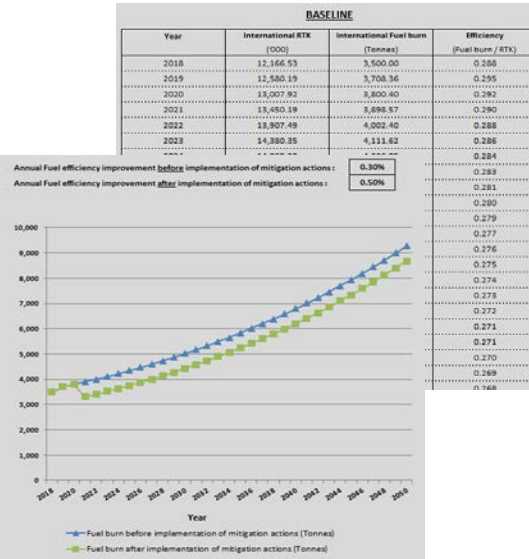


# Environmental Benefits Tool (EBT)

**EXPECTED RESULTS - FUEL SAVINGS**

Year	Annual Fuel burn <i>before</i> implementation of mitigation actions (Tonnes)	Annual Fuel burn <i>after</i> implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2018	3,500.00	3,500.00	0.00	0.00
2019	3,708.36	3,708.36	0.00	0.00
2020	3,800.40	3,800.40	0.00	0.00
2021	3,898.57	3,303.82	594.74	-15.26
2022	4,002.40	3,407.65	594.74	-14.86
2023	4,111.62	3,516.87	594.74	-14.46
2024	4,228.09	3,631.31	594.74	-14.07
2025	4,356.08	3,750.88	594.74	-13.69
2026	4,495.28	3,875.54	594.74	-13.30
2027	4,645.04	4,005.30	594.74	-12.92
2028	4,805.94	4,140.20	594.74	-12.56
2029	4,978.05	4,280.30	594.74	-12.20
2030	5,161.46	4,425.46	594.74	-11.85
2031	5,356.27	4,575.48	594.74	-11.50
2032	5,562.48	4,730.74	594.74	-11.16
2033	5,780.09	4,891.20	594.74	-10.83
2034	6,009.10	5,057.46	594.74	-10.51
2035	6,249.51	5,229.72	594.74	-10.20
2036	6,501.42	5,407.98	594.74	-9.90
2037	6,764.93	5,592.24	594.74	-9.60

Expected Results



Baseline Scenario





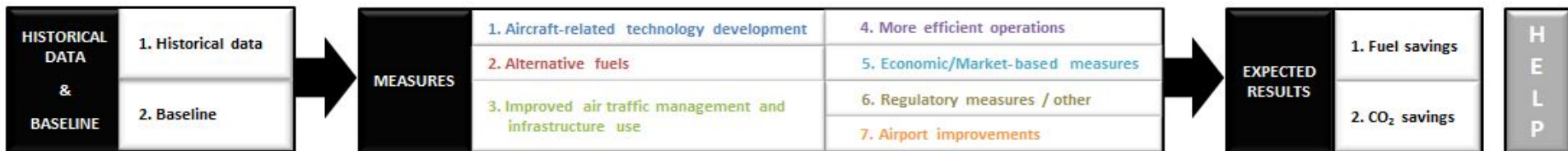
## Environmental Benefits Tool (EBT)

- Description:
  - The EBT is a tool developed for supporting States in the development of their State Action Plan.
  - This tool allows easily generating a baseline scenario, estimating the impact of mitigation measures and finally generating expected results.





