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ICAO Supporting Tools

Neil Dickson

Chief, Environmental Standards, ICAO





ICAO Environmental Tools

Items	Sessions
Action Plan Emissions Reduction (APER) Website	10 minutes
Environmental Benefit Tool (EBT) with Demo	25 minutes
ICAO Carbon Emission Calculator (ICEC)	10 minutes
Coffee Break	5 minutes
Marginal Abatement Cost (MAC) Curve Tool with Demo	25 minutes
ICAO Fuel Savings Estimation Tool (IFSET)	15 minutes
E-Learning Training Course on States Action Plan	10 minutes

For assistance, please contact actionplan@icao.int



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ICAO Environmental Tools Suite

These tools can be divided into two categories:

- Publicly Available Tools
- Dedicated Tools – Not Publicly Available



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ICAO Environment – Public Tools Suite



ICAO Carbon Emissions Calculator

Allows passengers to estimate CO₂ 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 CO₂ emissions from air travel to attend meetings



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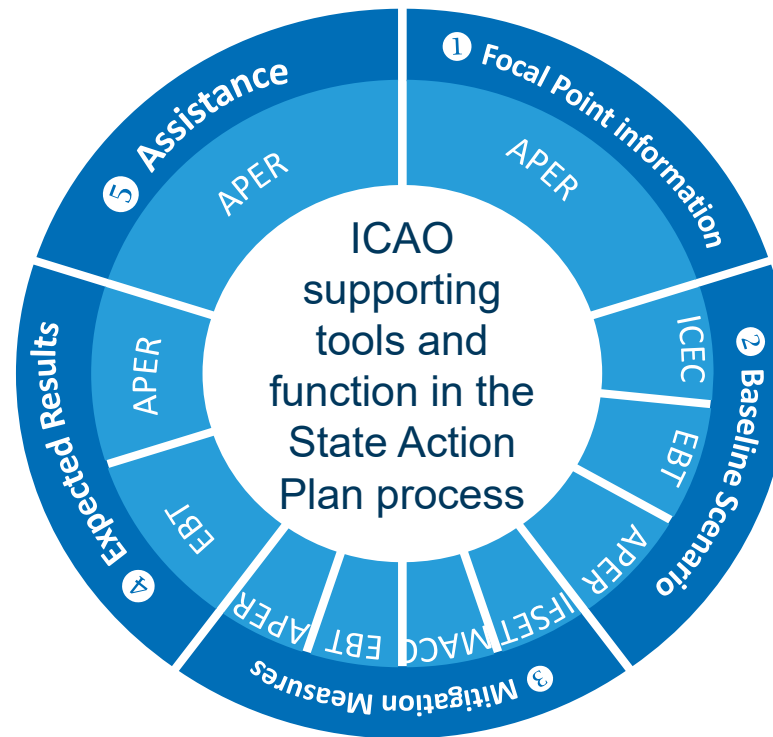
ICAO Environment – Dedicated Tools

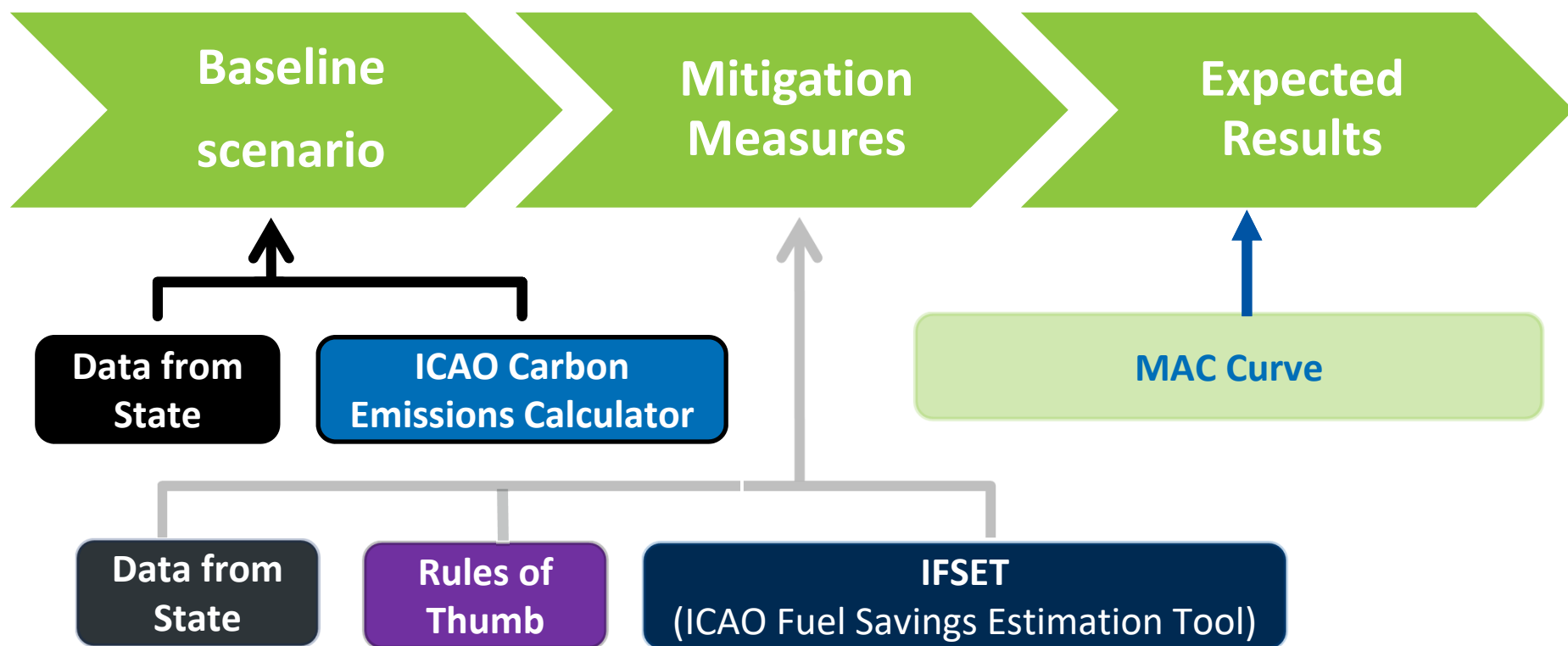
Developed for specific uses and for specific users

