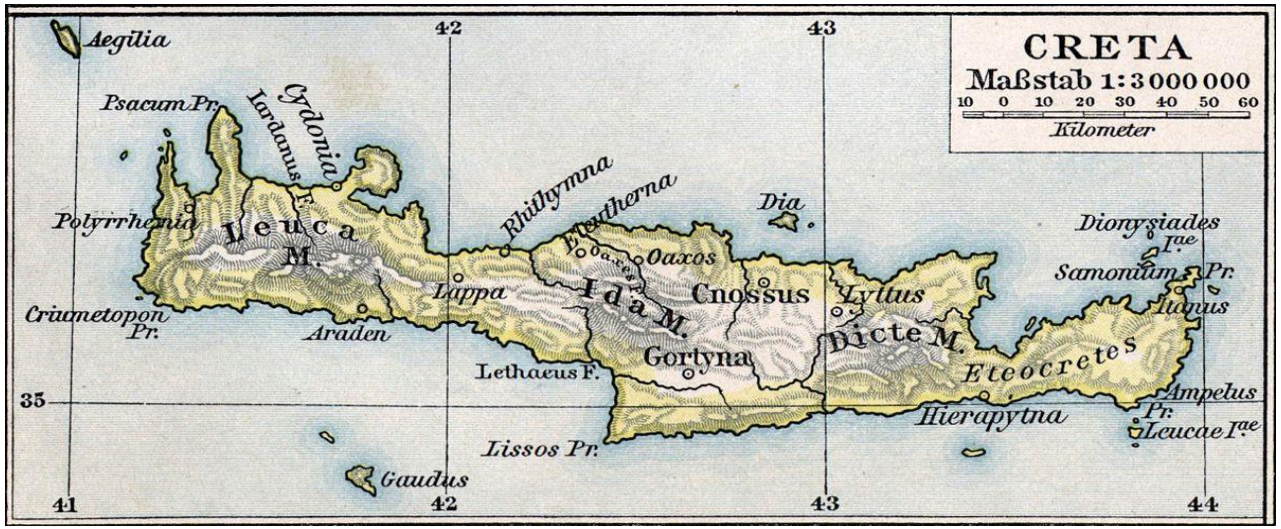
Policy Workshop
on
Maximizing sustainable aviation fuel benefits beyond CO2 reduction

Aviation in H2020, from funding to regulation: The support of the European Commission in Aviation and Sustainable Aviation Fuels Research

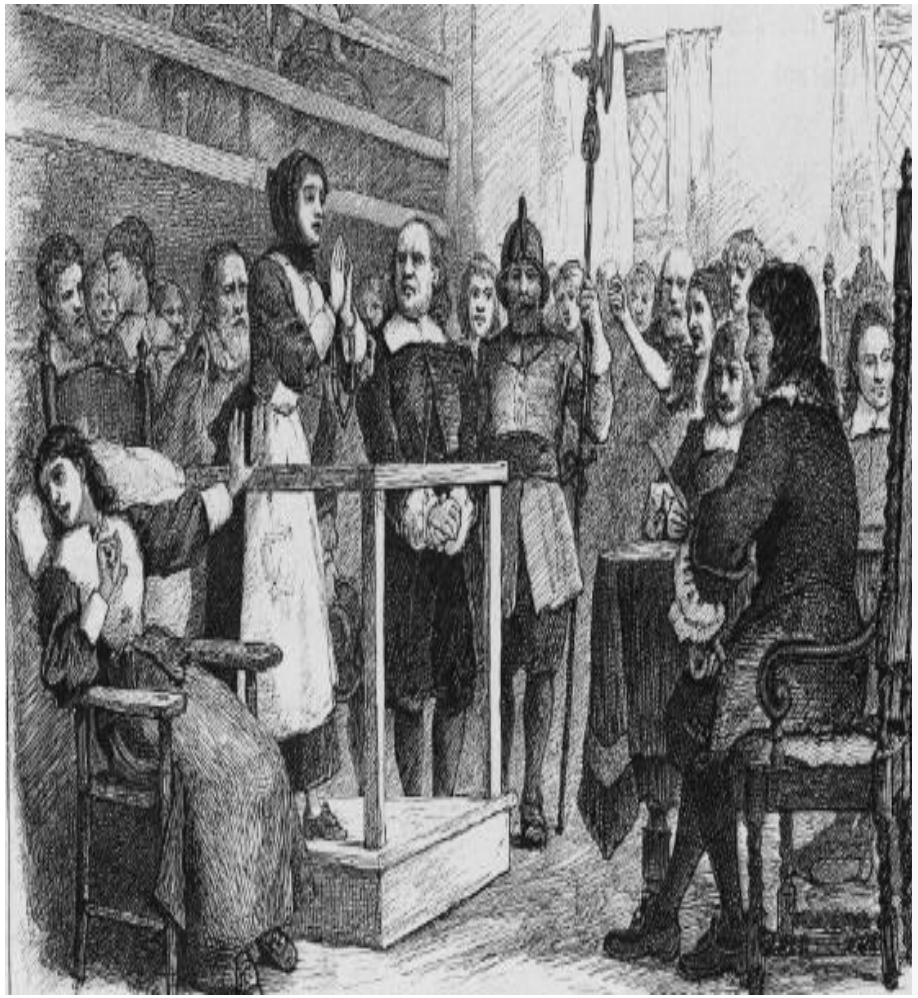
Dr Marina Kousoulidou

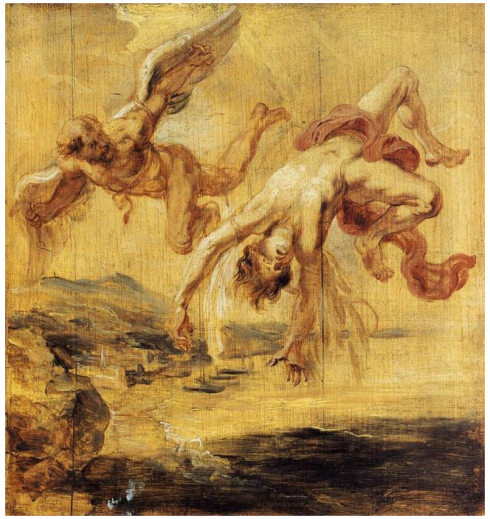
European Commission, INEA, Transport Unit

"The Fall of Icarus", by Pierre Paul Rubens
1636
Musées Royaux des Beaux-Arts, Brussels



Montgolfier brothers, 1783





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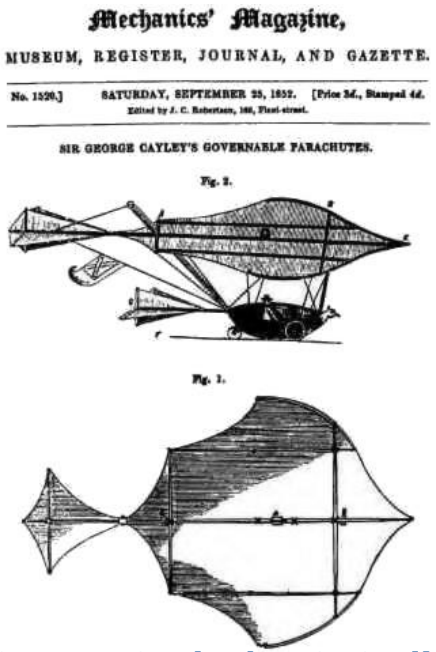


