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ICAO CAPACITY BUILDING SEMINAR ON LOW EMISSIONS AVIATION MEASURES

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

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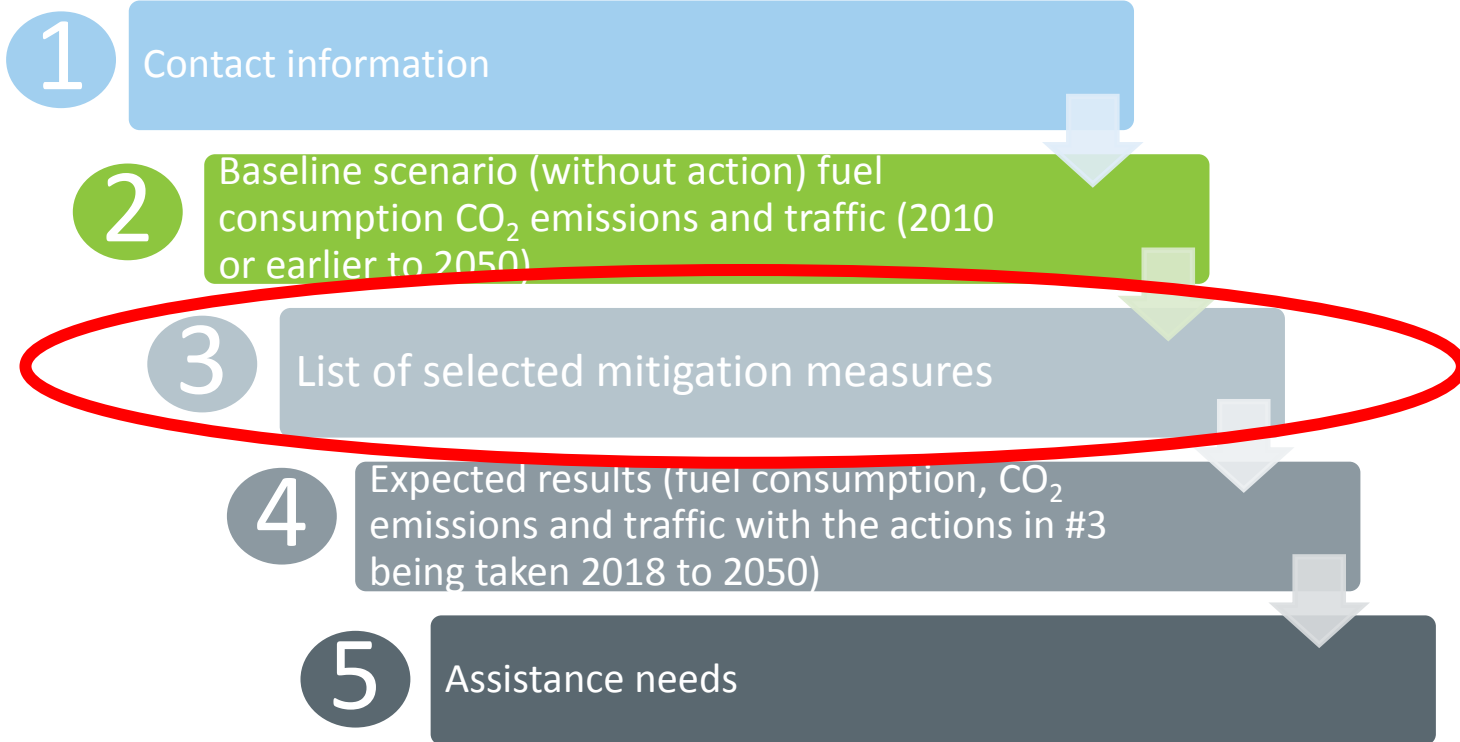


