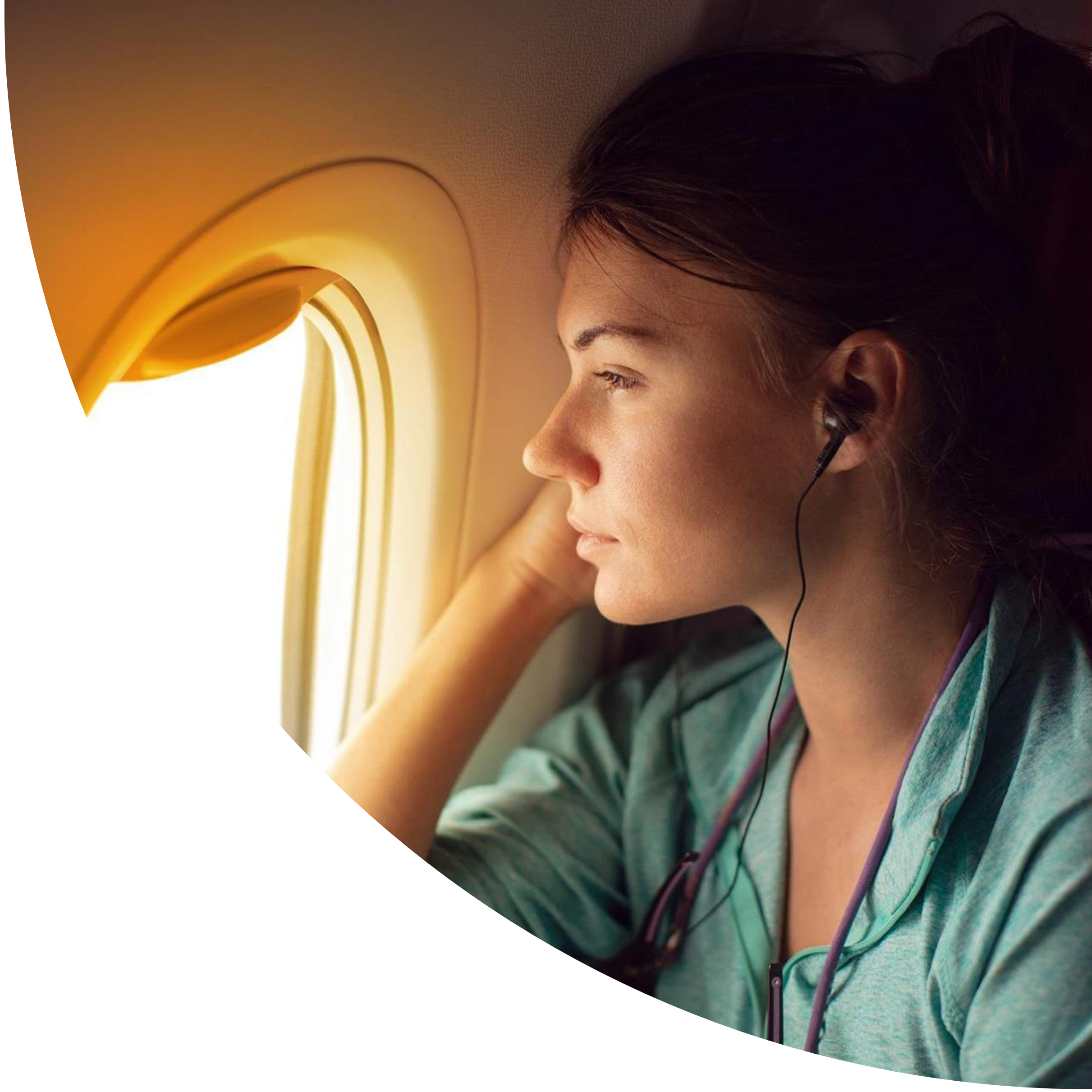
# Decarbonization of Aviation

# Reaching Net Zero by 2050



**Michael Schneider**

Assistant Director IATA

Sustainability Programs



15 November 2023

IATA

# IATA Sustainability & Economics Division

# Mission

## Work for air transportation's environmental and financial sustainability through:

Research

Advocacy

Standards

Programs

# S&E Division

## Policy & Standards

- Research and analysis which underpins the development of robust policy and industry standards.
- Stakeholder engagement and broad-based advocacy.

## Net Zero Transition

- Fuel supply reliability and pricing
- Net zero research and planning
- Sustainable fuel production ramp-up
- Acceleration programs

## Sustainability Programs

- Best practices & standards
- Support mechanism & systems
- Protect environmental data interests

## Industry Analysis

- Forecasting of passenger & cargo traffic
- Forecasting the industry’s financial performance
- Analyzing the industry in all its facets

## Data Science

- Support in DS on educational, applied and strategic level
- Enhancing team's BI tooling and capabilities
- Enabling Generative AI solutions

## Knowledge & Engagement

- Operational efficiency
- Knowledge products & tools
- Engagement platforms

# Value of Aviation - global support for employment and economic activity

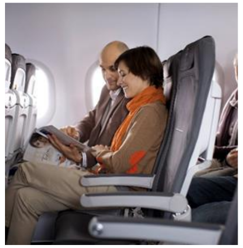
**648,000**
Airport operator staff

**5.5 million**
Other on-airport staff

**3.6 million**
Airline staff

**1.3 million**
Civil aerospace staff

**237,000**
ANSP staff






**17th** Largest economy
by GDP

| 11.3 million | Aviation direct | $961.3 billion |
|---|---|---|
| EMPLOYMENT | | ECONOMIC BENEFIT (GDP) |

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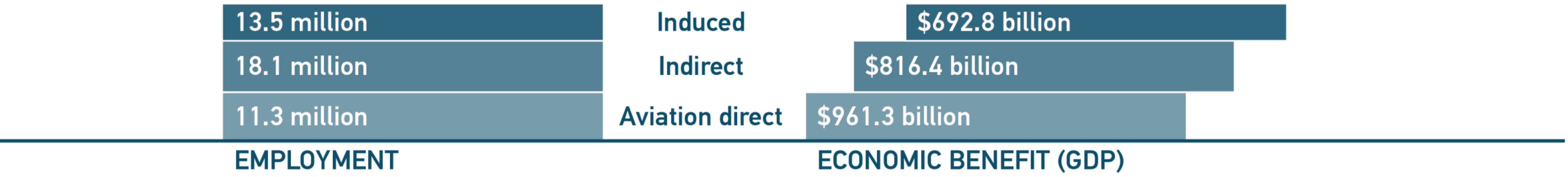
# Global support for employment and economic activity

