States' strategy to deal with international aviation CO_2 emissions: Mitigation Measures

Outline

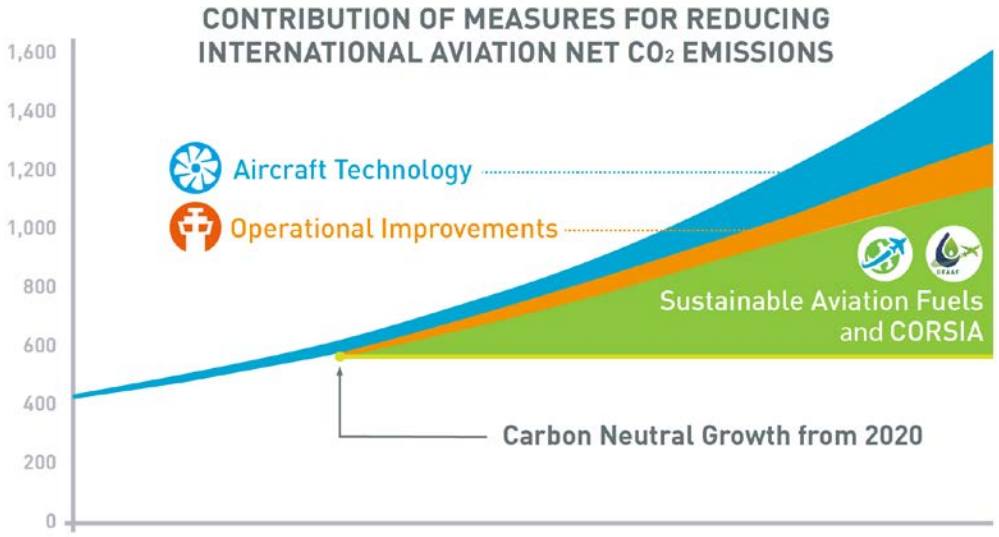
- ICAO State Action Plan Minimum Content Review
- Defining ICAO's Basket of Measures
  - Mitigation Measures – Seven (7) categories of measures
  - Mitigation Measures – ICAO Basket of Measures
- Guidance on Selecting Measures
- Additional Guidance
- Additional Support
- Summary

State Action Plan Minimum Content

1. Contact information
2. Baseline scenario (without action) fuel consumption CO_2 emissions and traffic (2010 or earlier to 2050)
3. List of selected mitigation measures
4. Expected results (fuel consumption, CO_2 emissions and traffic with the actions in #3 being taken 2018 to 2050)
5. Assistance needs

ICAO Global Aspirational Goals (A39-2)

- **ICAO aspirational goal - Carbon neutral growth (CNG) from 2020 onwards.**
- To be achieved with a "basket of measures" for CO_2 reduction



ICAO Basket of Measures

- **Technology and Standards**
- **Operational Improvements**
- **Sustainable Aviation Fuels**
- **Market-Based Measures (CORSIA)**

Range of CO_2 reductions from Sustainable Aviation Fuels (SAF)

Context within Doc 9988

- **Chapter 4** – Selection of measures and quantifying their expected results
- **Appendix A** – Basket of measures to limit or reduce CO2 emissions from international civil aviation
- **Appendix C** – Key stakeholders, analysis methods and tools
- **Appendix D** – Reference material relevant to the implementation of mitigation measures
- **Appendix E** - Examples of measures selected in action plans
- **Appendix F** – Costs and benefits related to the basket of measures

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

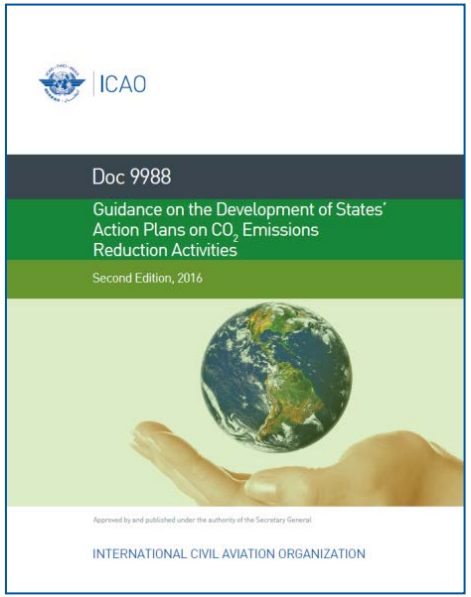
- sustainable aviation fuels
- airport improvements
- more efficient operations
- improved air traffic management and related infrastructure use
- economic / market-based measures
- aircraft-related technology development
- regulatory measures / other

ICAO Basket of Measures

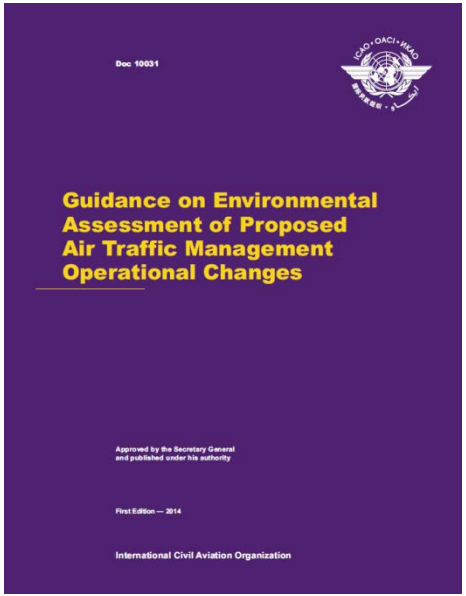
Aircraft technology	First-ever global CO_2 certification Standard for new types and in-production aeroplanes. Fast-paced innovation (new designs, composite materials, hybrid-electric aircraft, renewable energy sources, etc.).	
Operational improvements	CO_2 benefits from air traffic management; air navigation; green airports; etc.	
Sustainable aviation fuels	Around 200,000 commercial flights with drop-in aviation fuels; 6 conversion processes; 7 airports distributing drop-in aviation fuels	
Global market-based measure	Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	

