Flightpath
Alternative fuels for Europe

Flightpath 2050 – A long term vision for alternative fuels for aviation

Ruben Alblas
Public Affairs
KLM

22 June 2017 – Charlemagne, Room Jenkins

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Flightpath 2050 – A long term vision for alternative fuels for aviation

22 June 2017 – Charlemagne, Room Jenkins

14:00 Welcome – introduction and setting the scene

14:10 Alysia Tofflemire - Boeing
14:20 Angelica Hull – Swedish Biofuel
14:30 Pauliina Uronen - NESTE
14:40 Robert Boyd - IATA
14:50 Alexander Zschocke – consultant to the Commission
15:00 Questions, answers and discussion
15:20 Communication strategy
15:30 End of session

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Setting the scene

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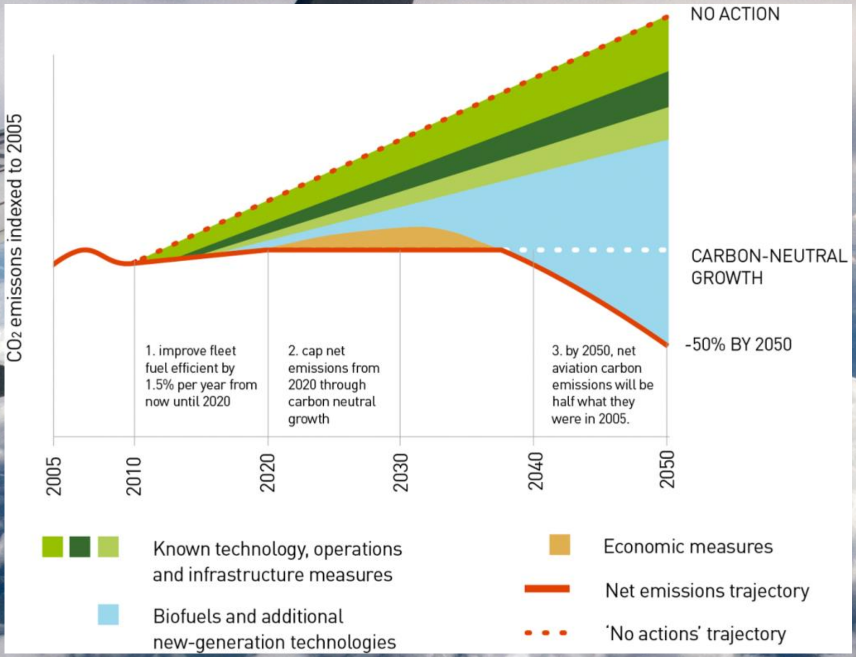
Aviation industry's ambition



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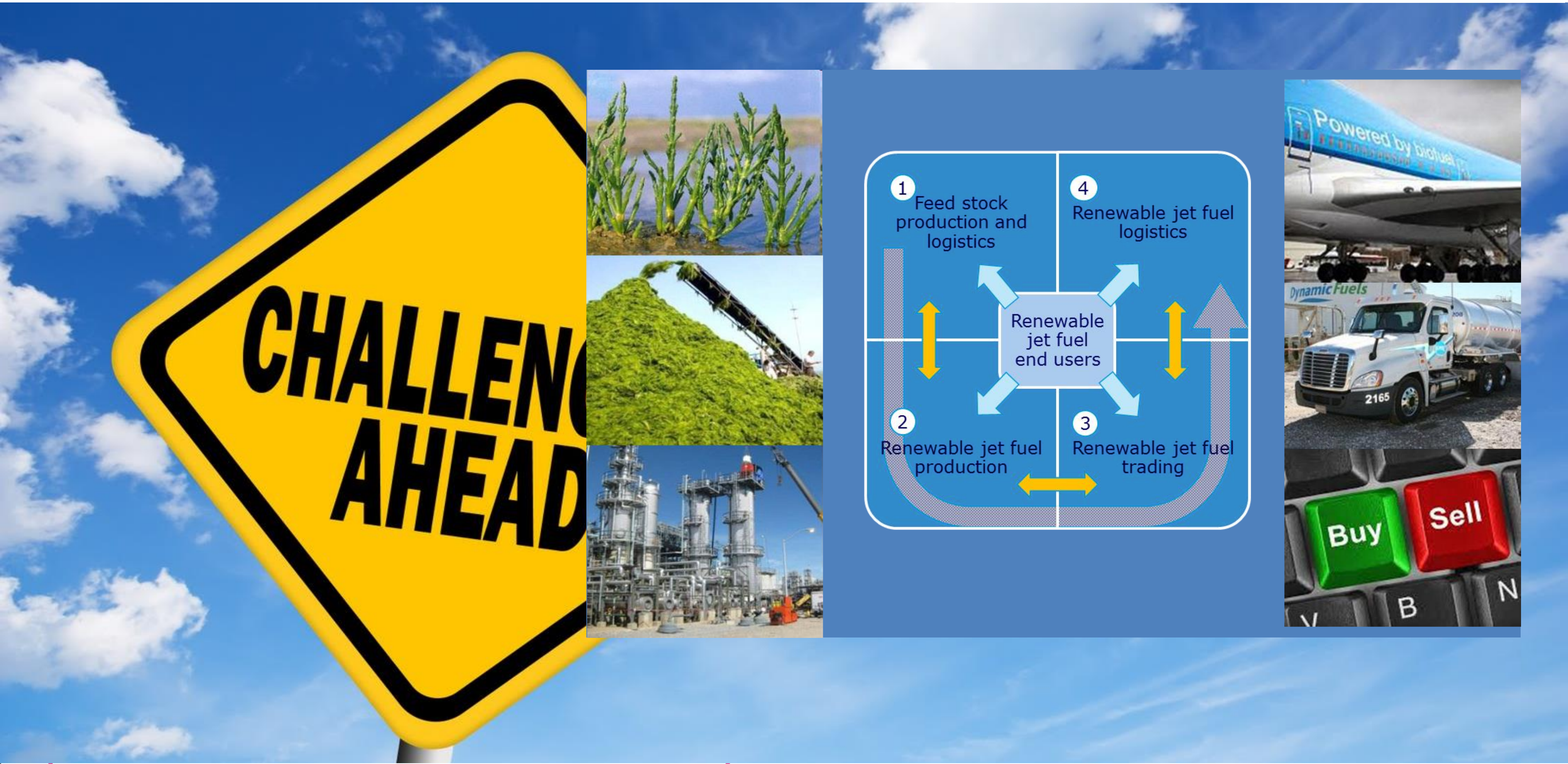

Boeing
& the Environment

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Alysia Tofflemire
EU Government Affairs
Environment & CSR

The Boeing Company

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Boeing in Europe

Boeing employs **4,000 people** in **19** European countries

Boeing's programmes support more than **136,000 jobs** across Europe

Boeing has delivered **4,500 commercial** aircraft to more than **125 European** customers in the last six decades

Boeing sourced more than **€7.8 billion** in airplane components and assemblies from tier 1 European-based companies in 2015