Outline

- 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





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

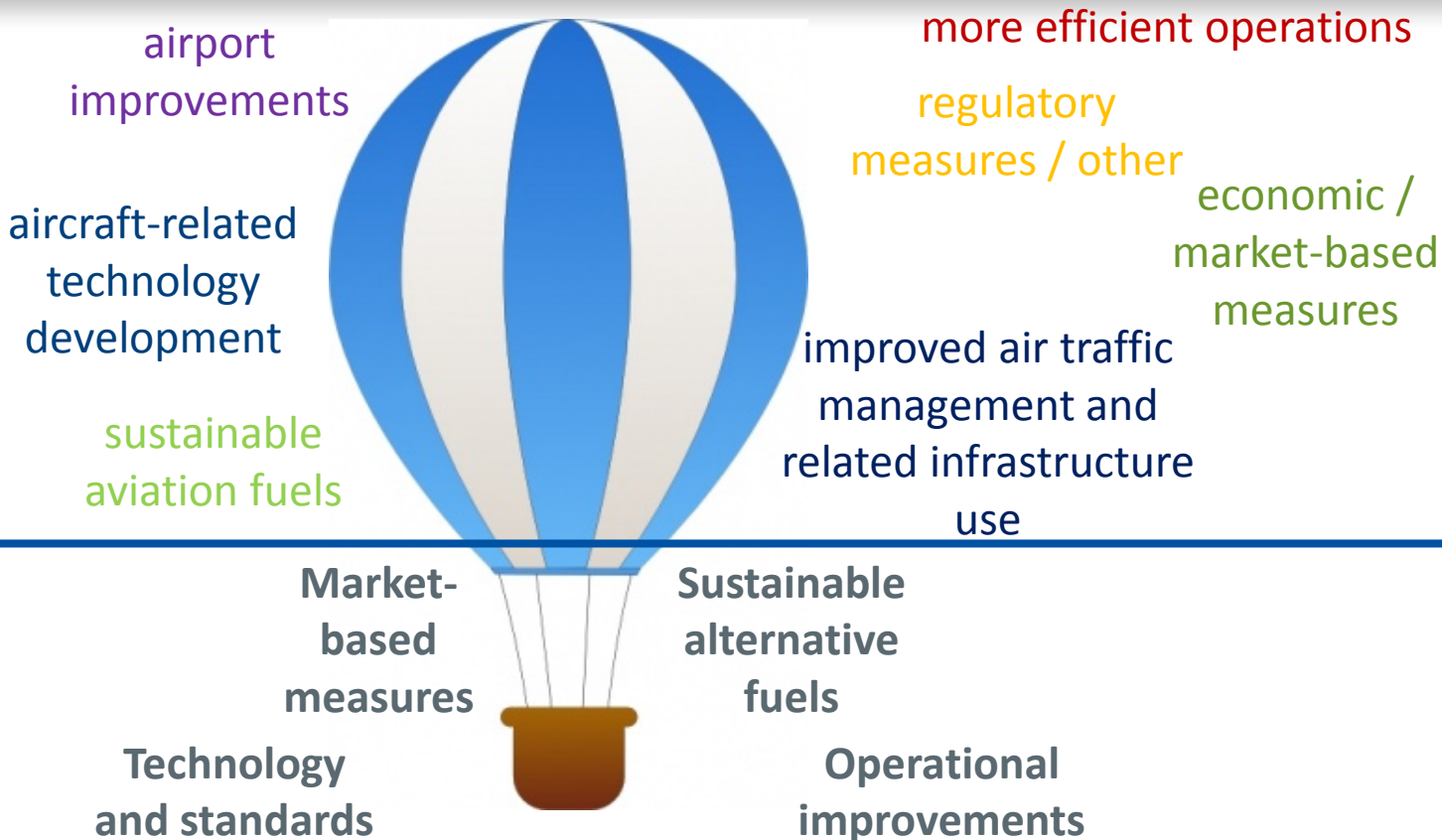
Operational
improvements

Market-based
measures



7 Categories of Measures

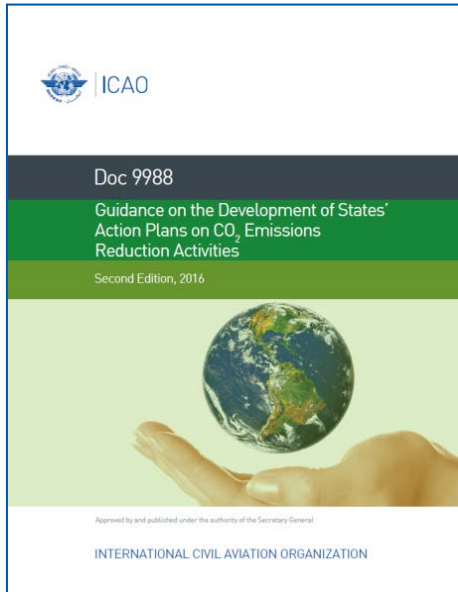
ICAO Basket of Measures



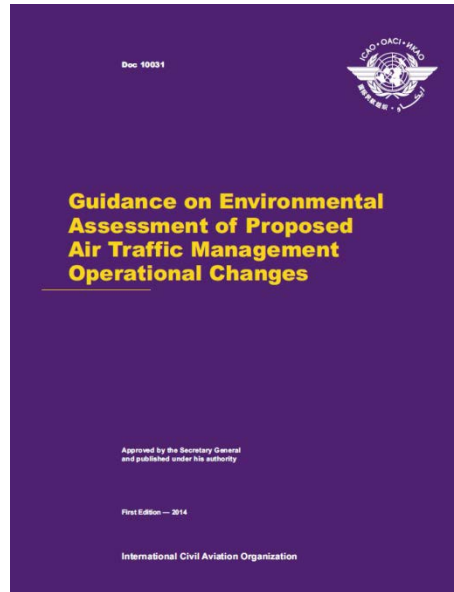


Guidance on Selecting Measures

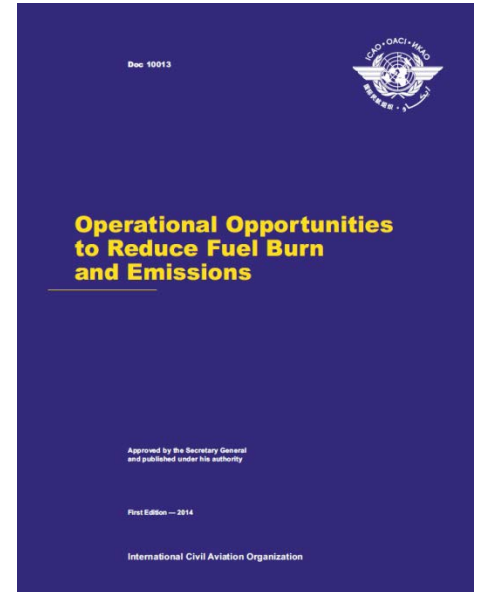
- Reference material:



ICAO Doc 9988



ICAO Doc 10031



ICAO Doc 10013



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Additional Guidance

TRANSFORMING GLOBAL AVIATION COLLECTION 20A

RENEWABLE ENERGY FOR AVIATION:
PRACTICAL APPLICATIONS TO ACHIEVE CARBON REDUCTIONS AND COST SAVINGS

ICAO ENVIRONMENT | UN DDP | GEF GLOBAL ENVIRONMENT FACILITY INVESTING IN OUR PLANET