Guidance on Selecting Measures

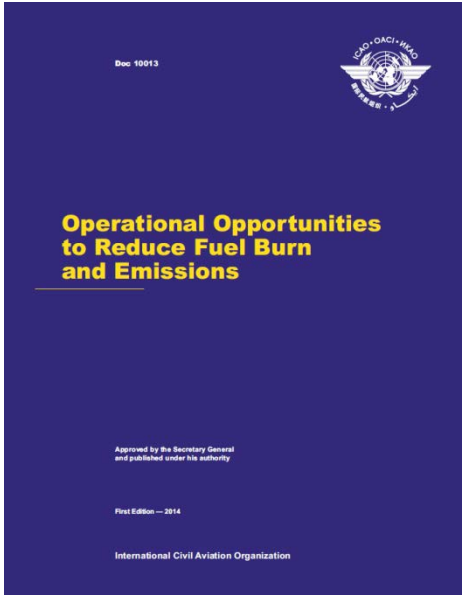
- Reference material:



ICAO Doc 9988

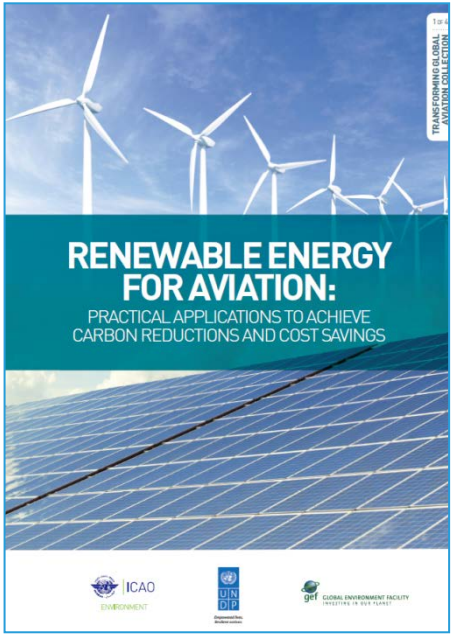


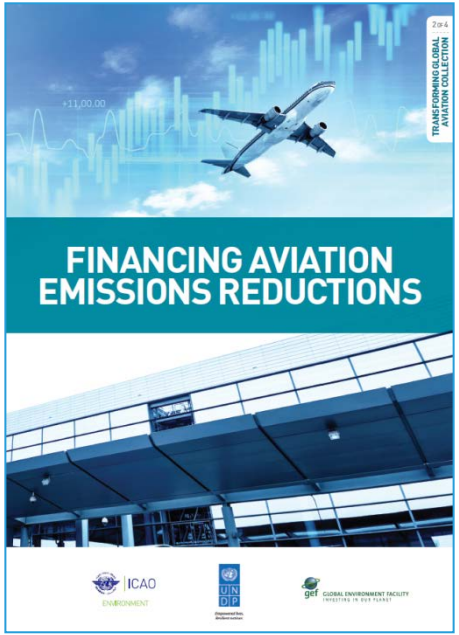
ICAO Doc 10031

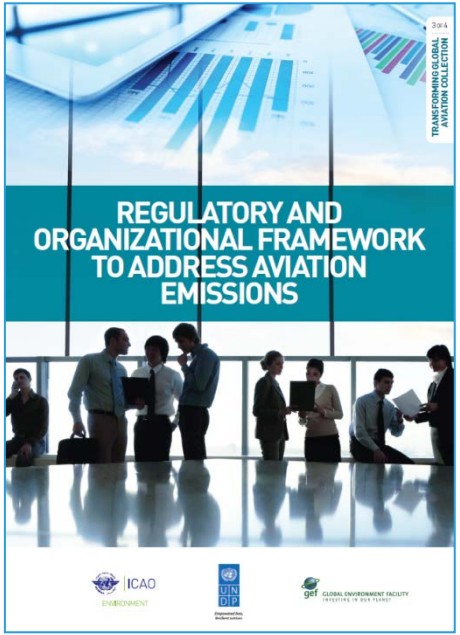


ICAO Doc 10013

Additional Guidance Documents







Additional Support

- ICAO MAC Curve Tool
  - Supporting Developing States and SIDS
  - Provides information on financial costs compared to CO_2 emissions reductions benefits
  - Available for the FPs on the APER website

ICAO UNDP gef

Examples of Mitigation Measures

Aircraft Technology Development

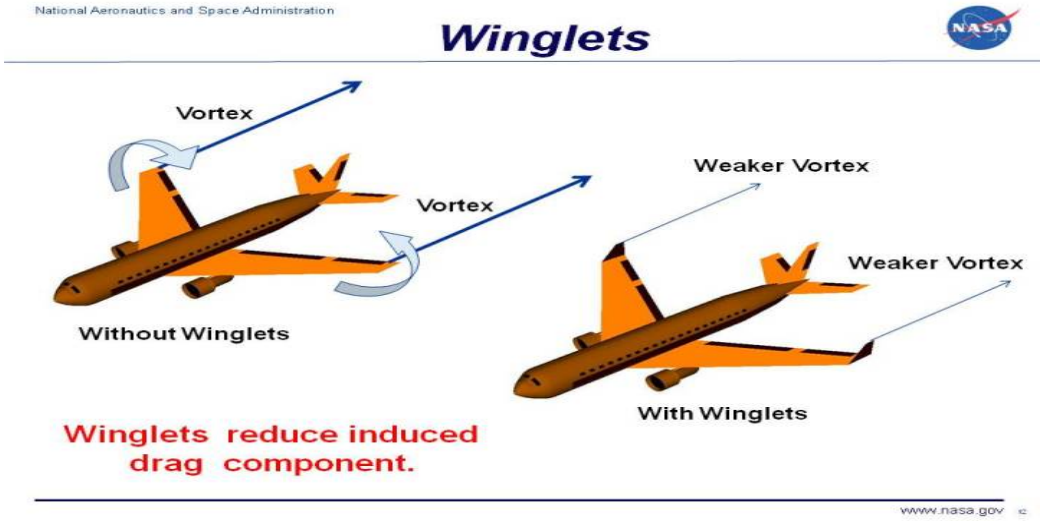
- To improve fuel efficiency there are continuous efforts in:
  - Aircraft structures – weight reductions
  - Propulsion
  - Aerodynamics

