ICAO Supporting Tools
States' Action Plan

ICAO Environmental - ENV Tools Suite

ICAO Carbon Emissions Calculator – for States

Allows passengers to estimate CO_2 emissions from their air travel

ICAO Fuel Savings Estimation Tool (IFSET)

To assist States in estimating fuel savings from operational improvements

ICAO CORSIA CO2 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_2 emissions from air travel to attend meetings

ICAO EBT – Environmental Benefit Tool

ICAO MAC Curves

Baseline scenario

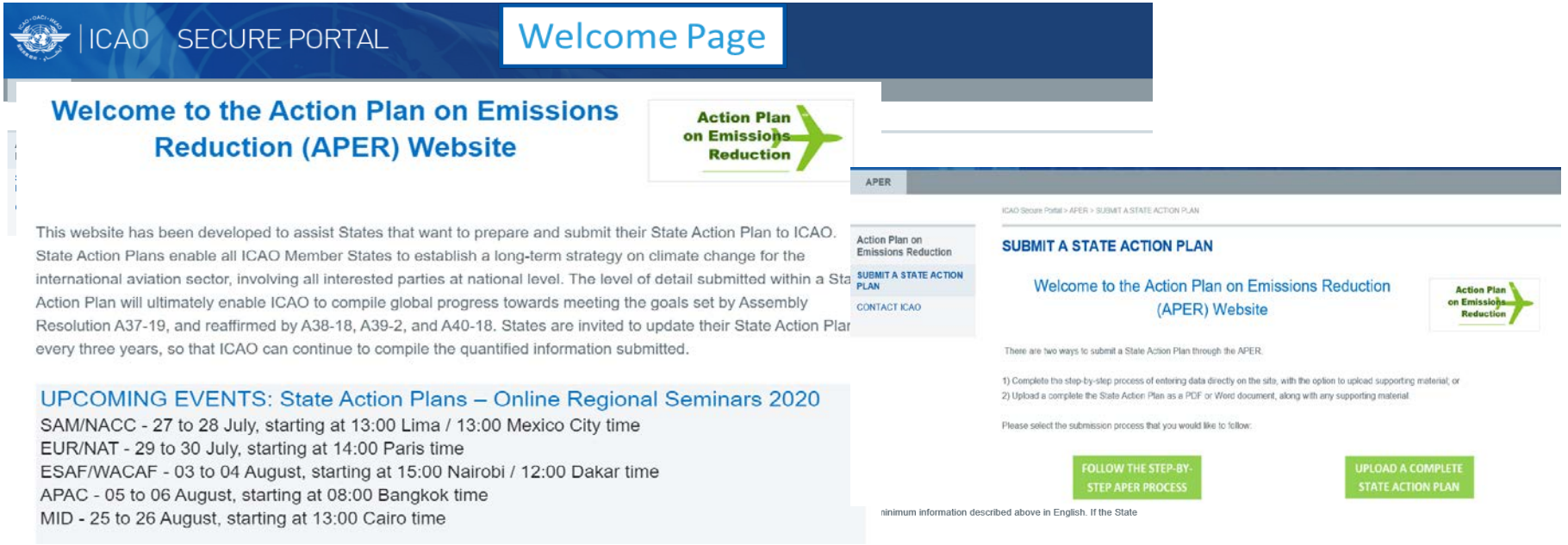
Mitigation Measures

Expected Results

EBT

MAC CURVES

Action Plan Emissions Reduction (APER) Website



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

- **Tools links and 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

- **Miscelleanous**

Assembly Resolution A40-18 – Climate Change

International RTK by State

Form M

Seminar Material

ICAO E-Learning Training Tutorial

ICAO UNITAR Online Training Tutorial

UN CC:e-Learn
Think, Talk, Act Climate

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 .

