



ICAO

ENVIRONMENT

NO COUNTRY LEFT BEHIND



ICAO CAPACITY BUILDING SEMINAR ON LOW EMISSIONS AVIATION MEASURES

# Implementation of low emissions measures: sustainable aviation fuels

Neil Dickson, Chief, Environmental Standards Section, ICAO





# Outline - Sustainable Aviation Fuels Guide

- Purpose of the Guidance Document
- Chapter 1 – Introduction
- Chapter 2 – Background
- Chapter 3 – Conditions for promoting sustainable aviation fuels
- Chapter 4 – How to produce sustainable aviation fuels
- Chapter 5 – How to promote sustainable aviation fuels
- Chapter 6 – Case studies and best practices
- Additional examples – current experience with alternative fuels
- Additional information about the ICAO GFAAF



# Purpose of the Guidance Document



*The purpose of this guidance is to inform ICAO Member States on how sustainable aviation fuels can be deployed to reduce CO<sub>2</sub> emissions from international aviation activities, and describes fuel production pathways, usage constraints, environmental and other benefits, and policy perspectives on the use and development of these fuels.*



## Chapter 1– Introduction

- Introduction
  - The work of ICAO on Environmental Impacts and Climate Change
  - The work of ICAO on Sustainable Aviation Fuels
  - The work of ICAO on a Global Market-Based Measure



## What is ICAO's role in SAF?

### → ICAO is facilitating SAF development and deployment

- Sharing information and best practices, including through ICAO's **Global Framework for Aviation Alternative Fuels (GFAAF)**
- Ongoing work within ICAO's Committee on Aviation Environmental Protection (CAEP) Alternative Fuels Task Force (AFTF)
- Development of **sustainability criteria**
- Organization of information-sharing events



CAAF/2 – Mexico City, Mexico (11-13 October 2017)

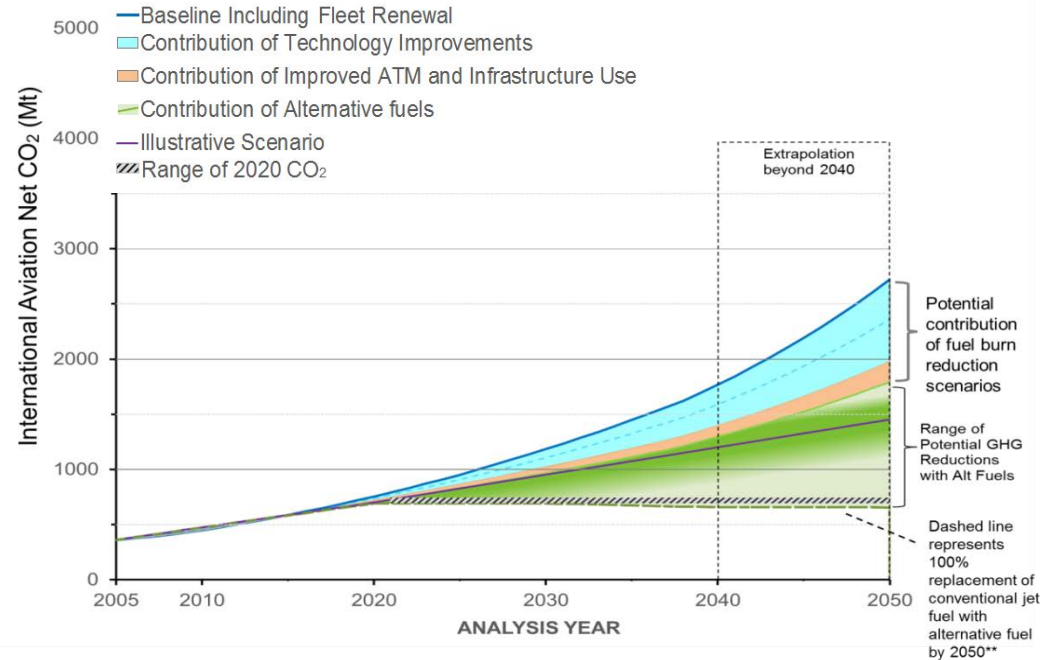




## Chapter 2 – Background

### The Growing Interest in Sustainable Aviation Fuels

- ➔ Potential for significant emissions reductions
  - Depends on feedstock type and cultivation, conversion process...
  