- 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



http://www.airlinereporter.com/

- Drive towards increased propulsive efficiency:
  - Higher by-pass ratio engines deliver thrust at lower fuel consumption
  - Lighter and higher temperature materials

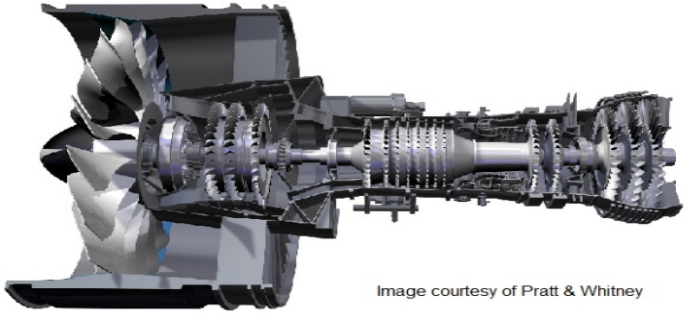
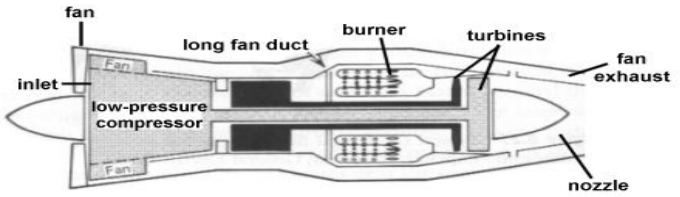
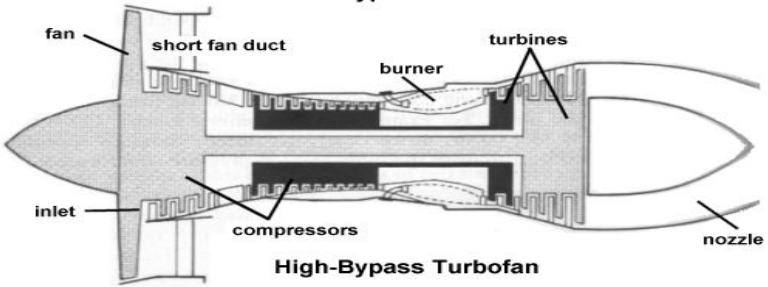


Image courtesy of Pratt & Whitney



Low-Bypass Turbofan



High-Bypass Turbofan

http://www.ecomagination.com/portfolio/genx-aircraft-engine
http://machinedesign.com/archive/fewer-trips-fuel-truck

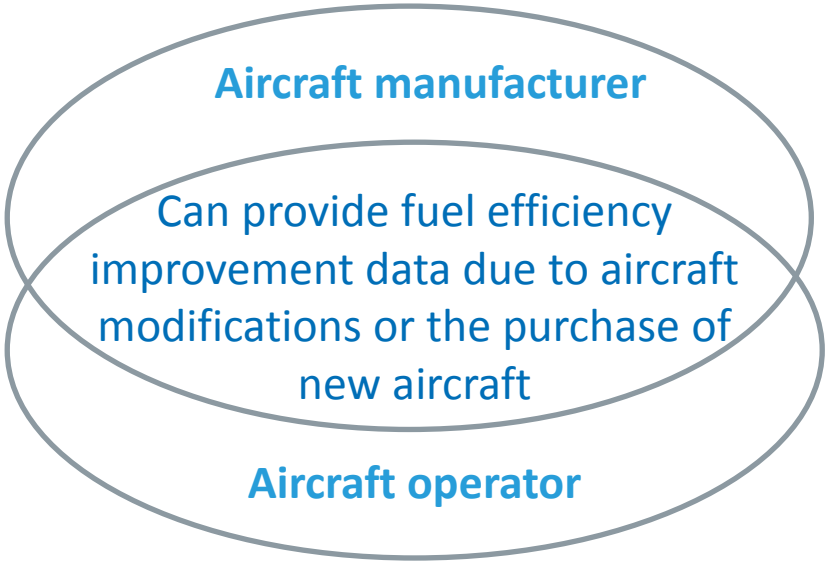
- Who should be involved?

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



What is Sustainable Aviation Fuels ?