## Environmental Benefit Tool (EBT)



### Part 1 : Historical Data & Baseline

1. Select baseline methodology:
  - *Method A* – The main national air carrier of the State has a fleet of no more than 10 aircraft
  - *Method B* – The State has access to data for 5 years or more
  - *Method C* – The State only has data available for a single year
2. Generate the baseline up to 2050

© ICAO 2020

### Part 2 : Mitigation Measures

Calculate the impacts of the mitigation measures based on Rules of Thumb, IFSET or State data

### Part 3 : Expected Results

Generate the expected results by combining baseline and mitigation measures information

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# Environmental Benefit Tool (EBT)



HISTORICAL DATA

Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Intl. Fuel burn / Intl. RTK)
2007	500,000.00	200,000.00	0.400
2008	550,000.00	215,000.00	0.391
2009	650,000.00	250,000.00	0.385
2010	700,000.00	260,000.00	0.371
2011	850,000.00	325,000.00	0.382
2012	900,000.00	345,000.00	0.383
2013	1,100,000.00	415,000.00	0.377
2014	1,100,000.00	414,000.00	0.376
2015	1,350,000.00	490,000.00	0.363

Example based on Method B - The State has access to data for 5 years or more



## Environmental Benefit Tool (EBT)

Minimising weight

Level of automation selected :

**ICAO methodology**

From (year)

To (year)

Aircraft category

Total number of aircraft / year

Annual flight time / aircraft (hr)

Weight reduction / aircraft (Kg)

% of implementation

**State methodology**

From (year)

To (year)

Annual fuel savings (tonnes)

Annual growth rate (%) - Optional

### Minimising weight

#### Inputs from State:

- Time period (from, to)
- Aircraft category
- Total number of aircraft per year
- Annual flight time per aircraft
- Weight reduction per aircraft
- % of implementation





## Environmental Benefit Tool (EBT)

Minimising weight

**Minimising weight**

Level of automation selected :

**ICAO methodology**

From (year)

To (year)

Aircraft category

Total number of aircraft / year

Annual flight time / aircraft (hr)

Weight reduction / aircraft (Kg)

% of implementation

**State methodology**

From (year)

To (year)

Annual fuel savings (tonnes)

Annual growth rate (%) - Optional

### Minimising weight

#### Inputs from State:

- *Time period (from, to)*
- *Aircraft category*
- *Total number of aircraft per year*
- *Annual flight time per aircraft*
- *Weight reduction per aircraft*
- *% of implementation*

**Annual Fuel Savings = Weight reduction factor \* Annual flight time \* Weight reduction \* Number of aircraft**



## Environmental Benefit Tool (EBT)

Minimising weight

Level of automation selected : **High** **Help** **Note** **Close**

**ICAO methodology**

From (year)

To (year)

Aircraft category

Total number of aircraft / year

Annual flight time / aircraft (hr)

Weight reduction / aircraft (Kg)

% of implementation

**Add** **Clear** **Multi-entry**

**State methodology**

From (year)

To (year)

Annual fuel savings (tonnes)

Annual growth rate (%) - Optional

**Add** **Clear**

### Minimising weight

#### Inputs from State:

- Time period (from, to)
- Aircraft category
- **Total number of aircraft per year**
- **Annual flight time per aircraft**
- Weight reduction per aircraft
- % of implementation

$$\text{Annual Fuel Savings} = \text{Weight reduction factor} * \text{Annual flight time} * \text{Weight reduction} * \text{Number of aircraft}$$