TRANSFORMING GLOBAL AVIATION COLLECTION 20A

FINANCING AVIATION EMISSIONS REDUCTIONS

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TRANSFORMING GLOBAL AVIATION COLLECTION 20A

REGULATORY AND ORGANIZATIONAL FRAMEWORK TO ADDRESS AVIATION EMISSIONS

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TRANSFORMING GLOBAL AVIATION COLLECTION 20A

SUSTAINABLE AVIATION FUELS GUIDE

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Additional Support

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



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Examples of Mitigation Measures





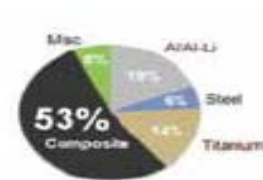
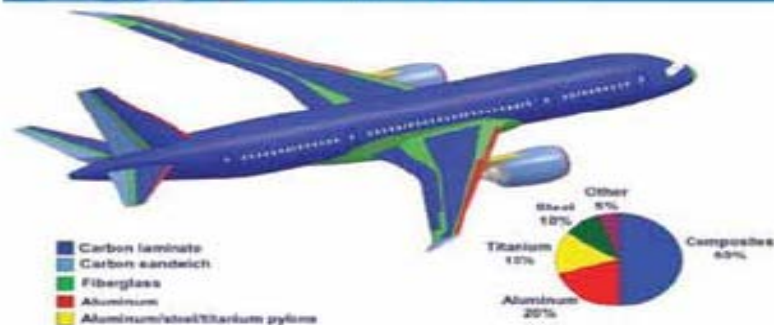
Aircraft Technology Development

- 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%.