- Must meet the same safety standards as current aviation fuels (e.g. ASTM Specifications)
- In addition to safety standards, SAF needs to meet Sustainability Criteria – generate lower carbon emissions on a life cycle basis

(net GHG emissions of at least 10% on a life cycle basis – CORSIA eligible fuels)

ICAO Assembly Resolution A39-2 (2016)

A39-2: *Acknowledging the need for such fuels to be developed and deployed in an economically feasible, socially and environmentally acceptable manner and the need for increased harmonization of the approaches to sustainability;*

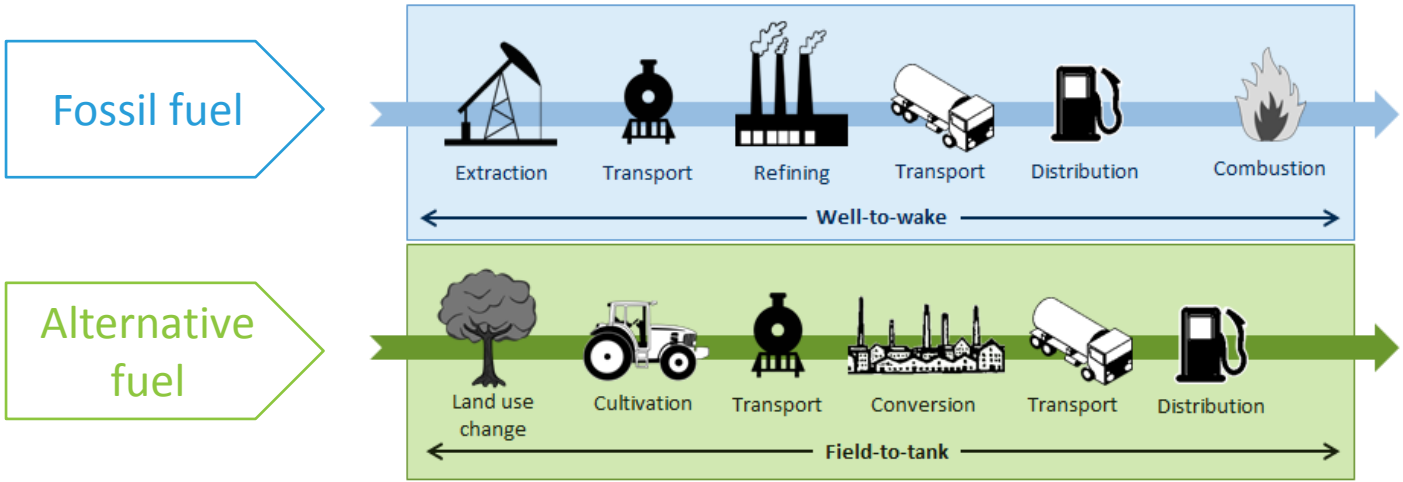
A39-2. *Requests States to recognize existing approaches to assess the sustainability of all alternative fuels in general, including those for use in aviation which should achieve net GHG emissions reduction on a life cycle basis; contribute to local social and economic development, competition with food and water should be avoided;*

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/

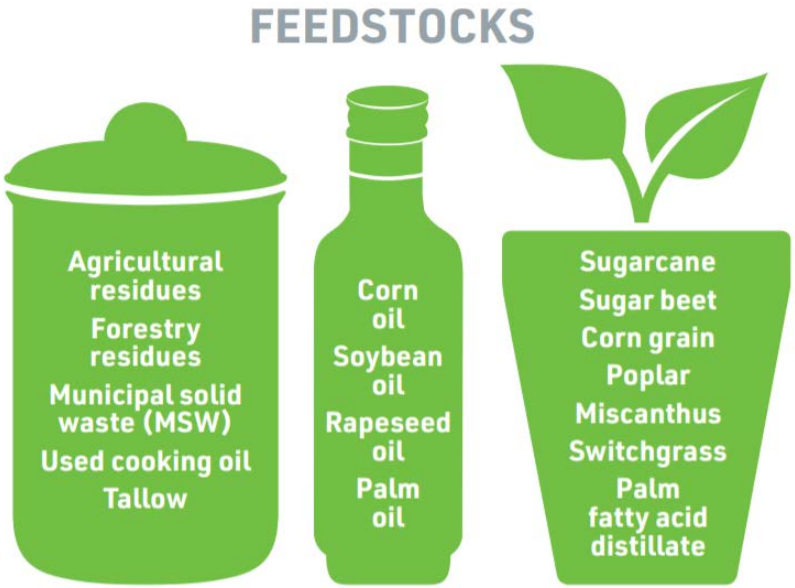
How can a drop-in fuel reduce CO2 emissions?

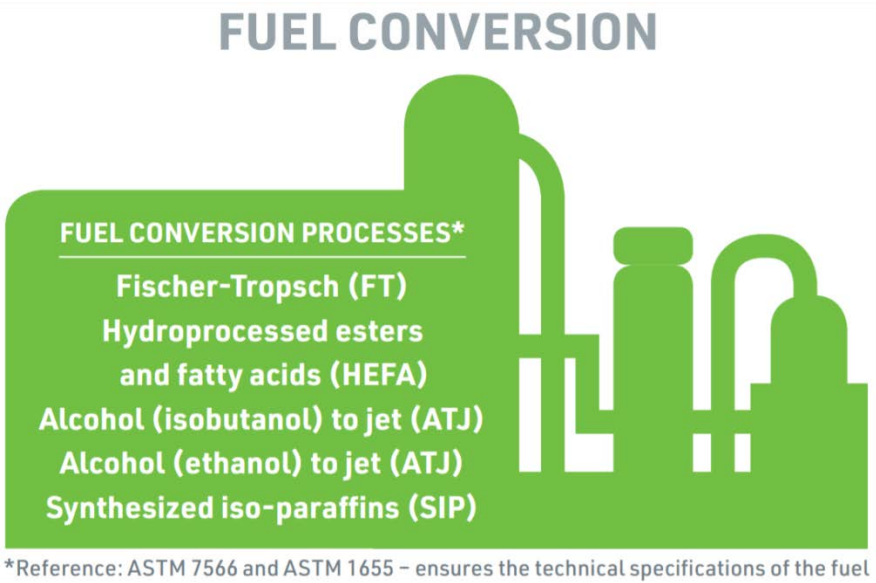


A SAF should generate lower carbon emissions on a life cycle basis

(net GHG emissions of at least 10% on a life cycle basis – CORSIA eligible fuels)

How can SAF be produced today?