- ➔ Emissions reductions are achievable with existing aircraft



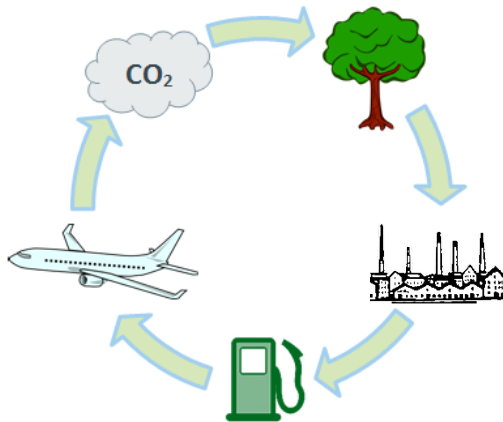




## Chapter 2 – Background

### Where do the benefits of SAF come from?

*Fuels made  
from biomass*



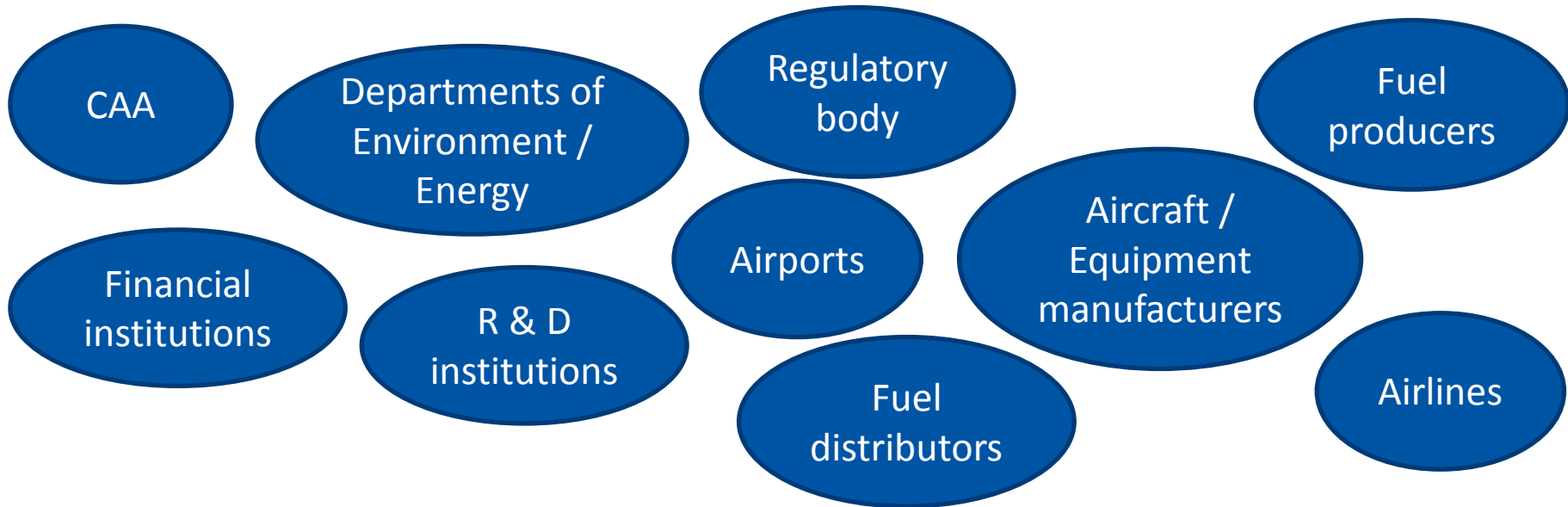
CO<sub>2</sub> emitted by combustion is up-taken by plant growth