# Environmental Benefit Tool (EBT)



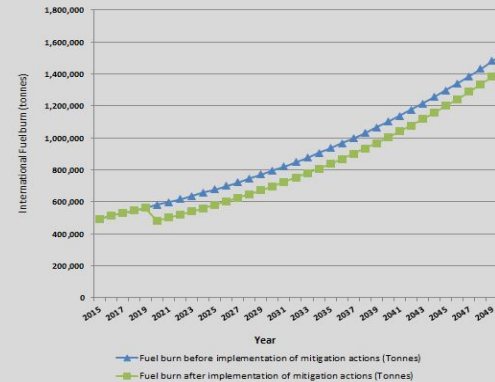
**Details**

**Download Results**

**EXPECTED RESULTS : FUEL SAVINGS**

Year	Annual Fuel burn <u>before</u> implementation of mitigation actions (Tonnes)	Annual Fuel burn <u>after</u> implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2015	490,000.00	490,000.00	0.00	0.00
2016	514,412.91	514,412.91	0.00	0.00
2017	530,004.55	530,004.55	0.00	0.00
2018	546,242.61	546,242.61	0.00	0.00
2019	563,133.25	563,133.25	0.00	0.00
2020	580,685.96	482,992.08	97,693.88	-16.82
2021	598,912.90	501,219.03	97,693.88	-16.31
2022	617,828.49	520,134.61	97,693.88	-15.81
2023	637,449.04	539,755.17	97,693.88	-15.33
2024	657,792.58	560,056.70	97,693.88	-14.85
2025	678,878.64	581,364.77	97,693.88	-14.39
2026	700,728.20	603,674.33	97,693.88	-13.94
2027	723,363.55	625,669.68	97,693.88	-13.51
2028	746,808.25	649,114.38	97,693.88	-13.08
2029	771,087.11	673,393.24	97,693.88	-12.67
2030	796,226.14	698,532.27	97,693.88	-12.27
2031	822,252.56	724,558.68	97,693.88	-11.88
2032	849,194.77	751,500.89	97,693.88	-11.50
2033	877,082.38	779,388.51	97,693.88	-11.14
2034	905,946.23	808,252.36	97,693.88	-10.78

Annual Fuel efficiency improvement before implementation of mitigation actions : **0.19%**  
 Annual Fuel efficiency improvement after implementation of mitigation actions : **0.37%**





## Environmental Benefit Tool (EBT)

- **Future developments**

1. Migrate EBT from Excel-based tool to Application (.exe)
2. Integrate the ICAO Carbon Emissions Calculator methodology and IFSET methodology into EBT
3. Provide more flexibility to users to import their own data into EBT
4. Improve connection between EBT and the APER website



# Marginal Abatement Cost Curve (MACC)

## Welcome Page

### CARBON EMISSION REDUCTION

[INTRODUCTION](#)   [20 MEASURES](#)   [GLOBAL MAC CURVE](#)   [CUSTOMIZE MAC CURVES](#)

The **Carbon Emission Reduction** tool allows ICAO Member States to conduct a cost-benefit analysis of the most popular mitigation measures included in the ICAO basket of measures to reduce CO<sub>2</sub> emissions from international aviation. It is simple to use and requires a limited amount of information from the user.

The results of the analysis performed by the tool will assist the Civil Aviation Authorities and National Action Plan Teams in the selection and prioritization of mitigation measures to be included in their State Action Plan on Emissions Reduction by presenting a brief overview of potential for CO<sub>2</sub> emissions reduction and associated costs for low carbon technologies in a given scenario. The tool includes the selection of relevant measures by the user, the input of State-related data, and the automatic computation of a Marginal Abatement Cost (MAC) curve with different time horizons.

The methodology of the tool is based on a comprehensive **Carbon Emission Reduction** report developed by ICAO and UNDP joint project "Transforming the Global Aviation Sector: Emissions Reductions from International Aviation".

This tool has been developed as part of the ICAO and European Union Assistance Project "Capacity Building for CO<sub>2</sub> mitigation from international aviation" – EuropeAid/DCI-ENV/2013/322-049. For additional information, please visit [https://www.icao.int/environmental-protection/Pages/ICAO\\_EU.aspx](https://www.icao.int/environmental-protection/Pages/ICAO_EU.aspx)