- Environmental Benefits Tool (EBT)
- Marginal Abatement Cost Curve
- ICAO Online Training course – UNITAR
- Aviation Environmental System (AES)



ICAO Environmental Tools Relations







Action Plan Emissions Reduction (APER) Website

ICAO SECURE PORTAL Welcome Page

APER

- 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



Environmental Benefit Tool (EBT)

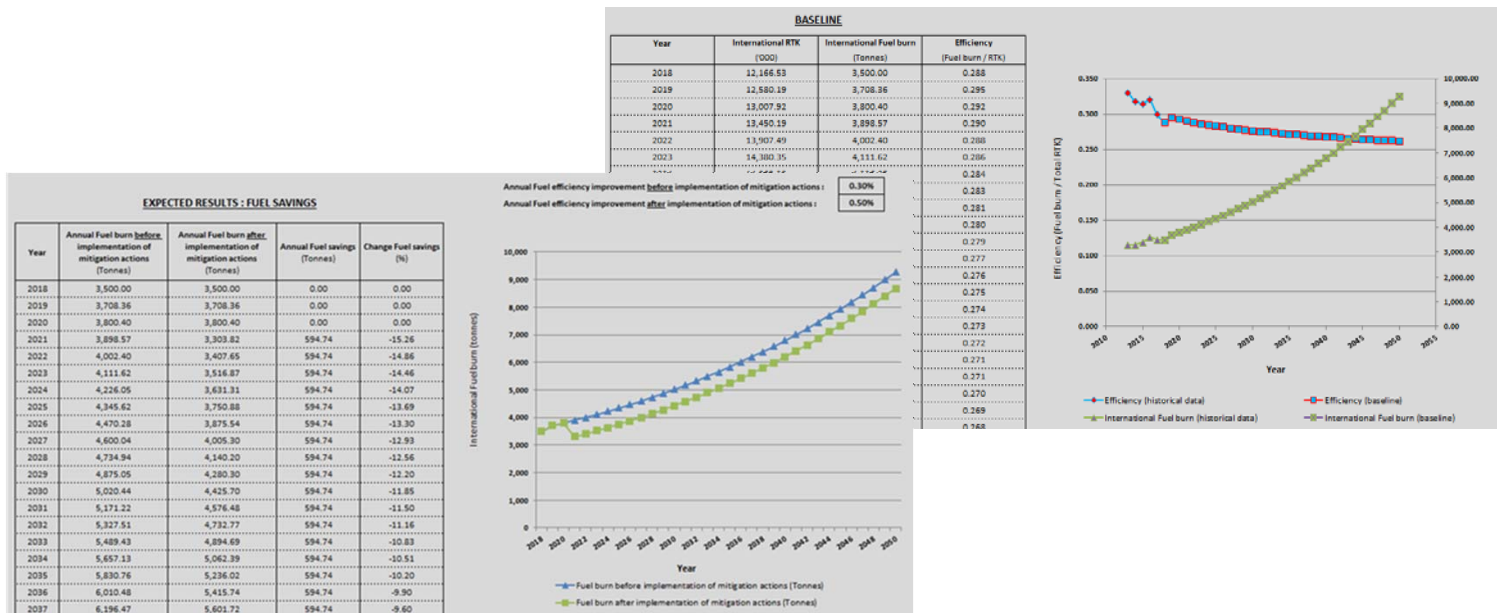
- Background

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

EBT



Environmental Benefits Tool (EBT)



