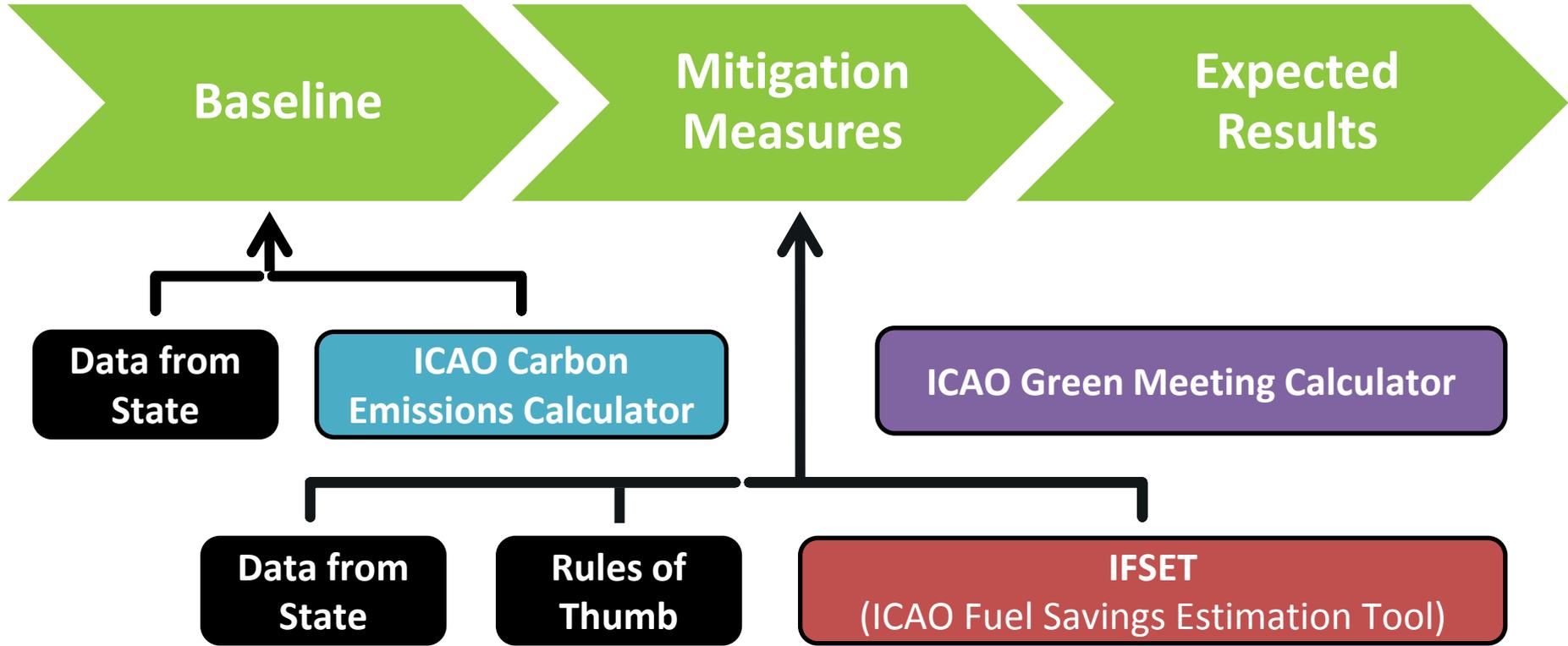




### 3. ICAO Supporting Tools – Not publicly available

ICAO Secretariat







- Rules of Thumb

- Excel spreadsheet to calculate the baseline

- RTK table

- ...

