States’ strategy to deal with international aviation CO₂ emissions: Mitigation Measures
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Outline

• ICAO State Action Plan Minimum Content Review
• Defining ICAO’s Basket of Measures
  – Mitigation Measures – Seven (7) categories of measures
  – Mitigation Measures – ICAO Basket of Measures
• Guidance on Selecting Measures
• Additional Guidance
• Additional Support
• Summary
State Action Plan Minimum Content

1. Contact information

2. Baseline scenario (without action) fuel consumption CO₂ emissions and traffic (2010 or earlier to 2050)

3. List of selected mitigation measures

4. Expected results (fuel consumption, CO₂ emissions and traffic with the actions in #3 being taken 2018 to 2050)

5. Assistance needs
Defining ICAO’s Basket of Measures

• High-level Meeting on International Aviation and Climate Change in October 2009 (HLM-ENV/09) endorsed the Programme of Action on International Aviation and Climate Change, which included:
  – global aspirational goals;
  – a basket of measures; and
  – the means to measure progress.
Mitigation Measures – Seven (7) categories of measures:

1. aircraft-related technology development;
2. sustainable aviation fuels
3. improved air traffic management and related infrastructure use
4. more efficient operations
5. economic/market-based measures
6. regulatory measures/other; and
7. airport improvements
Mitigation Measures – ICAO Basket of Measures

As defined in the ICAO 39th Assembly Resolution A39-2:

- Technology and standards
- Sustainable alternative fuels
- Operational improvements
- Market-based measures
7 Categories of Measures

ICAO Basket of Measures

Market-based measures
Sustainable alternative fuels
Operational improvements
Technology and standards

airport improvements
aircraft-related technology development
sustainable aviation fuels

more efficient operations
regulatory measures / other
economic / market-based measures

improved air traffic management and related infrastructure use
Guidance on Selecting Measures

- Reference material:

  - ICAO Doc 9988
  - ICAO Doc 10031
  - ICAO Doc 10013
Additional Guidance
Additional Support

- ICAO MAC Curve Tool
  - Will help Developing States and SIDS
  - Provides information on financial costs compared to CO₂ emissions reductions benefits
Aircraft Technology Development

• To improve fuel efficiency there are continuous efforts in:
  – Aircraft structures
  – Propulsion
  – Aerodynamics

• For example:
  – Aircraft minimum fuel efficiency standards;
  – Retrofitting and upgrade improvements on existing aircraft;
  – Optimizing improvements in aircraft produced in the near- to mid-term;
  – Avionics;
  – Adoption of revolutionary new designs in aircraft/engines.
• Reductions in weight are a key factor in reducing fuel burn:
  – Use of Carbon Fibre Reinforced Plastic (CFRP) and advanced alloys is increasing;
• Airbus A380 contains 25% composites.
• Boeing 787 and Airbus A350 have pushed the composite use to 50%.

Source: ICCAIA
• Aerodynamics, for example:
  – Drag reduction technologies
  – Wingtip devices
• Drive towards increased propulsive efficiency:
  – Higher by-pass ratio engines deliver thrust at lower fuel consumption
  – Lighter and higher temperature materials

http://www.ecomagination.com/portfolio/genx-aircraft-engine
http://machinedesign.com/archive/fewer-trips-fuel-truck
• **Who should be involved?**

  **Airport**
  
  If new aircraft are to be introduced, the airport may need to be informed.

  **ANSP**
  
  If new aircraft or avionics are to be introduced, the ANSP may need to be informed.

  **Aircraft operator**
  
  Can provide fuel efficiency improvement data due to aircraft modifications or the purchase of new aircraft.

  **Aircraft manufacturer**
  
  Can provide fuel efficiency improvement data due to aircraft modifications or the purchase of new aircraft.
Sustainable Aviation Fuels

• Potential for significant emissions reductions
• Emissions reductions achievable with existing aircraft
• Benefits will depend on:
  – the availability of such fuels and the time profile of their deployment;
  – their actual lifecycle emissions reduction
• Challenges
  – Decreasing production cost
  – Investment in feedstock production and conversion facilities
  – Ensuring a sustainable deployment
• States’ policy support is required

http://lae.mit.edu/alternative-fuels/
More than 5,500 commercial flights have been flown on sustainable alternative fuels
Five fuel production processes are certified for use in aviation.
How can a drop-in fuel reduce CO₂ emissions?
ICAO Global Framework for Aviation Alternative Fuels (GFAAF)

- Started in 2009
- Database for relevant activities
  - Frequently asked questions
  - Facts and Figures
  - News and Activities
  - Initiatives and Projects
• Who should be involved?

Fuel providers
- Can provide information on the benefits of using sustainable aviation fuels

Academia and research institutions

Aircraft operator
- Can provide fuel purchase data

Fuel providers

Other Government entities
- If standards requiring the use of sustainable aviation fuel are to be introduced
Improved ATM and infrastructure use

- Lead to moderate emissions reductions (significant in some cases)
- Involve substantial investments (ANSPs, air carriers)
- Other performance dimensions (safety, reliability, cost, capacity, etc.)