Baseline Scenario

Expected Results



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)

- **Objectives**

- Helps to develop the Baseline
- Helps to estimate the Mitigation Measures
- Helps to generate the Expected Results





Environmental Benefit Tool (EBT)



Part 1 : Historical Data & Baseline

- 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
- 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)



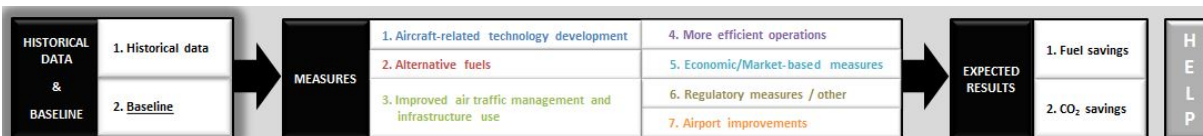
HISTORICAL DATA

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

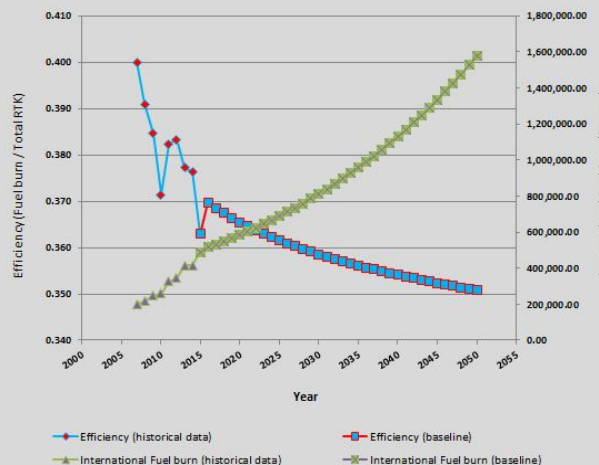
Example based on Method B - The State has access to data for 5 years or more



Environmental Benefit Tool (EBT)

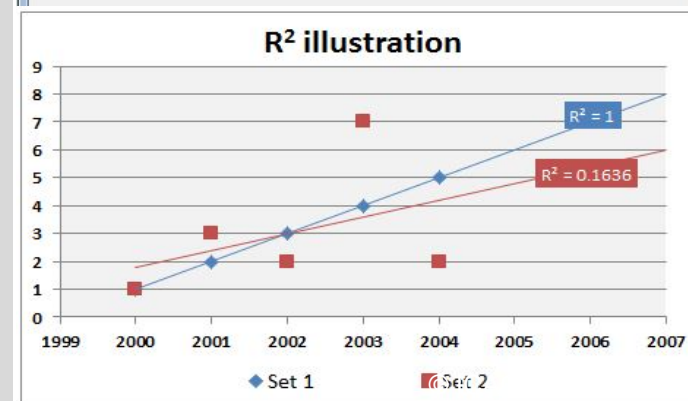


BASELINE			
Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Fuel burn / RTK)
2015	1,350,000.00	490,000.00	0.363
2016	1,397,250.00	516,659.80	0.370
2017	1,446,153.75	532,979.97	0.369
2018	1,496,769.13	549,968.52	0.367
2019	1,549,156.05	567,631.44	0.366
2020	1,603,376.51	585,978.77	0.365
2021	1,659,494.69	605,023.62	0.365
2022	1,717,577.00	624,781.65	0.364
2023	1,777,692.20	645,270.58	0.363
2024	1,839,911.43	666,509.95	0.362
2025	1,904,308.33	688,520.90	0.362
2026	1,970,959.12	711,326.08	0.361
2027	2,039,942.69	734,949.48	0.360
2028	2,111,340.68	759,416.46	0.360
2029	2,185,237.61	784,753.62	0.359
2030	2,261,720.92	810,988.84	0.359
2031	2,340,881.15	838,151.22	0.358
2032	2,422,811.99	866,271.12	0.358
2033	2,507,610.41	895,380.17	0.357
2034	2,595,376.78	925,511.23	0.357
2035	2,686,214.97	956,698.47	0.356
2036	2,780,232.49	988,977.39	0.356
2037	2,877,540.63	1,022,364.78	0.355



The best trend is: **Logarithmic**

Linear	R2 = 0.6771	Annual fuel efficiency improvement (%) = 1.01
Logarithmic	R2 = 0.7266	Annual fuel efficiency improvement (%) = 0.10
Exponential	R2 = 0.6745	Annual fuel efficiency improvement (%) = 0.81





Environmental Benefit Tool (EBT)

Mitigation Measures

Front end

Back end

```
Dim ctrl As Control
For Each ctrl In Me.Frame1.Controls
    If TypeOf ctrl Is msforms.TextBox Or TypeOf ctrl Is msforms.ComboBox
        If ctrl.Text = "" And ctrl.Enabled = 1
            MsgBox "Please fill the form entirely"
            Exit Sub
        End If
    End If
End For
Next
```



Environmental Benefit Tool (EBT)

Minimising weight

Minimising weight

Level of automation selected : **Low** **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



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Environmental Benefit Tool (EBT)

What are the Rules of Thumb ?