E-Learning Training Course on States Action Plan

MODULE 1

STATES' ACTION PLANS ON CO_2 EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION

This module describes the main components of the States' Action Plans on CO_2 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_2 emissions from international aviation
- Estimate international aviation fuel burnt, CO_2 emissions, and International Revenue Tonnes Kilometer (RTK)
- Calculate the baseline using the ICAO Environment Benefits Tool (EBT)

UN CC:e-Learn
Think, Talk, Act Climate

MODULE 3

MITIGATION MEASURES

This module provides an overview of mitigation measures to limit or reduce CO_2 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_2 emissions
- Identify relevant measures that can be taken by a State to reduce CO_2 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

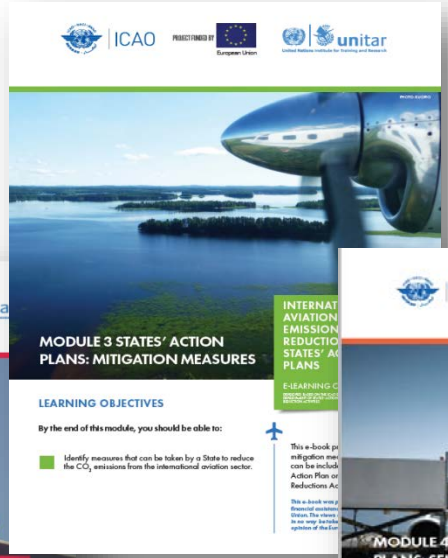
MODULE 5

TOOLS AND EXPECTED RESULTS

This module presents the tools that allow the Civil Aviation Authorities (CAA) to calculate, as well as to monitor CO_2 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_2 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_2 emissions from the aviation sector, if available in the State

E-Learning Training Course on States Action Plan



Estimating aircraft fuel burn and CO_2 emissions: 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

Delete All Location(s) | Delete Leg | Add New Leg

Reset | Compute

Metric (KG / KM) | **Standard** (LBS / MI)

Total

Dep Airport	Arr Airport	Number of passengers	Cabin Class	Trip	Aircraft Fuel Burn/journey (KG)[ab]	Total passengers' CO2/journey (KG)[c]
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)[a]	Passenger CO_2/pax/leg (KG)
GVA	YUL	5901.0	333	46048.4	318.2

ICAO Carbon Emissions Calculator Methodology (cont.)

- **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**
- **Methodology Developed through CAEP**
- **Expert inputs provided from**

  ICAO Secretariat, ICAO Member States, Universities

  NGOs, International Air Transport Association – IATA (Airlines),

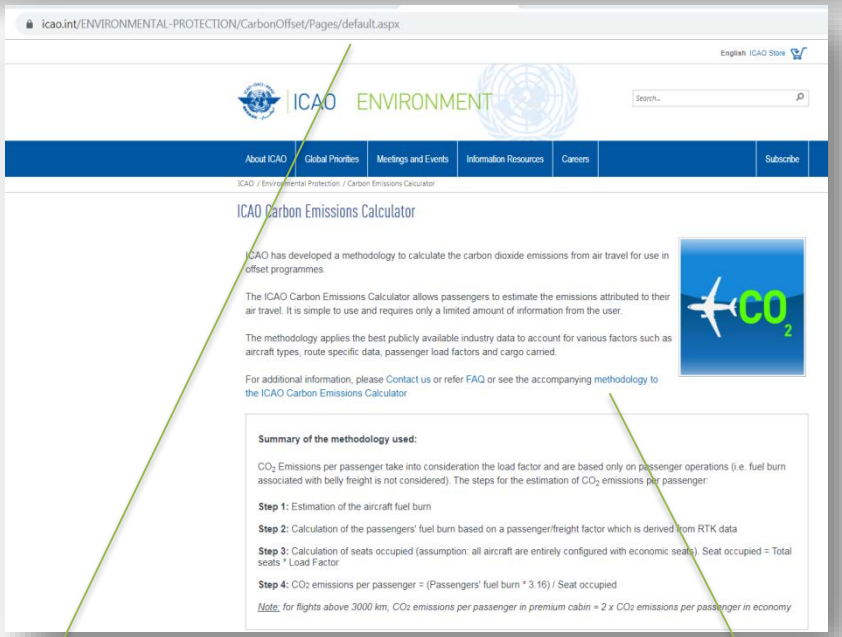
  International Coordinating Council of Aerospace Industries Associations – ICCAIA (Manufacturers)