787 Composite Solutions Applied Throughout the 787



• **Titanium**
 • High load frames
 • Door surroundings
 • Landing gear
 • Pylons
 • No corrosion tasks



• **CFRP**
 • Wings
 • Center wing box and keel beam
 • Tail wire (Scissors 11)
 • Skin panels
 • Frames, stringers and doublers
 • Doors (Passenger & Cargo)
 • No corrosion & fatigue tasks

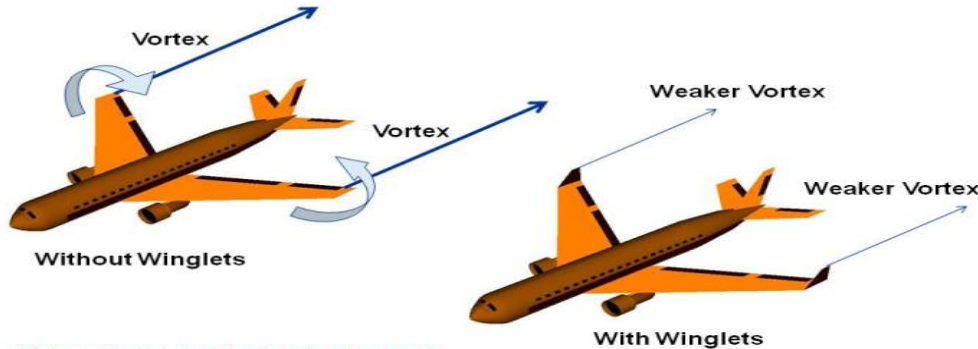
Source: ICCAIA



- Aerodynamics, for example:
 - Drag reduction technologies
 - Wingtip devices

National Aeronautics and Space Administration

Winglets



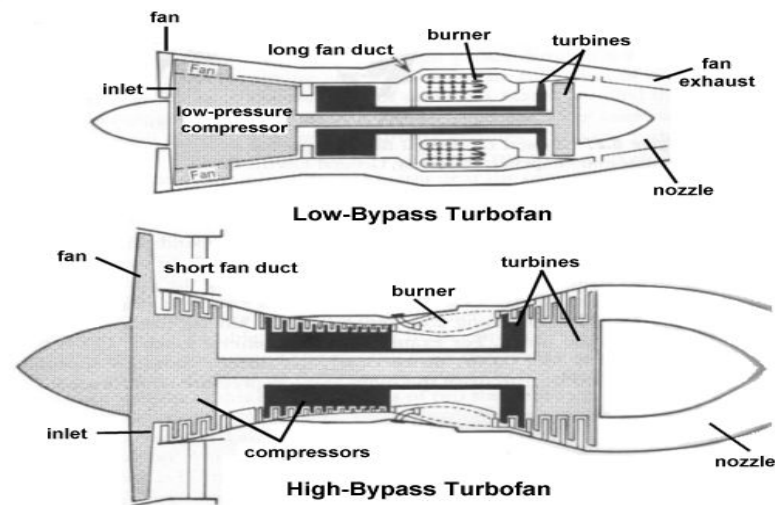
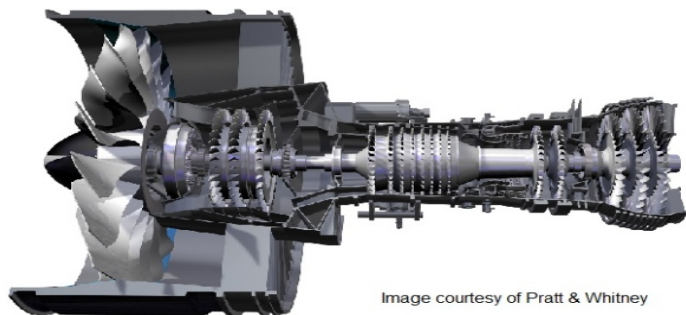
Winglets reduce induced drag component.



<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



<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 manufacturer

Can provide fuel efficiency improvement data due to aircraft modifications or the purchase of new aircraft

Aircraft operator



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/>



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More than 5,500 commercial flights have been flown on sustainable alternative fuels