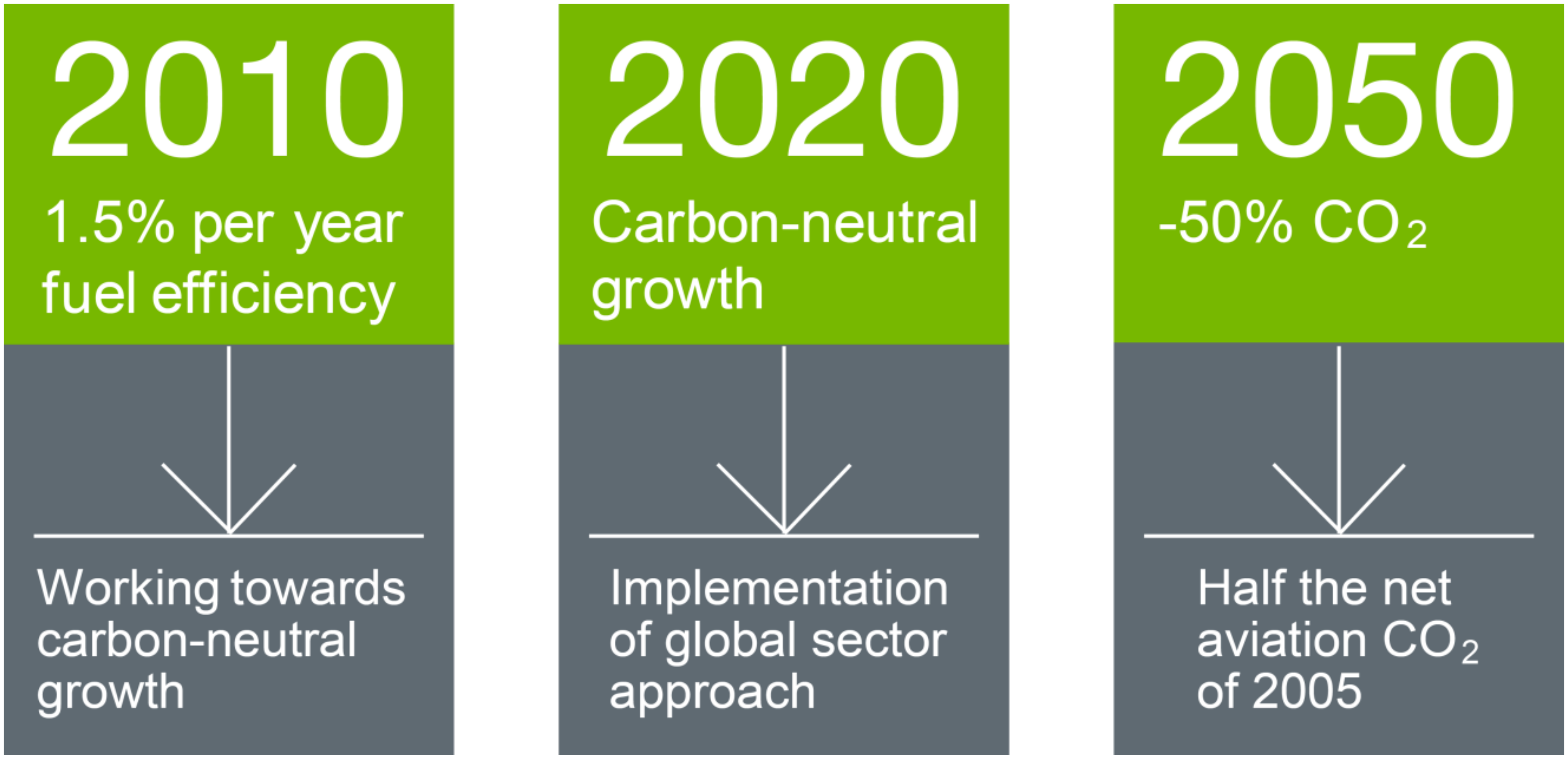
Boeing's advanced defence platforms are in service with **23 European armed forces**

Boeing's latest market outlook predicts demand for **7,500+ airplanes in Europe** by 2036

Boeing employees in Europe ↑
(Symbols are placed in the capital of a country where Boeing has employees.)

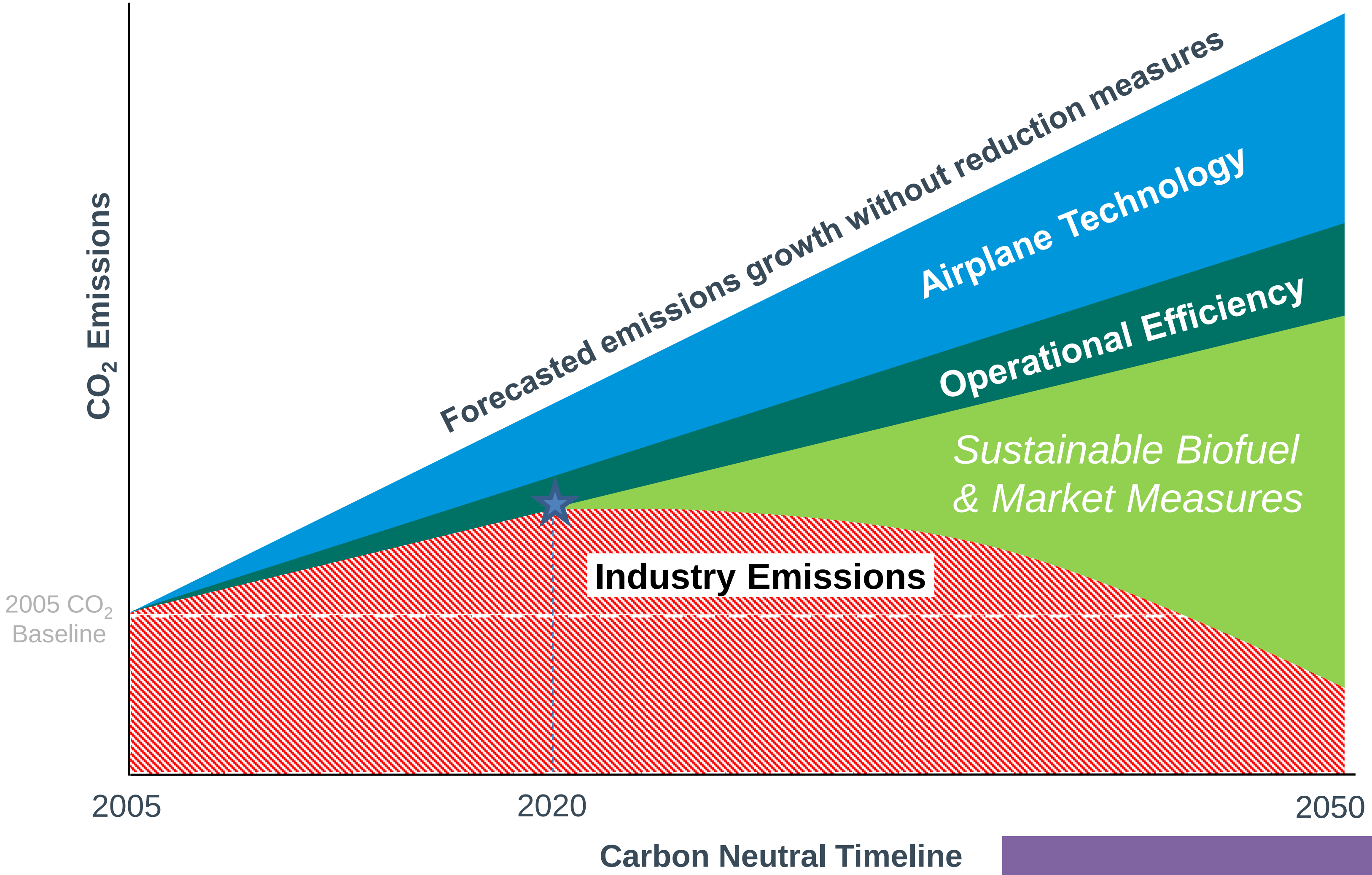
Partnership and **innovation** define our business, including how we work with governments, industry, academia, and communities across Europe.