*“Method or procedure derived from practice or experience,
rather than theory or scientific knowledge.”*

(Oxford English Dictionary)



Environmental Benefit Tool (EBT)

Minimising weight

Minimising weight

Level of automation selected : Low 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*

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



Environmental Benefit Tool (EBT)

Fleet details

Year of reference : -

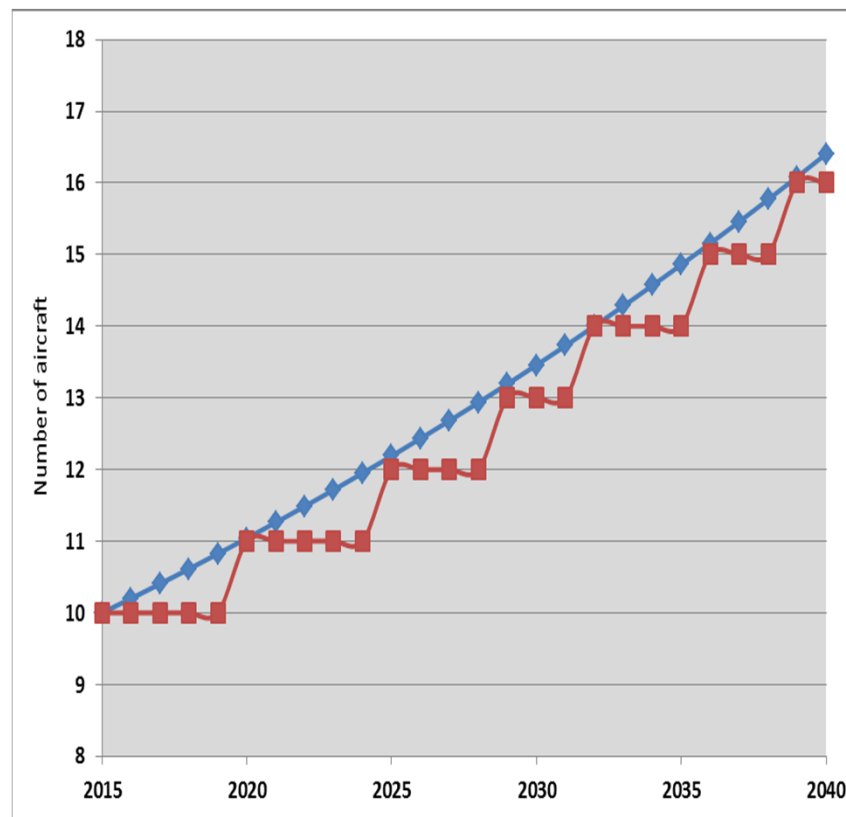
International RTK - CAGR (%):

Average number of movements / aircraft (optional):

Aircraft category	Annual number of aircraft	Annual number of movements per aircraft
Business Turboprop	<input type="text"/>	<input type="text"/>
Large Business Jet	<input type="text"/>	<input type="text"/>
Large Quad Twin Aisle Jet	<input type="text"/>	<input type="text"/>
Large Single Aisle Jet	<input type="text"/>	<input type="text"/>
Large Twin Aisle Jet	<input type="text"/>	<input type="text"/>
Medium Business Jet	<input type="text"/>	<input type="text"/>
Regional Jet	<input type="text"/>	<input type="text"/>
Single Aisle Jet	<input type="text"/>	<input type="text"/>
Small Business Jet	<input type="text"/>	<input type="text"/>
Three Plus Engine Twin Aisle Jet	<input type="text"/>	<input type="text"/>
Turboprop	<input type="text"/>	<input type="text"/>
Twin Aisle Jet	<input type="text"/>	<input type="text"/>



Year	CAGR	Rounded
2015	10.00	10
2016	10.20	10
2017	10.40	10
2018	10.61	10
2019	10.82	10
2020	11.04	11
2021	11.26	11
2022	11.49	11
2023	11.72	11
2024	11.95	11
2025	12.19	12
2026	12.43	12
...





