

AVIATION AND CLIMATE CHANGE

The air transport industry is a key driver of the global economy, supporting connectivity, a third of world trade and 65.5 million jobs. Like all other sectors, it has an impact on the environment and climate change.

Like nearly all human activities, air transport produces carbon dioxide (CO₂) emissions as it uses fuel to power aircraft. The efficiency of aircraft has improved continuously and, in fact, a flight taken today will produce half the CO₂ that the same flight would have in 1990. However, the industry is also growing rapidly to meet the needs of citizens around the world who wish to travel. That growth is often faster than the efficiency improvements, leading to a rise in overall emissions.

CO₂ emissions

Aviation produces around 2% of all human-induced CO₂ emissions: 895Mt of CO₂ in 2018. By comparison, this is less than the shipping sector and around the same as the servers and transmission cables of the internet (not including the computers and tablets accessing the internet)¹. Bitcoin mining alone produced 69Mt of CO₂ in 2017².

↳ International aviation (which falls outside of national CO₂ accounting) is around 1.3% of total CO₂ emissions – the size of Indonesia or Canada.

Other emissions

Whilst carbon dioxide is the greenhouse gas that has the most long-term impact (and is the only so-called 'Kyoto gas' generated by aviation), there are other emissions from flight. The exhaust of a jet engine is made up of:

- » 5% to 6% CO₂;
- » 2% water vapour;
- » around 0.03% nitrogen oxides, unburned hydrocarbons, carbon monoxide and sulphur oxides;
- » traces of hydroxyl family and nitrogen compounds and small amounts of soot particles (although the industry has managed to more or less eliminate soot emissions over the past few decades);
- » between 91.5% and 92.5% of aircraft engine exhaust is normal atmospheric oxygen and nitrogen.

It is important to note that not all gasses have the same climate impacts. CO₂ is the most notable greenhouse gas because of its long life, whereas some other gases (such as methane from agriculture and waste) have a much stronger impact on climate change, but a very short life.

Emissions at altitude

Some people assume that aviation emissions have more of an impact because they are released at higher altitudes than emissions from ground-based sources. For CO₂ emissions, the impact is the same no matter which altitude it is released. Other gases, such as nitrogen oxides, do have a larger climate impact as they react to other gases in the upper atmosphere.

Aviation produces

2.1%

of global CO₂
emissions

1.3% international
0.7% domestic

80% of aviation
emissions are from
flights over 1,500km
(that cannot easily be
replaced).

Total human CO₂*
2018:

42Gt

Total human GHG*
2018:

53Gt

Total aviation CO₂
2018:

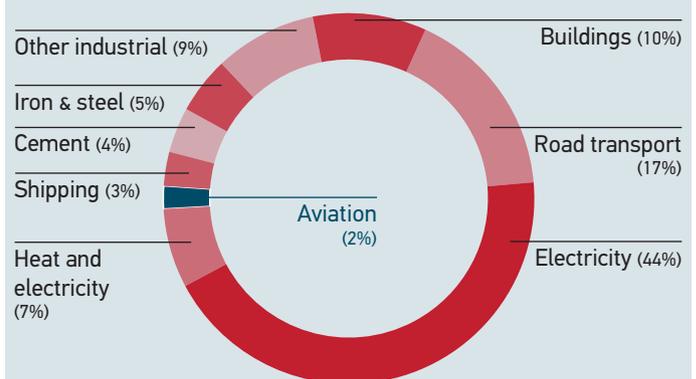
895Mt

80%

Today's aircraft are over 80% more efficient than the first jets from the 1950s.

Counting CO₂

Aviation makes up around 2% of global CO₂ emissions. Figures from 2014³.



NB: energy-related CO₂ emissions only. Does not include land use change emissions from agriculture or forestry which between them are around 25% of global greenhouse gas emissions.