George Cayley's 1853 glider

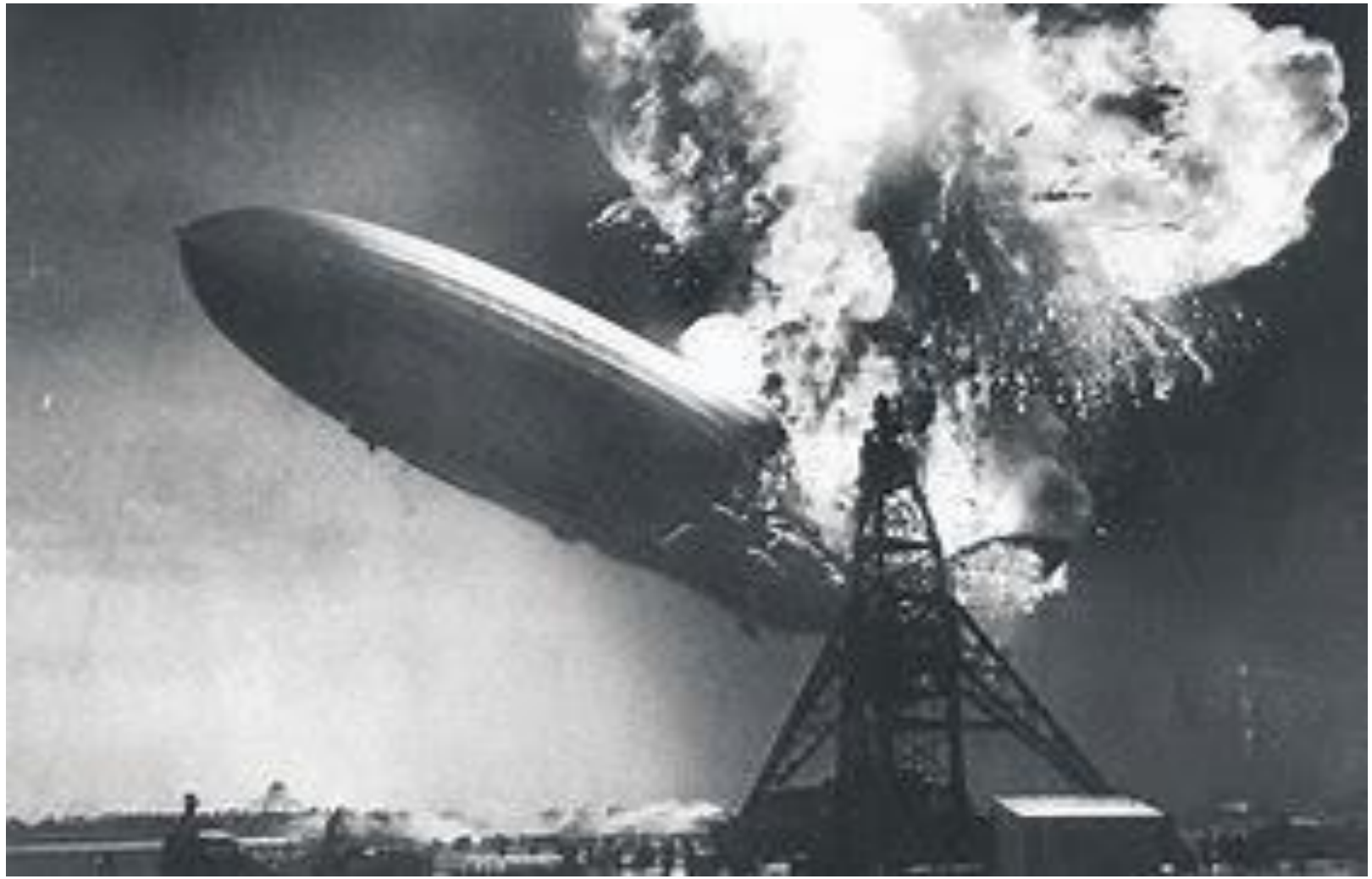
Wright Flyer, 1903: world's first controlled, sustained flight of a powered, heavier-than-air aircraft

Plane manufacturers turned their attention to commercial aviation

May 6, 1937

"Oh, the humanity, this is the worst thing I've ever witnessed"

— Herbert Morrison, Transcription of WLS radio broadcast describing the Hindenburg disaster



Aviation in the last decades

Faster, Higher, Farther

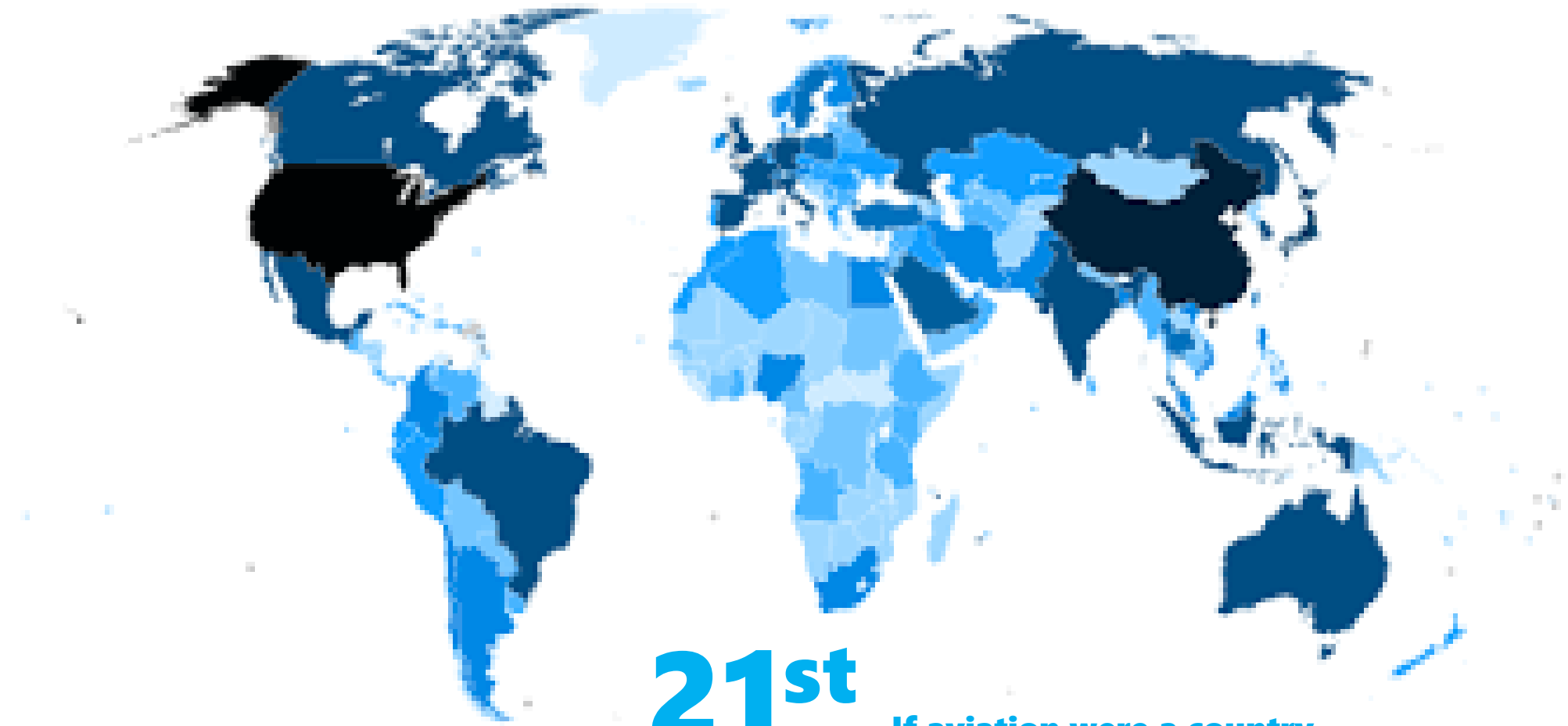
Today

Aviation in numbers

Today: Aviation in numbers

3.6% Global GDP supported by aviation

European Commission



21st

If aviation were a country,

it would rank 21st in size by GDP

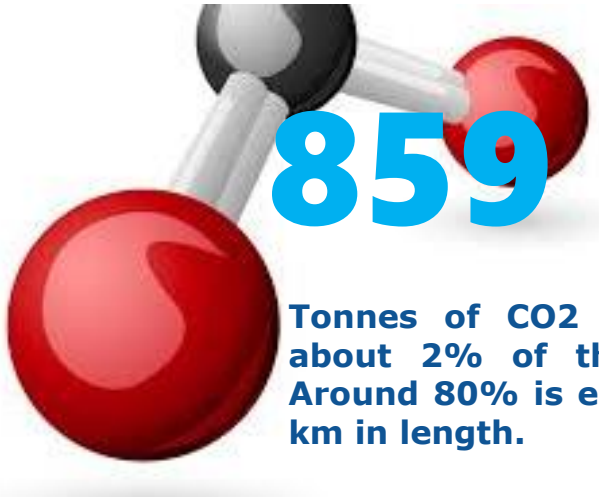
Today: Aviation in numbers

341 billion

Litres of jet fuels used by commercial operators. This was blended with conventional fuel over 52k flights. ~10% of global liquid fuel use.

€135 billion

Amount the world's airlines paid for fuel



859 million

Tonnes of CO2 emitted by airlines. This is about 2% of the global human emissions. Around 80% is emitted from flights over 1500 km in length.

14 million

Litres of neat sustainable aviation fuel used by commercial flights. This was blended with conventional fuel over 52k flights.