IBERIA



Thomson



AIRFRANCE



AIR CANADA



UNITED



norwegian



Linhas aéreas inteligentes

Scandinavian Airlines

CATHAY PACIFIC

British Midland International



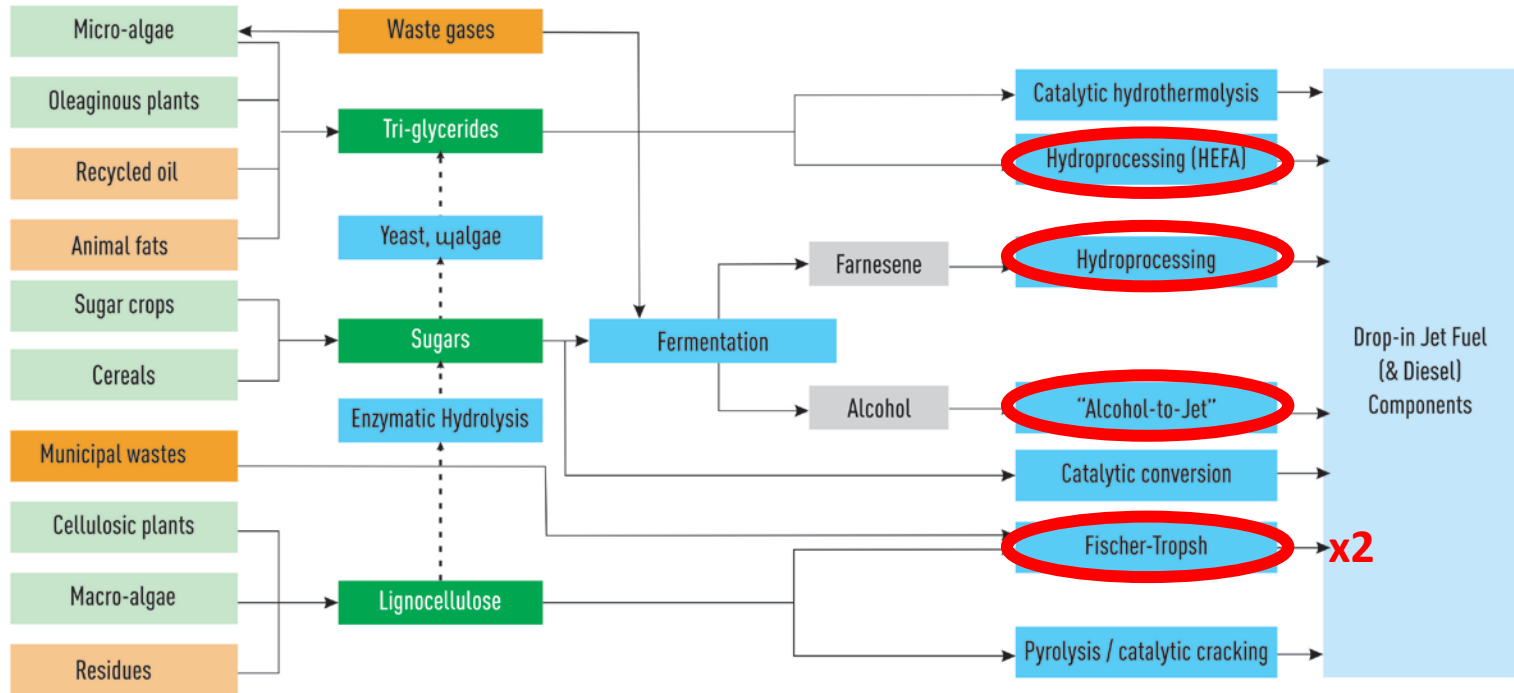
SOUTH AFRICAN AIRWAYS



海南航空
HAINAN AIRLINES

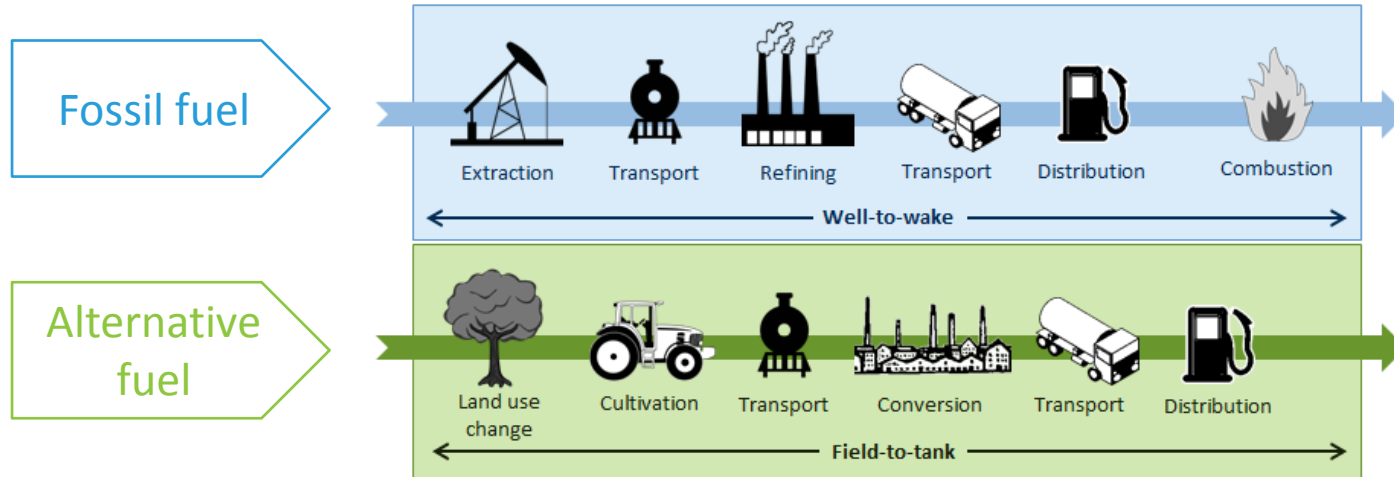


- Five fuel production processes are certified for use in aviation





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

Current Activities



Or to see more information visit the [News and Activities page](#).
**Zoom in for best results*

Current Initiatives



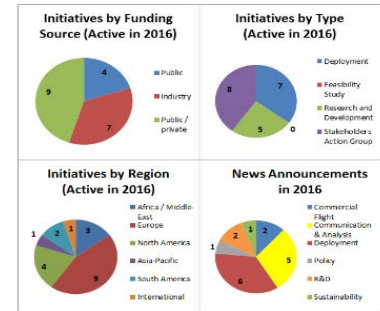
Or to see more information visit the [Initiatives & Projects page](#).

Frequently Asked Questions

