

GREEN FLIGHT

From sustainable fuel to hydrogen-propelled engines, the aviation sector is experimenting with various technologies for a clean future

SEEMA PRASAD,
NEW DELHI

THE GLOBAL aviation sector consumes over one billion litres of fuel a day, according to a 2021 research paper published in *IOF Science*. The sector was also directly responsible for 2 per cent of the global carbon emissions in 2021, as per the International Energy Agency (IEA). "If things continue as they are, emissions from the sector will not meet net-zero targets," says Lynnette Dray, a senior research associate at University College London who specialises in aviation emissions and airline competition.

Little wonder, the sector is exploring a host of green technologies that include cleaner fuel sourced from biomass, hydrogen and e-aircraft. The technologies are in the early stages and success will depend on several factors.

SOURCING GREEN FUEL

This February, Indian Oil, the country's largest aviation fuel provider, announced that at least 2 per cent of its aviation fuel by 2030 will be sourced from ethanol, a green fuel made from plant waste. The company has tied up with LanzaJet, a US-based fuel

manufacturer that has a refinery in Panipat, to achieve the target.

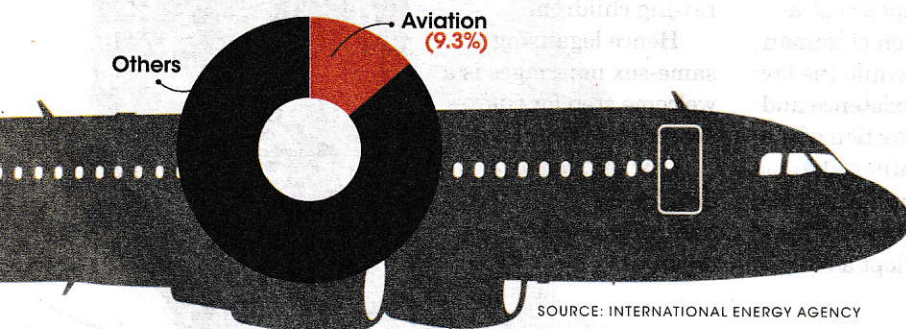
Sustainable aviation fuels are hydrocarbon molecules sourced from plant or animal material and usually blended with conventional aviation fuel sourced from fossil fuels. The green hydrocarbon molecules are collected through a process called hydrodeoxygenation, in which oxygen and other impurities such as sulphur and nitrogen are chemically removed.

In November 2021, the Indian Air Force became the first domestic agency to give a provisional clearance to the use of sustainable aviation fuel, developed by the Indian Institute of Petroleum (IIP) in Dehradun. "So far, we have produced 10,000 litres from non-edible and edible oil sources such as palm stearin, used cooking oil, sapium oil, jatropha, *karanja* and algae oil," says Anjan Ray, director, IIP.

Indian airlines such as Vistara and Indigo are collaborating with

DIRTY FUEL

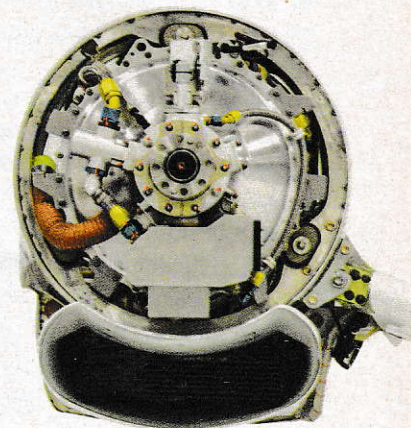
Share of aviation in transport sector's greenhouse gas emissions in 2021



SOURCE: INTERNATIONAL ENERGY AGENCY



PHOTOGRAPHS: AIRBUS, EVIATION ALICE



IIP to develop clean fuel. In 2015, SpiceJet flew an aircraft using sustainable aviation fuel sourced from jatropha crops and blended with 75 per cent conventional fuel. This fuel is awaiting international certification, ASTM D4054.