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

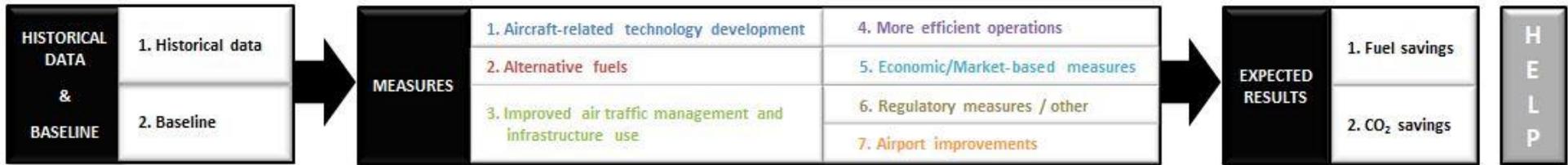
A large, light blue arrow pointing to the right, with a dark blue circle containing the letters 'EBT' in white. The arrow is positioned in the upper right quadrant of the slide.

**EBT**

## What EBT does...

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





## 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



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



Input

Next (Baseline)

### HISTORICAL DATA

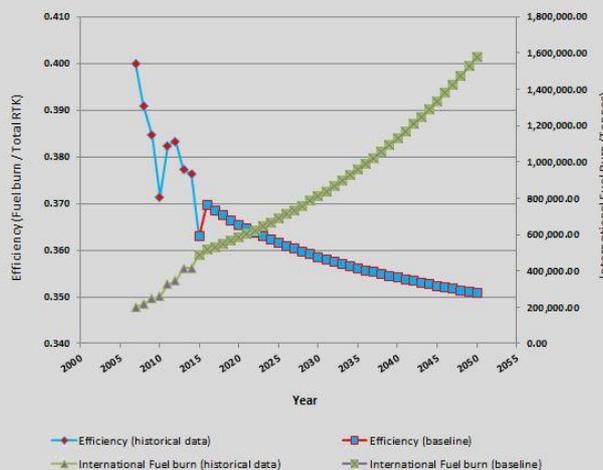
Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Intl. Fuel burn / Intl. RTK)
2007	500,000.00	200,000.00	0.400
2008	550,000.00	215,000.00	0.391
2009	650,000.00	250,000.00	0.385
2010	700,000.00	260,000.00	0.371
2011	850,000.00	325,000.00	0.382
2012	900,000.00	345,000.00	0.383
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



# Environmental Benefits Tool (EBT) Part 1: Baseline



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	1,022,384.78	0.355

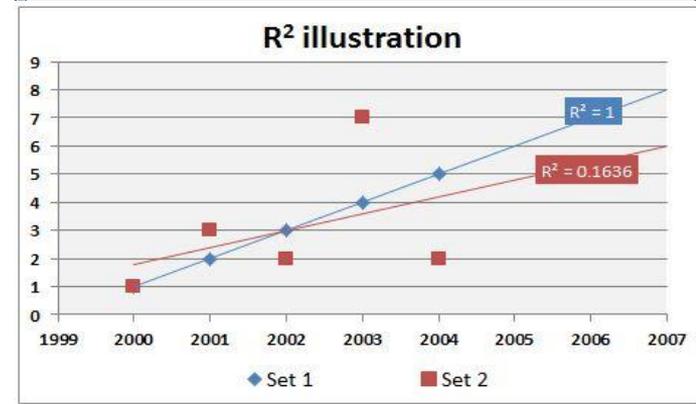


The best trend is: **Logarithmic**

**Linear** R2 = 0.6771 Annual fuel efficiency improvement (%) = 1.01

**Logarithmic** R2 = 0.7266 Annual fuel efficiency improvement (%) = 0.10

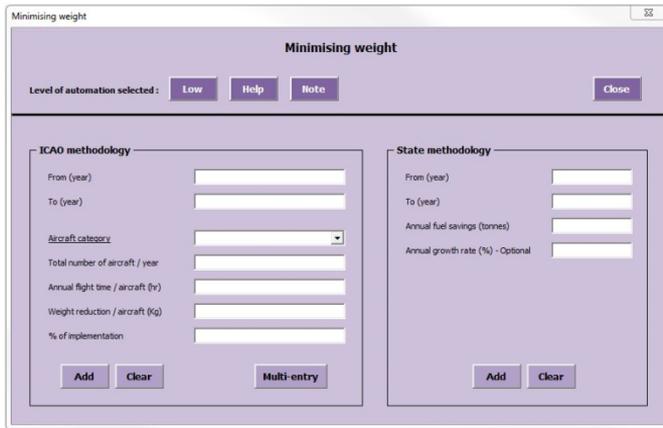
**Exponential** R2 = 0.6745 Annual fuel efficiency improvement (%) = 0.81



# Mitigation Measures

Front end

Back end



The screenshot shows a web form titled "Minimising weight". At the top, it says "Level of automation selected:" with buttons for "Low", "Help", "Note", and "Close". The form is divided into two main sections: "ICAO methodology" and "State methodology".