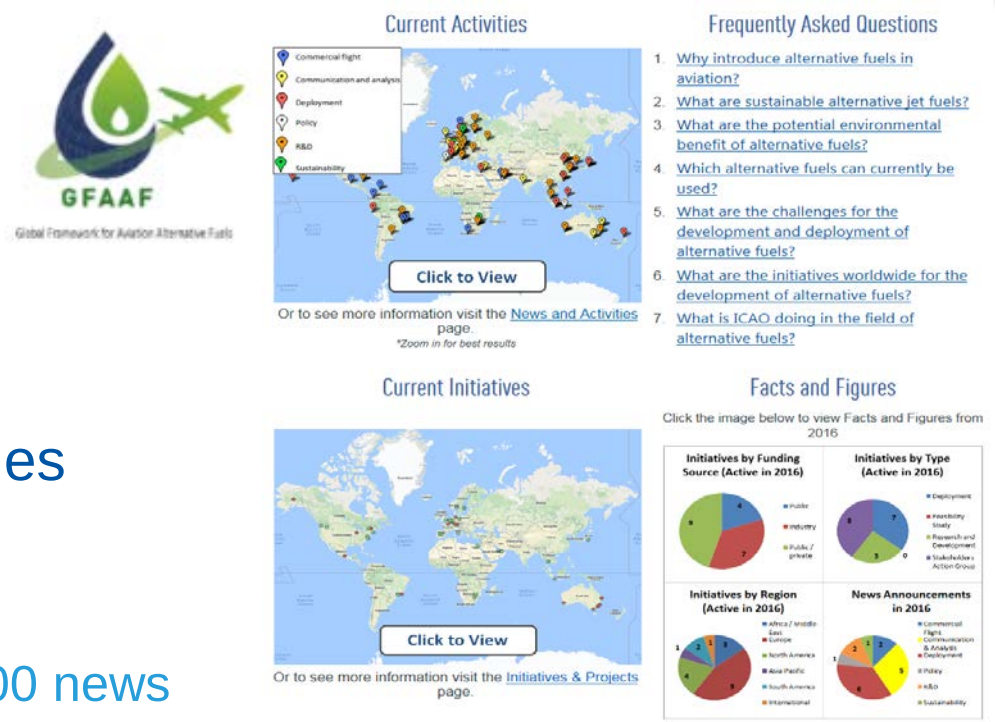


*Reference: ASTM 7566 and ASTM 1655 – ensures the technical specifications of the fuel

ICAO Global Framework for Aviation Alternative Fuels (GFAAF)

www.icao.int/environmental-protection/GFAAF/

- Started in 2009
- Database for relevant activities
  - Frequently asked questions
  - Facts and Figures
  - News and Activities – over 600 news
  - Initiatives and Projects

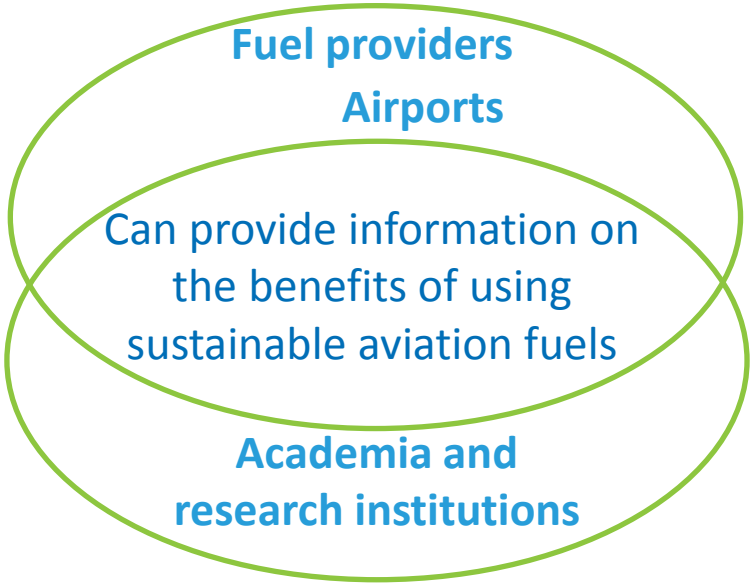


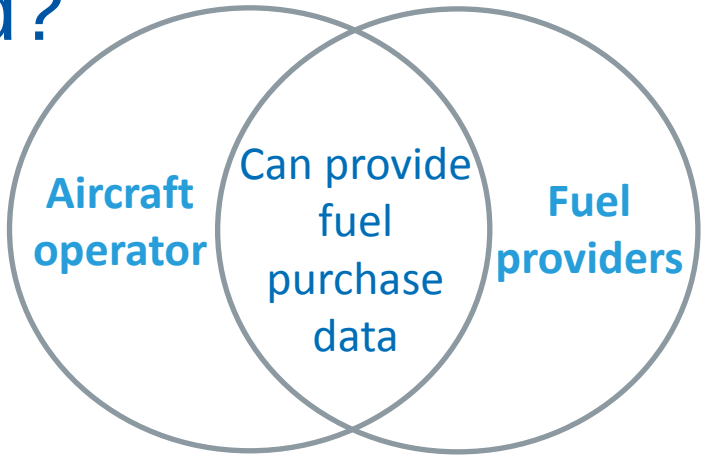
ICAO is facilitating SAF Development and deployment

- Establishing policies and measures
- Developing globally-accepted sustainably criteria and life cycle methodologies
- Organizing events fro information sharing and outreach
- Sharing information and best practices

ICAO work on SAF is supporting the ICAO 2050 Vision

- Who should be involved?