## Chapter 3 – Conditions for Promoting SAF

- Discusses challenges of developing a SAF supply chain and how these challenges can be addressed, focusing on the role of different stakeholders





## Chapter 3 con't – Conditions for Promoting SAF

- Stakeholders' perception of drivers and constraints for promoting SAF:

Drivers	Constraints
Need for reducing emissions	Feedstock supply readiness
Oil price fluctuation and fuel insecurity	High costs and funding
Carbon price	Sustainability
Lack of alternative technology	Policy incentives
New growth market for biofuels	Fuel consistency and infrastructure
Green public relations	Funding for public relations

(Source: Adapted from Gegg and others, 2015)



## Chapter 4 – How to Produce SAF

Annex	Conversion Process	Abbreviation	Possible Feedstocks	Blending ratio by Volume	Commercialization Proposals
1	Fischer-Tropsch hydroprocessed synthesized paraffinic kerosene	FT-SPK	Coal+, natural gas+, biomass	50%	Fulcrum Bioenergy, Red Rock Biofuels, SG Preston, Kaidi, Sasol, Shell, Syntroleum
2	Synthesized paraffinic kerosene produced from hydroprocessed esters and fatty acids	HEFA-SPK	Bio-oils, animal fat, recycled oils	50%	AltAir Fuels, Honeywell UOP, Neste Oil, Dynamic Fuels, EERC
3	Synthesized iso-paraffins produced from hydroprocessed fermented sugars	SIP-HFS	Biomass used for sugar production	10%	Amyris, Total
4	Synthesized kerosene with aromatics derived by alkylation of light aromatics from non-petroleum sources	SPK/A	Coal+, natural gas+, biomass	50%	Sasol
5	Alcohol-to-jet synthetic paraffinic kerosene	ATJ-SPK	Biomass used for starch and sugar production and cellulosic biomass for isobutanol production	30%	Gevo, Cobalt, Honeywell UOP, Lanzatech, Swedish Biofuels, Byogy



## Chapter 5 – How to promote sustainable aviation fuels

- Economic considerations
- Supporting measures for SAF industry
- Logistics of aviation fuels ←
- Quality certification of SAF
- Developing a national SAF programme



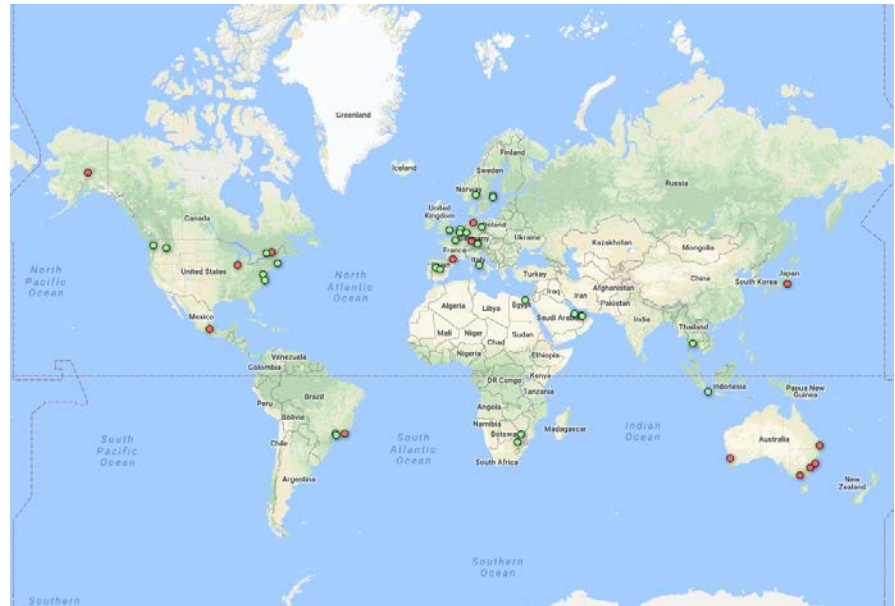
## Chapter 5 con't - Alternative fuel off-take agreements

