

Big Challenges Facing the Aviation Industry in Reducing Fuel Emissions - Path to Net Zero?

Carbon dioxide emissions, primarily from the combustion of fossil fuels, have risen dramatically since the start of the industrial revolution. In 2022, Global energy-related CO₂ emissions grew by more than 300 million tonnes, reaching a high of 37 billion tonnes (CO₂eq). Emissions from oil grew by 2.5% (268 Mt) to 11.2 Gt in 2022. Approximately half of this increase, 235Mt, resulted from aviation as air travel continued its recovery from the covid pandemic lows. Annual jet fuel consumption is approaching 100 bn gallons per year. Estimations of the contribution of overall emissions by the global aviation fleet range between 2.5% and 3.5%. The lower percentage value accounts for CO₂ emissions alone while the higher percentage includes vapour condensation trails (contrails) which contribute additionally to atmospheric warming. The number of domestic and global airline flights worldwide was estimated at 22 million in 2021. With approximately 30,000 flights per day, the number of 'passenger flights' per year was 4.5bn, with expected growth to 7.7bn by 2050.

The world is at a crisis point owing to atmospheric emissions and their adverse impacts on global climate. Responsibility rests with individuals, companies, nations, and sectors to make the necessary adjustments that will help reduce the levels of greenhouse gases in Earth's atmosphere. The target is to achieve **net zero emissions by 2050**.

The aviation industry has much to be proud of, not least the outstanding achievements from the early years of flight, - *Wright Brothers (1903)*, *radar (1942)*, *the International Convention of Civil Aviation (1944)*... So much has been achieved in the interim 80 years, a relatively short period of time. Today, General Electric, Rolls Royce and Pratt & Whitney are leading names in the manufacture of gas turbine engines. It is hoped that advancements in the development of Sustainable Aviation Fuels (SAF) – made from non-petroleum feedstocks, may become a viable cleaner alternative to existing petroleum fuel. If successful, SAF, coupled with engine refinements, will help flatten the rising curve associated with aviation emissions. Other emerging fuel developments including biodiesel – manufactured from vegetable oil, and ethanol – made from corn, may also contribute as alternative sustainable solutions.

In parallel to sustainable fuel development, Hydrogen as a power source by fuel-cell generation (Airbus zero-emission challenge), and electric and hybrid-electric powered airlines will also emerge as maturing members of tomorrow's global fleet. There are also new design innovations in rotary aircraft for the modern age.

Moving further afield, Spaceflight has truly emerged as 'the new frontier'. – *Perseverance missions to Mars*, *Exploration of the Moons of Jupiter (JUICE)*, and *SpaceX Ariane (ESA)*, to name but a few of the scientific wonder projects of modern times.

In order to launch, a spaceflight provides the initial thrust to overcome the force of gravity and propel the spacecraft from the surface of the Earth. Once in space, it's motion, whether unpropelled or under propulsion, is determined under the influence of gravity between the craft and other planetary bodies. Some spacecrafts have remained in space indefinitely, creating space pollution and potential hazard to other spacecraft. Most spacecraft are terminated by atmospheric re-entry, in which they disintegrate, or their re-entry is controlled to safely reach a surface by landing on land or sea.

Whether actual timelines to 'zero emissions 2050' are achievable, is debatable. What is not debatable is the necessity to make every effort to reduce emissions and to ensure that Earth's atmosphere is returned to better health. We must all come aboard with unified mission.