- **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_2 – suitable for use with offset programs
- Available since June 2008



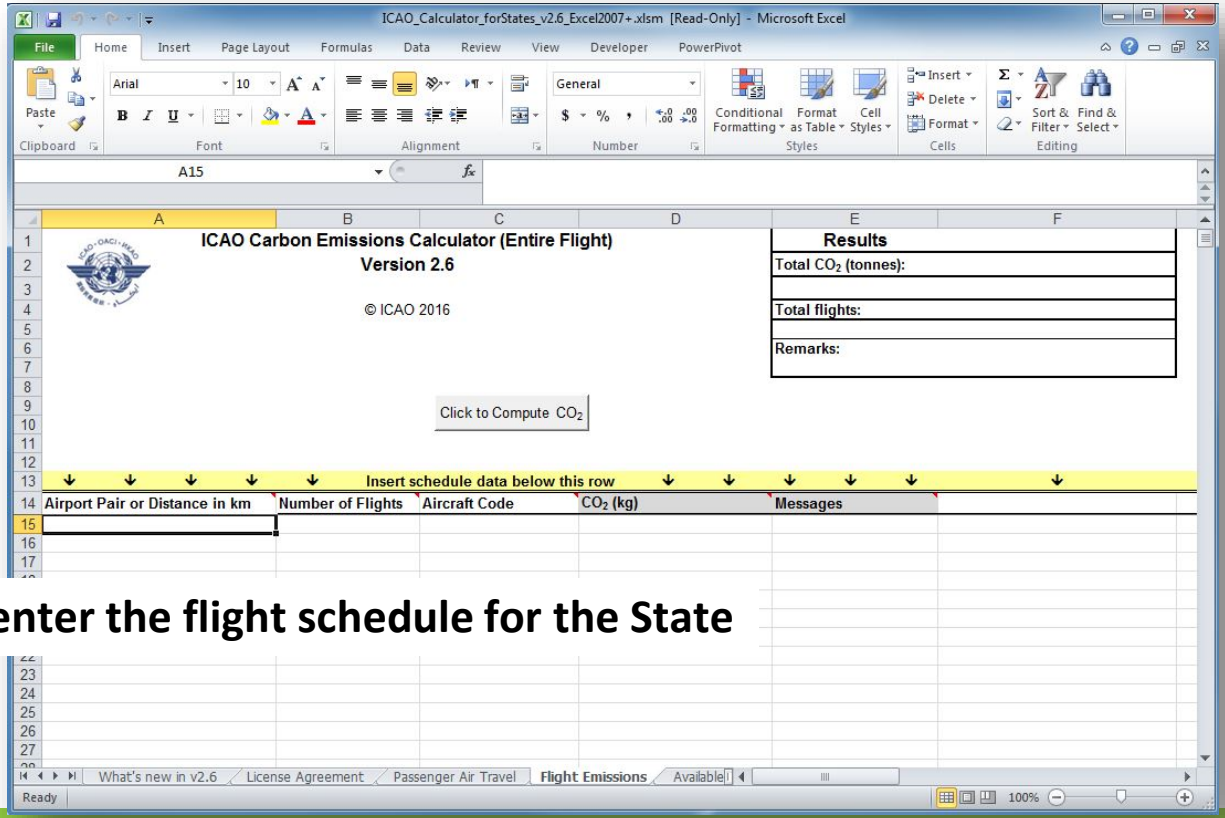
http://www.icao.int/ENVIRONMENTAL-PROTECTION/CarbonOffset/Pages/default.aspx