1. [Why introduce alternative fuels in aviation?](#)
2. [What are sustainable alternative jet fuels?](#)
3. [What are the potential environmental benefit of alternative fuels?](#)
4. [Which alternative fuels can currently be used?](#)
5. [What are the challenges for the development and deployment of alternative fuels?](#)
6. [What are the initiatives worldwide for the development of alternative fuels?](#)
7. [What is ICAO doing in the field of alternative fuels?](#)

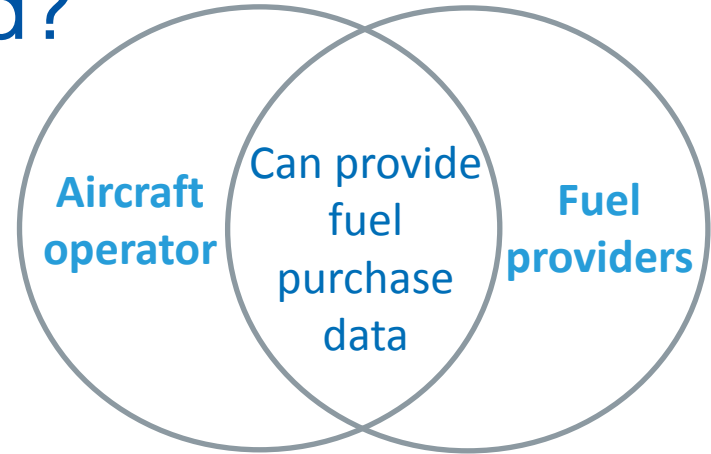
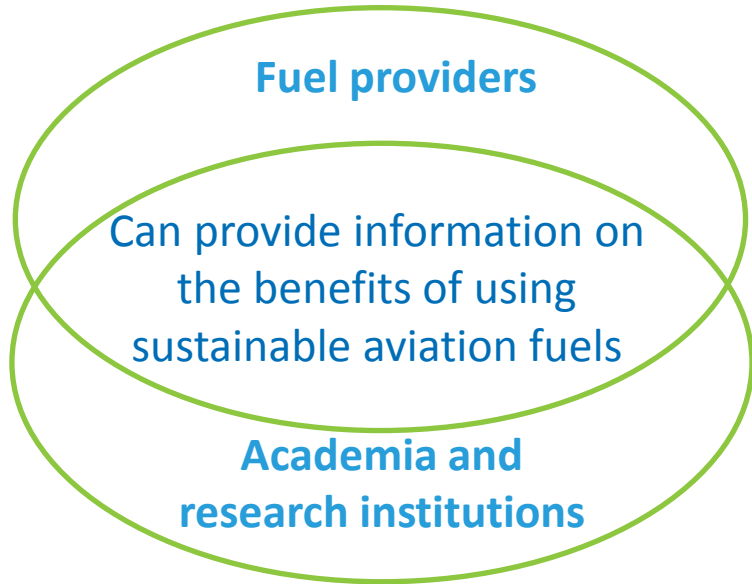
Facts and Figures

Click the image below to view Facts and Figures from 2016





• 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.