# Global support for employment and economic activity

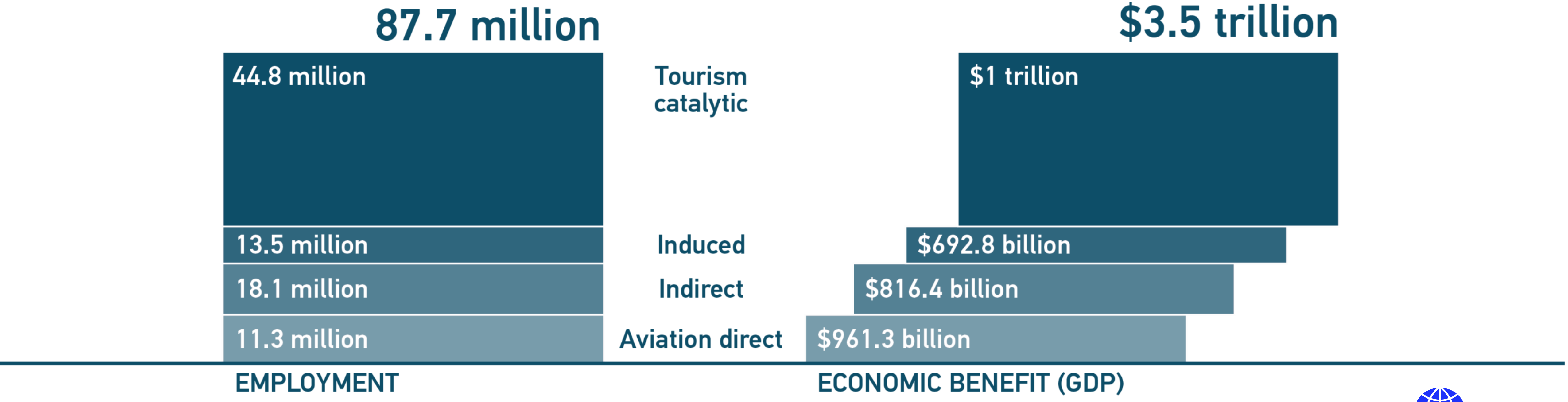


# Global support for employment and economic activity

**58%** **International tourists**
transported by air

**35%** **Global trade**
transported by air (by value): $6.5 trillion

# Global support for employment and economic activity

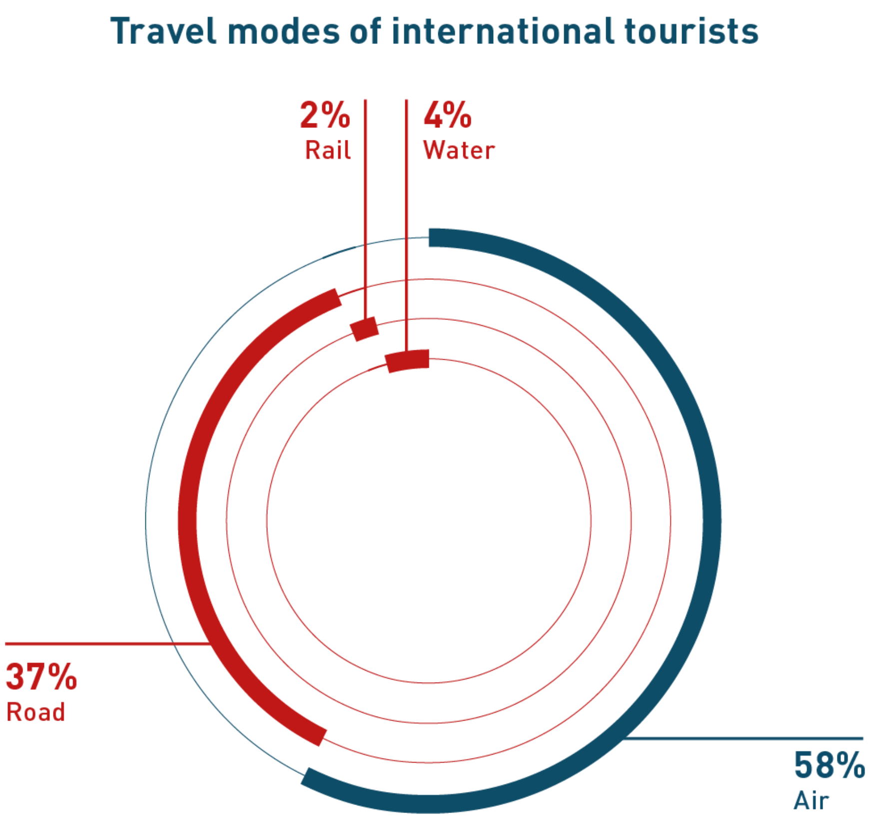


# Your holiday provides someone else's income

**44.8 million**
Tourism jobs supported by air transport

**$1 trillion**
in global GDP supported by air transport-related tourism

**$902 billion**
spent by international tourists in 2019



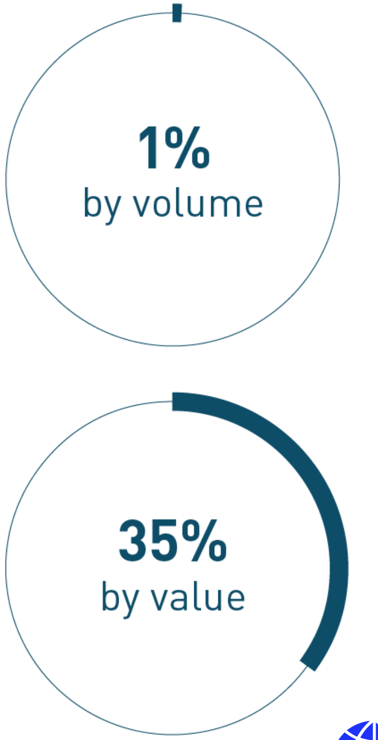
# What about Cargo?

## $6.5 trillion
Value of cargo handled by air, 2019

## 61 million
tonnes of cargo handled by air, 2019

## High value
Goods tend to be sent by air: e-commerce, perishables, medicines and electronics

**Proportion of global trade transported by air**



# Supporting UN sustainable development: 15 of 17 SDGs

- 1: NO POVERTY
- 2: ZERO HUNGER
- 3: GOOD HEALTH & WELLBEING
- 4: QUALITY EDUCATION
- 5: GENDER EQUALITY
- 6: CLEAN WATER & SANITATION
- 7: AFFORDABLE & CLEAN ENERGY
- 8: DECENT WORK & ECONOMIC GROWTH
- 9: INDUSTRY, INNOVATION & INFRASTRUCTURE

- 10: REDUCED INEQUALITIES
- 11: SUSTAINABLE CITIES & COMMUNITIES
- 12: RESPONSIBLE CONSUMPTION & PRODUCTION
- 13: CLIMATE ACTION
- 14: LIFE BELOW WATER
- 15: LIFE ON LAND
- 16: PEACE, JUSTICE & STRONG INSTITUTIONS
- 17: PARTNERSHIPS FOR THE GOALS

www.aviationbenefits.org/SDGs

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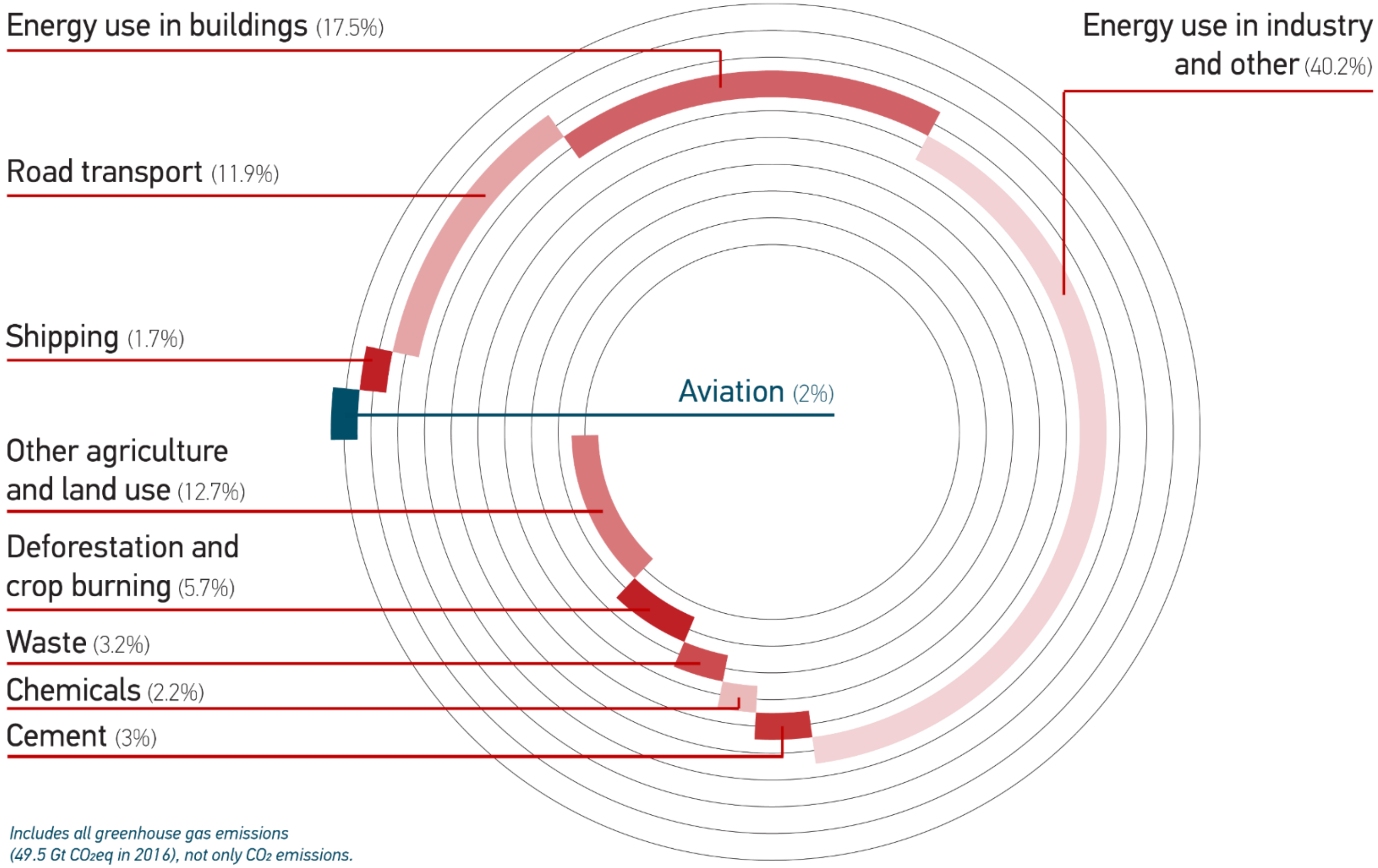
# Aviation's footprint