Today: Aviation in numbers

- Direct emissions from aviation account for about:
  - **3% of the EU's total greenhouse gas emissions**
  - **more than 2% of global emissions**

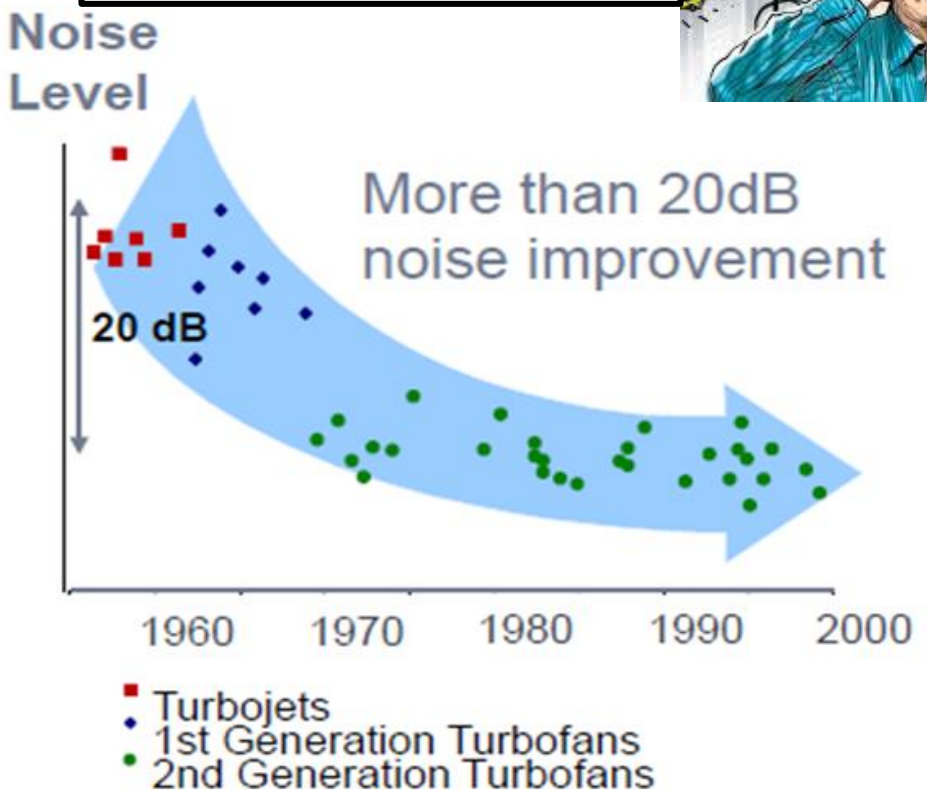
- Most significant emissions related to health impacts from aviation activities are particulate matter (PM), nitrogen oxides (NO_X) and volatile organic compounds (VOCs), but also noise

Noise

- Technological improvements
- Fleet renewal
- Increased operational efficiency

partially counterbalance the impact of recent growth

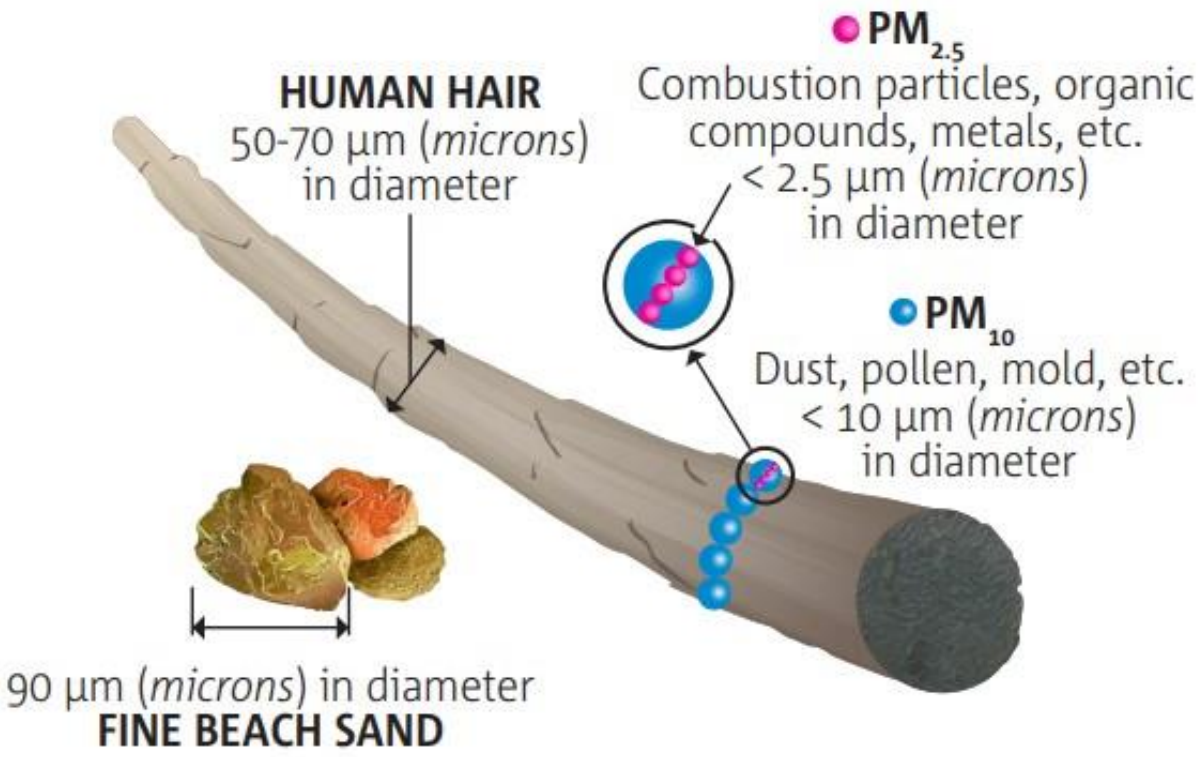
Night flying restrictions apply to reduce noise exposure at night



Source: AIRBUS

Significant emissions-Health Impact-Air Quality

- **NOx**
  - Adverse effects on human health
  - NO_2 also plays a key role in the **formation of secondary particles** and ground-level ozone.
  - Direct and an indirect impact on air quality
- **PM**
  - PM_{10} and $PM_{2.5}$ emissions and ultrafine particles
  - Solid UFP can **trigger inflammation** - act as carriers for toxic substances - **damage the genetic information in cells**
  - Measurements of aircraft engine emissions have also focused on the number of emitted particles



2005-2017

	Indicator	Units	2017	% change since 2014	% change since 2005
Traffic	Passenger kilometres flown by commercial flights[1]	billion	1,643	+20%	+60%
	Number of city pairs served most weeks by scheduled flights[1]		8,603	+11%	+43%
Noise	Number of people inside L_{den} 55 dB noise contours[2]	million	2.58	+14%	+12%
	Average noise energy per flight[3]	10^9 Joules	1.24	-1%	-14%
Emissions	Full-flight CO_2 emissions[1]	million tonnes	163	+10%	+16%
	Full-flight 'net' CO_2 emissions with ETS reductions[1]	million tonnes	136	+3%	n/a[4]
	Full-flight NO_x emissions[1]	thousand tonnes	839	+12%	+25%
	Average fuel consumption of commercial flights[1]	litres fuel per 100 passenger kilometres	3.4	-8%	-24%