Examples

- more efficient Air Traffic Management (ATM) planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities;
- more efficient use and planning of airport capacities;
- collaborative research endeavours.
NO COUNTRY LEFT BEHIND

Departure

Climb

- B0-ACDM Airport collaborative decision making
- B0-RSEQ Runway sequencing
- B0-CCO Continuous climb operations

Cruise

- B0-NOPS Network operations
- B0-FRTO Free route Operations
- B0-ASUR Alternative surveillance

Approach

- B0-OPFL Optimum flight levels
- B0-WAKE Wake turbulence separation
- B0-CDO Continuous descent operations

Arrival

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Resource list:

• ICAO’s Global Air Navigation Plan (Doc 9750)
• ICAO’s Global Air Navigation Report – April 2014
• ICAO’s PIRGs’ environmental initiatives
• ICAO’s Aviation System Block Upgrades
• The Global Air Traffic Management Operational Concept (Doc 9854)
• Manual on Air Traffic Management System Requirements (Doc 9882)
• Manual on Global Performance of the Air Navigation System (Doc 9883)
• Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes (Doc 10031)
• Who should be involved?

Aircraft operator
Can provide data on how changes impact fuel burn

Other Government entities
Will be involved if procedural changes will become standards

ANSPs
Need to be aware of new procedures and changes to the airspace

Community groups
Should be informed if changes to flight paths will impact communities

Aircraft Operator

Airports
• Best practices in operations – ICAO Doc 10013;
• Optimized aircraft maintenance;
• Selecting aircraft best suited to the mission.

Engine washing

Use of Ground Power Units

Green Taxiing

**Taxi-bot**

On engaging with the TaxiBot, the nose wheel of the aircraft enters the vehicle turret and is quickly clamped securely into position. The turret is able to rotate freely and can hence take steering and braking requests directly from the nose wheel - the flight crew can thus manoeuvre the aircraft around the taxi-ways of the airport without using the plane’s main engines.


**Wheel tug**

Assessment

- Short-term
- Lead to moderate emissions reductions (significant in some cases)
- Require minimal (or no) investment

Resource List

- ICAO’s *Procedures for Air Navigation Services — Aircraft Operations* (Doc 8168),
- *Operational Opportunities to Minimize Fuel Use and Reduce Emissions* (Doc 10013),
- Airbus’ *Getting to Grips with Fuel Economy* (and technical documentation and guidance)
- Boeing’s *Fuel Conservation Strategies: Descent and Approach* (and technical documentation and guidance).
• Who should be involved?

**Airports**
May need to be involved for operational procedures impacting ground support

**Aircraft operator**
Can determine the most realistic changes to their operations
Can provide data on how changes impact fuel burn
The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
Regulatory measures/other

- airport movement caps/slot management
- enhancing weather forecasting services
- requiring transparent carbon reporting
- conferences/workshops
- other
• Who should be involved?

- Airport
  - Can implement airport movement caps/slot management

- ANSPs

- Aircraft operator
  - Can determine the most realistic changes to their operations
  - Can provide data on how changes impact fuel burn

- Other Government entities
  - Can enact regulatory changes
Airport Improvements

- Offer significant potential for emissions reduction, however, not all of those changes will directly affect international aviation emissions ("co-benefits")

Airfield improvements

- Use cleaner alternative sources of power generation (photovoltaic panels)

Conversion of GSE to cleaner fuels

Improved public transport access

[Links to images and further information]


http://www.globalgse.com/

http://www rtcwashoe.com/section-public-transportation
• Who should be involved?

- **Airports**: Can determine the most appropriate changes for their operations in consultation with:
  - **Ground handling companies**
  - **Airlines**
Context within the Action Plan Development Process

1. Contact information

2. Baseline (without action) fuel consumption CO₂ emissions and traffic (2010 or earlier to 2050)

3. List of selected measures

4. Expected results (fuel consumption, CO₂ emissions and traffic with the actions in #3 being taken 2014 to 2050)

5. Assistance needs
• ICAO Assembly Resolution A39-2, para 11

“Invites those States that choose to prepare or update action plans to submit them to ICAO” and in doing so, include “quantified information on the expected environmental benefits from the implementation of the measures chosen from the basket”

• Expected results are the effect of the implementation of the selected measures on the baseline
• Only aggregated expected results need to be submitted

• However, the techniques shown in the guidance allow the incremental benefits of each measure to be calculated.
• Promote the use of the Environmental Benefit Tool (EBT) available to Focal Points on the ICAO APER website, unless more accurate data is available.
In Summary

• Selecting appropriate mitigation measures are an integral part of a complete State Action Plan

• ICAO has developed a collection of guidance materials to assist States in the process of selecting mitigation measures

• The ICAO-UNDP-GEF Project has allowed ICAO to develop additional materials to support Member States in the process of selecting and implementing mitigation measures

For more information on this project, please visit ICAO’s website: https://www.icao.int/environmental-protection/Pages/ICAO_UNDP.aspx