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

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



Environmental Benefit Tool (EBT)

HISTORICAL DATA & BASELINE

1. Historical data
2. Baseline

MEASURES

1. Aircraft-related technology development
2. Alternative fuels
3. Improved air traffic management and infrastructure use
4. More efficient operations
5. Economic/Market-based measures
6. Regulatory measures / other
7. Airport improvements

EXPECTED RESULTS

1. Fuel savings
2. CO₂ savings

H
E
L
P

Details

Download Results

EXPECTED RESULTS : FUEL SAVINGS

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
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
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
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



ICAO Carbon Emissions Calculator



Welcome Page

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' CO ₂ /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

- **Background**

- Escalation 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

- **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



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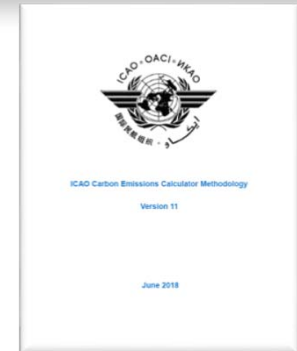
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ICAO Carbon Emissions Calculator

Available on the
public website



- **Methodology**

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



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ICAO Carbon Emissions Calculator

- **Public Interface**

- Transparent
- Easy-to-use
- Publicly available
- Delivers consistent estimates of CO₂ – suitable for use with offset programs
- Available since June 2008

ENVIRONMENTAL-PROTECTION/CarbonOffset/Pages/default.aspx

English ICAO Store

ICAO ENVIRONMENT

About ICAO Global Priorities Meetings and Events Information Resources Careers Subscribe

ICAO / Environmental Protection / Carbon Emissions Calculator

ICAO Carbon Emissions Calculator

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:

CO₂ 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 CO₂ 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: CO₂ emissions per passenger = (Passengers' fuel burn * 3.16) / Seat occupied

Note: for flights above 3000 km, CO₂ emissions per passenger in premium cabin = 2 x CO₂ emissions per passenger in economy

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

[Link to Methodology](#)



ICAO Carbon Emissions Calculator

- Interface for Action Plans

The screenshot shows the ICAO Carbon Emissions Calculator (Passenger) spreadsheet. The interface includes a title bar, a ribbon menu, and a main data entry area. The main area is divided into several sections:

- ICAO Carbon Emissions Calculator (Passenger) Version 2.8**: Includes the ICAO logo and the text "For use by Government Agencies of ICAO member States only".
- Database version: 7.0 Official**: © ICAO 2020
- Schedules date: 31-Dec-2016**
- Load factors date: 31-Dec-2015**
- Class of Service Column:** A dropdown menu with "B" selected and a "Click to Compute CO₂" button.
- Route Column:** A dropdown menu with "A" selected.
- Compute CO₂ options:** Radio buttons for "Compute CO₂ for all rows" (selected) and "Compute CO₂ only if the CO₂ field is blank".
- Results Section:** A table with columns for "Total number of passengers", "Total number of premium class passengers", "Total number of Kilometers traveled", and "Total Tonnes CO₂".
- Uncertainties Section:** A table with columns for "Low CO₂ (Value)", "Low CO₂ (1%)", "High CO₂ (Value)", and "High CO₂ (1%)".
- Remarks:** A text area containing "Economy Class Codes: YSBHKLMNQTVX", "Premium Class Codes: FAPRCJDIJZWE", and "Airport Field Separators: /-".
- Data Entry Table:** A table with columns for "Route", "Class", "CO₂ (kg)", "Trip Distance (km)", "Additional CO₂ Uncertainty (low) (kg)", "Additional CO₂ Uncertainty (high) (kg)", and "Messages". A yellow bar above the table says "Insert travel data below this row".



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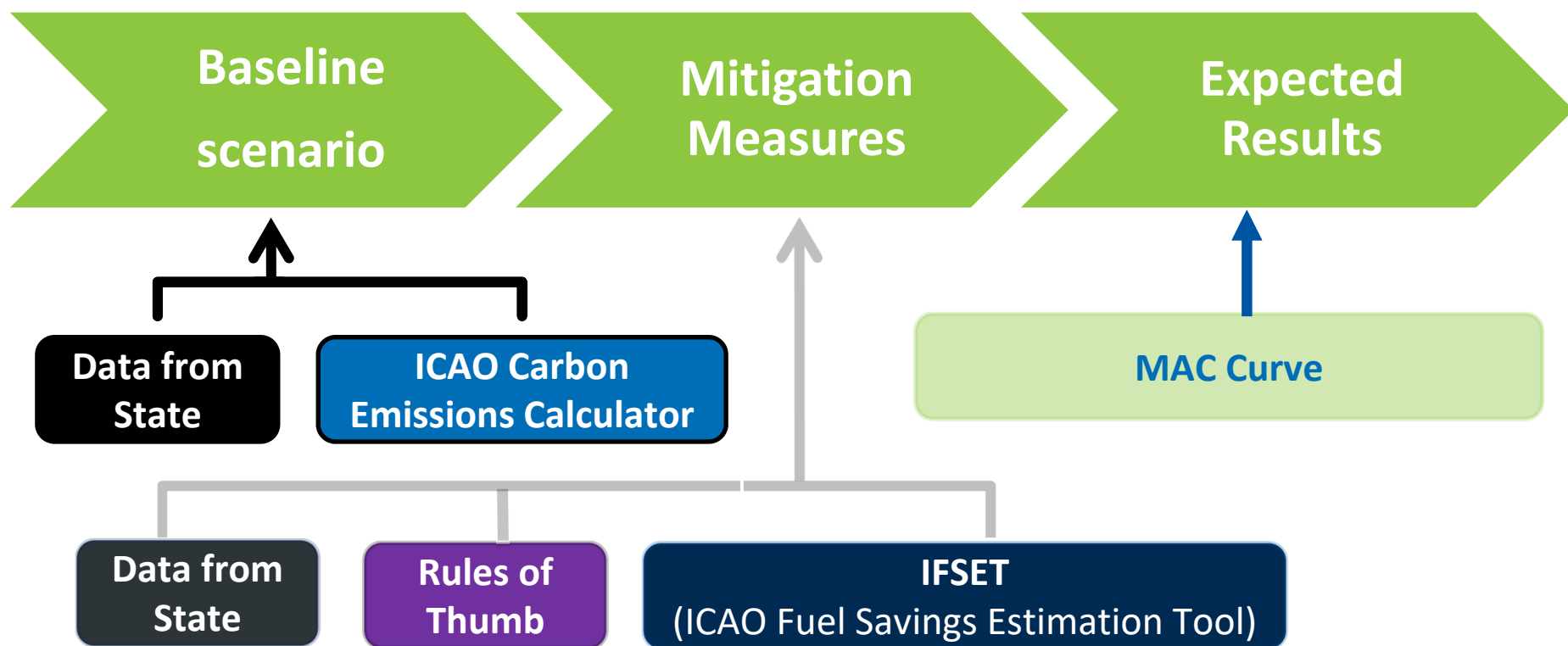