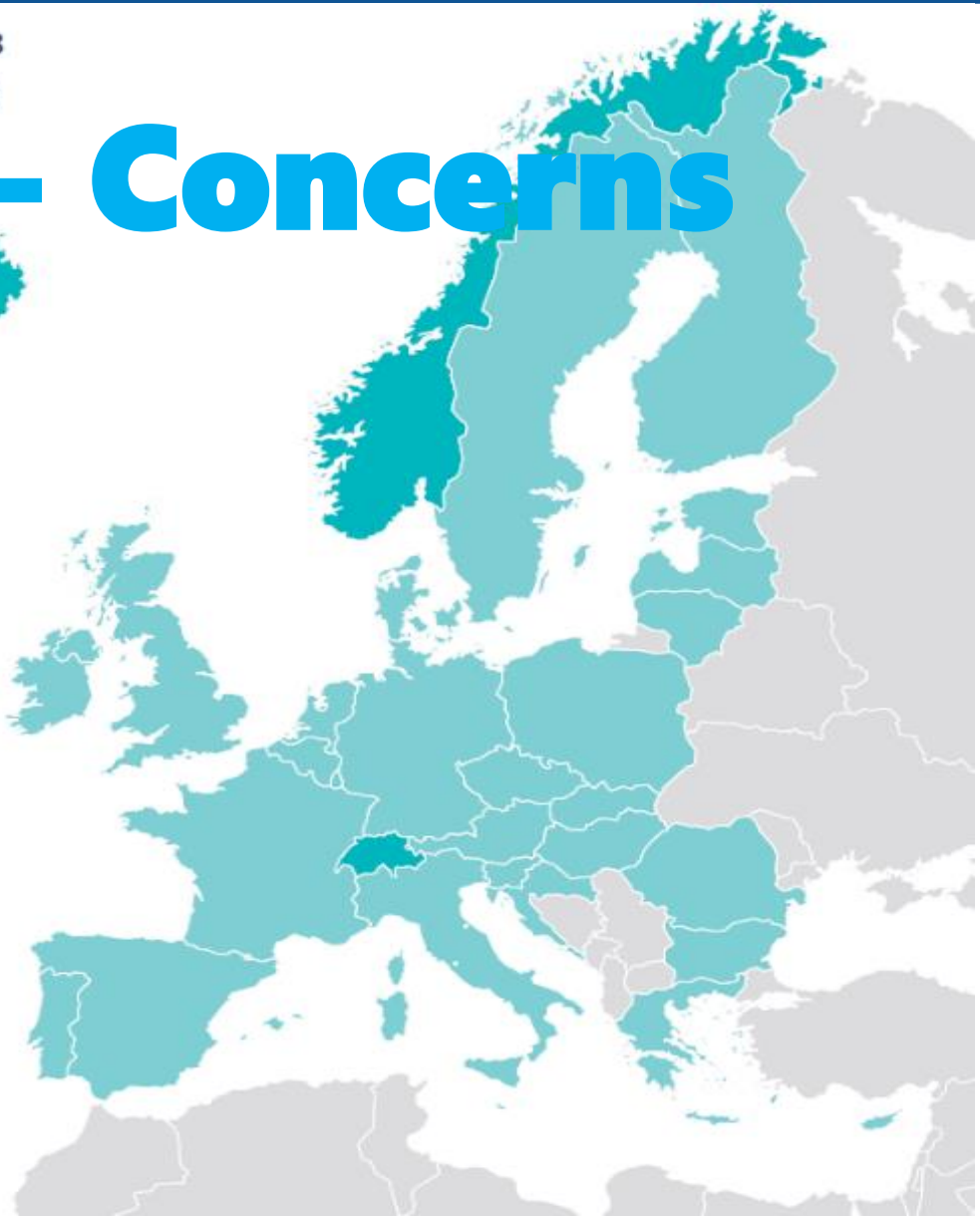
All departures from EU28 + EFTA

Source: European Aviation Environmental Report

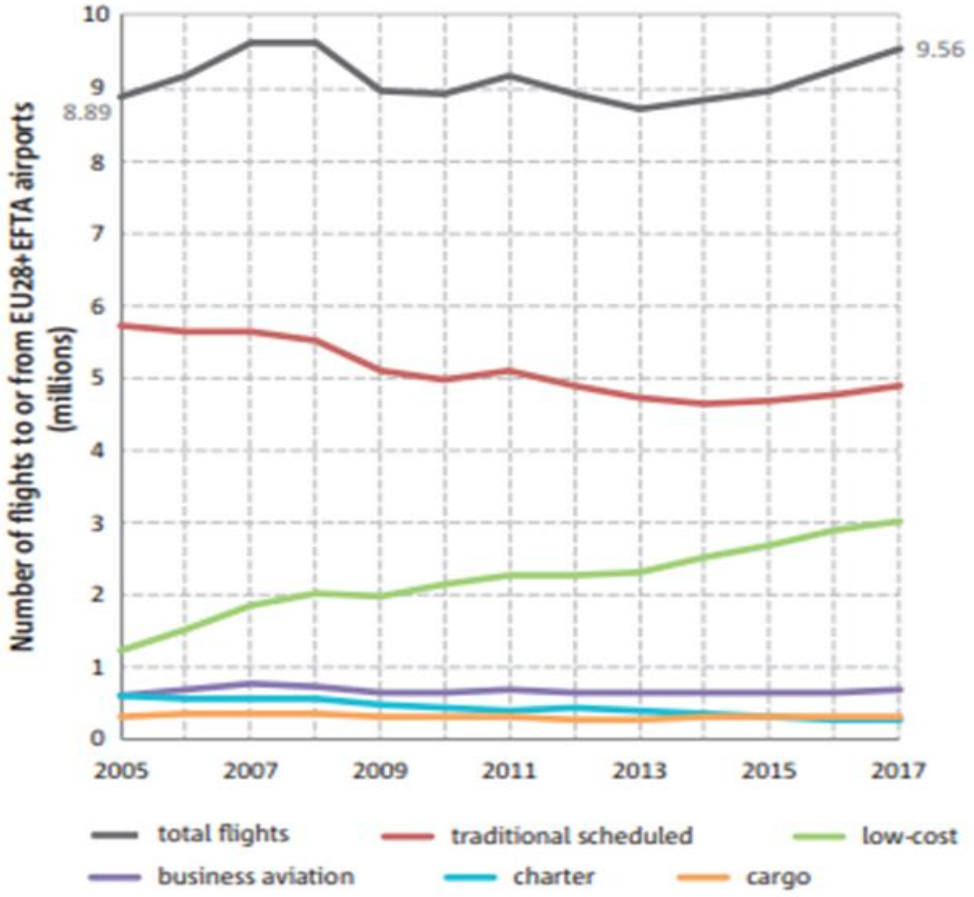
Trends – Projections - Concerns

- 2017-2040: The number of flights in EU28+EFTA: 42% increase in the most-likely forecast

- **How does this shape any concerns?**



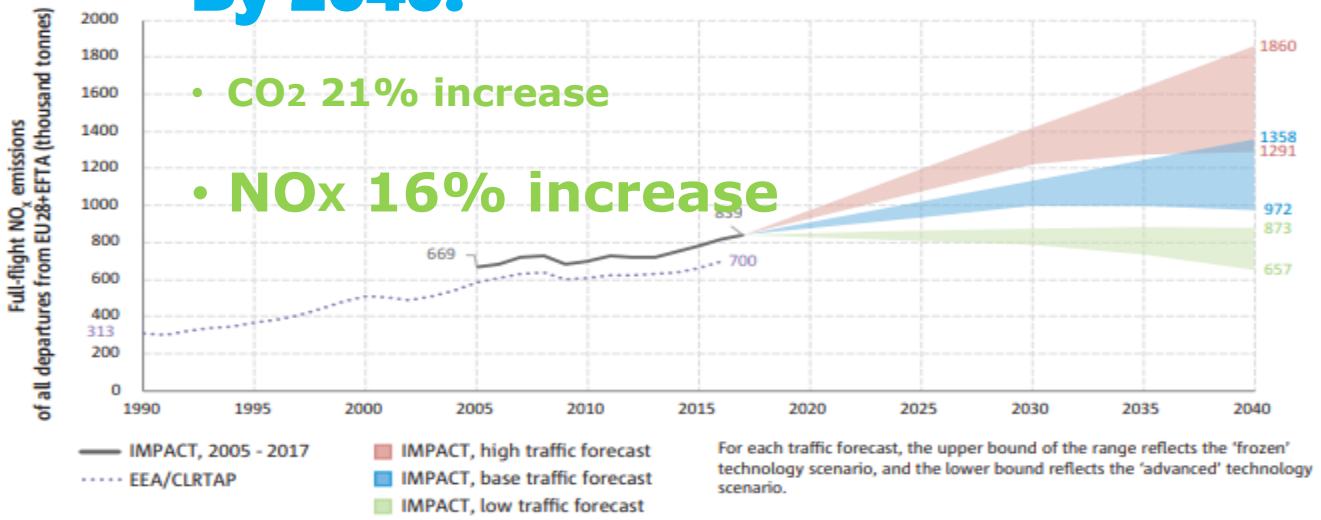
Growth comes with impacts

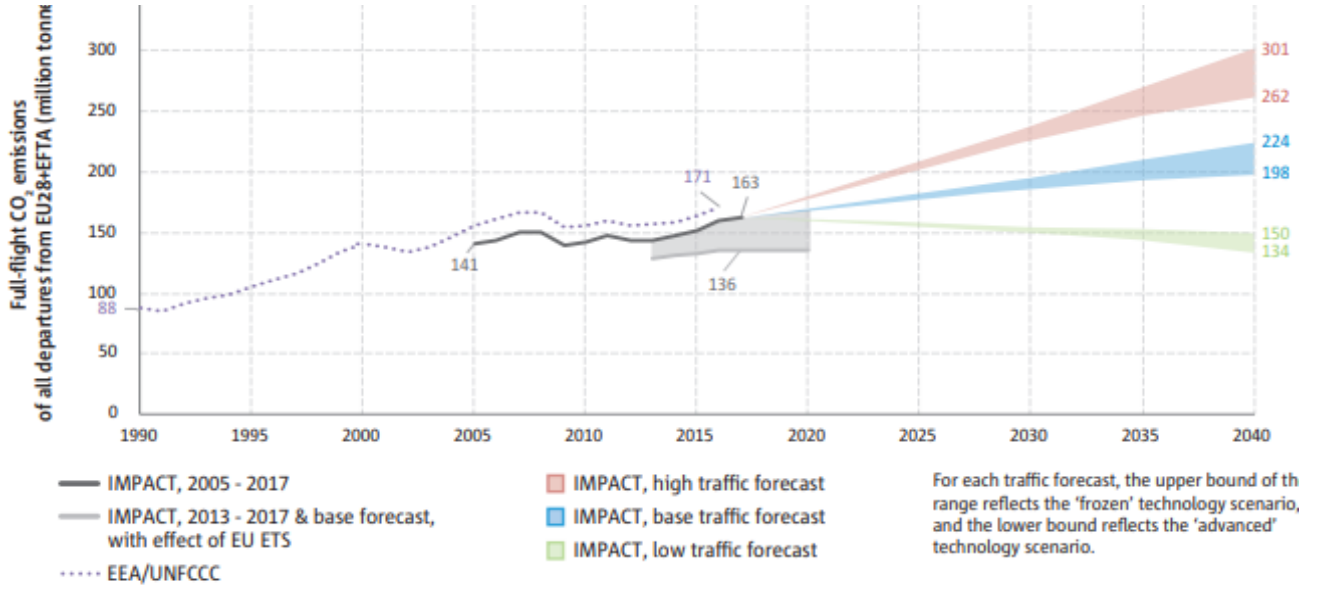


Source: European Aviation Environmental Rep

By 2040:

- CO_2 21% increase
- NOx 16% increase

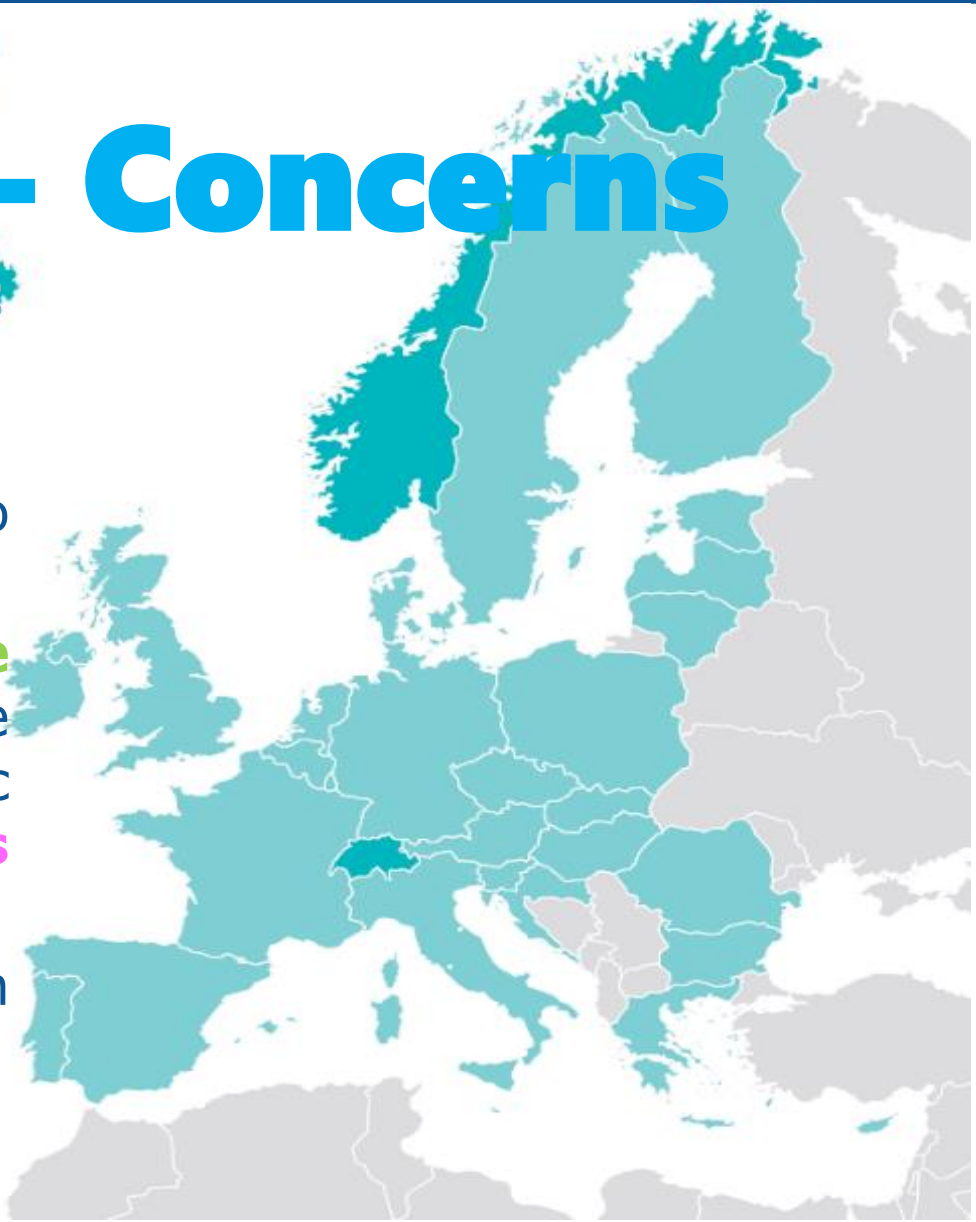




Trends – Projections - Concerns

- 2017-2040: The number of flights in EU28+EFTA: 42% increase in the most-likely forecast

- CO_2 effects are well understood and are proportional to the fuel used
- Climate impacts from non-CO_2 emissions **cannot be ignored** as they represent **warming effects** that are important in the shorter term, but the level of scientific **understanding of the magnitude of the effects is medium to very low**
- Exposure and health effects of ultrafine particles from aviation needs to be filled with **additional research**

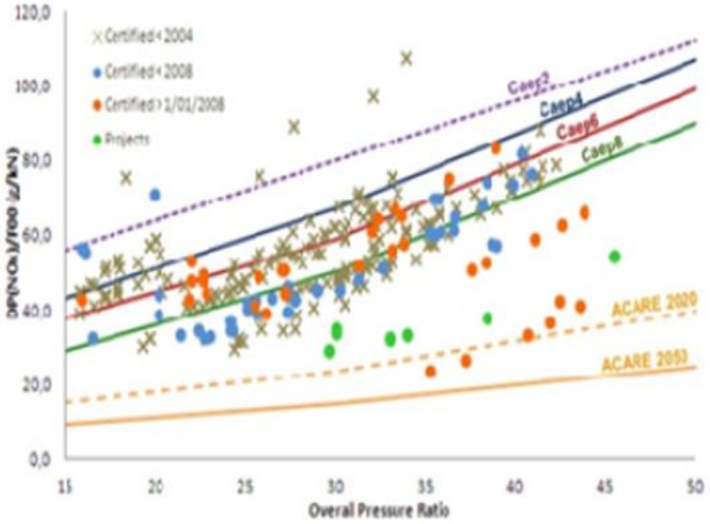


Impacts-Solutions

Environmental impacts

Mitigation technical solutions

Regulation technical issues



Source: FORUM-AE, EU funded project

Targets: Improve-Stabilise-Reduce

- **Improve 1.5%**

Aviation will improve its fleet fuel efficiency by an average of 1.5% per annum between 2009 and 2020

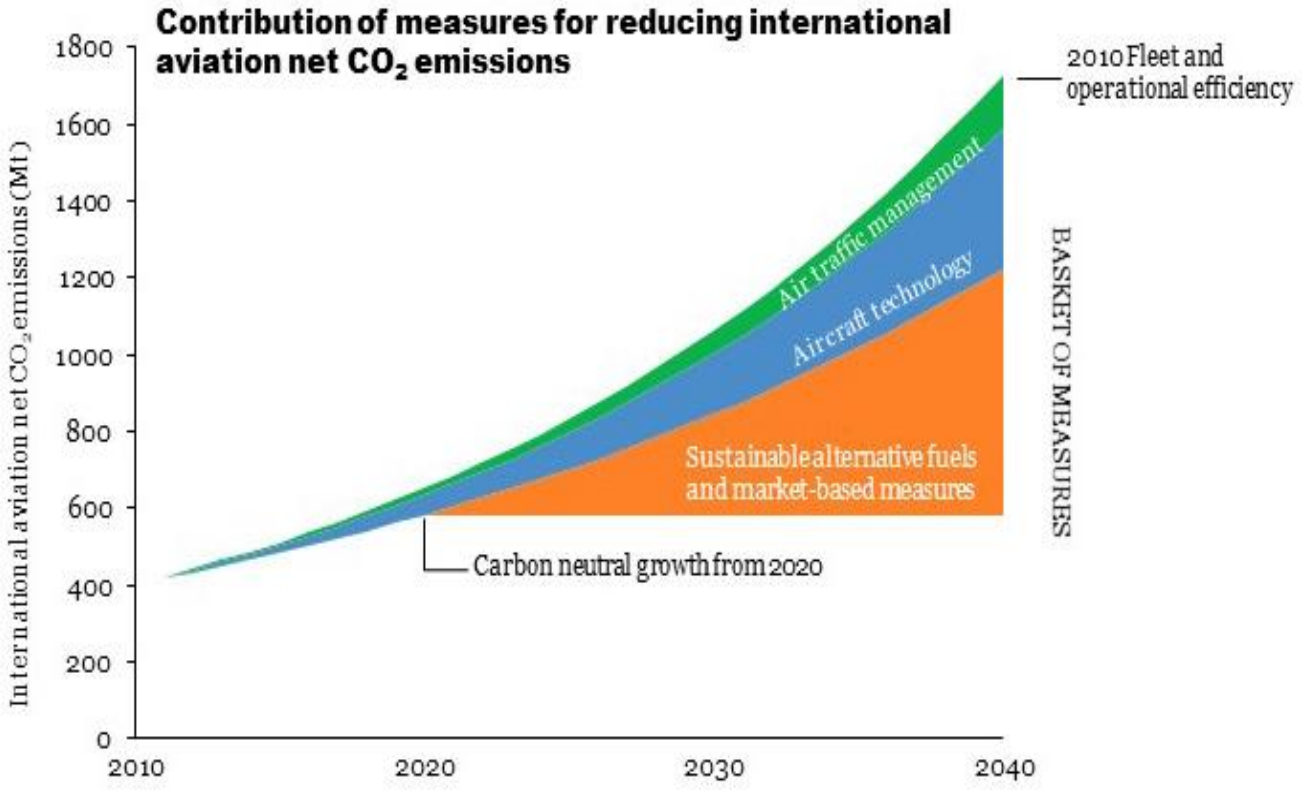
- **Stabilise**

From 2020, net carbon emissions from aviation will be capped through carbon-neutral growth