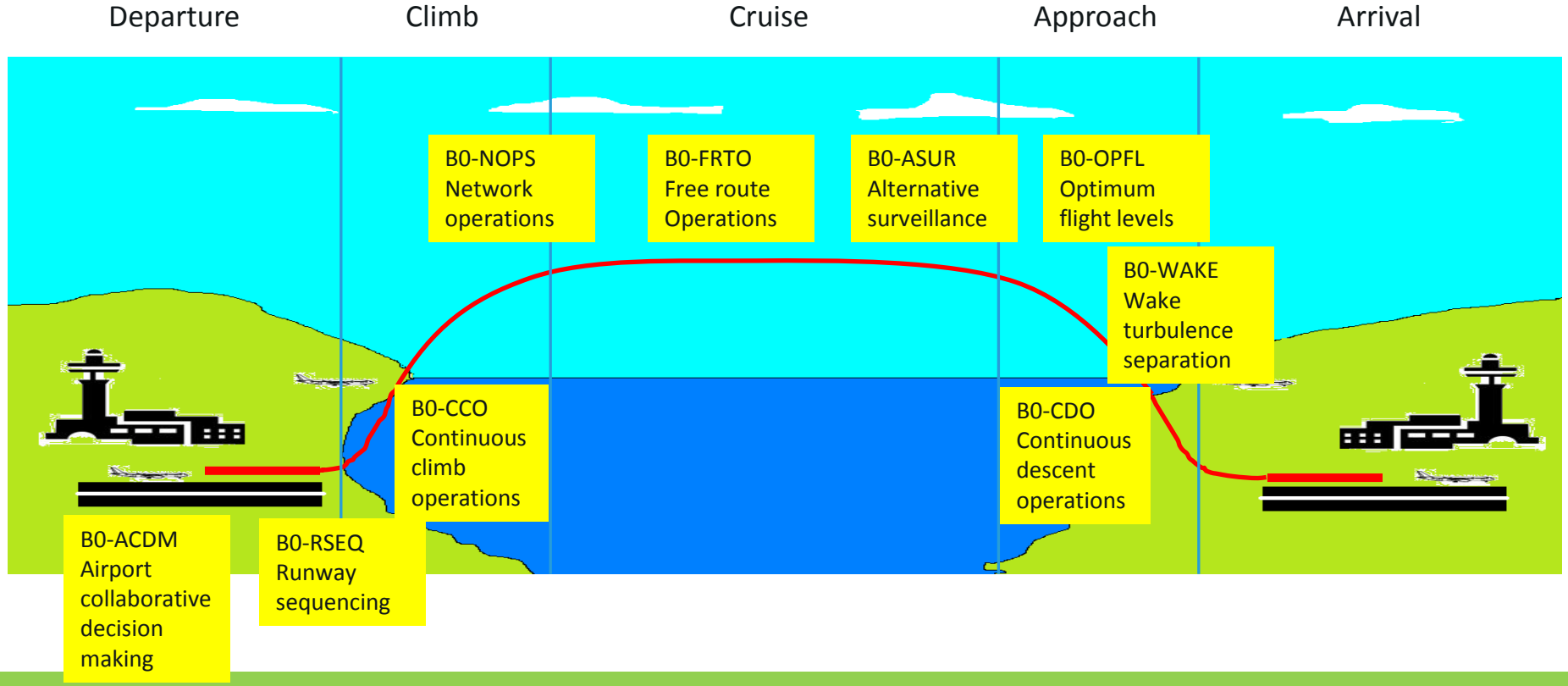


Other Government entities
If standards requiring the use of sustainable aviation fuel are to be introduced

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.


Departure
Climb
Cruise
Approach
Arrival
B0-NOPS Network operations
B0-FRTO Free route Operations
B0-ASUR Alternative surveillance
B0-OPFL Optimum flight levels
B0-WAKE Wake turbulence separation
B0-CCO Continuous climb operations
B0-CDO Continuous descent operations
B0-ACDM Airport collaborative decision making
B0-RSEQ Runway sequencing

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

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

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

Engine washing

Use of Ground Power Units

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)

CORSIA and State Action Plans

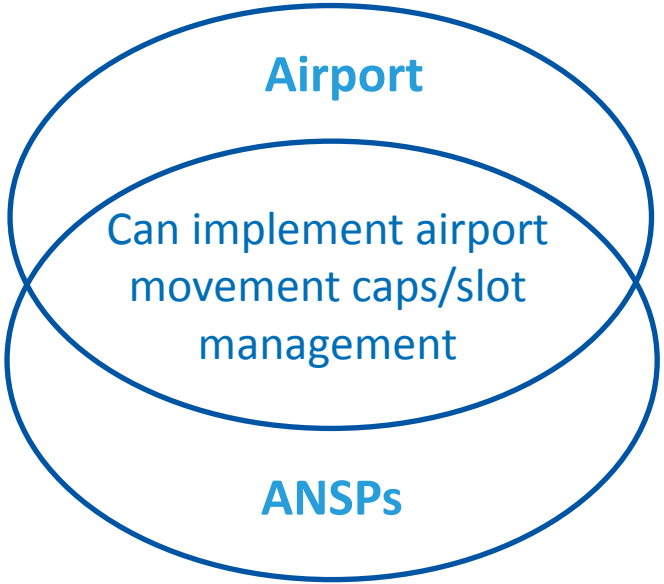
Synergies between States' Action Plans and CORSIA

- **CORSIA can be one of the measures to be included in States' Action Plan**
- Para 20 A39-3, all States whose aircraft operator undertakes international flights need to undertake a monitoring, reporting and verification (MRV) of CO_2 emissions from international flights starting from 1 January 2019
- State Action Plans containing a robust data collection, monitoring and reporting mechanism provide a good basis, from which the CORSIA MRV can be derived
- State Action Plans can reflect the **results of CO_2 emissions offsetting for international flights** under CORSIA by (voluntarily) participating States **from 2021**

Regulatory measures/other

- airport movement caps/slot management
- enhancing weather forecasting services
- requiring transparent carbon reporting
- conferences/workshops
- other

- Who should be involved?