Link to Methodology

ICAO Carbon Emissions Calculator User Interface for Action Plans

Action Plan on Emissions Reduction

Available on the APER Website



Simply enter the flight schedule for the State

Estimating Fuel Savings from Operational Changes:

ICAO Fuel Savings Estimation Tool (IFSET)

ICAO Fuel Savings Estimation Tool

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

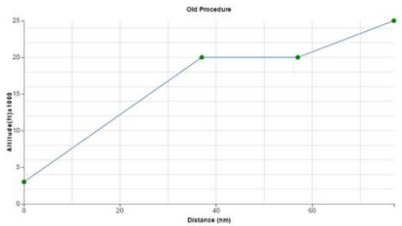
Scenario Name	Old Fuel Consumption (KG)	New Fuel Consumption (KG)	Savings (KG)	Savings (%)
Example	1337600	1283000	-54500	-4.10

Estimated Detailed Fuel Changes Report

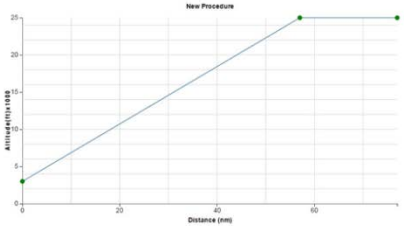
Old Climb Fuel (KG)	New Climb Fuel (KG)	Climb Savings (KG)
923000	921000	-2100
Old Descent Fuel (KG)	**New Descent Fuel (KG)**	**Descent Savings (KG)**
0	0	0
Old Level Fuel (KG)	**New Level Fuel (KG)**	**Level Savings (KG)**
155800	146400	-9400
Old Taxi Fuel (KG)	**New Taxi Fuel (KG)**	**Taxi Savings (KG)**
258800	215600	-43100

Graphics

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



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



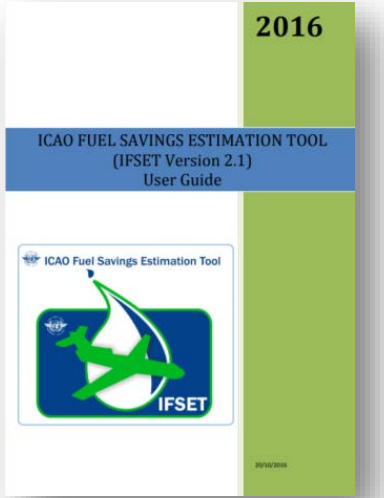
Description:

Operational measures are one of the instruments available to States to improve fuel efficiency and reduce CO_2 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 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_2 emissions