*Source: World Resources Institute, 2020*

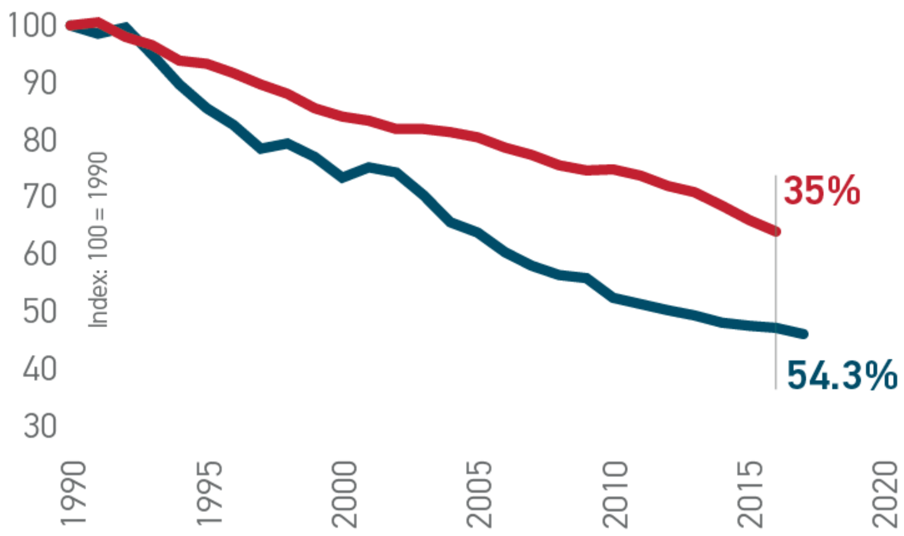
**2%**
Global $CO_2$ emissions

**1.3%** International / **0.7%** Domestic

**915Mt**
Aviation $CO_2$ in 2019

# Demonstrating continuous efficiency gains

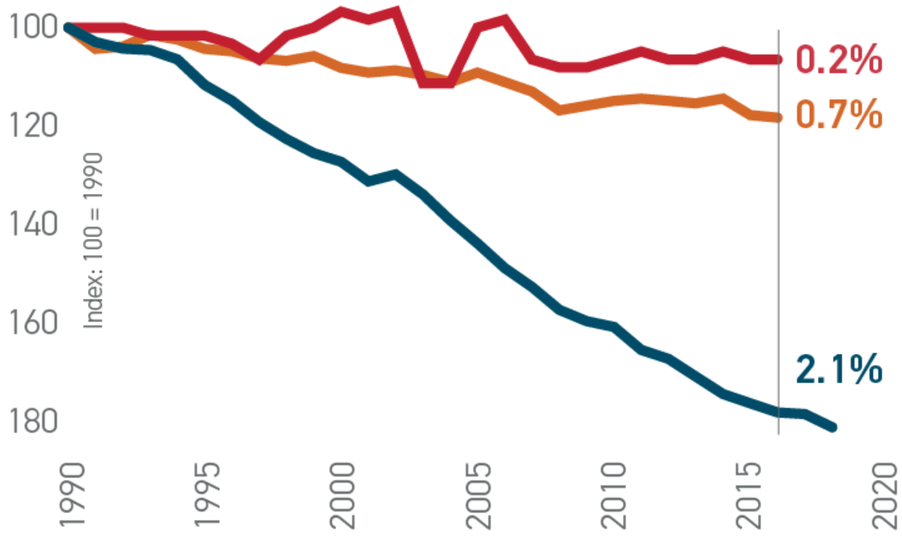
**Efficiency improvement since 1990** (index)