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For assistance, please contact actionplan@icao.int





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 CO₂ 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 CO₂ 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 CO₂ mitigation from international aviation" – EuropeAid/DCI-ENV/2013/322-049. For additional information, please visit https://www.icao.int/environmental-protection/Pages/ICAO_FU.aspx

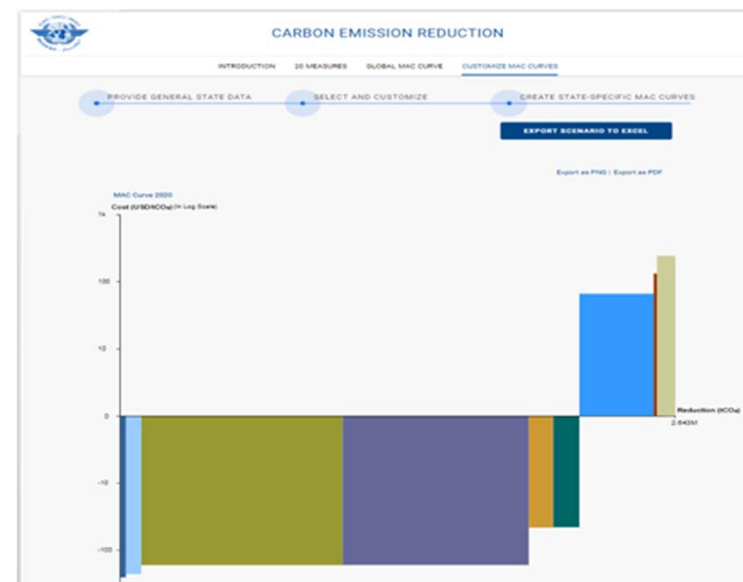


This online tool has been developed under the International Civil Aviation Organization (ICAO) - European Union (EU) Assistance Project: "Capacity Building for CO₂ Mitigation from International Aviation" - EuropeAid/Development Cooperation Instrument DCI-ENV/2013/322-049. This project, funded by the European Union and implemented by ICAO, has the overarching objective of contributing to international, regional and national efforts to address growing CO₂ 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 CO₂ emissions mitigation measures, in light of their respective costs and CO₂ 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 CO₂ 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 CO₂ emissions reductions among possible measures on a comparative cost basis.

Each proposed CO₂ emissions mitigation measure requires a specific investment to achieve CO₂ emissions reductions.



Similarly each proposed CO₂ 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 CO₂ 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 CO₂ 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.