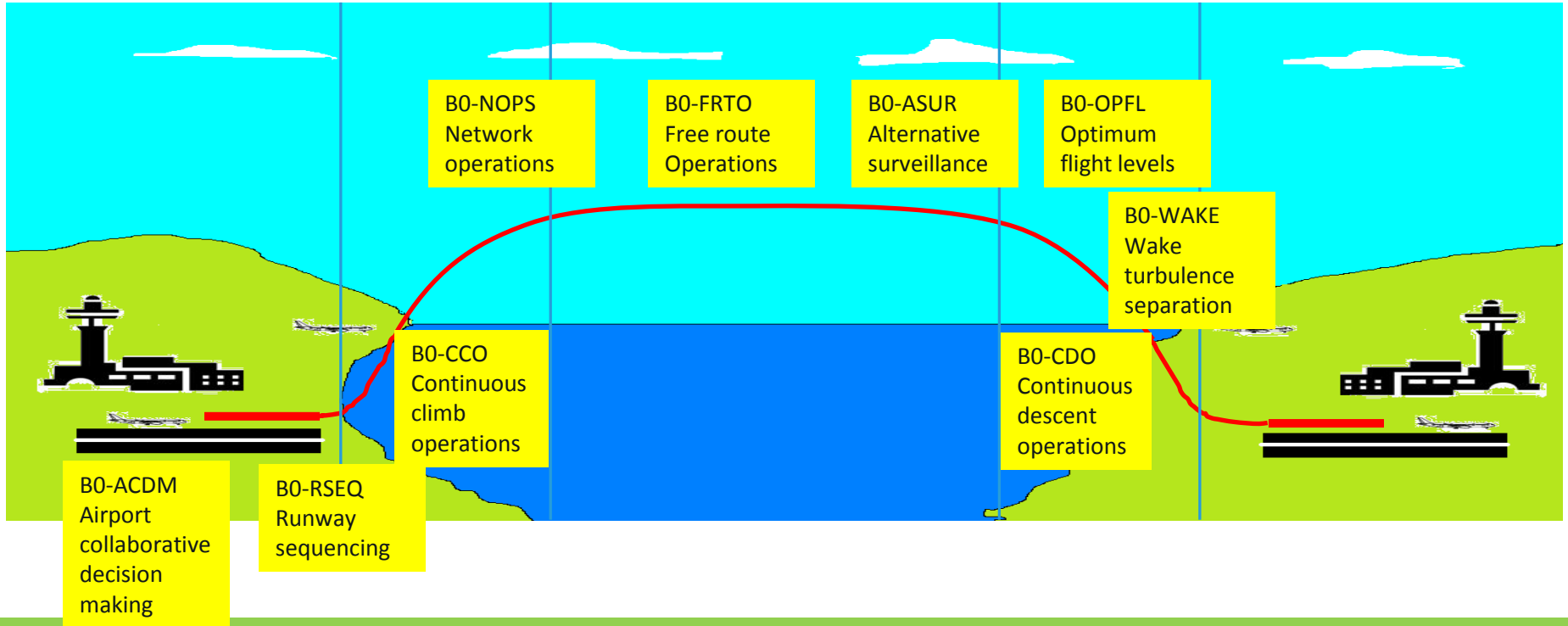
Departure

Climb

Cruise

Approach

Arrival





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





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

<http://www.planet-trucks.com/truck-news/a32889/taxibot-causes-zero-fuel-emission-and-zero-noise-pollution.html>



http://www.aviationpros.com/press_release/10705890/altali-a-and-wheeltug-sign-electric-taxiing-partnership

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



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The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIIA)





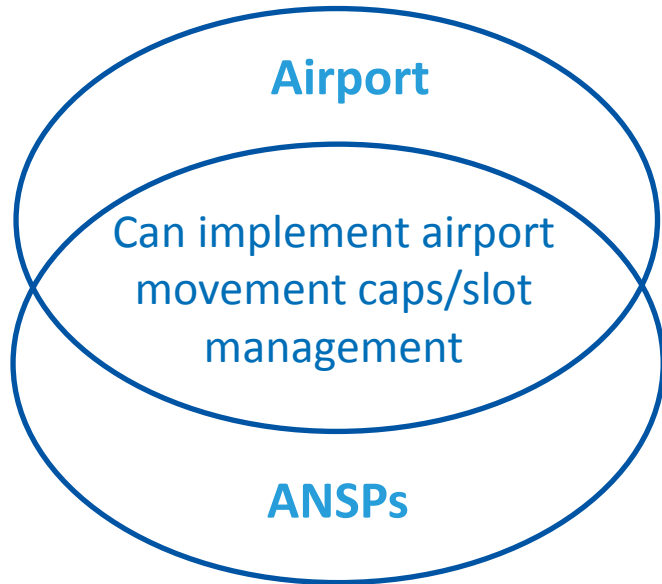
Regulatory measures/other

- 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 cleaner alternative sources of power generation (photovoltaic panels)