- **Reduce 50%**

By 2050, net aviation carbon emissions will be half of what they were in 2005

Flightpath 2050: 90% reduction in NOx emissions. 65% reduction in noise (relative to the capabilities of typical new aircraft in 2000)



Source: ICAO

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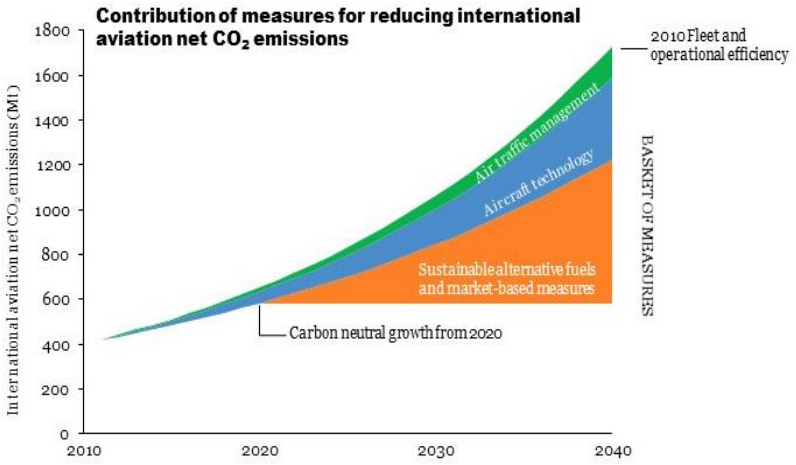


Sustainable Alternative Fuels

The role of SAF in Reducing Environmental Impact

- The EU sees an important role for SAF in contributing to reduce the environmental impact of aviation

Taking action in a number of areas to support a greater uptake of SAF within the European market, including research within:

- the **'Horizon 2020'** programme that supports the development and pre-commercial production of SAF
- From 2013 to 2020, a total budget **€464 million** is available to study advanced biofuels and other renewable sources, **€25 million** has been specifically allocated to SAF

Sustainable Aviation Fuels

- SAFs: potential to make an important contribution to mitigating the current and expected future environmental impacts of aviation- Bio-based aviation fuels production pathways have been certified, and several others are in the approval process

- There is interest in 'electrofuels', which potentially constitute **zero-emission alternative fuels**. However, few demonstrator projects have been brought forward due to high production costs

- The use of SAF is currently **minimal** - uptake by airlines remains minimal due to various factors, including the cost relative to conventional aviation fuel and low priority in most national bioenergy policies (€600/tonne vs €950-€1,015/tonne for bio-based aviation fuel produced from used cooking oil)

- Recent **policy developments** and industry initiatives aim to have a positive impact on the uptake of sustainable aviation fuels in Europe

Directives, Policies, Initiatives

The Renewable Energy Directive (RED)

- Adopted in 2009, established an overall policy framework for the production and promotion of energy from renewable sources in the EU.
- Requires all EU countries to ensure that at least **10%** of their transport energy comes from renewable sources **by 2020** (and 14% by 2030)

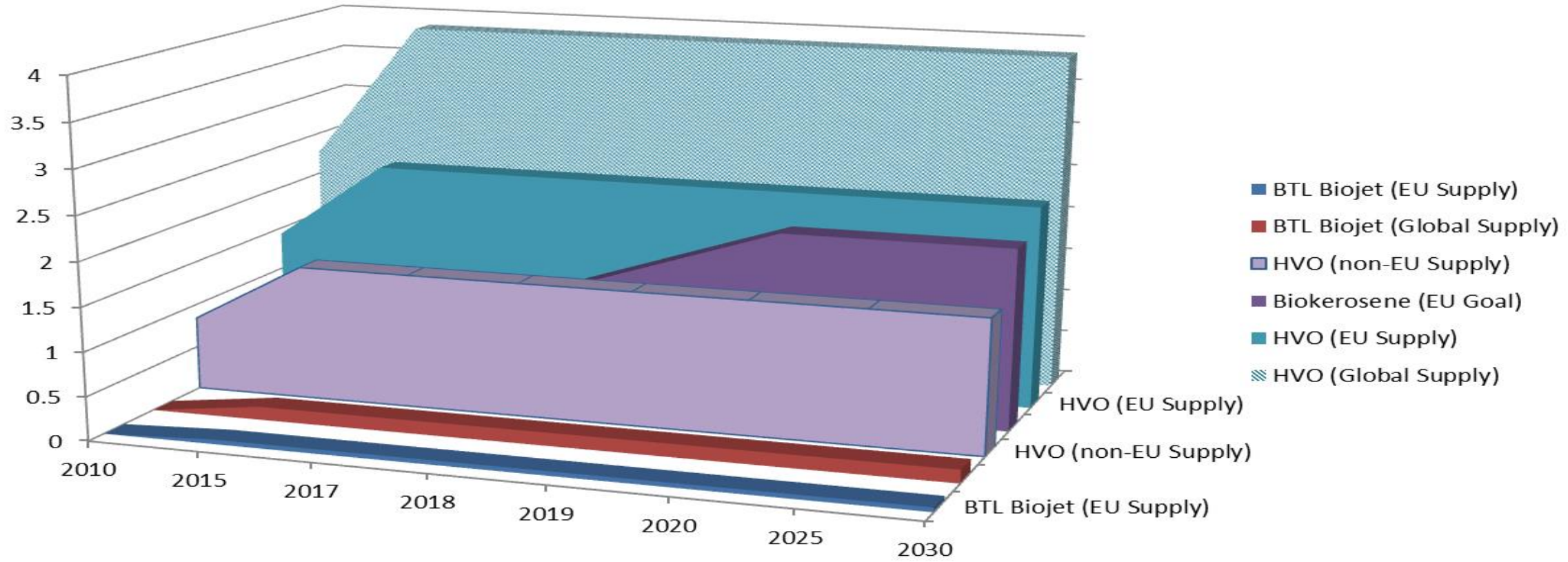
EU Emissions Trading System (EU ETS)

- Provides an incentive to aircraft operators to use SAF that comply with the sustainability criteria defined in the RED by attributing them zero emissions under the scheme

European Advanced Biofuels Flightpath

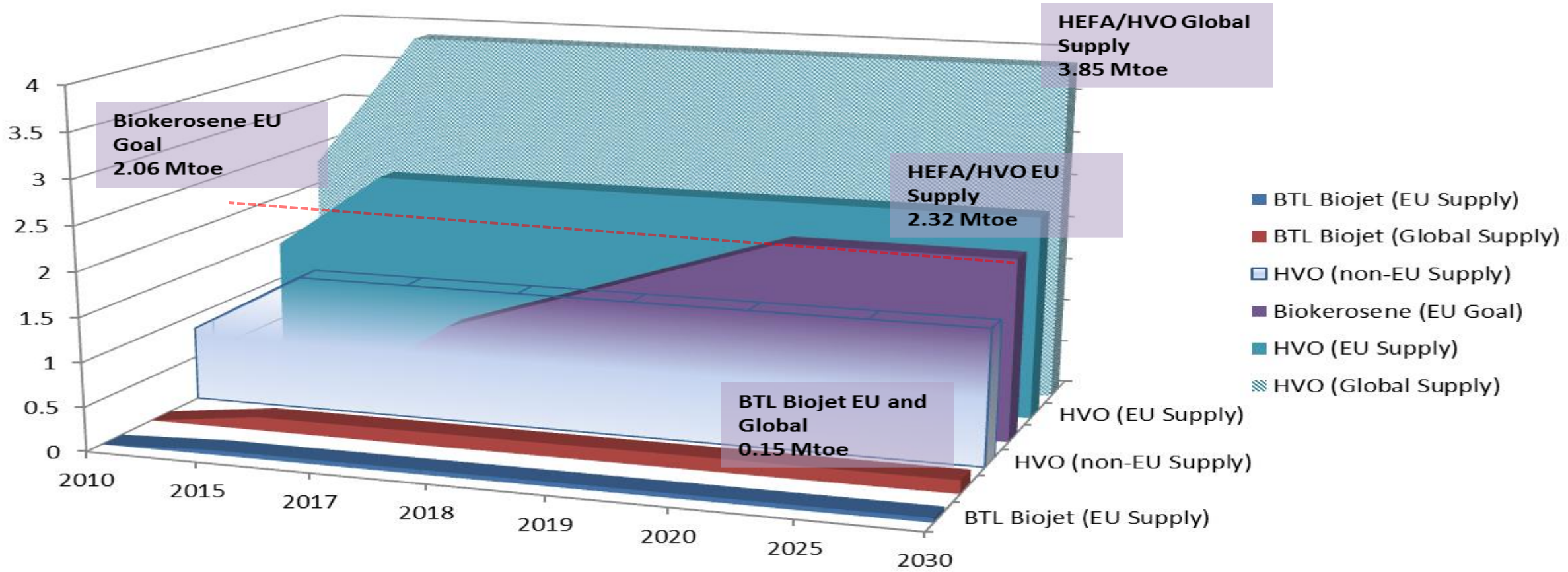
- Launched artnership between th sion and major Europ n the aim to **accelera** n SAF are brought to m
- To achiev n of **two million to** produced biofuel for a

