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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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ICAO Doc 9988 and the Rules of Thumb

Chinga Mazhetese

Blandine Ferrier

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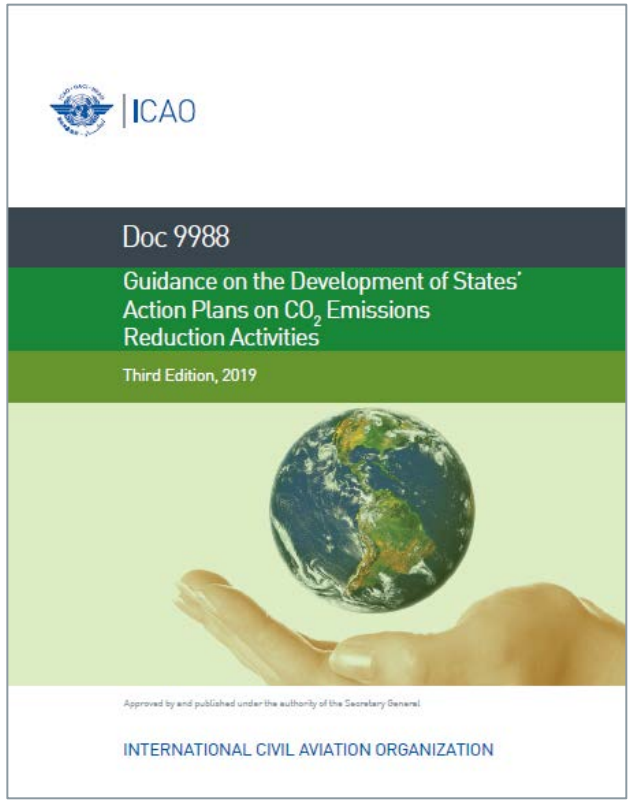
Rules of Thumb for Estimating Benefits

Overview of Doc 9988

Guideline on the Development of States' Action Plan on CO_2 emissions Reduction Activities



- provides **guidance for States**
  - to help them **prepare or update** their action plans
  - is designed **for use by those responsible for the preparation** of an action plan.

The rules of thumb presented in Table C-2 of Doc 9988 can be applied if the data or resources are not available to use a more advanced technique

However, a more detailed analysis may be warranted if the results are to be applied in support of an investment decision or cost-benefit analysis.

Objective of the rules of thumb is to provide a reasonable approximation of the benefits associated with a specific measure, thereby allowing all action plans to include a quantified expected results section.

Table C-2 also includes brief examples to illustrate how to apply each rule of thumb

Technology and standards

- *Purchase of new aircraft*

- **Rule of Thumb**
  - **FS = [0.9% to 1.05%] * a/c' age (year) * old a/c fuel burn**

An airline has 5 narrow-body aircraft that are 10 years old with an average fuel consumption of 2.411 tonnes per hour and 5 wide-body aircraft that are 12 years old with an average fuel consumption of 12.183 tonnes per hour. All 10 aircraft will be replaced with new aircraft.

Each aircraft in the narrow-body fleet operates for an average of 2,700 hours per year, and each aircraft in the wide-body fleet operates for an average of 3,800 hours per year.

The annual fuel savings can be estimated as:

— narrow-body: 0.009 * 10 * 5 * 2.411 * 2,700 = 2,929 tonnes of fuel

— wide-body: 0.009 * 12 * 5 * 12.183 * 3,800 = 25,000 tonnes of fuel

Total: 27,929 tonnes of fuel saved per year (low end of range)

Technology and standards

- *Retrofitting and upgrade improvements on existing aircraft*
- Improve fuel efficiency through development of modification:
  - *Split winglets with scimitar tips (IATA)*
- **Rule of Thumb**
  - **FS = [2% to 6%] * FB**

An airline has 5 aircraft with an average fuel consumption of 2.411 tonnes per hour that are used, on average, 2,700 hours per year. The airline intends to install split winglets on all 5 of these aircraft.