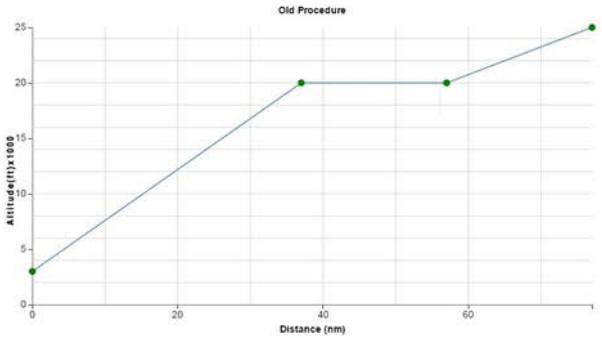
Sample Graphical View

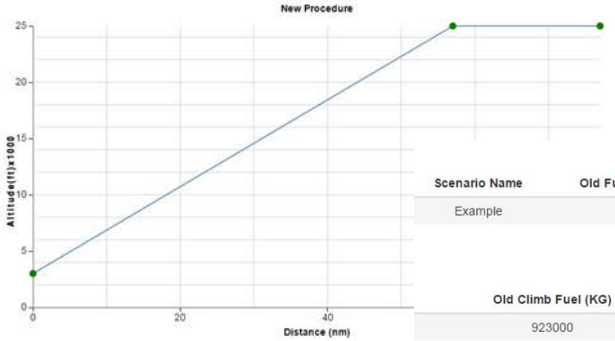
Step 3 - Estimated Fuel Changes Report

Scenario Name: Example

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

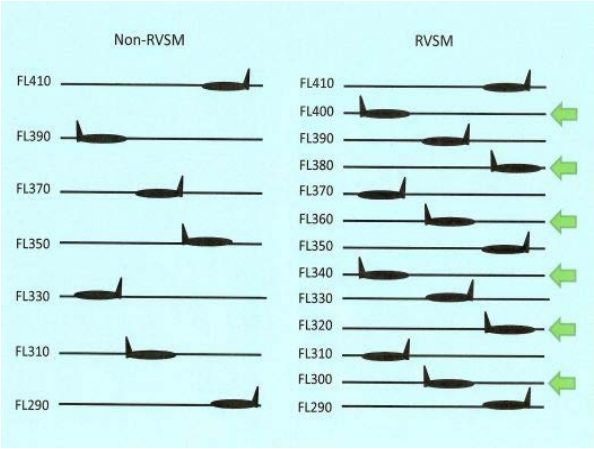
Old Descent Fuel (KG)	New Descent Fuel (KG)	Descent Savings (KG)
0	0	0

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



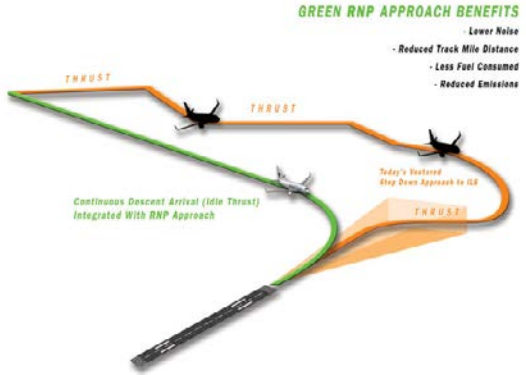
Operational Measure Implementation (planned or post)

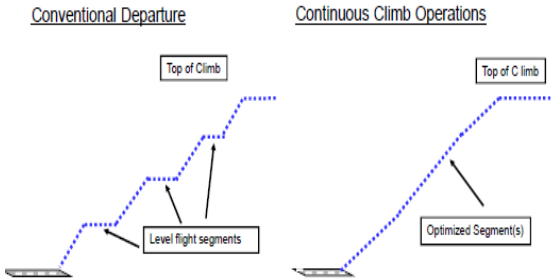
+

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

=

USE IFSET





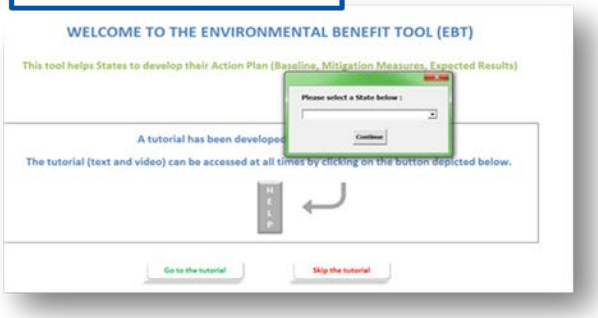
Environmental Benefits Tool (EBT)

- Description:

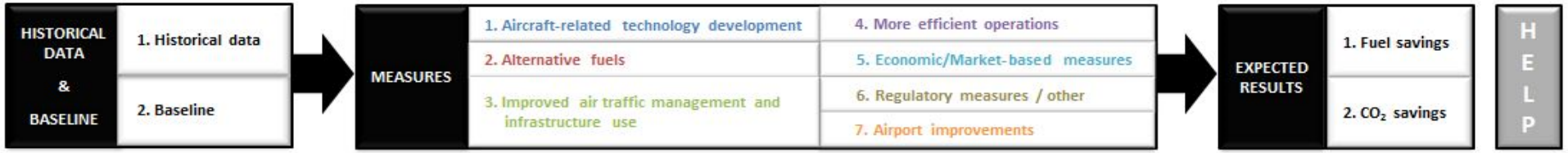
The EBT is a tool developed for supporting States in the development of their State Action Plan.