Conversion of GSE to cleaner fuels

Improved public transport access



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

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

<http://www.globalgse.com/>

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

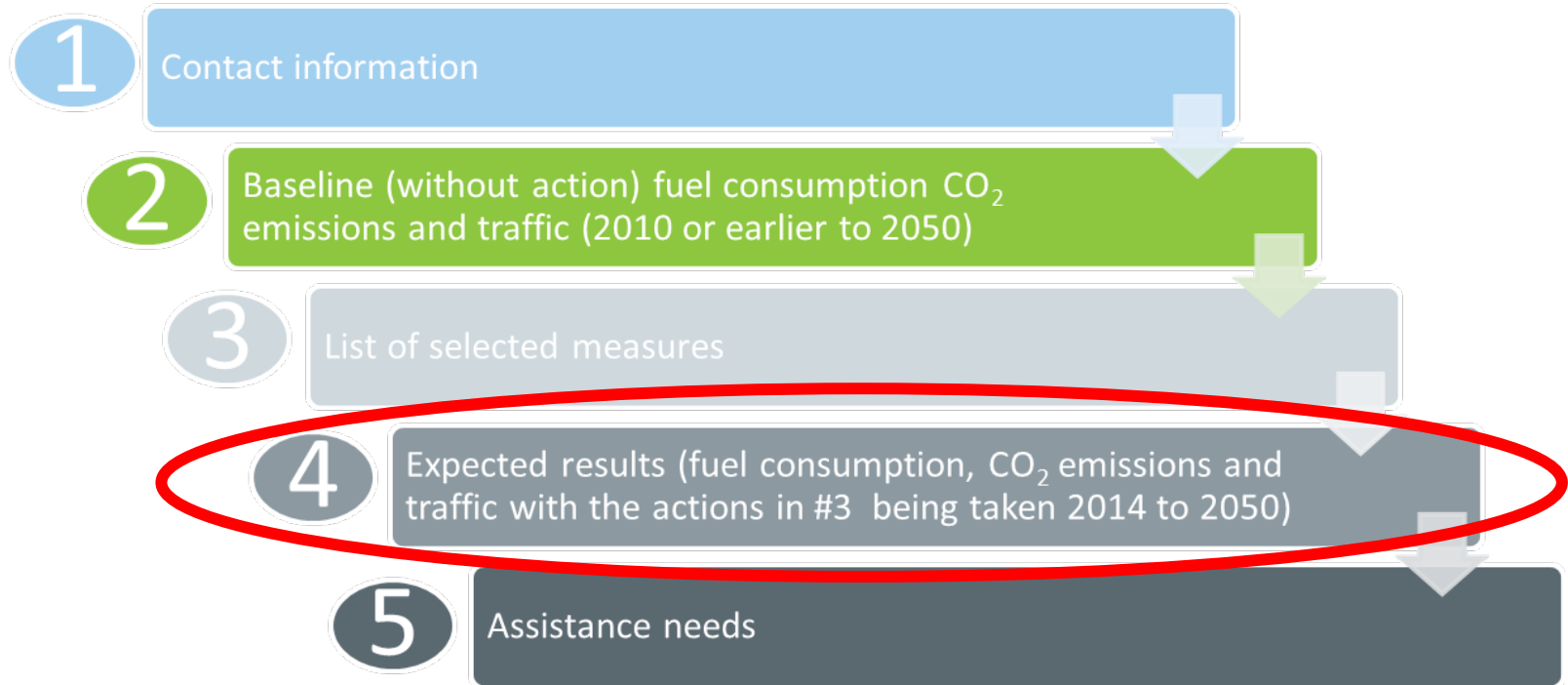


- Who should be involved?





Context within the Action Plan Development Process





- 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



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North Atlantic
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Southern African
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Nairobi

Asia and Pacific
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