The annual fuel savings can be estimated as:

0.02 * 5 * 2.411 * 2,700 = 651 tonnes of fuel saved per year (low end of range)

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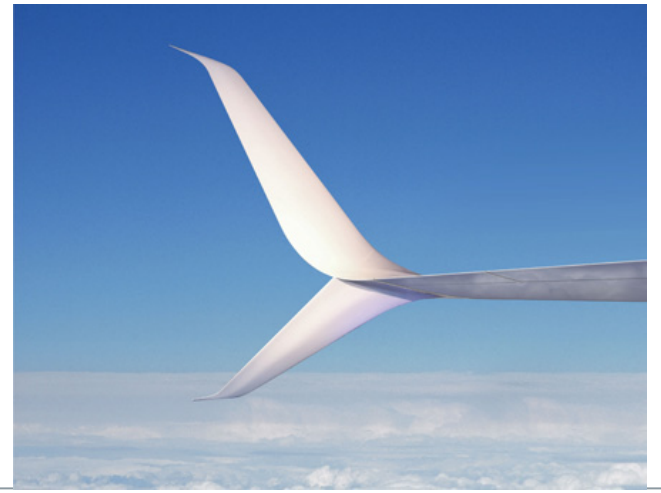

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Operational improvements

- *More efficient ATM planning, ground operations, terminal operations, en-route operations, airspace design and usage, aircraft air navigation capabilities*

- Measures to improve fuel-efficient departure and approach procedures:
  - *CDO*

A State averages 1,000,000 flights per year. Currently, 10 of its airports offer CDO which accounts for approximately 4,800,000 arrival movements. Expert judgement estimates that CDO at these airports is performed 100% in off-peak hours which accounts for approximately 35% or 1,680,000 traffic movements.

The annual fuel savings can be estimated as:

0.06 * 1,680,000 = 100,800 tonnes of fuel saved

- **Rule of Thumb**
  - **Use IFSET or**
  - **FS = 60 kg (0.06 tonnes) of fuel * number of CDOs**

Operational improvements

- *More efficient ATM planning, ground operations, terminal operations, en-route operations, airspace design and usage, aircraft air navigation capabilities*

- Measures to improve fuel-efficient departure and approach procedures:
  - *PBN STAR (Performance Based Navigation- Standard Terminal Arrivals)*

A State averages 1,000,000 flights per year. Currently, 50 of its airports have implemented PBN STAR which is estimated to be used by 250,000 arrival movements. Expert judgement is that 100% of these arrivals fly the PBN STAR.

The annual fuel savings can be estimated as:

— 0.02 * 250,000 = 5,000 tonnes of fuel saved (low end of range)

— 0.05 * 250,000 = 12,500 tonnes of fuel saved (high end of range)

- **Rule of Thumb**
  - **Use IFSET or**
  - **FS = 20kg to 50kg of fuel (0.02 to 0.05 tonnes) of fuel * number of arrivals on PBN STAR**

Operational improvements

- *More efficient ATM planning, ground operations, terminal operations, en-route operations, airspace design and usage, aircraft air navigation capabilities*

- Measures to improve fuel-efficient departure and approach procedures:
  - *CCO*

A State averages 2,000,000 flights per year. Currently, 50 of its airports offer CCO which accounts for approximately 200,000 departure movements. Expert judgement estimates that CCO is performed by 80% of the departures, a total of 160,000 departure movements.

The annual fuel savings can be estimated as:

— 0.09 * 160,000 = 14,400 tonnes of fuel saved (low end of range)

— 0.15 * 160,000 = 24,000 tonnes of fuel saved (high end of range)

- **Rule of Thumb**
  - **Use IFSET or**
  - **FS = 90-150kg (0.09- 0.15 tonnes) of fuel * number of CCOs**

Operational improvements

- *Best practices in operations*
  - Single engine taxi-NB

An aircraft with 3,000 operations per year typically spends a total of 26 minutes taxiing per operation. All-engine taxi requires 12 kg (0.012 tonnes) per minute. It will spend 20 minutes taxiing single-engine per operation.

The annual fuel savings can be estimated as:

0.28 * 0.012 * 20 * 3,000 = 201.6 tonnes of fuel saved

- **Rule of Thumb**
  - $FS = \sum[28\% * FB_i$/min (idle) * time with 1 engine off (min)]
    - Where i is the a/c type

Sustainable Aviation Fuels (SAF)

- *Standards/ requirements for SAF use*
- Improve fuel efficiency through development of modification:
  - *Use SAF (ICAO Secretariat)*
- **Rule of Thumb**
  - **CO2 savings = utilization (%) * FB * 3.16 (until international agreement is reached regarding life-cycle analysis- Doc 9988)**

An airline has 5 aircraft with an average fuel consumption of 2.411 tonnes per hour that are used, on average, 2,700 hours per year. The airline intends to use a 20% blend of SAF in all operations.

The CO_2 savings can be estimated as:

0.2 * 5 * 2.411 * 2,700 * 3.16 = 20,551 tonnes of CO_2 saved per year

Note.— This measure only reduces net CO_2 emissions, not fuel.

Questions

Thank You!

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