This tool allows easily generating a baseline scenario, estimating the impact of mitigation measures and finally generating expected results.

Welcome Page



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

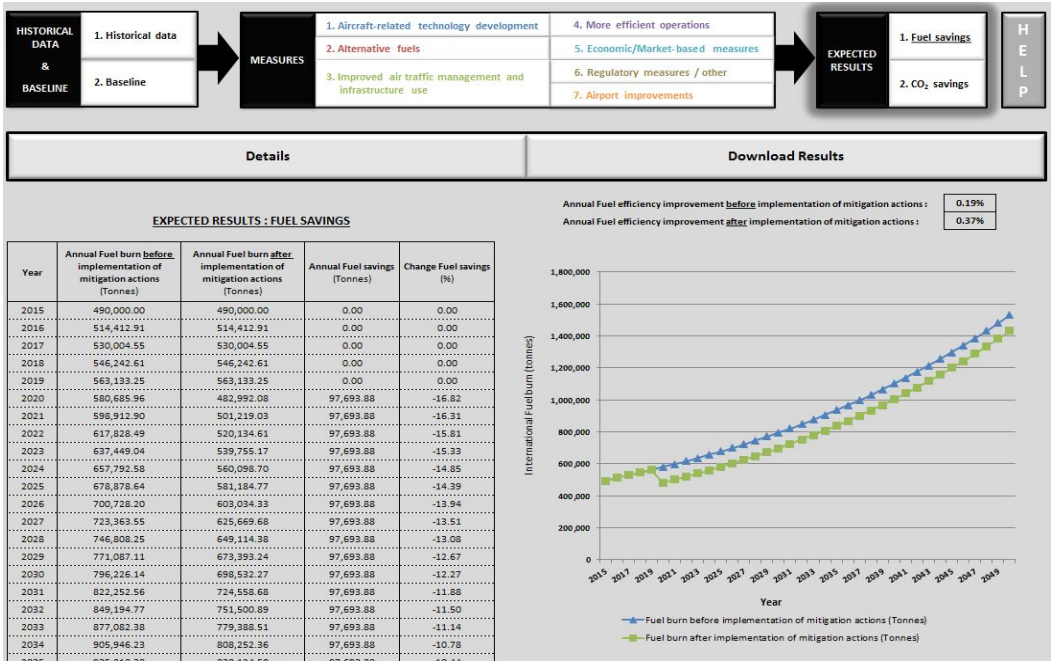
Part 2 : Mitigation Measures

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

Environmental Benefit Tool (EBT)