Contrails

One of the most visible signs of aircraft movements are the white trails left behind as flights move through some areas of the sky. These are called contrails and are made up of ice crystals from the condensation of water vapour (like naturally-occurring clouds) produced from the combustion process inside the engine.

The impact of contrails (and the hazy cirrus clouds they sometimes generate as they dissipate) on climate change are not yet well understood. Some recent studies have shown that contrail-induced cirrus could help cool the planet during the day, but warm it at night.

It is actually possible to avoid creating contrails, either by flying around the areas of super-saturated cold air in which they form, or flying at a different altitude. However, this brings with it some downsides, as airlines use more fuel (and therefore emit more CO₂) to avoid these areas.

A number of airlines and aviation experts are engaged with research teams to investigate the impacts further.

A multiplier?

Given the fact that air transport does not just produce CO₂ but also other gases, some climate researchers like to multiply the CO₂ emissions by a factor to account for the extra warming generated by these other emissions. However, it should be remembered that most other sources of CO₂ also generate other greenhouse gases, these are often not included in sectoral accounting. Due to the uncertainty surrounding this multiplier (and the fact that it would differ depending on routes, times of year and even day or night operations), it is inappropriate for determining individual flight CO₂ emissions. The industry supports more research to understand the impact of other gases and to identify potential mitigation opportunities. Also, if it is to be applied to aviation, then a specific multiplier should also be applied to other sectors.

An energy transition

Until 2011, there was no certified alternative to traditional fossil fuel for air transport. However, airlines are now able to tap in to new sources of energy through sustainable aviation fuels produced from a variety of feedstocks – including waste by-products, non-food crops and potentially synthetic fuels. These currently cost significantly more than fossil jet fuel, but as production ramps up and supply increases, we expect sustainable aviation fuel to become more cost-competitive.

Eventually, there may be an option for electric or hybrid-electric aircraft to be used on short-haul flights. This is an area of increasing research in the aerospace industry.

Historical and future comparisons

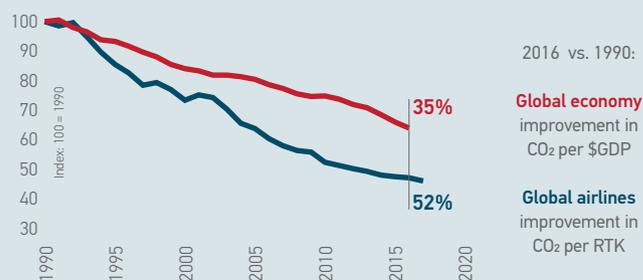
Aviation's CO₂ emissions have remained at around 2% of total global emissions since at least as far back as 1992⁴. Despite the growth in traffic of aviation, the industry's efforts to improve efficiency have ensured that the CO₂ growth has at least not outgrown the growth of emissions from the rest of the economy.

However, as all parts of the economy wake up to the need to cut emissions (and as other sectors already have access to low- or zero-carbon energy options), emissions from air transport are likely to become a larger proportion of total CO₂.

On this basis, the air transport industry came together in 2009 to launch a climate action plan – one of the first for any global transport network. You can read more about the industry plan on www.enviro.aero. At its heart is the need to balance the growth in connectivity and economic activity supported by air transport, with the need to react to climate change concerns. The industry is focused on cutting out CO₂ emissions whilst retaining the benefits of air transport in the long-term.

Improving efficiency faster than global economy

CO₂ emissions per unit of productivity



Improving efficiency faster than road vehicles

Average fuel efficiency improvement per year since 1990



* CO₂ emissions includes CO₂ from forestry and other land-use change. GHG: including CO₂-eq from other greenhouse gas emissions covered by the UNFCCC / Kyoto Protocol

¹ University of Hawai'i study published in Nature Climate Change *Bitcoin emissions alone could push global warming above 2°C*, 2018

² Boston Consulting Group study, November 2017

³ Science Magazine, *Net-zero emissions energy systems*, June 2018

⁴ IPCC *Special Report on Aviation and the Global Atmosphere*, 1999