Producer	Purchaser	Off-take production per year		Start/Length of agreement (years)
		(million gallons)	(Mt)	
<b>Air Total</b>	Airbus / China Airlines	5 A350-900 deliveries at 10% blend		2017 / N/A
<b>AltAir</b>	United Airlines	5	0.015	2016 / 3
	Gulfstream/World Fuel	N/A	N/A	N/A / 3
	SkyNRG/KLM	N/A	N/A	2016 / 3
<b>AltAir/Neste</b>	KLM / SAS / Lufthansa / AirBP	0.33	0.001	N/A / 3
<b>Amyris / Total</b>	Airbus / Cathay Pacific	48 A350 deliveries at 10% blend		2016 / N/A
<b>Fulcrum</b>	Cathay Pacific	35	0.106	N/A / 10
	United Airlines	90-180	0.274-0.547	N/A / 10
	Air BP	50	0.152	N/A / 10
<b>Gevo</b>	Lufthansa	8	0.024	N/A / 5
<b>RedRock</b>	Southwest	3	0.009	N/A / N/A
	FedEx	3	0.009	N/A / 7
<b>SG Preston</b>	Jet Blue	10	0.030	2019 / 10
	Qantas	8	0.024	2020 / 10
<b>TOTALS</b>		212.33 to 302.33	0.645 to 0.918	



## Chapter 6 – Case Studies and Best Practices

- This chapter looks at policies and alternative fuel initiatives in:
  - Australia
  - Brazil
  - Canada
  - European Union
  - Germany
  - Indonesia
  - Mexico
  - United States



(Source: ICAO GFAAF)





# Additional examples – current experience with alternative fuels



## Active alternative fuel purchase agreements:

Airlines	Departing from
United Airlines	Los Angeles International Airport
KLM	
Lufthansa	Oslo Airport
SAS	
KLM / KLC	
SAS	Stockholm Arlanda Airport
KLM	
BRA	
All Departures	Bergen Airport

Batches of AAF have also been delivered to: Stockholm Bromma Airport, Åre Östersund Airport, Göteborg Landvetter Airport, Karlstad Airport, Halmstad Airport, Brisbane Airport, Chicago O'Hare International Airport.



## ICAO GFAAF – What other information is available?

- Database for relevant activities
  - News and Activities
  - Initiatives and Projects
  - Facts and Figures
  - Frequently asked questions
  - ICAO Vision
  - Literature
  - Additional Links
  - And...

News and Activities

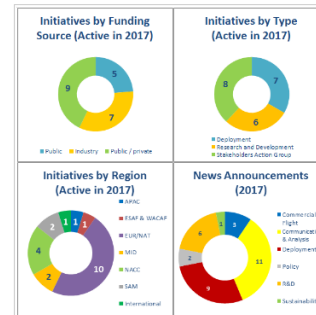


Initiatives and Projects



Facts and Figures

Click the image below to view Facts and Figures from 2017



Frequently Asked Questions

Click here to find the answers to frequently asked questions about aviation fuels.