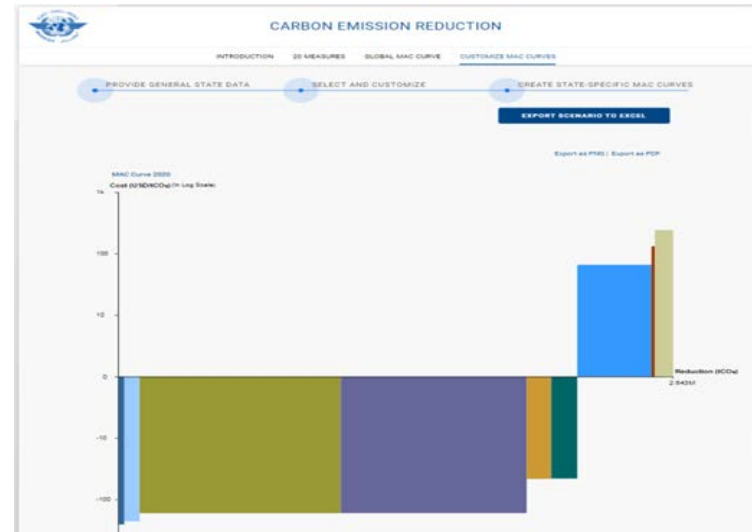


This online tool has been developed under the International Civil Aviation Organization (ICAO) - European Union (EU) Assistance Project: "Capacity Building for CO<sub>2</sub> Mitigation from International Aviation" – EuropeAid/Development Cooperation Instrument DCI-ENV/2013/322-049. This project, funded by the European Union and implemented by ICAO, has the overarching objective of contributing to international, regional and national efforts to address growing CO<sub>2</sub> emissions from international aviation.



## Marginal Abatement Cost Curve (MACC)

- **Description**
  - This tool offers the possibility to States to identify and rank up to 20 mitigation measures in order to facilitate decision-making.
  - The tool includes a user-friendly interface and is fully customizable to fit the State's situation





# Marginal Abatement Cost Curve (MACC)

## MAC CURVES

Under the framework of the ICAO-UNDP-GEF project, ICAO has designed a tool to support States and their stakeholders prioritize the most appropriate international aviation CO<sub>2</sub> emissions mitigation measures, in light of their respective costs and CO<sub>2</sub> emissions reductions. The tool is particularly focussed on developing States and Small Island Developing States (SIDS).

Numerous measures are available to States and their aviation stakeholders seeking to reduce CO<sub>2</sub> emissions from international aviation. Limited financial and technical resources represent a challenge for the implementation of these measures and make prioritizing a necessity. Marginal abatement cost (MAC) curves illustrate the relative CO<sub>2</sub> emissions reductions among possible measures on a comparative cost basis.

Each proposed CO<sub>2</sub> emissions mitigation measure requires a specific investment to achieve CO<sub>2</sub> emissions reductions.



Similarly each proposed CO<sub>2</sub> emissions reduction measure has a limit in terms of the maximum possible reductions.



Marginal abatement cost (MAC) curves are a way to compare measures on a common basis, comparing measures in terms of cost per tonne of CO<sub>2</sub> emissions reduced while highlighting the total potential reductions.



Based on the analysis of the mitigation measures included in the State Action Plans submitted by ICAO Member States, ICAO has developed global MAC curves, which simplify the process of assessing the CO<sub>2</sub> emissions reductions and the costs for individual measures and so help States and aviation stakeholders put them in priority order. A MAC Curve Tool can be tailored to the individual reality of States, allowing them to input their local data, create MAC curves and therefore prioritize the measures to be implemented in light of their own circumstances and conditions.