Commercial Aviation Industry Commitments



Source: ATAG

Boeing Strategy for Reducing Emissions



A comprehensive approach

Most Efficient, Quieter Family of New Airplanes

777X

12% Reduction in fuel and CO_2
Substantially smaller noise footprint

*than the A350-1000

787

20% Reduction in fuel and CO_2
60% Smaller noise footprint

*than the model it replaces

737 MAX

20% Reduction in fuel and CO_2
40% Smaller noise footprint

*than the original Next-Generation 737

747-8

16% Reduction in fuel and CO_2
30% Smaller noise footprint

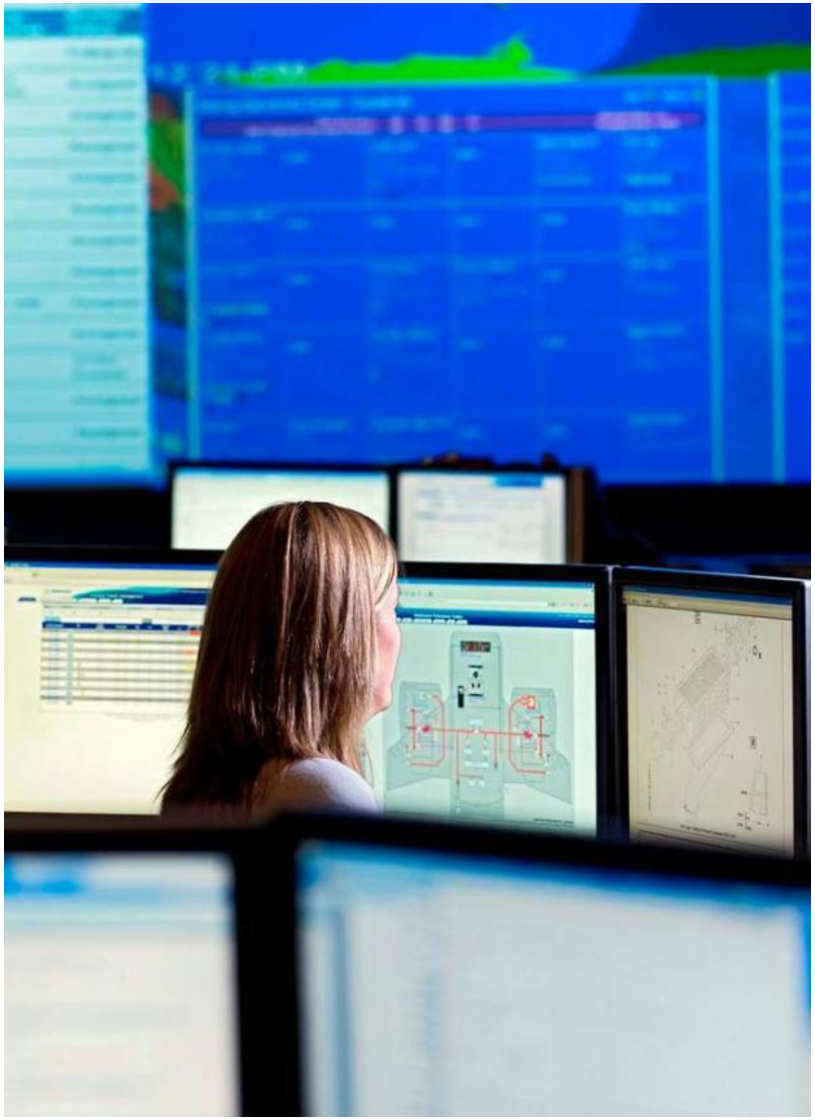
*than the model it replaces

Innovative Solutions

- New Technologies

Recycling composites

Renewable solar power



Digital aviation

Global collaboration for environmental performance

Status of biojet market

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Prof. Angelica Hull
Swedish Biofuels AB

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Overview

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- Approach – driving forces
- Technical readiness – biojet production pathways
- Supply mechanism - building bioports
- Performance – industry development
- Production of SAF – current EU capacity
- Bottlenecks
- Achieving the goal

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Energy security

Most EU countries do not have oil but do have access to biological materials

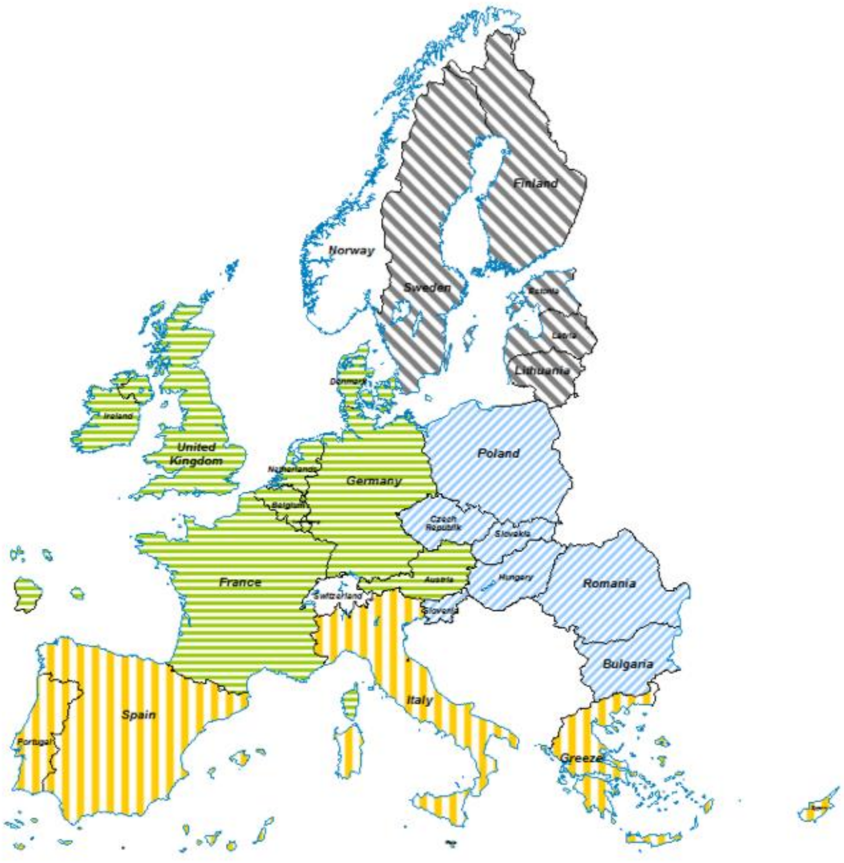
Characterised by:

West: Dense population

North: Vast forest

South: Dry

East: Mixed



Data source: Mantau, U. et al. 2010: EUwood - Real potential for changes in growth and use of EU forests.-Final report. Hamburg/Germany, June 2010.