**Global economy** improvement in $CO_2$ per $GDP

**Global airlines** improvement in $CO_2$ per RTK

**Average efficiency improvement per year** (index)



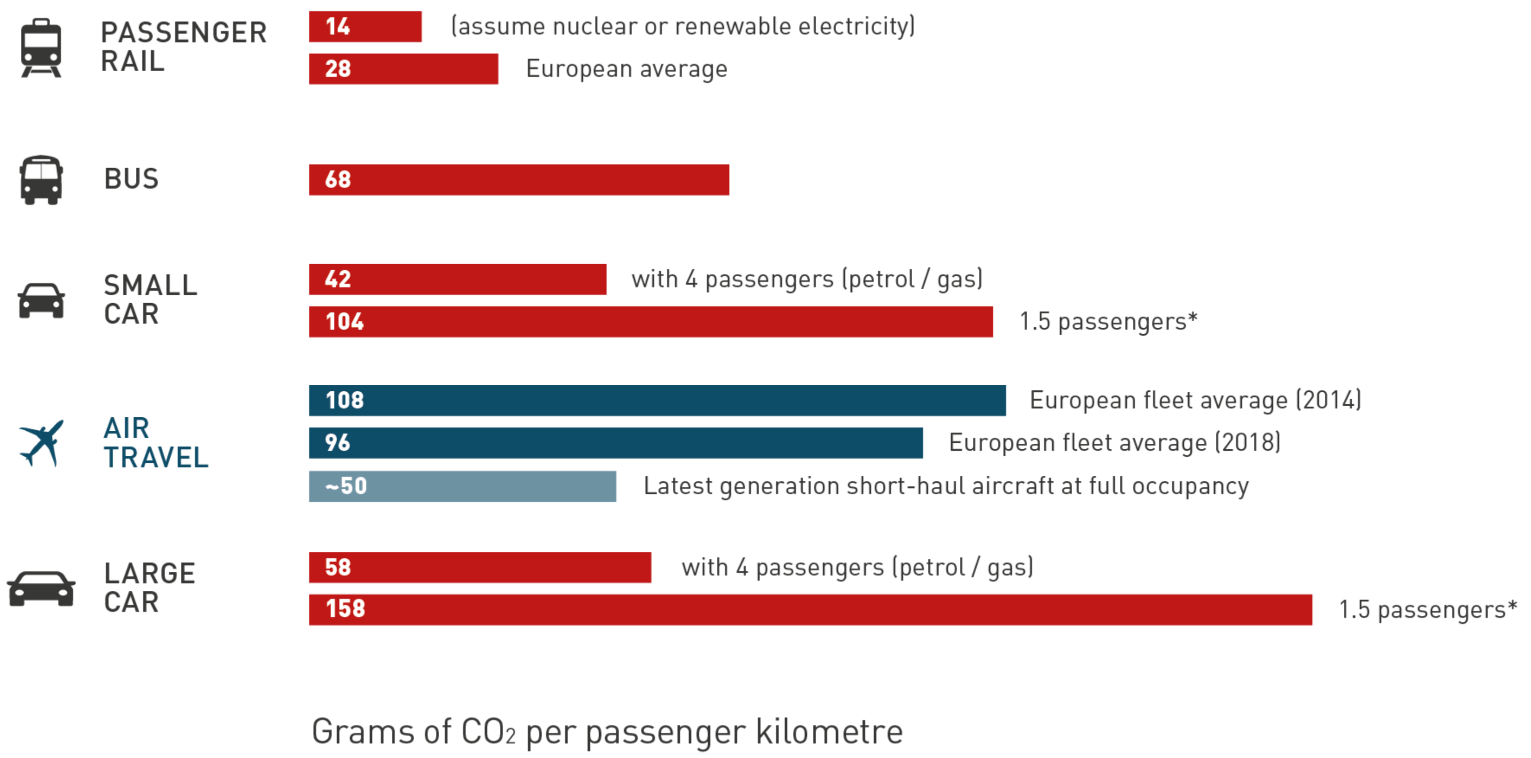

**Heavy-duty trucks** (US) gallons per mile

**Passenger cars** (US) gallons per mile

**Aircraft** gallons per tonne-kilometre

# Rapid efficiency gains compared with other transport modes

## Comparison of operational fuel efficiency between different modes of transport, 2014 EU




*Average occupancy of cars is around 1.5. These figures do not include embedded emissions from construction and maintenance of infrastructure, which are less important for aviation.

*Source: European Environment Agency and ATAG additional data*

Latest generation short-haul aircraft can have per-seat emissions of around 50g $CO_2$ per kilometre.

# Aviation Climate Goals

GOAL 1

1.5% AVERAGE ANNUAL FUEL EFFICIENCY IMPROVEMENT 2009-2020

*Pre-Covid-19 tracking above average at around 2% per annum*

GOAL 2

STABILISE NET AVIATION $CO_2$ EMISSIONS THROUGH CARBON-NEUTRAL GROWTH

*To be delivered for international aviation through the UN (ICAO CORSIA)*

GOAL 3

REACH NET-ZERO $CO_2$ EMISSIONS BY 2050

FLY NET ZERO

# Aviation's global climate strategy: goals and pillars of action

GOAL 1

1.5% AVERAGE ANNUAL FUEL EFFICIENCY IMPROVEMENT 2009-2020

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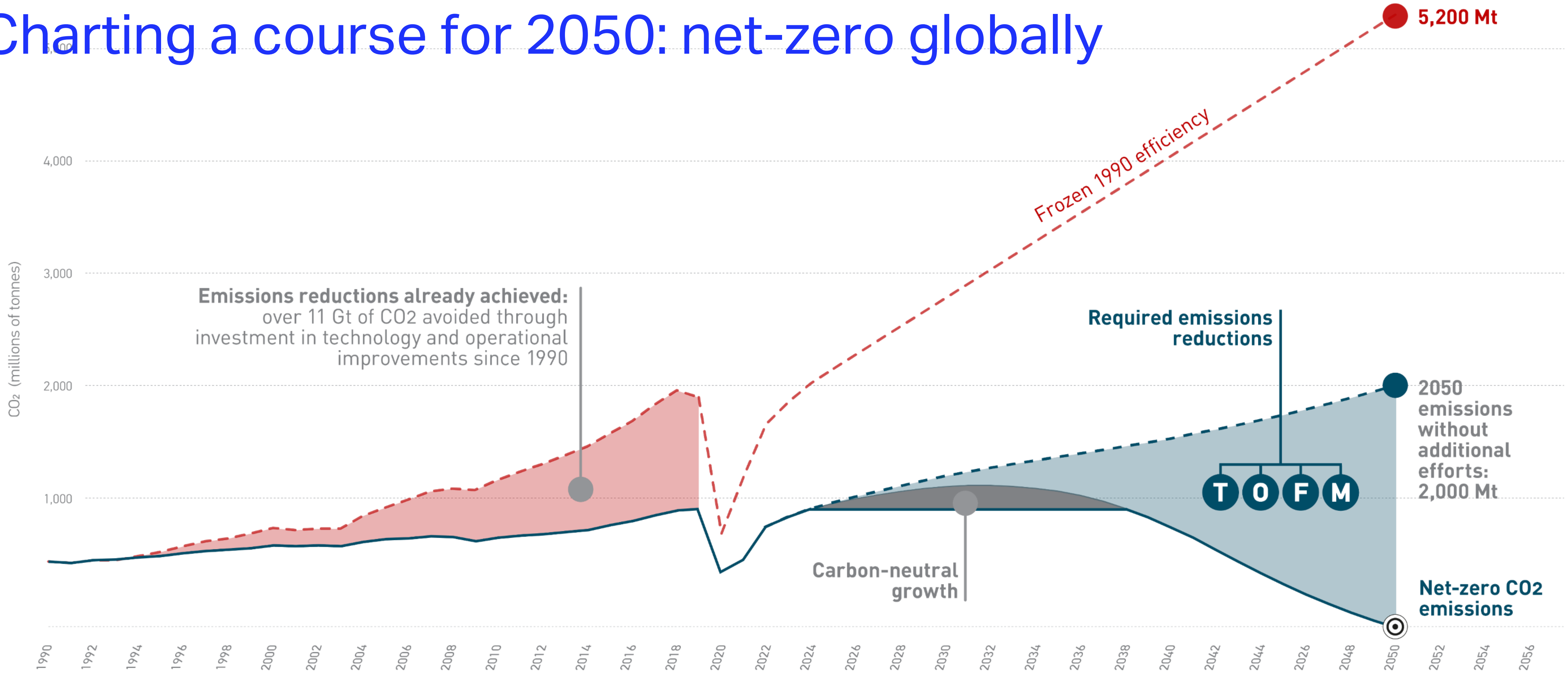
REACH NET-ZERO $CO_2$ EMISSIONS BY 2050

FLY NET ZERO

| T | O | F | M |
|---|---|---|---|
| TECHNOLOGY | OPERATIONS & INFRASTRUCTURE | SUSTAINABLE AVIATION FUEL | MARKET-BASED MEASURES |
| *Investing trillions in researching, certifying, launching and purchasing new technology aircraft.*<br><br>*Including evolutionary designs and revolutionary new concepts such as electric, hybrid and hydrogen options.* | *Improving the operational performance of aircraft (cutting weight, retrofitting new technologies, working with flight crews to fly more efficiently).*<br><br>*Infrastructure efficiency such as streamlined air traffic management.* | *Kick-starting an energy transition in aviation fuels away from fossil sources and towards fuels made from non-food crops, wastes and eventually from renewable electricity.* | *Committing to world's first sectoral carbon-pricing mechanism (CORSIA) and, by 2050, out-of-sector emissions reductions likely in the form of carbon removal opportunities.* |

# Charting a course for 2050: net-zero globally



# Technology

# What types of technology developments can we expect?

Over

**15,000**

new aircraft have been ordered by airlines since 2009

(Many of these to replace older, less-efficient aircraft)

**$15bn**

annually spent on efficiency research by manufacturers

Each new generation of aircraft is

**~20%**

more fuel efficient

Advancing radical new technologies:

**Electric, hybrid** and **hydrogen** aircraft for

**2035**

# Improve efficiency

| | 2023 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|

## Reducing in-flight energy

- Engine BPR of 10+ in service
- Geared turbofan in service thrust class: 150kN
- Laminar flow control in service on some aircraft and selected surfaces
- Electric actuation of some control surfaces
- Composite material wings and fuselage sections in service
- High Power Density Small Core Demo
- Open fan flight demonstrator
- Continuation of more electric control surfaces into all aircraft classes
- UHBPR: Low $NO_x$ engine flight test
- UHAR wing demonstrator
- Flight test: Revolutionary aircraft architecture – UHAR
- Hybrid or Blended wing body demonstrator
- Multi-function structures demonstrated
- **EIS of mild hybrid turboprop regional aircraft**
- **EIS of revolutionary Narrow Body Aircraft**
- **EIS of Next-gen Wide Body Aircraft (aspirational)**

**NET ZERO**

Propulsion

Aerodynamics and structures

Flight demonstrator

Systems

Decision point

Major milestone

**Acronyms**

**UHBPR**: Ultra High By-Pass Ratio
**EIS**: Entry Into Service
**SAF**: Sustainable Aviation Fuels
**a/c**: Aircraft
**UHAR**: Ultra High Aspect Ratio
**NM**: Nautical Miles
**HFC**: Hydrogen Fuel Cell
**KPI**: Key Performance Indicator
**GI**: Gravimetric Index
**$LH_2$**: Liquid Hydrogen
**UAM**: Urban Air mobility

# Changing the fuel... H2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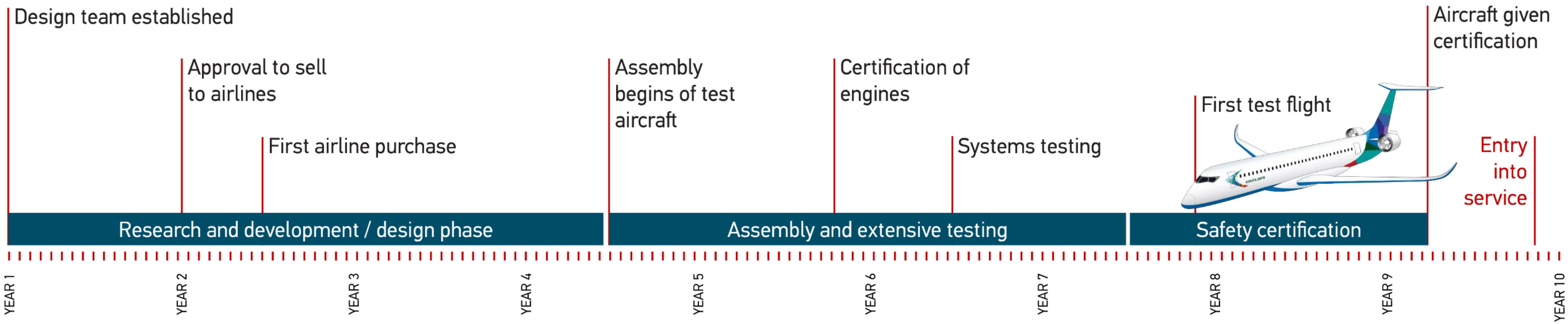
# How long does it take to develop and deliver a new aircraft?




## $10-30bn

Cost of developing a brand-new aircraft, depending on complexity

O

# Improvements in **operations** and **infrastructure**

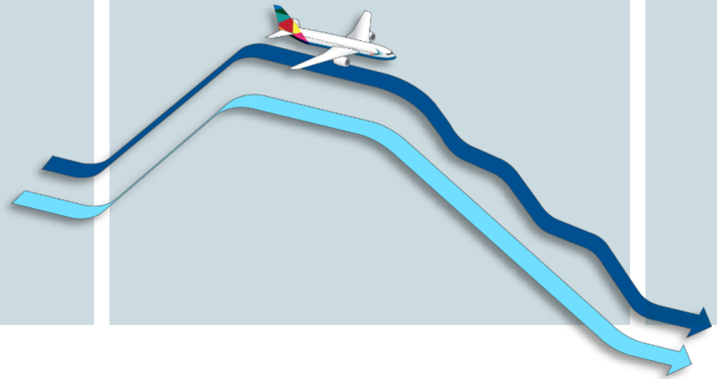
# Operational measures that can be deployed

## Flying better

- Wingtips reduce fuel use 4%
- Continuous descents save 150kg per landing
- Green departures to save fuel
- Cleaning engines to improve efficiency
- Single-engine taxiing (electric taxiing soon)

## Collaboration

- Real time information sharing between all operational partners (airport collaborative decision-making, A-CDM)



## Aircraft diet

- Lightweight seats
- Using tablets instead of paper flight documents
- Cabin equipment made of new materials
- Refuelling and loading water at the last minute

# F

# Deployment of **sustainable aviation fuel**

# Current state of deployment

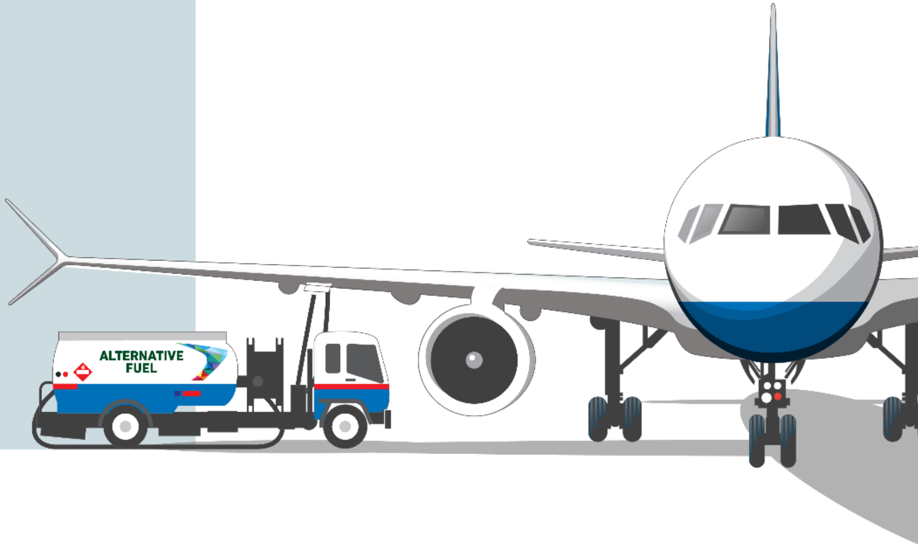
**600,000+**
Flights on SAF since 2011

**7**
technical pathways approved

**$40 bn**
SAF in (public) airline forward purchase agreements so far…

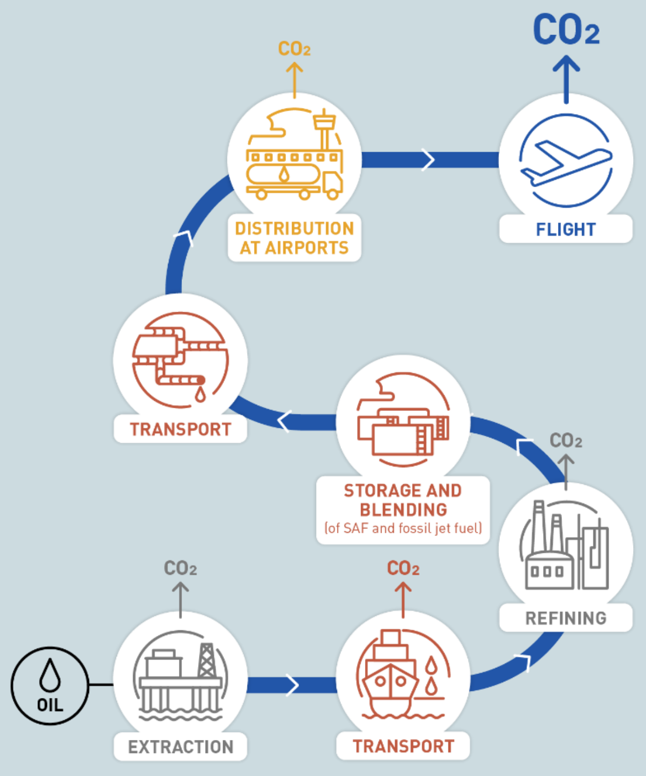
**<1%**
of global jet fuel is SAF currently