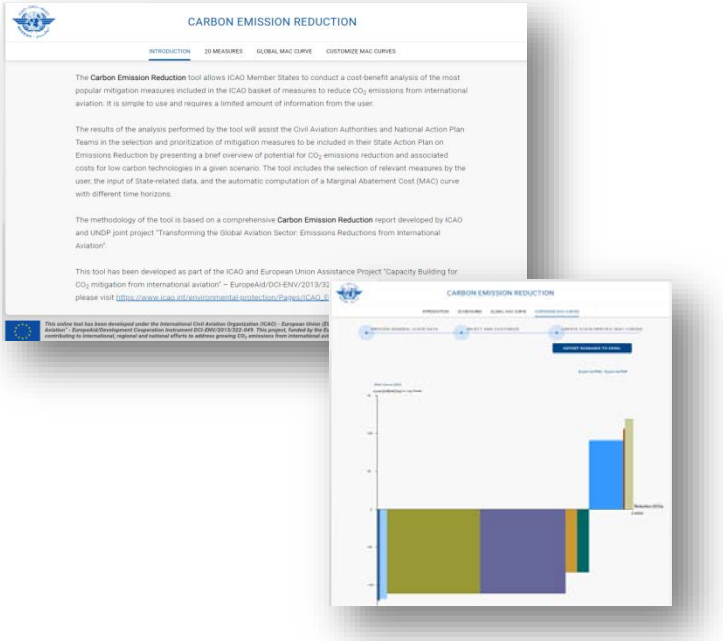


Year	Annual Fuel burn before implementation of mitigation actions (Tonnes)	Annual Fuel burn after implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2015	490,000.00	490,000.00	0.00	0.00
2016	514,412.91	514,412.91	0.00	0.00
2017	530,004.55	530,004.55	0.00	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	560,098.70	97,693.88	-14.85
2025	678,878.64	581,184.77	97,693.88	-14.39
2026	700,728.20	603,034.33	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

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)



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_2 emissions mitigation measures, in light of their respective costs and CO_2 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_2 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_2 emissions reductions among possible measures on a comparative cost basis.

Each proposed CO_2 emissions mitigation measure requires a specific investment to achieve CO_2 emissions reductions.

Similarly each proposed CO_2 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_2 emissions reduced while highlighting the total potential reductions.

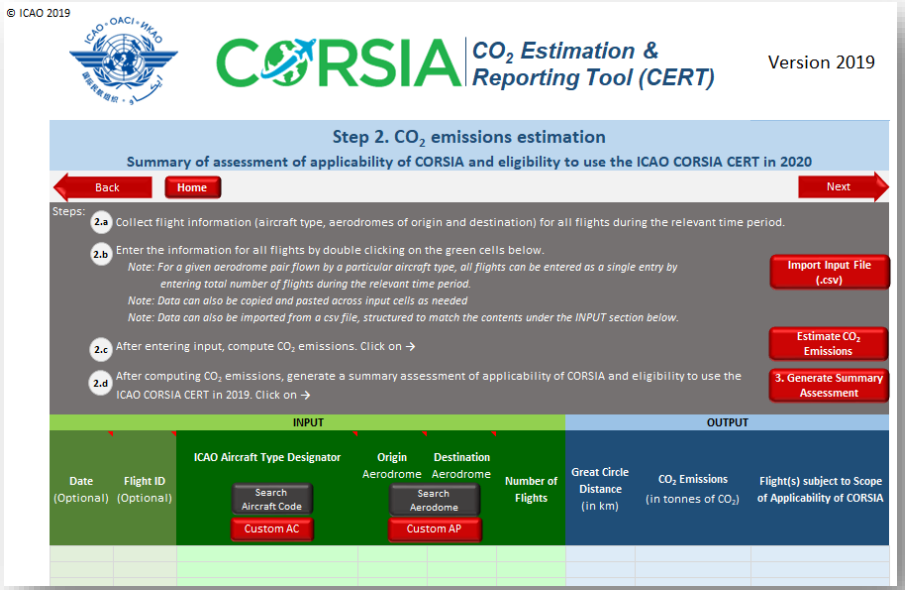
Based on the analysis of the mitigation measures included in the State Action Plans submitted by ICAO Member States, ICAO has developed global MAC curves, which simplify the process of assessing the CO_2 emissions reductions and the costs for individual measures and so help States and aviation stakeholders 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_2 emissions from international aviation, under the overarching ICAO initiative on States' Action Plans on CO_2 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.