**ICAO methodology section:**

- From (year):
- To (year):
- Aircraft category:
- Total number of aircraft / year:
- Annual flight time / aircraft (hr):
- Weight reduction / aircraft (kg):
- % of implementation:

Buttons: Add, Clear, Multi-entry

**State methodology section:**

- From (year):
- To (year):
- Annual fuel savings (tonnes):
- Annual growth rate (%) - Optional:

Buttons: Add, Clear

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



# Environmental Benefits Tool (EBT) Part 2: Mitigation Measures – Front end

## 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

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





## What are the Rules of Thumb ?

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

*(Oxford English Dictionary)*



# Environmental Benefits Tool (EBT) Part 2: Mitigation Measures – Back end (cont.)

## 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*

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**

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



# Environmental Benefits Tool (EBT) Part 2: Mitigation Measures – Back end (cont.)

**Fleet details**

Year of reference :  -

International RTK - CAGR (%):

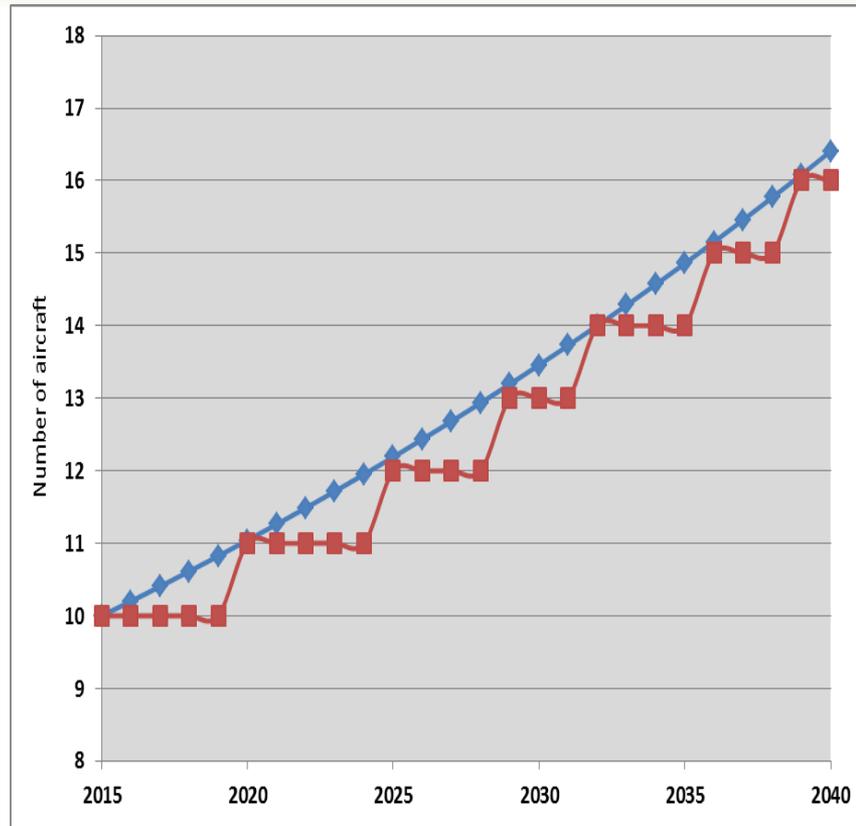
Average number of movements / aircraft (optional):

---

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 Benefits Tool (EBT) Part 2: Mitigation Measures – Back end (cont.)