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 of renewable energy sources for power generation (photovoltaic panels)

Availability of less polluting fuels

Improved public transport access

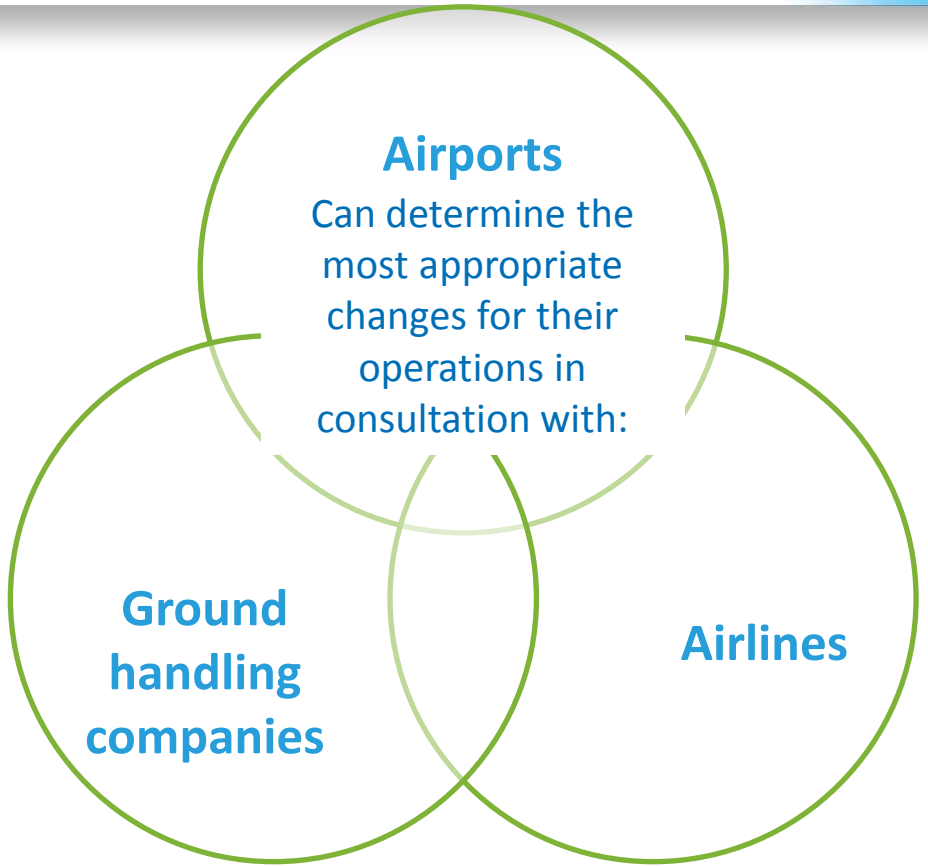
http://arabianindustry.com/construction/photos/2012/mar/20/pictures-chinas-hefei-xinqiao-airport-project-3534908/