Approach

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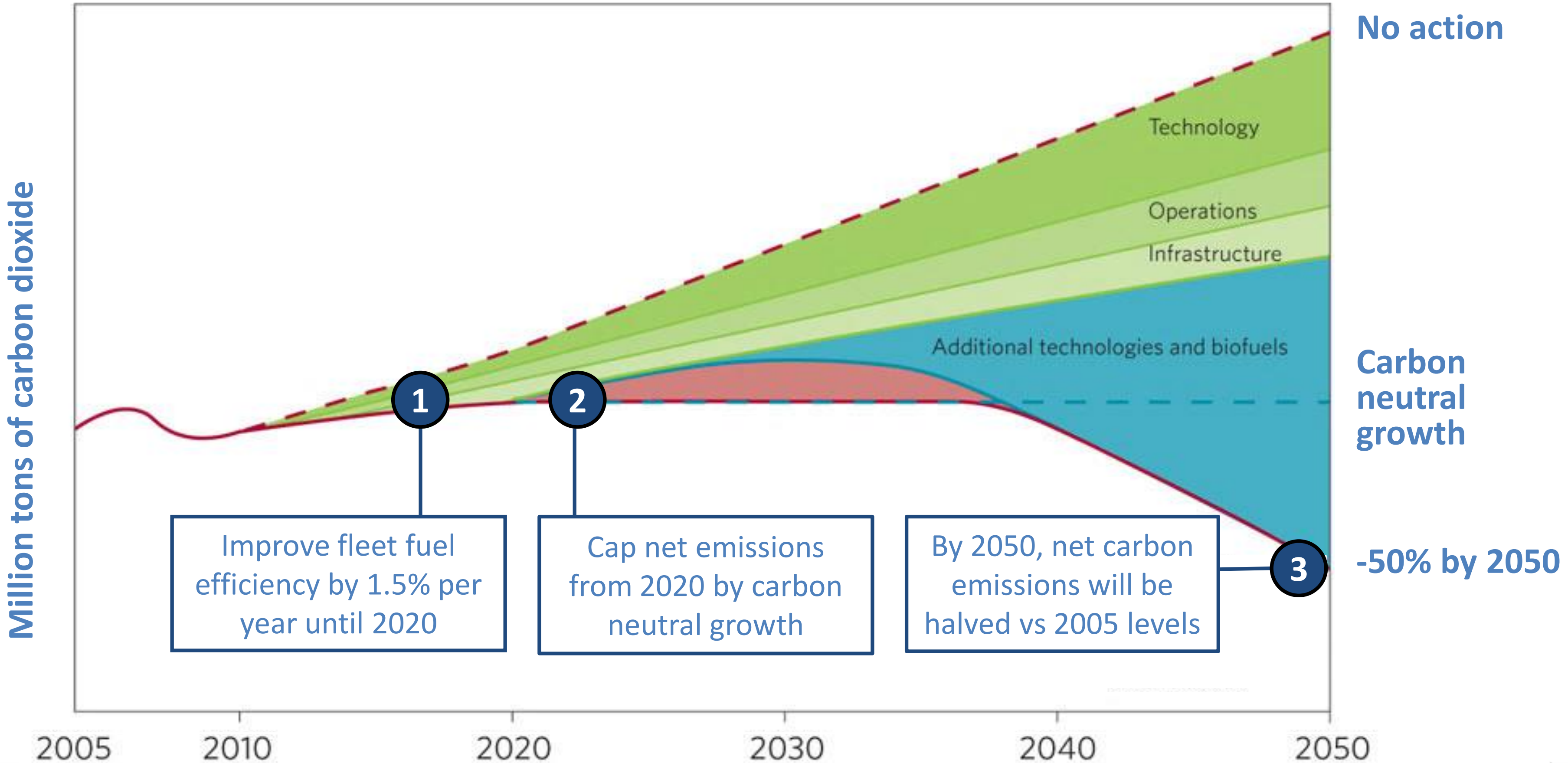
CO_2 reduction options for aviation 2005-2050



Source: ICAO, Environmental Report 2016

Technical readiness

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Feedstock	Process	Product	Technology Provider	Status
Syngas	FT	SPK, SKA	Sasol	Certified 50 %
	ATJ OXO	SKA	Swedish Biofuels	Report complete
Oils & fats	HEFA	SPK	(several)	Certified 50 %
	HRD	SPK	(several)	Under review
Sugars	SIP	Farnesane	Amyris	Certified 10 %
Alcohols	ATJ from IBA	SPK	Gevo	Certified 30 %
	ATJ from ETA	SPK	(several)	Under review
	ATJ OXO from mixed alcohols	SKA	Swedish Biofuels	Report complete

An additional 14 pathways are under development

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Supply mechanism

Building bioports for efficient and economical supply

2012
Canada: Porter Airlines
Test flights proved that fossil and alternative jet blends do not compromise performance

2014
Karlstad Airport
Initiative by Karlstad Airport, Statoil aviation and SkyNRG.

2015
Oslo Airport
Initiative by Lufthansa group, KLM, SAS, SkyNRG & AirBP. Production of 1000 t HEFA by Neste. FP7 support.

2017
Amsterdam Schipol Airport
LOI signed by Schipol Airport, SkyNRG, Dutch Govt, Neste and Port of Rotterdam.

Australia Brisbane Airport
Transformation initiative for first bioport in Asia Pacific region. LOI signed 2013 by SkyNRG and Brisbane Airport

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Performance

Year	2008	2010	2012	2014	2016	2018

Single test flights

Air New Zealand, Virgin Atlantic, JAL Japan Airlines, KLM, Air France, Continental Airlines, TAM Airlines, Finnair, Thai, Porter, Thomson Airways, AeroMexico, Air China, LAN, ANA, Etihad Airways, Air Canada, Qantas

Series of flights

Lufthansa, KLM, Alaska Airlines, Delta, Cathay Pacific

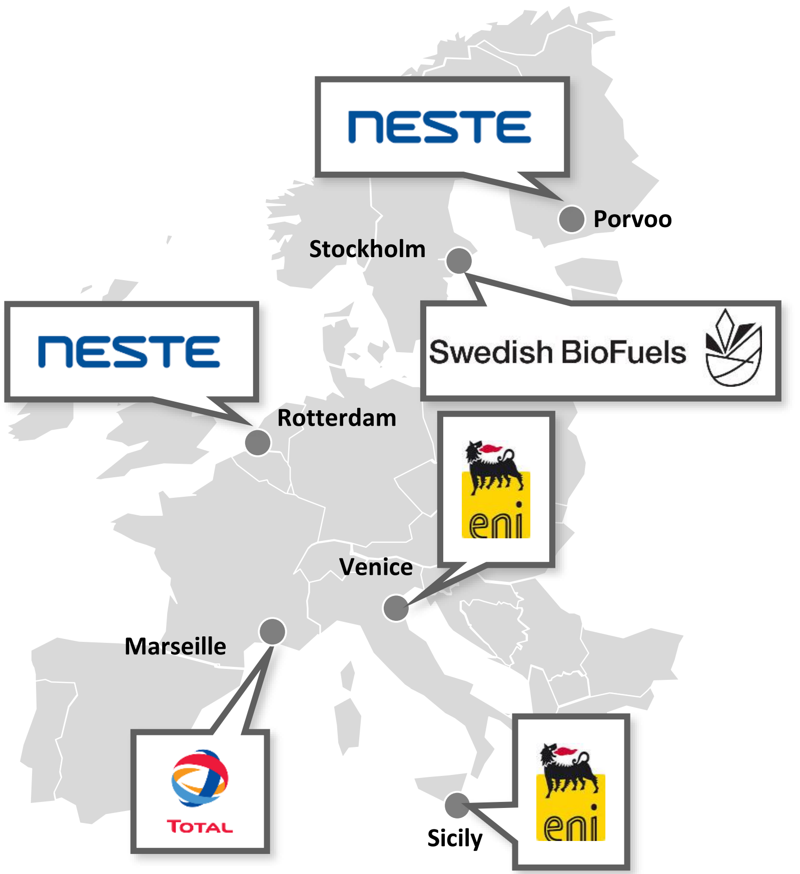
Continuous supply

Implementation in progress – launch planned for 2018 – Altair fuels

Courtesy of SkyNRG

Production capacity

- NESTE, TOTAL, ENI
  - Biodiesel production
  - Possible reconfiguration for HEFA
  - Lobbying for HRD at ASTM
- Swedish Biofuels
  - ATJ OXO technology provider
  - Ongoing production of jetfuel since 2009 (supported by US DARPA, Swedish Govt FMV)
  - Building 10,000 t/y (supported by EU FP7)



Bottlenecks

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Barriers to establishing European production capacity

- Current biojet market is not attractive to investors
- Price gap between fossil and biojet fuel
- No regulation to support the advance of biojet fuel
  - Competition for access to market with other transport fuels
  - Biojet is not eligible for fulfilling on-road mandates
- No funding mechanism to support biojet EPC projects for SMEs
- Uncertainty of stable and increasing supply of feedstock

Achieving the goal

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Recommendations from SGAB final report – Building up the future
10 March 2017

- Sustainable aviation fuel (SAF) is integral to any future fuels policy
- Prioritisation of the development of technologies for aviation and other sectors with limited substitution options
- Long term policy certainty and financial and risk sharing mechanisms must be provided for new technologies to encourage investment in advanced fuel production
- Aviation must be included in the incentive regime provided by REDII
- Support must be provided for scale up and rollout of SAF production capacity by providing financial products and services unlocking private sector capital
- Ensure that additional funding is available for R&D, leveraging private sector funding

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Angelica Hull

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Impact of RED II from the producers point of view. Other factors affecting the industry.