Biofuels Demand and Supply to 2030



(Source: Kousoulidou et al. 2016)

Biofuels Demand and Supply to 2030



The most developed process to date produces Hydroprocessed Fatty Acid Esters and Free Fatty Acid (HEFA)

(Kousoulidou et al. 2016)

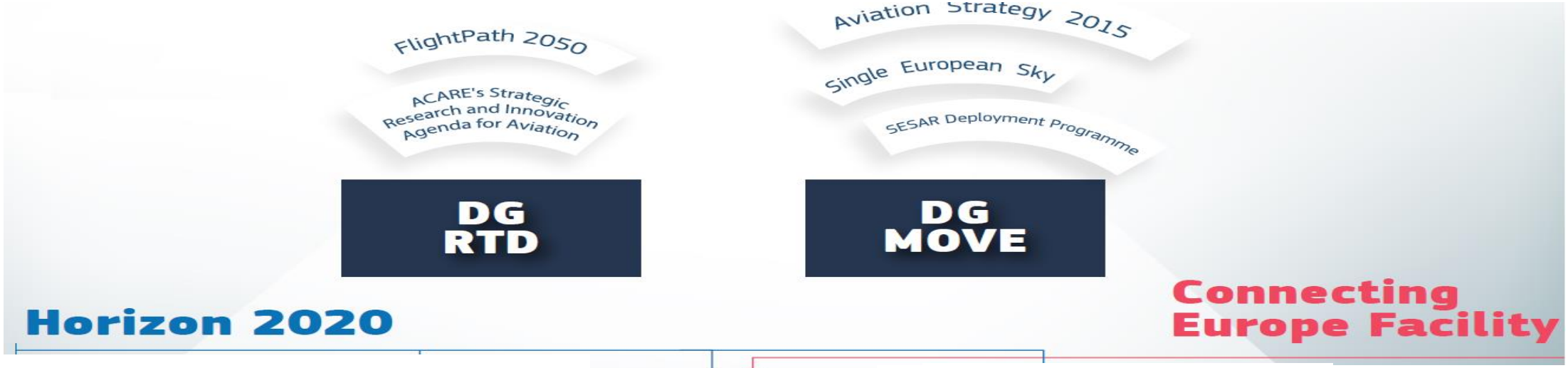
EU-Funding in R&I for Aviation

EU-Funding in R&I for Aviation

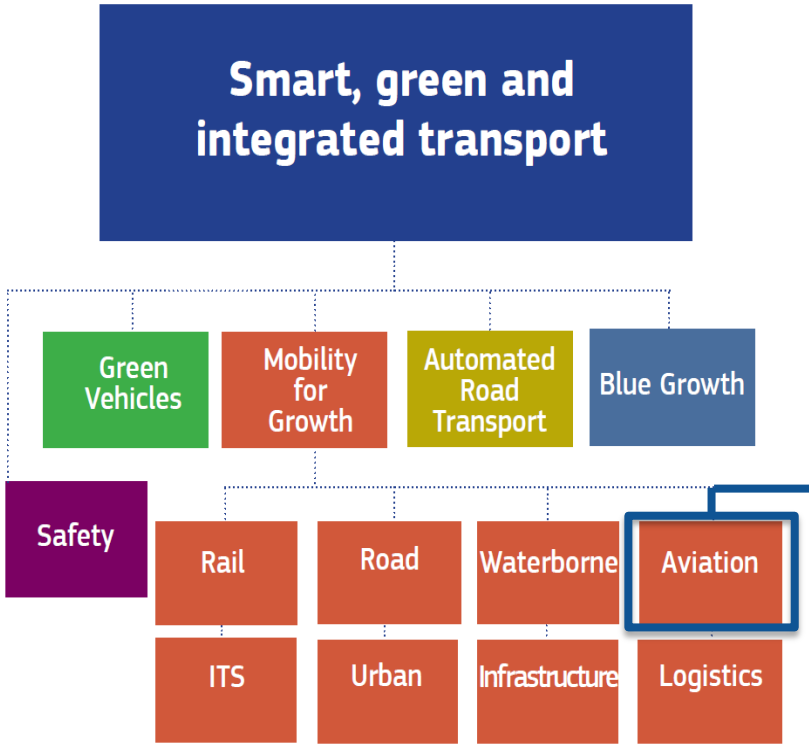
Focus on:

- **Maintaining and extending the European industrial leadership in aeronautics**
- **Addressing the citizen and business needs for improved transport services**
- **Covering safety, security and environmental concerns.**

EU Aviation R&I family



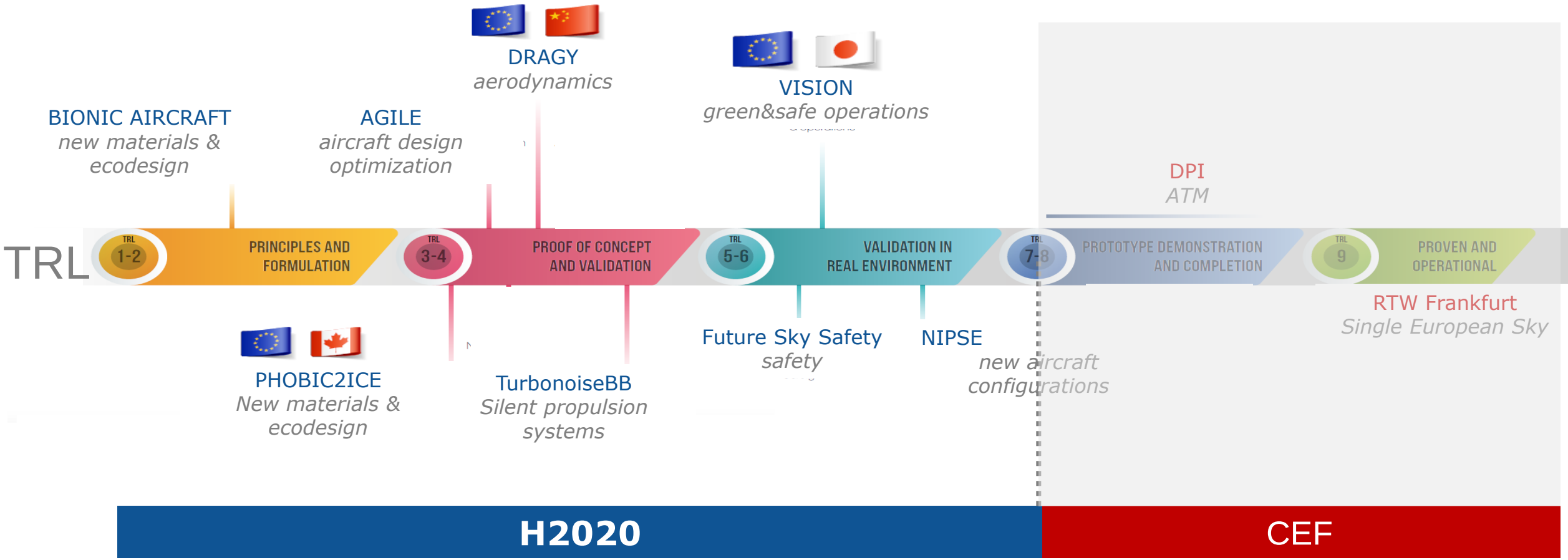
How is the EC supporting aviation ?



Aviation Portfolio
80 projects
€400 million (executed budget)

- Cost efficiency
- Resource efficiency
- Seamless mobility
- Safety
- Breakthrough innovation
- Skills and knowledge
- Coord. Supp. Actions
- Reducing aviation noise
- International cooperation

On-going projects: from low to high TRL



Open to the world

International Cooperation in Aviation Research

EC promoting research on SAF

- LC-SC3-RES-24-2019: Boosting pre-commercial production of advanced aviation biofuels

(Focus area: Building a low-carbon, climate resilient future, TRL 5 to 7)

"Facilitate the market entry and increase the commercial capacity of advanced biofuels for aviation. In particular, it is expected that pre-commercial plant(s) for advanced biofuels for aviation will be accomplished and the deployment of their technologies will allow the competitive production of biojet fuels on a commercial scale."