http://www.passengerterminaltoday.com/viewnews.php?NewsID=36516

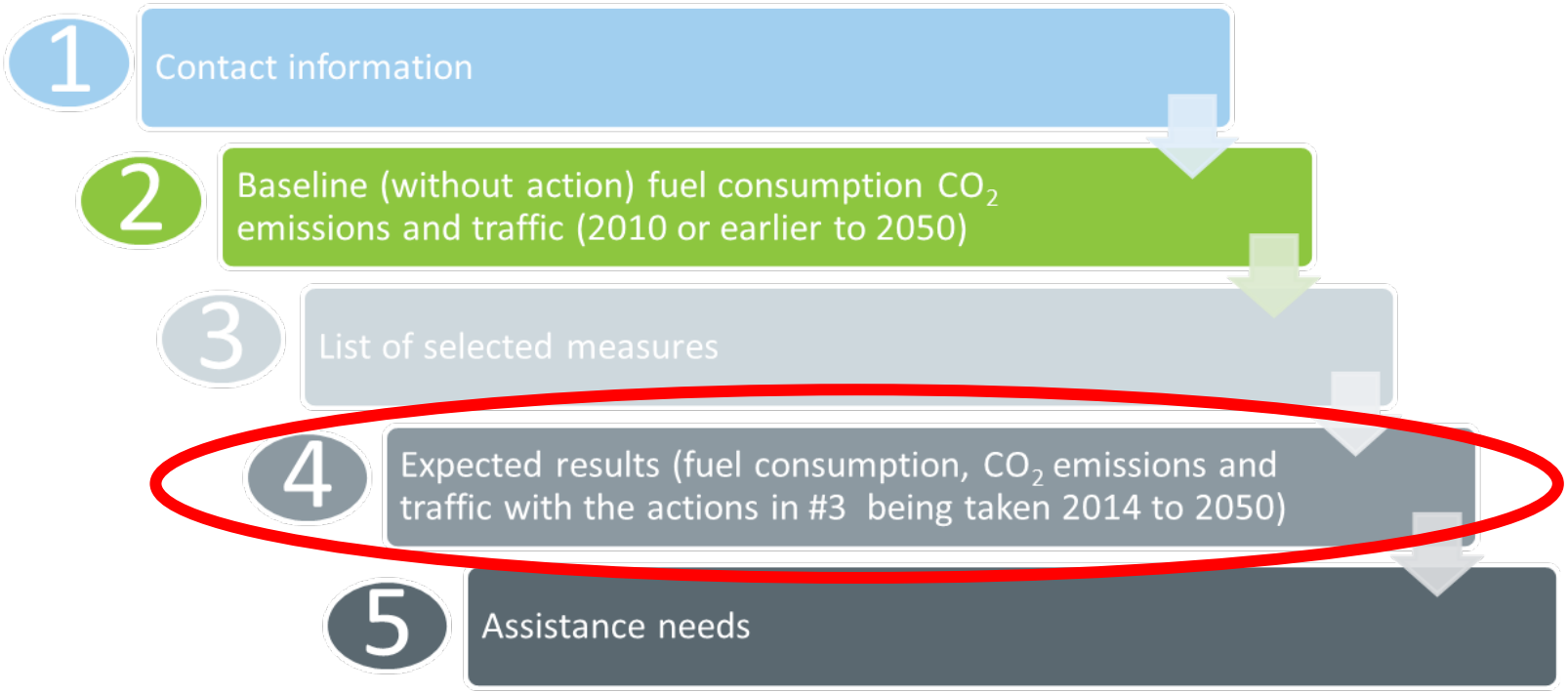
http://www.globalgse.com/

http://www.rtcwashoe.com/section-public-transportation

- Who should be involved?



Context within the Action Plan Development Process



Expected Results

- 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.

Expected results are the effect of the implementation of the selected mitigation measures on the baseline

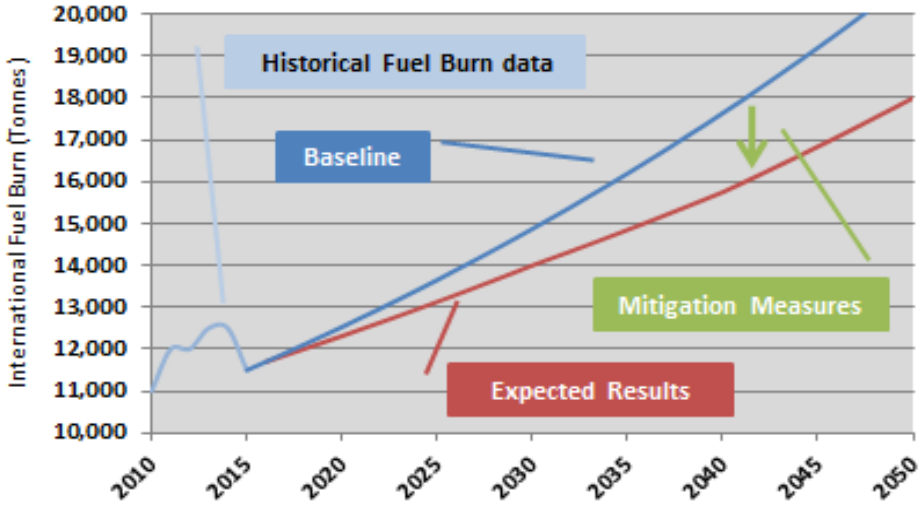
Year*	Total RTKs (tonne-kilometres)	International RTKs* (tonne-kilometres)	Total fuel (litres)	International fuel (litres)*	Total CO_2 emissions (metric tonnes)	International CO_2 emissions* (metric tonnes)
Future year						
2020						
Future year						
2050						

*Minimum data to be entered.

Note: the future years should match the baseline's future years.

Note: the traffic data (RTK) may not be identical to the baseline. Some measures may enable an increase in traffic or aim to reduce demand.

Expected Results



Baseline

List of Mitigation Measures

Expected Results

How to describe the selected measures in your Action Plan? ICAO Doc 9988

Measure	*Benefit/cost*
	Benefit: Relative potential gains: Co-benefits Cost: Cost range: Additional metric(s):

Title	
Description	
Category	
Measure	
Action	
Start date	
Date of full implementation	
Implemented by	(when there are benefits from the measures)
Economic cost	
Currency	
Reference to existing legislation	
Legislation is proposed	
Compliance	— voluntary — mandatory — N/A
Assistance needed	
Assistance needed (check more than one)	— finance — technology — technical support — education — research — other
Currency for financial assistance	
List of stakeholders involved	
Point of contact	

- Quantified results needed to assess the plan

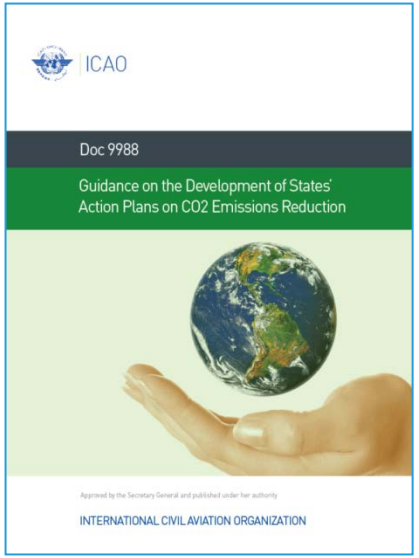
3.3 Incremental improvements/benefits of each measure

Please inscribe below the anticipated improvements/benefits associated with each specific measure. A measure can have several anticipated improvements for different years.

Year			
Improvement in total fuels (litres)			
Improvement in total fuels (%)			
Improvement in international fuels (litres)			
Improvement in international fuels (%)			
Improvement in total CO_2 emissions (kg)			
Improvement in total CO_2 emissions (%)			
Improvement in international CO_2 emissions (kg)			
Improvement in international CO_2 emissions (%)			
Anticipated co-benefits			

For More Information…

- See Chapter 4 and Appendix C of the Guidance, Second Edition



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 and implementing mitigation measures

ICAO

THANK YOU