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Dr. Pauliina Uronen

Neste R&D / Biotechnology

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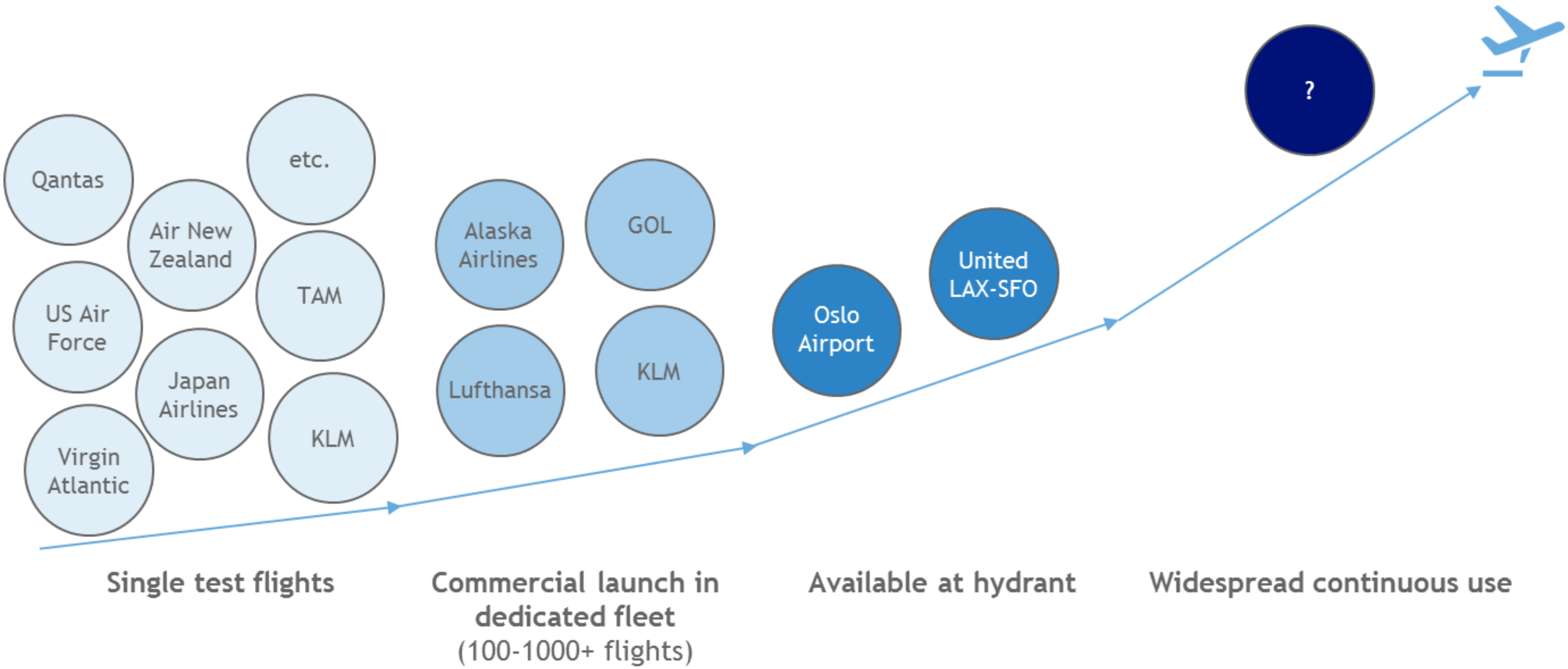
Neste renewable jet fuel technology is proven

Despite numerous test programs and commercial launch, widespread continuous use of RJF has not been achieved



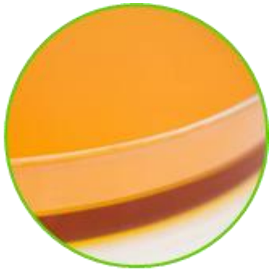
Neste uses a broad range of sustainable renewable raw materials

Animal fat from food industry waste

Fish fat from fish processing waste

Vegetable oil processing waste and residues

Used cooking oil



Technical corn oil

Crude palm oil

Rapeseed oil

Soybean oil

Camelina oil

Jatropha oil

Neste key messages to RED2

- Policy support for biofuels should be focused on areas where use of electricity and alternative fuels is difficult such as the heavy duty, maritime and aviation sectors
- Biofuel multiplier for Aviation should be higher than 1,2 – closer to 2 – in order to compensate for the higher production cost of aviation quality renewable fuels
- A blending target would also be a strong promoter for widespread use of renewable aviation fuels in the EU

Thank you!

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RED II and Sustainable Aviation Fuels - The airline perspective

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Robert Boyd - IATA

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Aviation has a strong track record on improving efficiency

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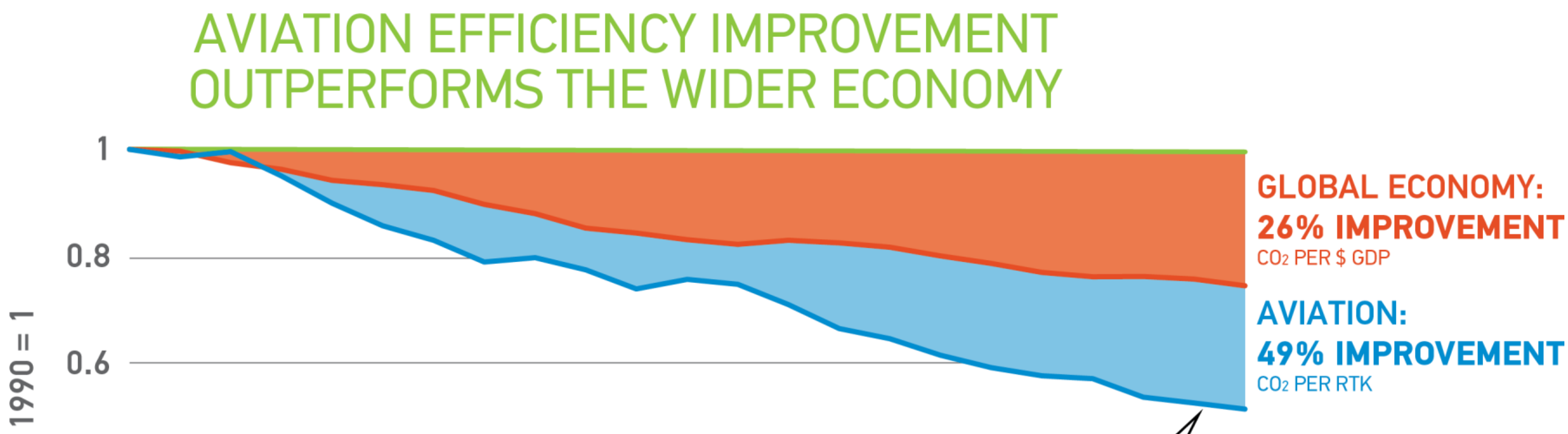