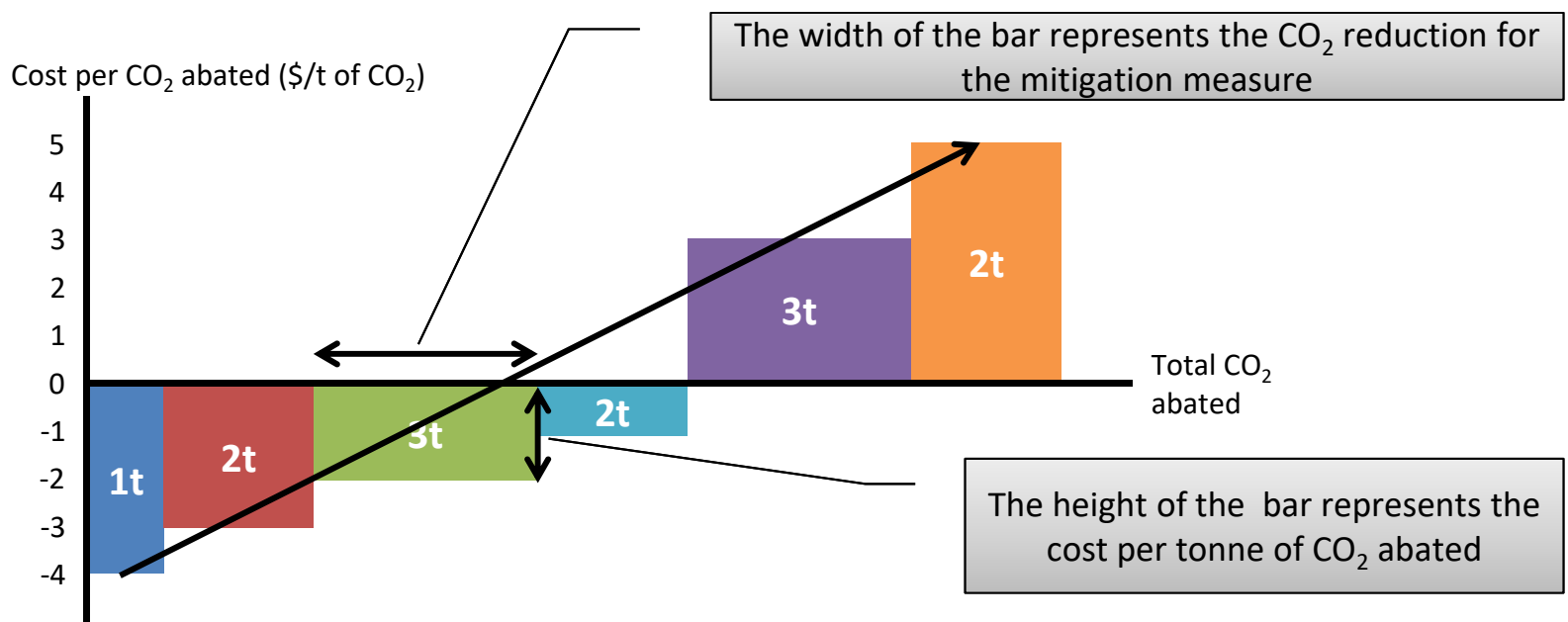
ICAO IDENTIFIED MITIGATION MEASURES

- 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 (take off 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 source 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 CO₂ emissions from international aviation, under the overarching ICAO initiative on States' Action Plans on CO₂ 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?





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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 CO2 emissions.
- 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 (GANP).

Input

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

Output

Estimated Fuel Changes Report

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

Estimated Detailed Fuel Changes Report

Old Climb Fuel (KG)	New Climb Fuel (KG)	Climb Savin
923000	921000	-210
Old Descent Fuel (KG)	New Descent Fuel (KG)	Descent Savin
0	0	0
Old Level Fuel (KG)	New Level Fuel (KG)	Level Savin
155800	146400	-940
Old Taxi Fuel (KG)	New Taxi Fuel (KG)	Taxi Savin
258800	215600	-4311

Graphics



ICAO Fuel Savings Estimation Tool

- **Functionalities**

- 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



ICAO Fuel Savings Estimation Tool

- **Functions not include:**
 - Replace detailed modelling or measurement of fuel consumption
 - Estimate fuel consumption from airborne holding
 - Compute other elements than fuel consumption / CO₂ emissions



ICAO Fuel Savings Estimation Tool

- 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



ICAO Fuel Savings Estimation Tool

Welcome Page

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

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ICAO Fuel Savings Estimation Tool

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".

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ICAO Fuel Savings Estimation Tool