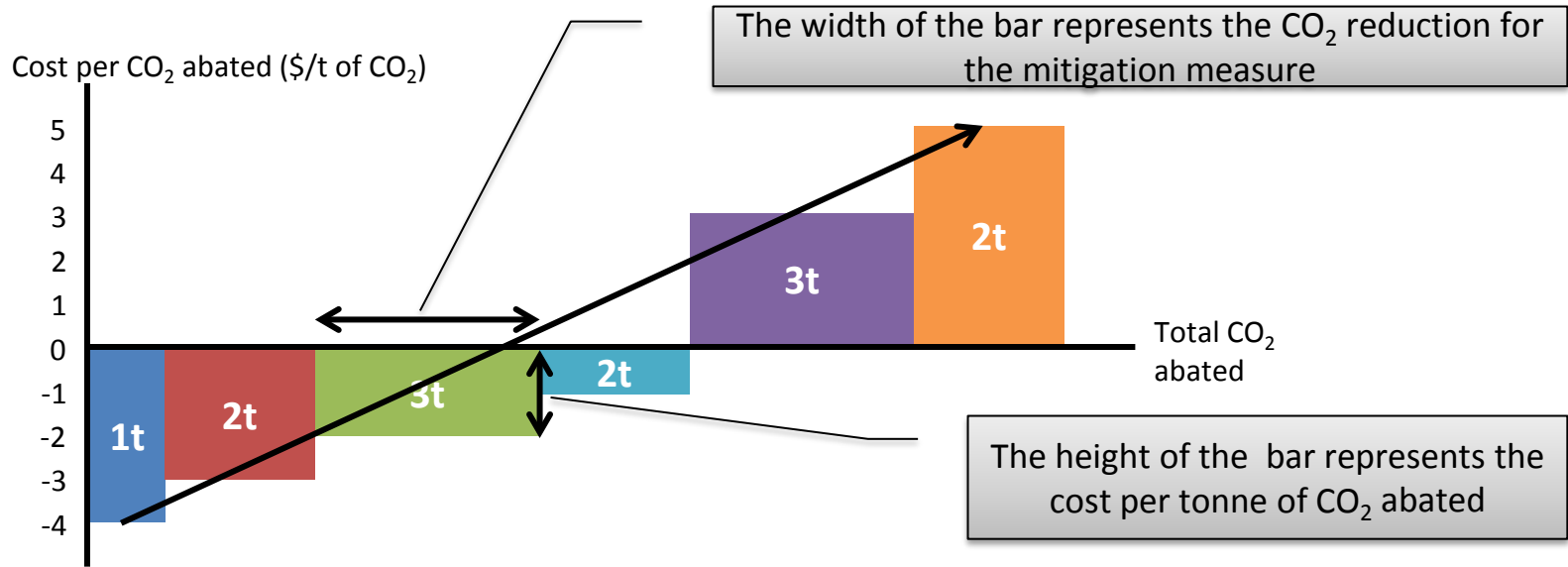
## ICAO IDENTIFIED MITIGATION MEASURES

- Purchase new aircraft
- Improve fuel efficiency through development or modification
- Replace engines
- Develop sustainable aviation fuel (SAF)
- Improve pre-departure planning (DMAN) and arrival planning (AMAN)
- Improve collaborative decision-making (A-CDM)
- Improve air traffic management in non-radar airspace
- Improve fuel efficiency of departure and approach procedures
- Introduce continuous climb and descent procedures
- Improve aircraft guidance on apron
- Improve taxiing
- Minimise weight
- Minimise flaps (takeoff and landing)
- Minimise reverser use
- Reduce speed
- Optimise aircraft maintenance (engine washing and zonal drying)
- Select aircraft best suited to the mission
- Install fixed electrical ground power and preconditioned air to enable auxiliary power unit switch-off
- Use cleaner alternative sources of power generation (for fixed electrical GPU and PCA)
- Construct taxiways and speed exits

MAC curves are a powerful decision-making tool. They were developed through ICAO's **Transforming the Global Aviation Sector: Emissions Reductions from International Aviation** joint assistance project with the United Nations Development Programme (UNDP), financed by the Global Environment Facility (GEF). ICAO is supporting developing States and SIDS in their efforts to reduce CO<sub>2</sub> emissions from international aviation, under the overarching ICAO initiative on States' Action Plans on CO<sub>2</sub> emissions reduction activities. The deliverables of the ICAO-UNDP-GEF project aim to increase the capacity of States and their stakeholders to take meaningful and coordinated action to address international aviation environmental issues.