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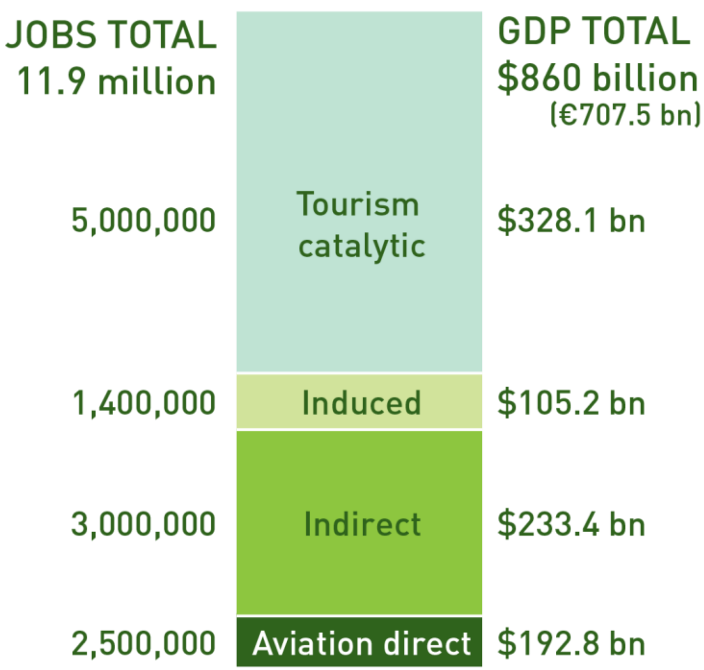
Aviation benefits in Europe

Air transport supports 11.9 million jobs and $860 billion in GDP in the Europe region. The region handles over a quarter of global passengers and, with a forecast growth rate of 3.6%, is one of the mature global markets.

Total jobs and GDP generated by air transport in Europe, 2014



873.4 million passengers

7,560,360 flights

667 commercial airports

387 airlines

46 air navigation service providers

Setting the strategic direction

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GOAL 1

PRE-2020 AMBITION

1.5% ANNUAL AVERAGE FUEL EFFICIENCY IMPROVEMENT FROM 2009 TO 2020.

T O I

GOAL 2

IN LINE WITH THE NEXT UNFCCC COMMITMENT PERIOD

STABILISE NET AVIATION CO_2 EMISSIONS AT 2020 LEVELS WITH CARBON-NEUTRAL GROWTH.

T O I + M

GOAL 3

ON THE 2°C PATHWAY

REDUCE AVIATION'S NET CO_2 EMISSIONS TO 50% OF WHAT THEY WERE IN 2005, BY 2050.

T O I

A theme of continuous improvement

T TECHNOLOGY

O OPERATIONS

I INFRASTRUCTURE

M MARKET-BASED MEASURE

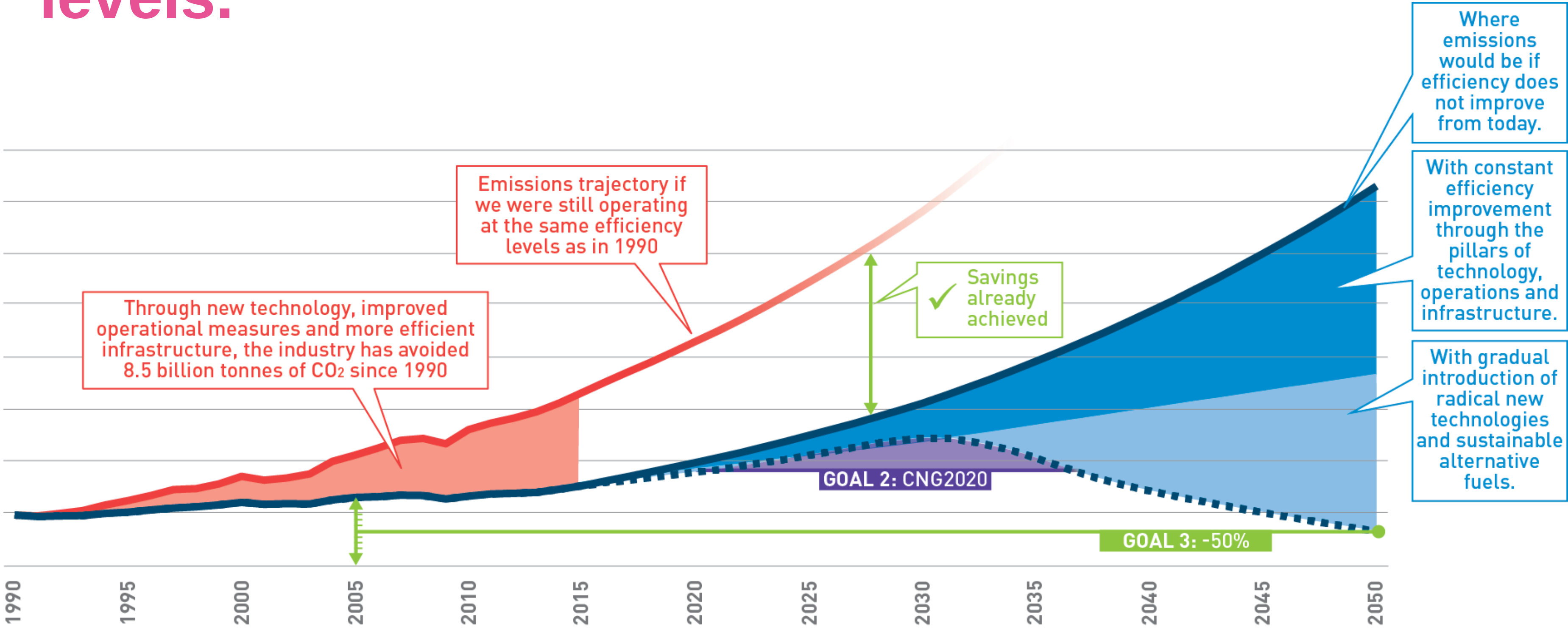
ICAO considered three MBM options

Offsetting:

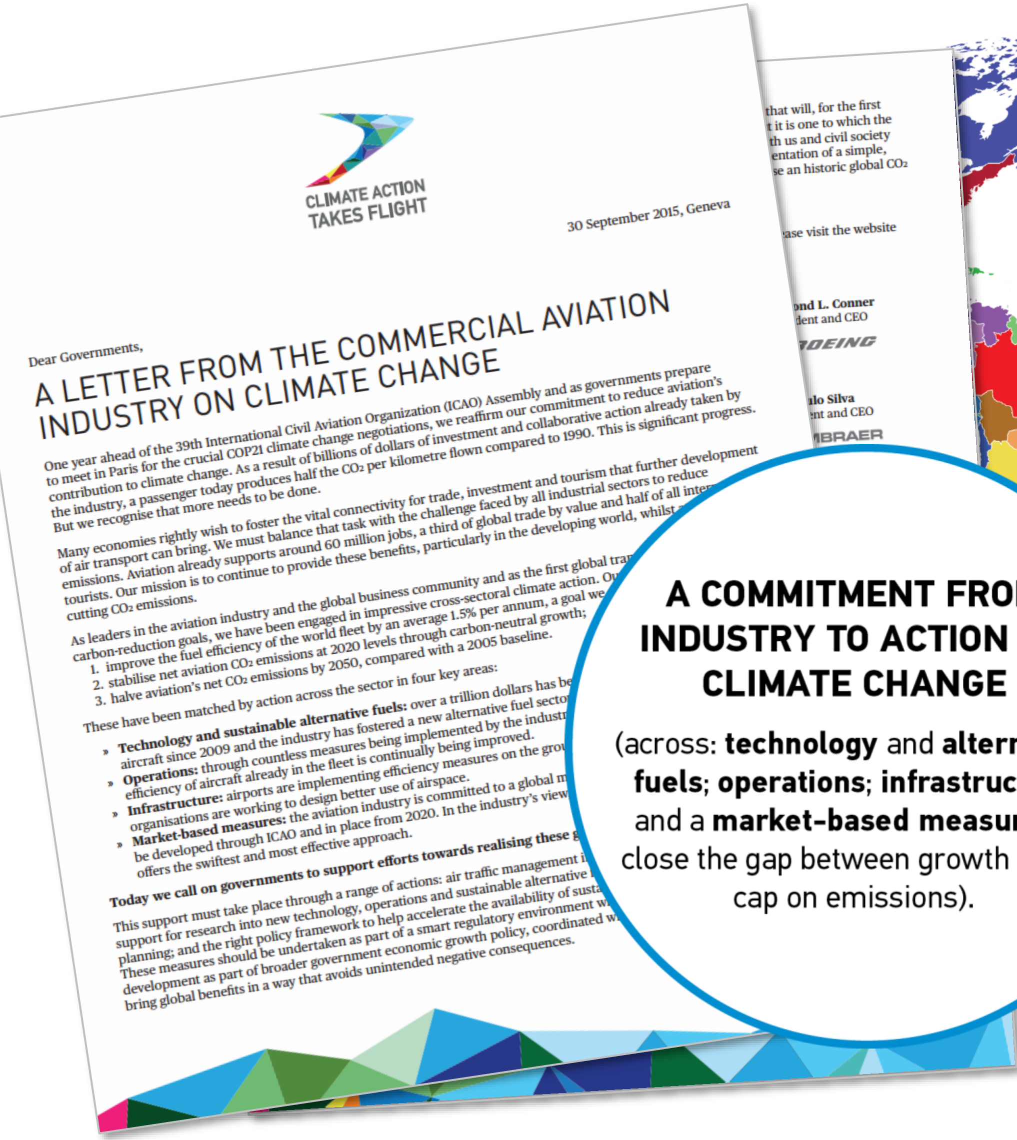
- Ties in with existing UNFCCC infrastructure
- Is simple enough to be implemented by all countries by 2020
- More cost-effective than a tax or levy
- Less complex than an emissions trading scheme
- Provides environmental integrity through funding of offset projects worldwide

Global offsetting

CORSIA aims to address any annual increase in total CO2 emissions from international civil aviation above 2020 levels.



Why does the industry support such action?


CLIMATE ACTION TAKES FLIGHT

30 September 2015, Geneva

Dear Governments,

A LETTER FROM THE COMMERCIAL AVIATION INDUSTRY ON CLIMATE CHANGE

One year ahead of the 39th International Civil Aviation Organization (ICAO) Assembly and as governments prepare to meet in Paris for the crucial COP21 climate change negotiations, we reaffirm our commitment to reduce aviation's contribution to climate change. As a result of billions of dollars of investment and collaborative action already taken by the industry, a passenger today produces half the CO_2 per kilometre flown compared to 1990. This is significant progress. But we recognise that more needs to be done.

Many economies rightly wish to foster the vital connectivity for trade, investment and tourism that further development of air transport can bring. We must balance that task with the challenge faced by all industrial sectors to reduce emissions. Aviation already supports around 60 million jobs, a third of global trade by value and half of all inter... tourists. Our mission is to continue to provide these benefits, particularly in the developing world, whilst ... cutting CO_2 emissions.

As leaders in the aviation industry and the global business community and as the first global tra... carbon-reduction goals, we have been engaged in impressive cross-sectoral climate action. Ou...

1. improve the fuel efficiency of the world fleet by an average 1.5% per annum, a goal we...
2. stabilise net aviation CO_2 emissions at 2020 levels through carbon-neutral growth;
3. halve aviation's net CO_2 emissions by 2050, compared with a 2005 baseline.

These have been matched by action across the sector in four key areas:

- **Technology and sustainable alternative fuels:** over a trillion dollars has be... aircraft since 2009 and the industry has fostered a new alternative fuel secto...
- **Operations:** through countless measures being implemented by the industr... efficiency of aircraft already in the fleet is continually being improved.
- **Infrastructure:** airports are implementing efficiency measures on the grou... organisations are working to design better use of airspace.
- **Market-based measures:** the aviation industry is committed to a global m... be developed through ICAO and in place from 2020. In the industry's view... offers the swiftest and most effective approach.

Today we call on governments to support efforts towards realising these g...

This support must take place through a range of actions: air traffic management ... support for research into new technology, operations and sustainable alternative ... planning; and the right policy framework to help accelerate the availability of susta... These measures should be undertaken as part of a smart regulatory environment w... development as part of broader government economic growth policy, coordinated w... bring global benefits in a way that avoids unintended negative consequences.

...that will, for the first ...t it is one to which the ...th us and civil society ...entation of a simple, ...se an historic global CO_2

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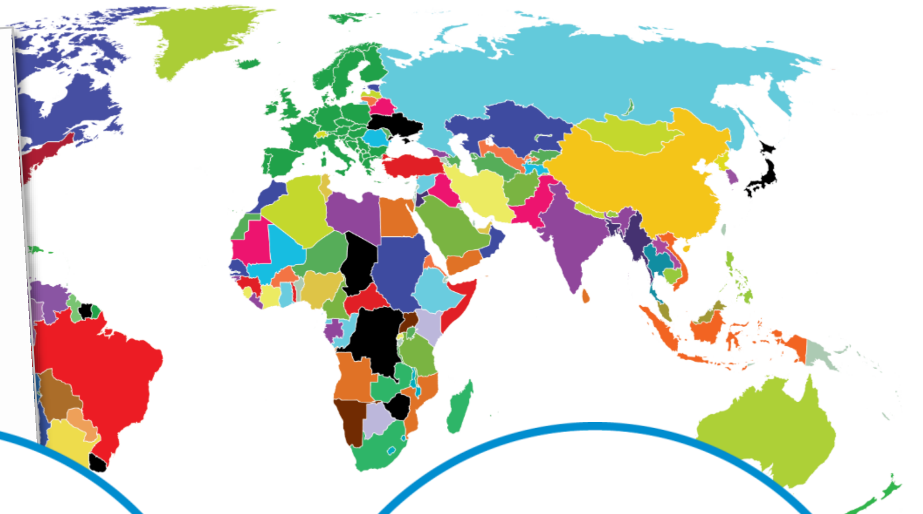

A COMMITMENT FROM INDUSTRY TO ACTION ON CLIMATE CHANGE

(across: **technology** and **alternative fuels**; **operations**; **infrastructure** and a **market-based measure** to close the gap between growth and a cap on emissions).

DESIRE TO AVOID A PATCHWORK OF WORLDWIDE MEASURES

These overlapping, uncoordinated mechanisms would bring extra cost and administrative burden to the sector.