ICAO CO_2 Estimation and Reporting Tool CERT

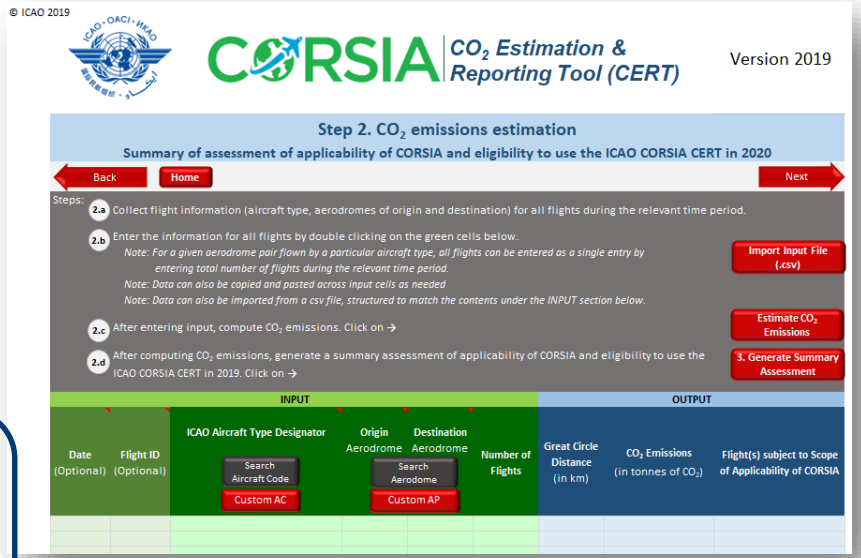


ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT)

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_2 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's environmental tools are available free of charge from:

http://www.icao.int/env and APER website

Designed for Windows 7, Vista, XP

Available on the App Store

Available on the Android App Store

Designed for Windows 7, Vista, XP

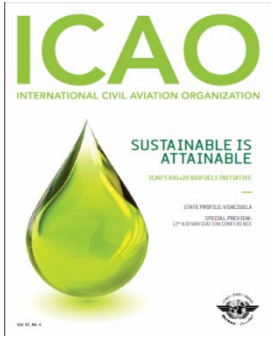
Designed for Windows 7, Vista, XP

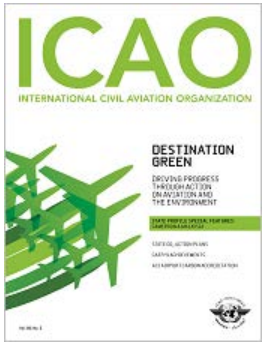
Available on the App Store

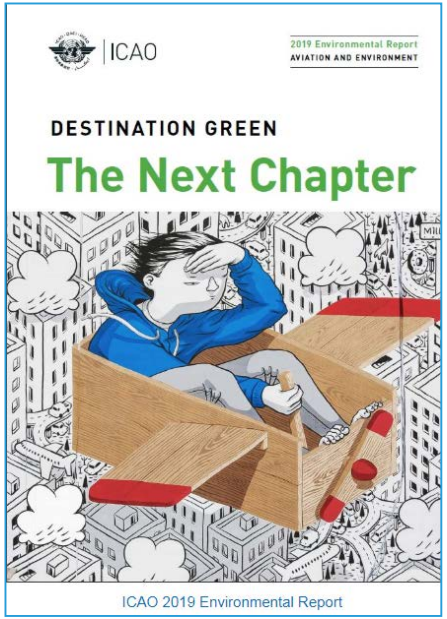
Available on the Android App Store

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

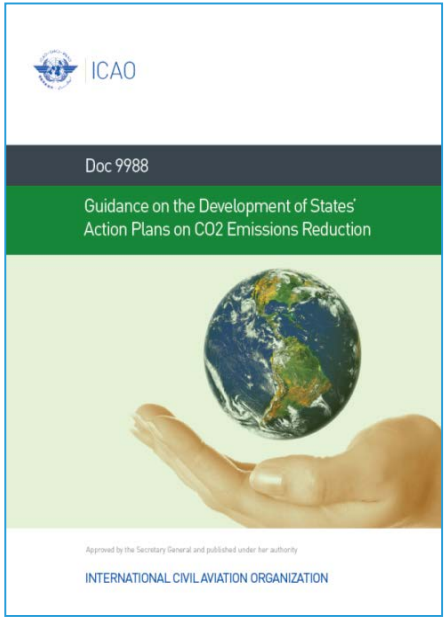
Additional Information







ICAO 2019 Environmental Report



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

ICAO