- LC-SC3-RES-23-2019: Development of next generation biofuel and alternative renewable fuel technologies for aviation and shipping

(Focus area: Building a low-carbon, climate resilient future, TRL 3 to 5)

"The supported projects are expected to reduce costs and improve performance of renewable fuels for aviation and shipping regarding the efficiency, the environment and society. The proposed solution is expected to contribute to achieving European leadership in this area."

EC promoting research on SAF

LC-MG-1-6-2019: Aviation operations impact on climate change (InCo flagship) –incl SAF (10mil Eur)

- Part of the Aviation International Cooperation Flagship called "Safer and Greener Aviation in a Smaller World"
- Bilateral international cooperation with China is encouraged

  Aim: to deliver scientifically founded and globally harmonised policy, regulations and operational improvements to support climate-friendly flight operations

LC-MG-1-5-2019: Advancements in aerodynamics and innovative propulsion systems for quieter and greener aircrafts (15mil Eur)

-takes into account the results of the FORUM-AE project

Calls and other Actions for 2020

LC-SC3-RES-25-2020: International cooperation for Research and Innovation on advanced biofuels and alternative renewable fuels

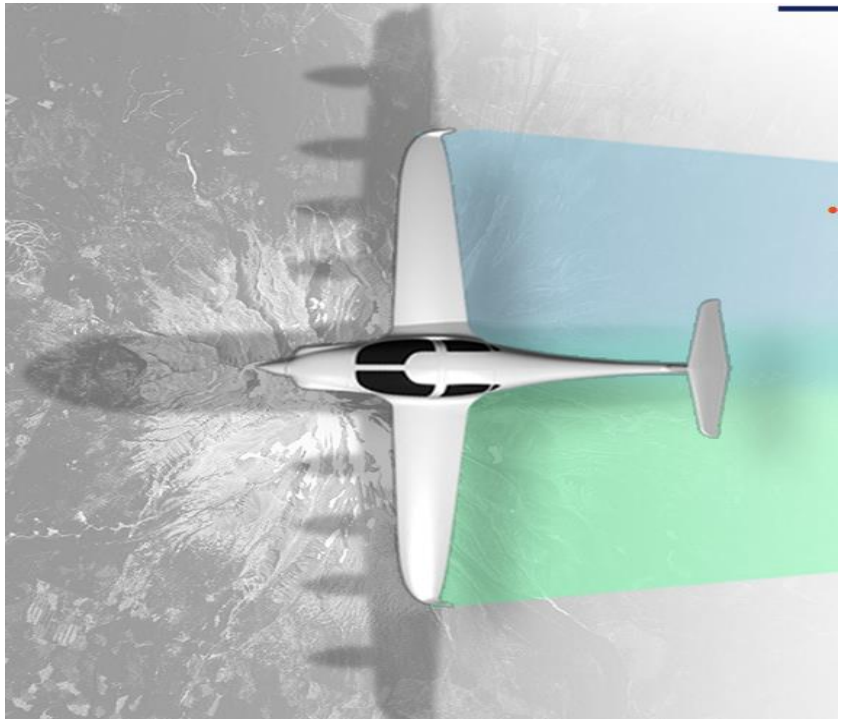
LC-SC3-RES-26-2020: Development of next generation biofuel and alternative renewable fuel technologies from CO2 and renewable energy (Power and Energy to Fuels)

LC-SC3-RES-3-2020: International Cooperation with USA on alternative renewable fuels for energy and transport (Mission Innovation Challenges 4 and 5)

On-going projects supported by H2020

Hybrid, electric, SAF

MAHEPA



Developing two new hybrid electric powertrains to enable **cleaner, quieter and more efficient aircraft propulsion**

JETSCREEN

Contributing to the **optimization** of alternative fuels in terms of achieving the **maximal energy density and lowest pollutant emissions**

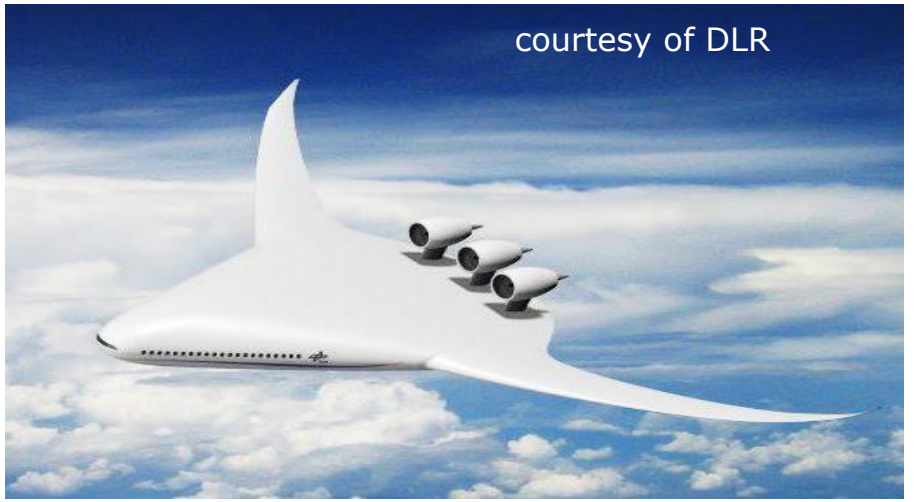
Hydrogen

ENABLE·H2

ENABLEH2 will mature critical technologies for LH2 based propulsion to achieve **zero mission-level CO2 and ultra-low NOx emissions**, with long term safety and sustainability

Disruptive aircraft configurations

Towards FlightPath2050 environmental goals



the "Prandtl Plane"

PARSIFAL PROJECT

CENTRELINE

Aircraft for civil transport based on the Prandlt closed wing concept, which should be characterized be reduced drag and lower noise emissions

Faster multidisciplinary-design optimization

AGILE

today

future

- Targets multidisciplinary optimization using distributed analysis frameworks
- 40% speed-up of MDO problems for next generation aircraft

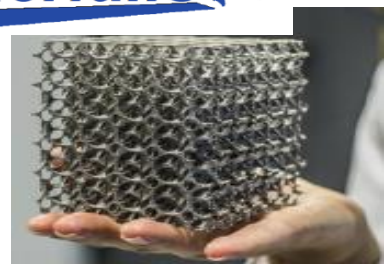
Reducing aviation noise

At aircraft and airport level

IMAGE

ANIMA

Aerialis



ARTEM

RUMBLE

Total EU funding:
34million €

High-speed

Paving the way for sustainable supersonic flights

Propulsion systems for stratospheric flights

(building on a >30m€ investments)

Low-sonic boom regulation

Project dedicated to the production of the scientific evidence requested by national, European and international **regulation authorities** to determine the acceptable level of overland sonic booms and the appropriate ways to comply with it.

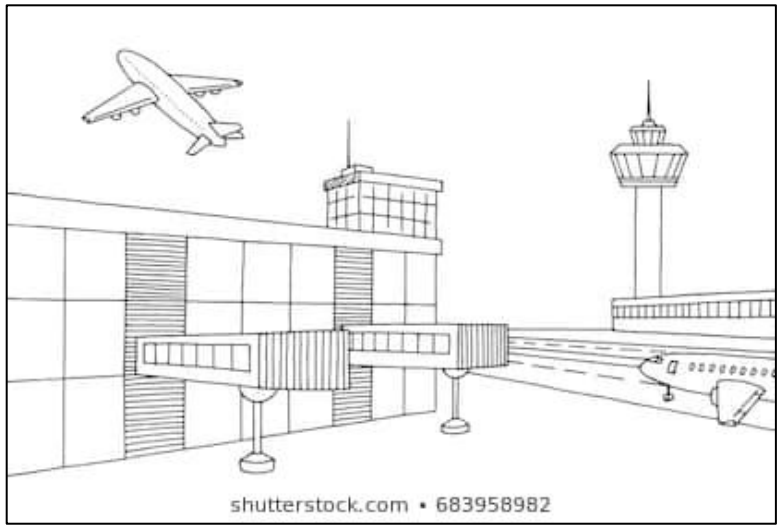
European Commission

Assessing the impact of aviation on local air quality at airports

AVIATOR

Future Airports for Green Aviation

How should airports transform to provide bio-fuel, electricity and hydrogen on planes?



Smart Airport

Funding opportunity:
H2020 LC-SC3-SA-1-2020,
deadline 29 Jan 2020

Urban Air Mobility

Funding opportunity:
H2020 MG-3.6-2020,
deadline 26 April, 2020

Contribution to aviation safety & security research

- 12 projects on safety & security research(€73 M)
- involvement of EASA

"Aeronautics was neither an industry nor a science. It was a miracle"

Igor Sikorsky

Thank you for your attention!

http://ec.europa.eu/transport/research/index_en.htm

http://ec.europa.eu/research/horizon2020

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