### ICAO Vision

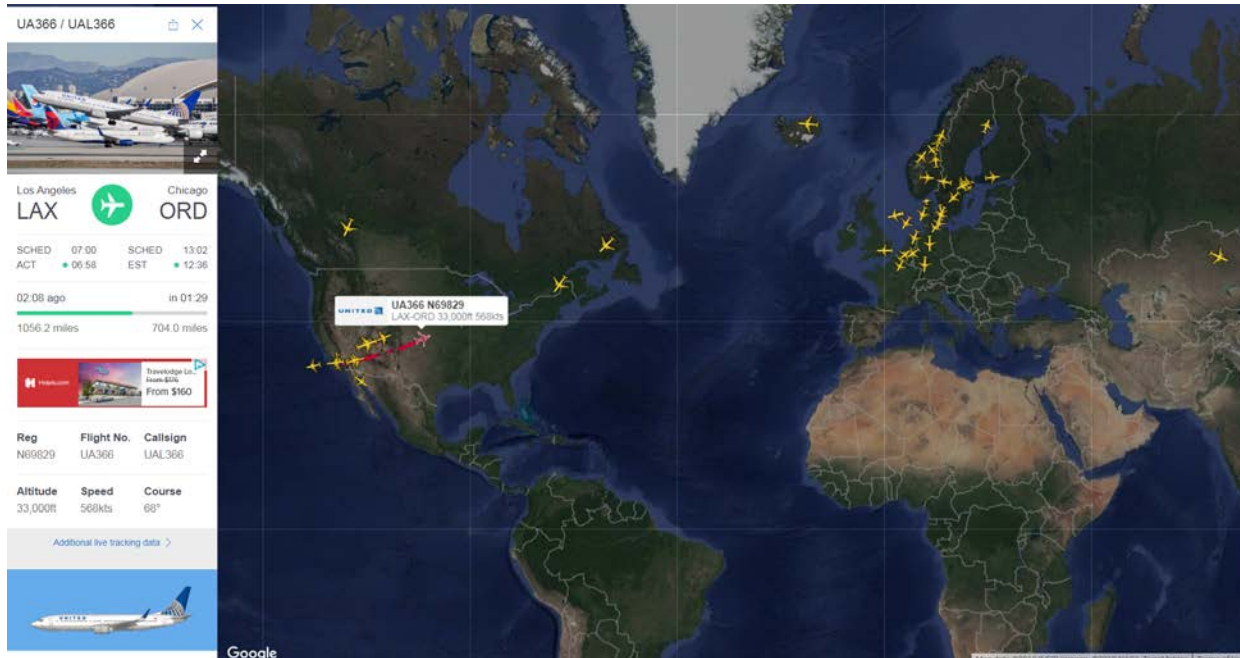
Click here to read the 2050 ICAO Vision for Sustainable Aviation Fuels, as endorsed by the ICAO Council in March 2018.

### Contact Us

States and stakeholders are invited to send information about their news, activities, and initiatives to: [officeenv@icao.int](mailto:officeenv@icao.int)



## ICAO GFAAF - Aviation Live Feed



The live feed is based on publically-available information from airports and airlines involved in on-going alternative fuel purchase agreements.

It displays:

- United Airlines and KLM departures from Los Angeles International Airport;
- Lufthansa, SAS, and KLM departures from Oslo Airport;
- SAS, KLM, and Brathens departures from Stockholm Arlanda Airport; and
- all departures from Bergen Airport.



## In Summary

- SAF are proven to be a safe and effective way to mitigate emissions from aviation
- SAF can be produced from a variety of feedstock
- ICAO plays an important role in facilitating the development and deployment of SAF
- The ICAO GFAAF provides relevant information for States interested in learning more about SAF
- This Sustainable Aviation Fuels Guidance Document will be an effective tool to help member States develop their own SAF supply chains

For more information on this project, please visit ICAO's website:

[https://www.icao.int/environmental-protection/Pages/ICAO\\_UNDP.aspx](https://www.icao.int/environmental-protection/Pages/ICAO_UNDP.aspx)



ICAO

ENVIRONMENT

NO COUNTRY LEFT BEHIND



ICAO

North American  
Central American  
and Caribbean  
[NACC] Office  
Mexico City

South American  
[SAM] Office  
Lima

ICAO  
Headquarters  
Montréal

Western and  
Central African  
[WACAF] Office  
Dakar

European and  
North Atlantic  
[EUR/NAT] Office  
Paris

Middle East  
[MID] Office  
Cairo

Eastern and  
Southern African  
[ESAF] Office  
Nairobi

Asia and Pacific  
[APAC] Sub-office  
Beijing

Asia and Pacific  
[APAC] Office  
Bangkok



THANK YOU