## 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

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**

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

# Environmental Benefits Tool (EBT)

## Part 3: Expected Results

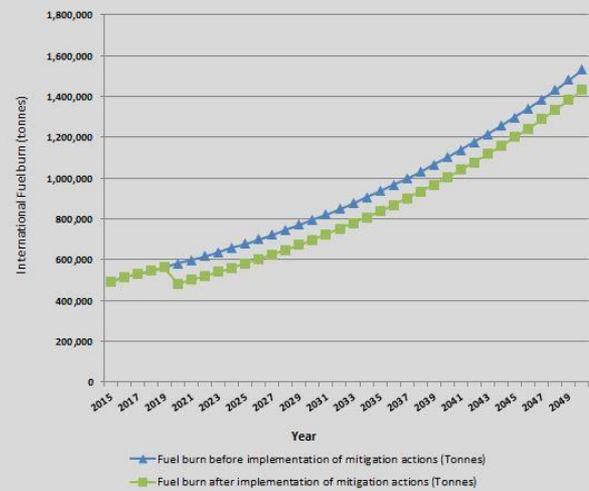


Details
Download Results

**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	560,098.70	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

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





## 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
5. **AND YOUR INPUTS ([officeenv@icao.int](mailto:officeenv@icao.int))**



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ENVIRONMENT

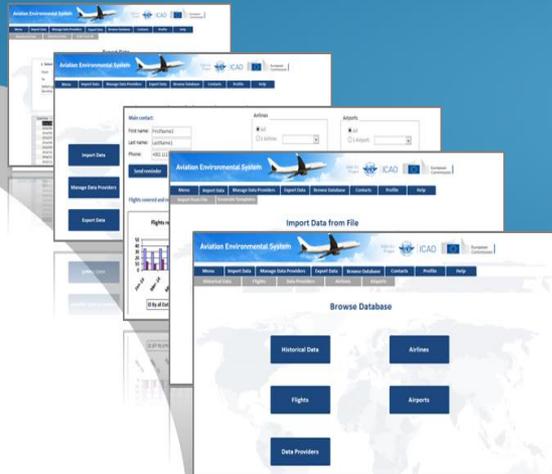
**Aviation Environmental System (AES)**

# **Aviation Environmental System (AES)**

## **ICAO-European Union Project**

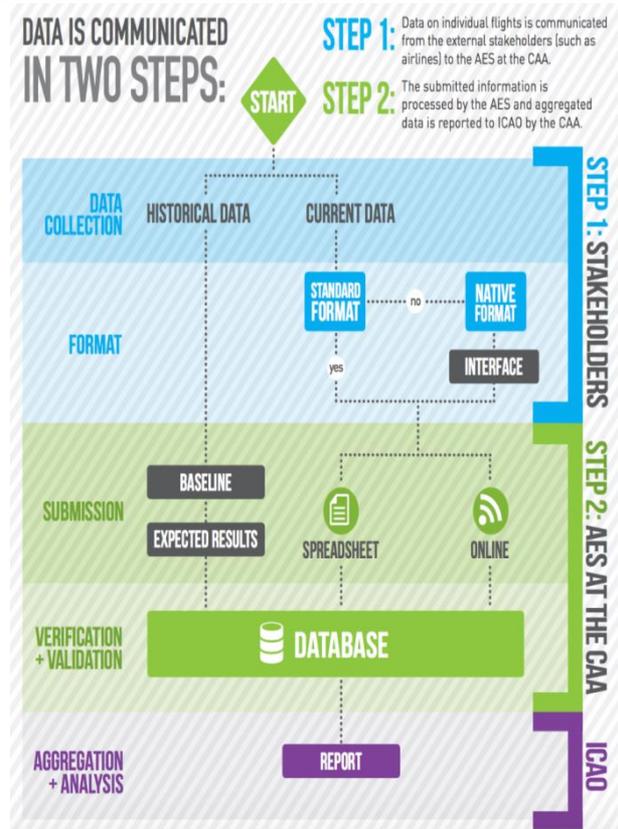
**A tool** developed in the scope of the ICAO-European Union Joint Assistance Project

**AES – Installed in the 14 beneficiary States**



1. Provide a user-friendly tool to allow Civil Aviation Authorities (CAA) to monitor CO<sub>2</sub> emissions from international aviation at the State level
2. Enforce the adoption of a single uniform format (Form ENV1) for data collection in all States
3. Automate the data reporting to ICAO

# Aviation Environmental System (AES)



Step 1: Stakeholders report data on individual flights to the Civil Aviation Authority (CAA), where it is imported into the AES.