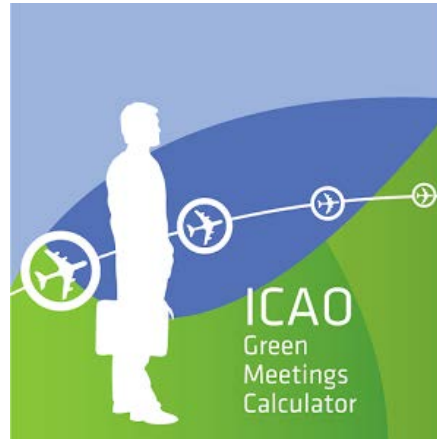


## How to read a MAC curve?





# Planning Meeting Locations: ICAO Green Meetings Calculator





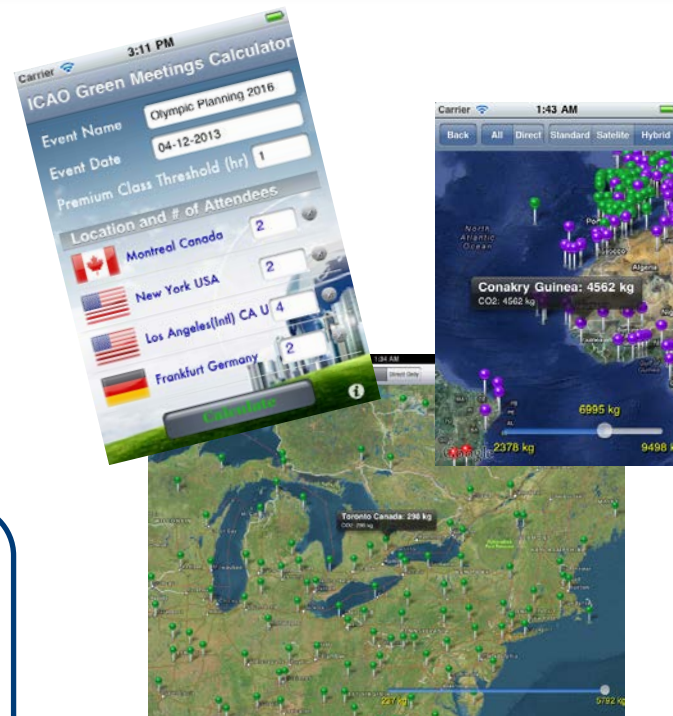


# ICAO Green Meeting Calculator

## Description:

The ICAO Green Meetings Calculator (IGMC) is a tool developed in response to request from UN Travel Offices designed to support decision-making in reducing the carbon emissions from air travel to attend meetings.

The software generates an optimal location for a meeting in terms of CO2 emissions, taking into consideration the city of origin and the number of participants, as well as other parameters. While many factors may affect the decision for where a meeting should be held, the calculator helps facilitate the planning process.



*(New interface and new functionalities under development)*



All of ICAO's environmental tools are available free of charge from:

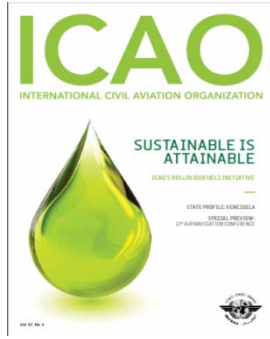
<http://www.icao.int/env>



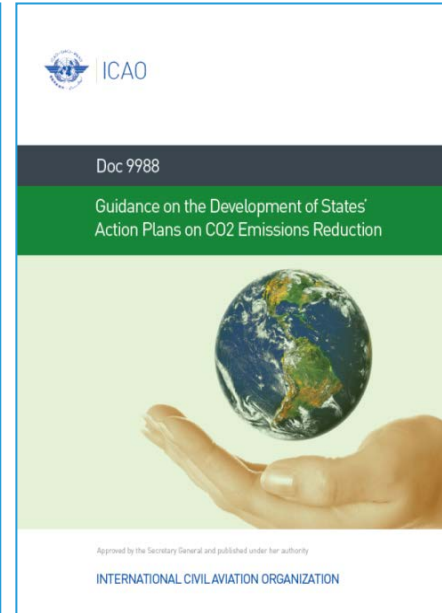
*\*The special interface to the ICAO Carbon Emissions Calculator is available through the APER portal.*



# Additional Information



ICAO 2016 ENVIRONMENTAL REPORT



For more information, please visit our website: <http://www.icao.int/env>



ICAO

ENVIRONMENT

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Central African  
(WACAF) Office  
Dakar

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THANK YOU