**14**
plants operating or under construction

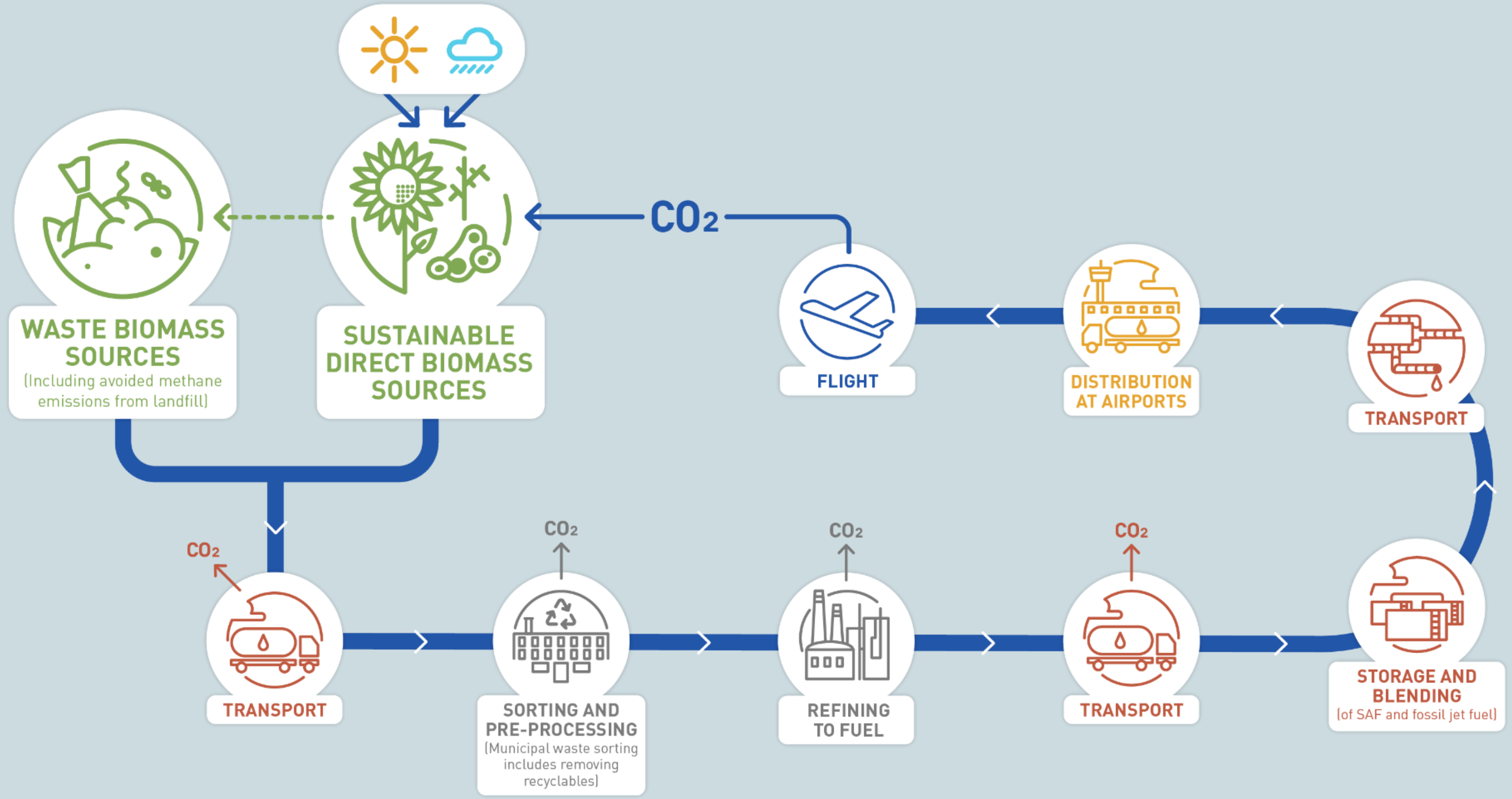


# How SAF leads to a reduction in $CO_2$

## Fossil jet fuel



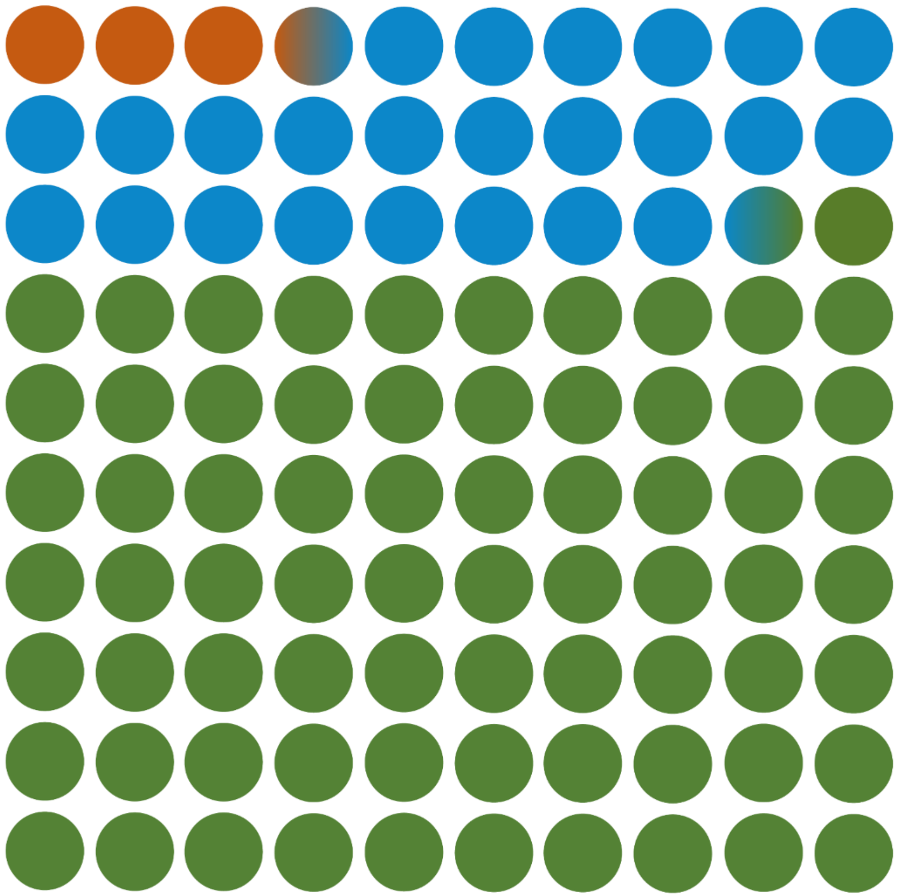

## Sustainable aviation fuel



# Indicative overview of where $CO_2$ measures could be deployed

| | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | |
|---|---|---|---|---|---|---|---|---|
| **Commuter**<br>» 9-50 seats<br>» <60 minute flights<br>» <1% of industry $CO_2$ | **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | ~27% of $CO_2$ emissions |
| **Regional**<br>» 50-100 seats<br>» 30-90 minute flights<br>» ~3% of industry $CO_2$ | **SAF** | **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | **Electric** or **hydrogen fuel cell** and/or **SAF** | |
| **Short-haul**<br>» 100-150 seats<br>» 45-120 minute flights<br>» ~24% of industry $CO_2$ | **SAF** | **SAF** | **SAF** | **SAF** potentially some **hydrogen** | **Hydrogen** and/or **SAF** | **Hydrogen** and/or **SAF** | **Hydrogen** and/or **SAF** | |
| **Medium-haul**<br>» 100-250 seats<br>» 60-150 minute flights<br>» ~43% of industry $CO_2$ | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** potentially some **hydrogen** | ~73% of $CO_2$ |
| **Long-haul**<br>» 250+ seats<br>» 150 minute + flights<br>» ~30% of industry $CO_2$ | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** | **SAF** | |

# SAF will remain a vital part of aviation decarbonisation



*ATAG schematic indication of potential energy use in 2050*

Even assuming highly optimistic use of **electric** and **hydrogen** energy for short-haul and some medium-haul operations in 2050, the vast majority of traffic (RPKs) will still rely on the use of **sustainable aviation fuel**.