Step 2: The CAA submits to ICAO aggregated data automatically generated by the AES.

For more information: [icao-eu-project@icao.int](mailto:icao-eu-project@icao.int)



# Aviation Environmental System AES



States are able to create **Monthly Reports** of CO<sub>2</sub> emission by routes, flights or airlines

## MONTHLY AVIATION CO<sub>2</sub> REPORT

Kenya

May-16

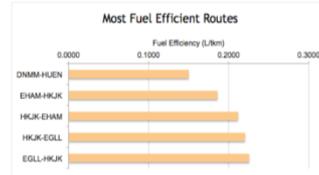
### KEY METRICS FOR INTERNATIONAL AVIATION

FLIGHTS	RTK (tkm)	FUEL BURN (L)	CO <sub>2</sub> EMISSIONS (t)	FUEL EFFICIENCY (L/tkm)
3,378	78,074,849	35,074,354	88,668	0.449

### TRENDS

MONTH-TO-MONTH	May-16	Apr-16	% CHANGE	6 MONTHS TREND
RTK (tkm)	78,074,849	67,629,826	↑ 15%	
FUEL BURN (L)	35,074,354	32,770,068	↑ 7%	
CO <sub>2</sub> EMISSIONS (t)	88,668	82,843	↑ 7%	
FUEL EFFICIENCY (L/tkm)	0.449	0.485	↓ -7%	

YEAR-TO-YEAR	May-16	May-15	% CHANGE	1 YEAR TREND
RTK (tkm)	78,074,849	98,242,919	↓ -21%	
FUEL BURN (L)	35,074,354	44,382,507	↓ -21%	
CO <sub>2</sub> EMISSIONS (t)	88,668	112,199	↓ -21%	
FUEL EFFICIENCY (L/tkm)	0.449	0.452	↓ -1%	



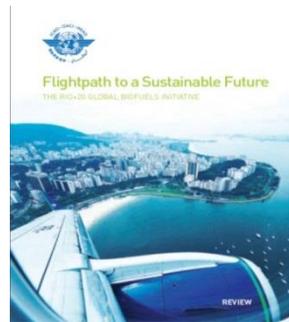
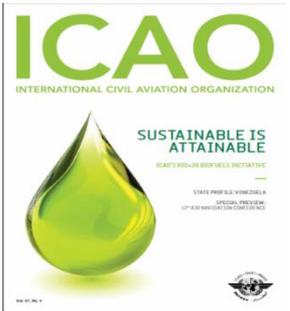
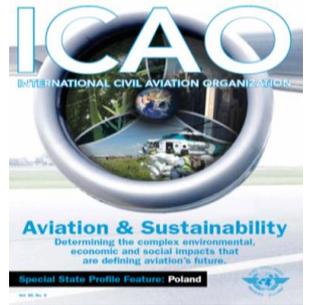
Comments:



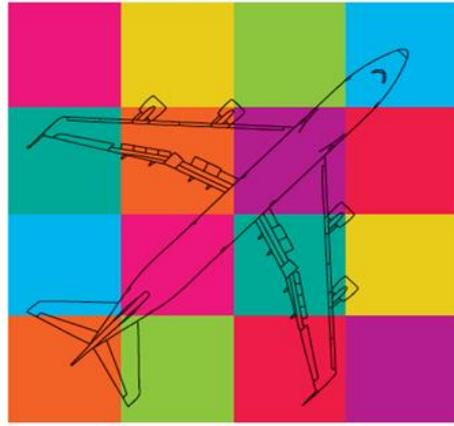
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# Additional information



## ON BOARD A SUSTAINABLE FUTURE



ICAO 2016 ENVIRONMENTAL REPORT

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