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	



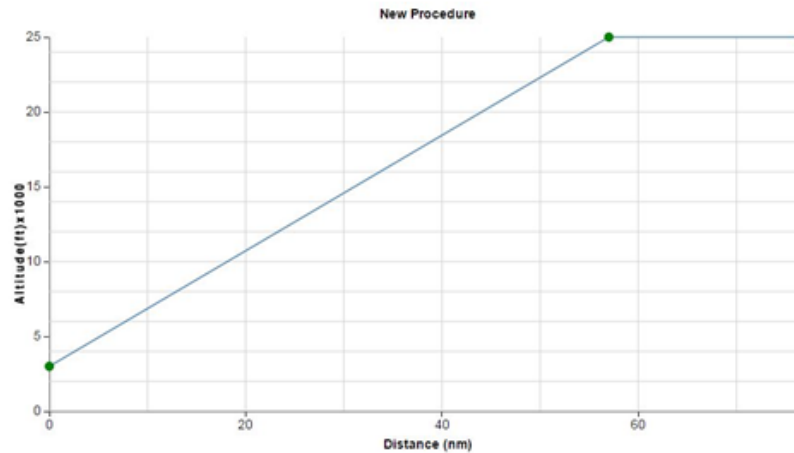
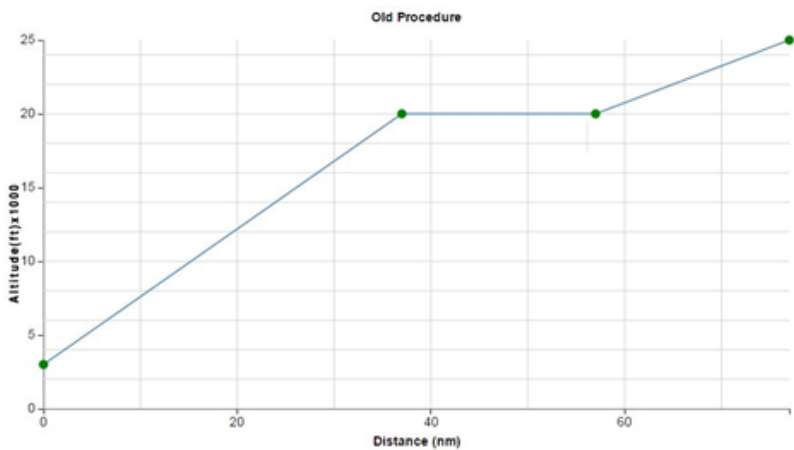
ICAO Fuel Savings Estimation Tool

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





ICAO Fuel Savings Estimation Tool

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



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ICAO Fuel Savings Estimation Tool

Operational Measure Implementation (planned or post)

+

Need to quantify change in fuel consumption



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E-Learning Training Course on States Action Plan

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International Aviation CO2 Emissions Reduction : States' Action Plans [Course page](#)

States' Action Plans on CO2 Emissions Reduction from International Aviation [Module page](#)

Module 1: Interactive lesson

Info Reports



States' Action Plans on CO2 Emissions Reduction from International Aviation

This module aims to familiarise the learners with States' Action Plans on CO2 Emissions Reduction from International Aviation. Section 1 provides a brief introduction on the current contribution of the aviation operations to total global CO2 emissions. Section 2 looks at the definition of a State Action Plan. Section 3 presents the elements of a State Action Plan. Section 4 discusses the various of mitigation measures from which States can choose to meet the CO2 emissions reduction target. Section 5 presents the types of assistance of which States can benefit. The module concludes with a set of key messages aimed to be considered by the learners once they have completed it.

Learning Objectives

After completing Module 1, participants will 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.



<https://unccelearn.org>



E-Learning Training Course on States Action Plan

MODULE 1

STATES' ACTION PLANS ON CO₂ EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION



This module describes the main components of the States' Action Plans on CO₂ 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 CO₂ emissions from international aviation
- Estimate international aviation fuel burnt, CO₂ 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 CO₂ 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 CO₂ emissions
- Identify relevant measures that can be taken by a State to reduce CO₂ 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 CO₂ 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 CO₂ 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 CO₂ emissions from the aviation sector, if available in the State



E-Learning Training Course on States Action Plan

MODULE 1: STATES' ACTION PLANS ON CO₂ EMISSIONS REDUCTION FROM INTERNATIONAL AVIATION

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.

INTERNATIONAL AVIATION CO₂ EMISSIONS REDUCTION: STATES' ACTION PLANS

MODULE 2: STATES' ACTION PLANS: BASELINE CALCULATION

LEARNING OBJECTIVES

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

- Define the Baseline;
- Estimate international aviation fuel burner CO₂ emissions, and International Revenue Tonnes Kilometer (IRTK);
- Calculate the baseline using the Environment Benefit Tool (EBT).

INTERNATIONAL AVIATION CO₂ EMISSIONS REDUCTION: STATES' ACTION PLANS

MODULE 3 STATES' ACTION PLANS: MITIGATION MEASURES

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 CO₂ emissions from the international aviation sector.

INTERNATIONAL AVIATION CO₂ EMISSIONS REDUCTION: STATES' ACTION PLANS

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

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.

INTERNATIONAL AVIATION CO₂ EMISSIONS REDUCTION: STATES' ACTION PLANS

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

LEARNING OBJECTIVES

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

- Use the ICAO tools to calculate CO₂ 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 CO₂ emissions from international aviation, if installed in the State.

INTERNATIONAL AVIATION CO₂ EMISSIONS REDUCTION: STATES' ACTION PLANS



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(NACC) Office
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South American
(SAM) Office
Lima

ICAO
Headquarters
Montréal

Western and
Central African
(WACAF) Office
Dakar

European and
North Atlantic
(EUR/NAT) Office
Paris

Middle East
(MID) Office
Cairo

Eastern and
Southern African
(ESAF) Office
Nairobi

Asia and Pacific
(APAC) Sub-office
Beijing

Asia and Pacific
(APAC) Office
Bangkok



THANK YOU