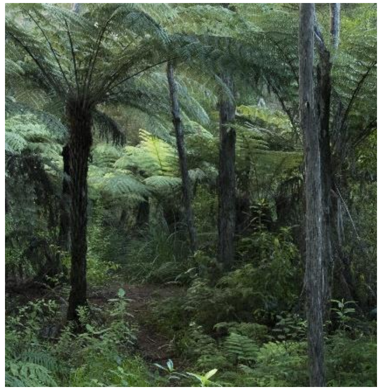
2050 % of operations by energy source (indicative example)

M

# **Offsetting**, market-based measures or investing in **out-of-sector carbon reduction**

# Carbon Offsetting



Current most common options → Most likely mid-century

Industrial carbon reduction

Renewable energy

Carbon reduction

Forestry

Natural carbon solutions

Carbon removal technology

# $CO_2$ Emissions Transparency & Calculations

# Ensuring Transparency on $CO_2$ Impact

- **$CO_2$ transparency** - rising expectations from passengers, corporates, agents, and regulators
- **Proliferation of calculators** and methodologies, no standardized approach
- **Lacking capacity** for all airlines to respond to requests

**1 out of 6**

IATA member airlines display $CO_2$ data on their website

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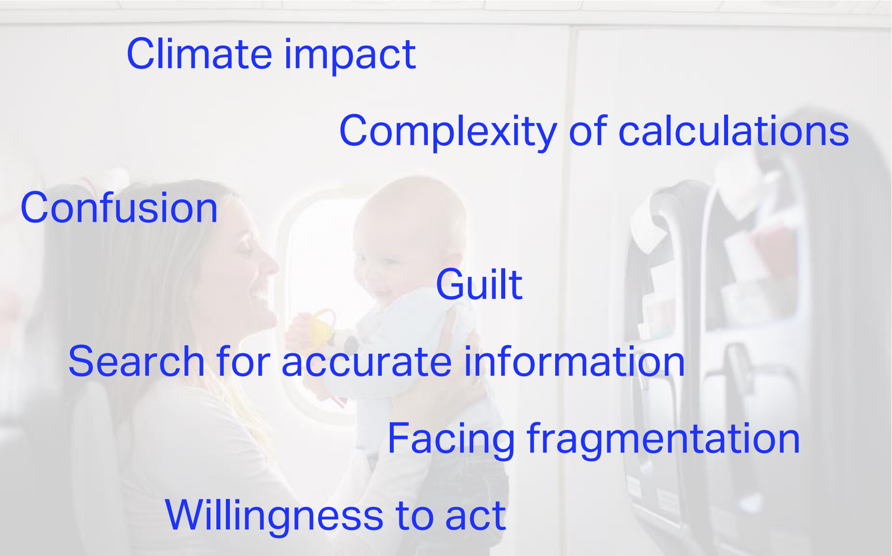
# The $CO_2$ Challenge

Urge to understand the environmental impact from flying.

## Passengers




## Airlines

# Background – $CO_2$ data

## Proliferation of calculators:

DEFRA
ICAO
ADEME
EN16258
Atmosfair
EcoTransit
EEA
...
...

- Lack of harmonization/standardization
- Methodology vs. calculator
- Theory vs. reality
- Absence of primary data
- Frequently outdated
- Need for adaptation & specific guidance

## Comparing results

150% variance between calculated results.

**LHR-GVA Economy - Return**

Calculator 1 – **183** kg $CO_2$
Calculator 2 – **210** kg $CO_2$
Calculator 3 – **274** kg $CO_2$
Calculator 4 – **240** kg $CO_2$

# Background – $CO_2$ data (2)

**Airline Mandate:**

1. Development of $CO_2$ methodology
2. Industry data model based on primary data
3. Global and consistent distribution of $CO_2$ results

57% of surveyed travel businesses indicated IATA as most credible source*

**survey conducted in November 2021*

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# IATA Standard Methodology (RP1726)

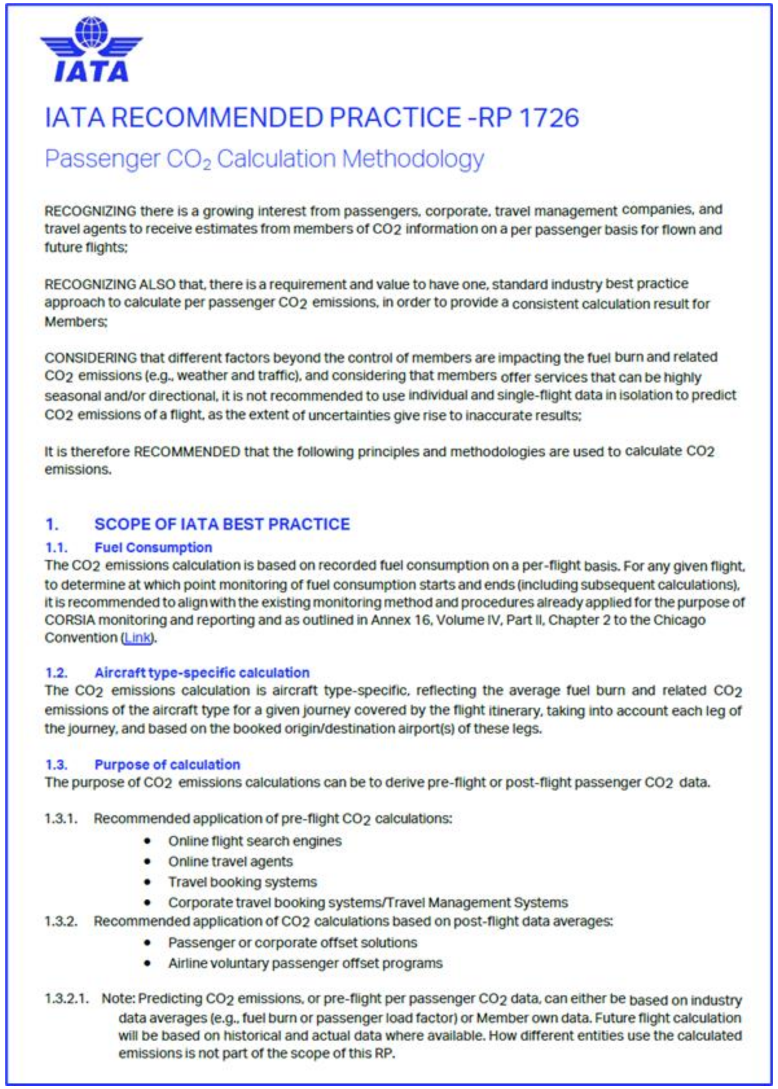
- Review of existing methodologies
- Identifying best practices within existing methodologies
- Step-by-step methodology based on airline best practices and with defined criteria in mind
- Degree of flexibility to account for airline or local specifics
- Developed by industry experts for the industry