Alternative Fuels in the CORSIA Context

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- ICAO is developing recommendations for the recognition of SAF CO_2 emissions reduction under CORSIA
- Global nature of the ICAO CORSIA requires a globally harmonized view of sustainability criteria
- Excellent opportunity for international aviation to define a globally recognized framework for sustainability of alternative fuels
- Build as much as possible upon existing sustainability standards and frameworks
  - Sustainability criteria (environmental, social, economic)
  - Compliance mechanism

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Airlines affirm commitment to Sustainable Aviation Fuels

***June 2017, Cancun** - The International Air Transport Association (IATA) 73rd Annual General Meeting (AGM) approved a resolution calling for governments to implement policies to accelerate the deployment of sustainable aviation fuels (SAF). The Resolution also reaffirmed the industry's commitment to work with governments to implement the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) global CO2 emissions agreement.*

Sustainable aviation fuels Airline perspective

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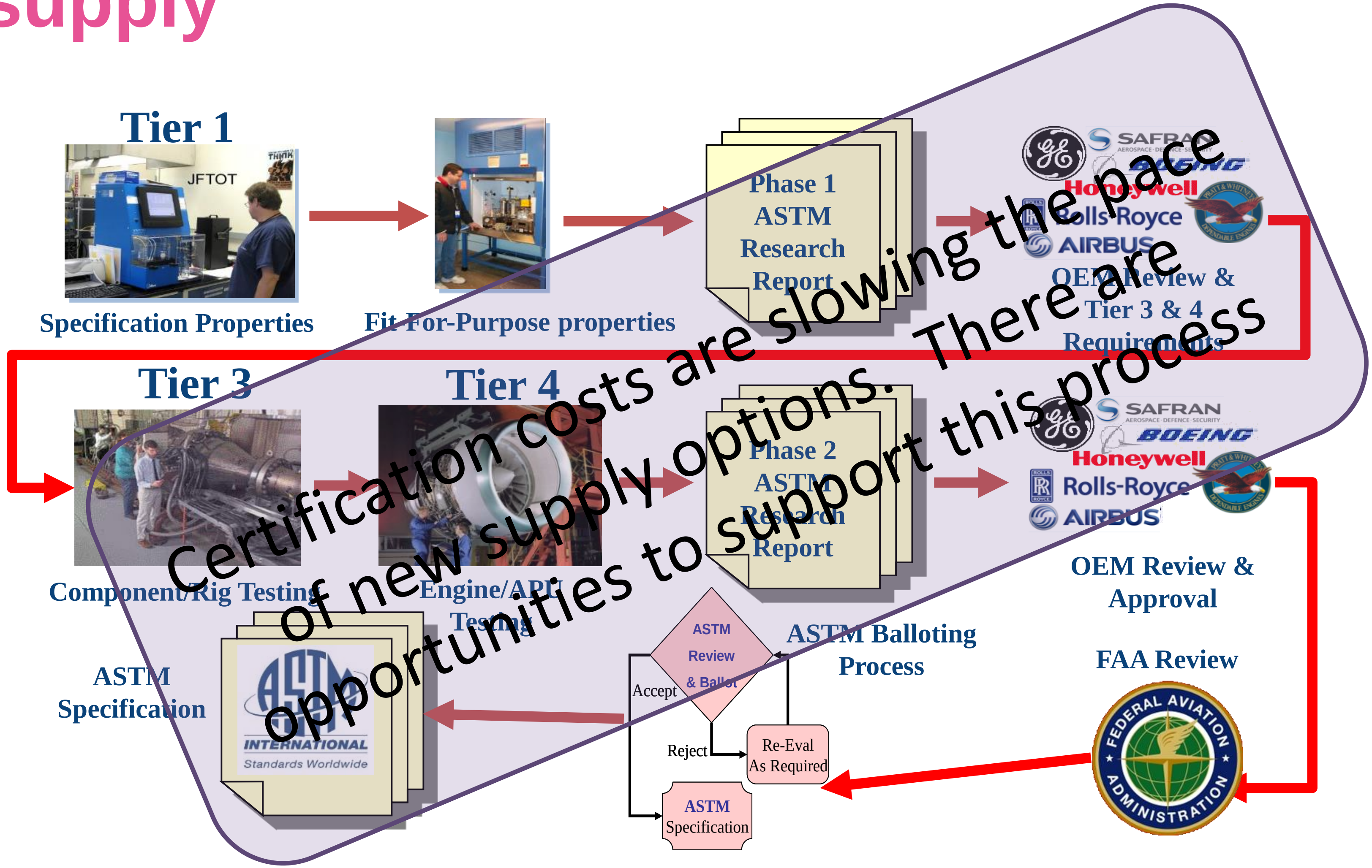
- Airlines support sustainable jet fuels as a major instrument to meeting aviation's long-term emissions reduction goals
- Since early 2016, continuous supply starting:
  - Airline/supplier offtake agreements (mostly US)
  - Bioports (e.g. OSL, LAX, GVA….)
- Today's barriers are economic rather than technical
- Sustainability is key requirement for most aviation customers

A positive political and legislative framework is needed

- RED I did not include aviation
    - Positive signals for RED II to include aviation
    - An aviation multiplier is positive
    - States should include aviation in national policies
    - IATA is feedstock agnostic as long as long as sustainability standards can be met
- New opportunity with RED II
    - Offtake agreements can be competitive
        - De-risk investments, encourage production
        - Effective examples in the US
    - ICAO CORSIA is an opportunity to progress global harmonization of standards inc. sustainability and accounting

New fuel certifications are critical for additional supply



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RED II, CORSIA and the Paris Agreement – the double counting issue

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Alexander Zschocke

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A long term vision for alternative fuels for aviation

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Bio kerosene support

- Various national / regional systems for bio kerosene support existing or under discussion

- Mandates for aviation usually not under consideration
  - Distortive effects on international competition, disadvantaging own airlines
  - Possibly in violation of international agreements
  - Indonesia an exception, reflecting support of palm oil industry

- Typical approach is to integrate bio kerosene support into overall national schemes

Examples

- US RIN system
  - Supply of bio kerosene to aviation generates RINs (Renewable Identification numbers) like any other biofuel
  - Can be traded
  - Essentially offsets price difference of bio kerosene to fossil fuel

- Dutch bio credit system
  - Supply of bio kerosene to aviation generates credits that be traded and used to meet road fuel blend mandates
  - In effect similar to US RIN system

Bio kerosene in RED II

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- Calculation share of renewable fuel as per Article 25
  - For the denominator, only the energy content of road and rail transport fuels is to be used
  - For the numerator, the energy content of biofuel supplied to all transport sectors (including aviation) is to be used
  - Incorporation obligation is on fuel suppliers
  - Aviation is not obligated, but supply to aviation counts against quota
  - Supply to aviation actually counts by bonus factor of 1.2

- Same principle as US RINs and Dutch system: Counting supply to aviation against general obligations

However:

- Allocation of fuel emissions under CORSIA:
  - International aviation treated as “quasi-state”
  - Emissions from fuel used on international flights are responsibility of aviation, not of individual states
  - Fuel use on international flights to be taken out of national CO_2 statistics
- Growth in CO_2 emissions beyond 2020 level to be offset
  - either by CO_2 reduction programmes
  - or by bio kerosene use
- Collective responsibility of aviation sector

The Paris agreement

- Double counting of CO_2 reductions prohibited by article 6 of Paris agreement:
  - Can count against obligations of financing state
  - But then cannot also count against obligations of national state where measures take place

- International aviation is not covered by Paris agreement

- However, principle of not to double count applies also for “quasi state” of international aviation

Conclusion:

- Current bio kerosene support schemes follow principle of counting aviation kerosene supply against national obligations
  - Will be traded by market actors, and become inseparable from other biofuel usage
  - Will be counted against national obligations under Paris agreement

- These fuels cannot also count against CORSIA, or there will be double counting

- Bio kerosene can only count against CORSIA if financed outside such national support

Bio kerosene in CORSIA

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- CORSIA alone will not help bio kerosene
  - CORSIA offers choice between offset by CO_2 reduction programs and offset by bio kerosene use
  - Cost of carbon by CO_2 reduction programs expected to fraction of cost of bio kerosene

- National / regional support will be required, but is currently excluded

- Cooperation between EU and ICAO will be needed to find solution by 2019

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Discussion
Q&A

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What will our approach be to:

- align interests and ambitions in a diverged stakeholder landscape?
- deal with constantly changing regulatory frameworks
- successfully deployment and scale up production of alternative fuels in Europe

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www.biofuelsflightpath.eu

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