While India is yet to use sustainable aviation fuel commercially, developed countries, particularly those in Europe and the US, are making the shift. Currently, over 300,000 flights across the world are powered by sustainable aviation fuel. Finland-based Neste produces over 12 million litres of green fuel annually. It is derived from used cooking oil and animal fat and can reduce greenhouse gas emissions by 80 per cent, claims the company. Similarly, US firm World Energy sells nearly 284 million litres of green fuel a year and plans to double its production by 2024. Airbus, the world's second-largest aircraft manufacturer, claims all

(Clockwise from above) A prototype aeroplane propelled by combusting liquid hydrogen stored in four tanks; a propeller system for electric aircraft; a fuel cell that can store electricity from hydrogen; sustainable aviation fuel that can be blended with conventional fuel



its existing flights can run on a 50 per cent sustainable aviation fuel blend.

Blended sustainable fuel remains the most popular green alternative as it does not require any engine modification. But experts say there is a huge mismatch between its demand and supply.

India, for instance, does not have a manufacturing plant so far. The first such plant is being set up by Mangalore Refinery and Petrochemicals and is expected to start production by 2025. "The plant will have a capacity of 7,000 tonnes per year. To achieve even

jet fuel in India, depending on the pathway and feedstock.

HYDROGEN FOR POWER

Besides sustainable aviation fuel, Airbus is betting high on hydrogen. The European company is exploring two ways in which hydrogen can be used to fly aircraft: first, hydrogen combustion in a gas turbine; and second, using fuel cells to convert hydrogen into electricity that can power a propeller engine.

In February 2022, Airbus announced its first prototype aircraft with a hydrogen combustion engine, ZeroE demonstrator. It

and Aircraft, a publication released in January 2023 by the International Transport Forum (ITF), an intergovernmental organisation of 64 countries. A study published in 2022 by the International Council on Clean Transportation on a narrow-body hydrogen aircraft found it had a shorter flight range than conventional flights. "Green hydrogen as a source of energy is still a scarce resource, and scaling it comes with its own set of challenges," says Jayanth Mukhopadhyay, author of the study.

GOING ELECTRIC

Manufacturers are also exploring the possibility of developing electric aircraft. US-based Eviation recently bagged a \$74 million deal from NASA to develop nine-seater electric planes. The firm successfully completed a test flight of a battery-operated, nine-seat aircraft, Eviation Alice, at an altitude of 1,000 metres above sea level last November. It is currently obtaining necessary certifications for commercial release. "Current battery energy density and weight severely restrict the range of battery-electric flights and the size of aircraft," says Till Bunsen at ITF.

"Sustainable aviation is going to require a mix of technologies to replace the existing combustion-based power. Electric, hydrogen, sustainable aviation fuel, and hybrids will all serve different missions. Short-haul flights are where we can make strides on zero-emission aviation in the near future with electric aviation," says Gregory Davis, president and CEO of Eviation Alice. [eviation.com](https://www.eviation.com) @down2earthindia

(The article is part of a series on innovations to clean the transport sector)



On January 19, ZeroAvia successfully completed a 10-minute pilot flight of a 19-seat aircraft powered with hydrogen fuel cells at Cotswold Airport in Gloucestershire, UK

1 per cent blending in India, we will need about 60,000 tonnes a year," says Ray. A similar problem also exists in the global market. "If you look at the current blend mandate suggested by countries around the world and the rate of increased planned production capacity for years to come, there appears to be a mismatch," says Dray. The fuel is also expensive. According to the "World Economic Report 2021", it is 200–500 per cent more expensive than fossil

plans to commercially roll out the technology by 2035. In November 2022, the company unveiled a hydrogen-powered fuel cell engine.

However, the technology has its fair share of problems. "Liquid hydrogen requires systems that are larger and heavier than conventional systems and do not fit in aircraft wings. Fuel tanks may therefore need to be installed in the aircraft body, affecting the aircraft seating capacity," says *The Potential of E-fuels to Decarbonise Ships*