**Criteria**

- Accuracy
- Simplicity
- Transparency
- Informative/Educational
- Alignment

# IATA Recommended Practice RP1726

- Based on **aircraft type-specific fuel consumption**
- Recommends use of **CORSIA MRV**
- **Clearly defined $CO_2$ scope**, including guidance regarding non-$CO_2$ emissions and RFI
- Weight-based $CO_2$ **allocation between pax and cargo**
- Cabin class factors **based on industry data**
- Guidance on **non-revenue pax/cargo and no-show pax**
- Guidance on **SAF and carbon offsetting**
- Recommends use of **independently audited data**



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IATA RECOMMENDED PRACTICE -RP 1726

Passenger $CO_2$ Calculation Methodology

RECOGNIZING there is a growing interest from passengers, corporate, travel management companies, and travel agents to receive estimates from members of CO2 information on a per passenger basis for flown and future flights;

RECOGNIZING ALSO that, there is a requirement and value to have one, standard industry best practice approach to calculate per passenger CO2 emissions, in order to provide a consistent calculation result for Members;

CONSIDERING that different factors beyond the control of members are impacting the fuel burn and related CO2 emissions (e.g., weather and traffic), and considering that members offer services that can be highly seasonal and/or directional, it is not recommended to use individual and single-flight data in isolation to predict CO2 emissions of a flight, as the extent of uncertainties give rise to inaccurate results;

It is therefore RECOMMENDED that the following principles and methodologies are used to calculate CO2 emissions.

1. SCOPE OF IATA BEST PRACTICE

1.1. Fuel Consumption

The CO2 emissions calculation is based on recorded fuel consumption on a per-flight basis. For any given flight, to determine at which point monitoring of fuel consumption starts and ends (including subsequent calculations), it is recommended to align with the existing monitoring method and procedures already applied for the purpose of CORSIA monitoring and reporting and as outlined in Annex 16, Volume IV, Part II, Chapter 2 to the Chicago Convention (Link).

1.2. Aircraft type-specific calculation

The CO2 emissions calculation is aircraft type-specific, reflecting the average fuel burn and related CO2 emissions of the aircraft type for a given journey covered by the flight itinerary, taking into account each leg of the journey, and based on the booked origin/destination airport(s) of these legs.

1.3. Purpose of calculation

The purpose of CO2 emissions calculations can be to derive pre-flight or post-flight passenger CO2 data.

1.3.1. Recommended application of pre-flight CO2 calculations:

- Online flight search engines
- Online travel agents
- Travel booking systems
- Corporate travel booking systems/Travel Management Systems

1.3.2. Recommended application of CO2 calculations based on post-flight data averages:

- Passenger or corporate offset solutions
- Airline voluntary passenger offset programs

1.3.2.1. Note: Predicting CO2 emissions, or pre-flight per passenger CO2 data, can either be based on industry data averages (e.g., fuel burn or passenger load factor) or Member own data. Future flight calculation will be based on historical and actual data where available. How different entities use the calculated emissions is not part of the scope of this RP.

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# IATA's CO2 CONNECT

IATA's industry data → $CO_2$ emissions calculation engine → $CO_2$ emissions data → Airlines / Online Travel Agents / Travel Management Companies / Online Booking Tools / Corporates / Travel Metasearch

Voluntary airline data contributed to improve accuracy

Based on a standard methodology developed by the industry

Data available via API, as a static data set & microsite

Airlines get consistency of $CO_2$ emissions shown across the distribution network





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# Calculation example: Flight XB123

**Flight information**

BKK-SIN
Date: 31.01.2023
Flight No: XB123
A/C: 738
Time: 140 mins
Airline: XB

**Aircraft-specific fuel burn**

Fuel: 5,508 kg

**Conversion to $CO_2$**

$CO_2$: 17,405 kg

**Weight distribution**

Passengers:
*13,800 kg (93%)*
Belly cargo:
1,038 kg (7%)

| | Econ | Prem | Biz | First |
|---|---|---|---|---|
| # Pax | 132 | 0 | 6 | 0 |

**Passenger breakdown**

**Weight based $CO_2$ allocation**

**Passenger** $CO_2$:
16,188 kg

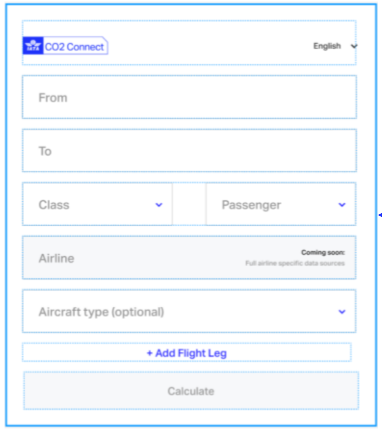
**Cabin factors (RP1726)**

| | Econ | Prem | Biz | First |
|---|---|---|---|---|
| Narrow | 1 | 1 | 1.5 | 1.5 |
| Wide | 1 | 1.5 | 4 | 5 |

**$CO_2$ – Economy**
**114.81 kg**

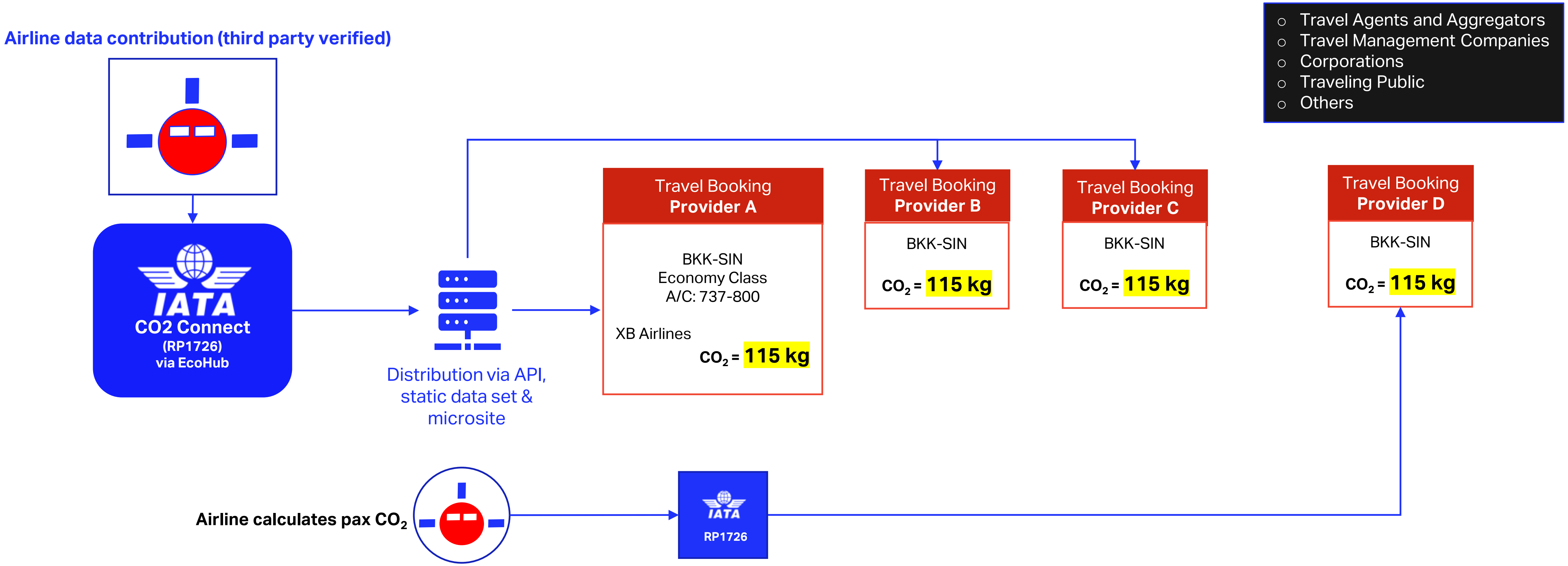
**$CO_2$ – Business**
**172.21 kg**

Airline Primary Data
IATA EcoHub




Public access
iata.org

# **Consistency of $CO_2$ emissions** shown across the distribution network.



# THANK YOU – Questions?