INTESA SANPAOLO INNOVATION CENTER

MOST
CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

SPOKE 14

INDUSTRY TRENDS REPORT

AUTOMOTIVE, TRANSPORTATION & LOGISTICS

AVIATION AND ADVANCED AIR MOBILITY

FROST & SULLIVAN

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

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EXECUTIVE SUMMARY

Commercial aviation makes up approximately 3% of all carbon dioxide (CO2) globally and without emissions control efforts this percentage is expected to continue to rise.

As a response, market participants are working to move to alternative power sources with new fuels potentially contributing 65% to 2050 net-zero targets. Alternatives to conventional jet fuel include hydrogen and electricity as well as sustainable substitutes such as synthetic sources and nuclear. In addition to helping to achieve emissions goals, new fuels offer a long-term economic benefit and allow industry stakeholders to fulfil regulatory obligations.

Uptake of **hydrogen fuel** is being sponsored by financial support for the wider hydrogen (H2) space which stems from national and international governmental organizations. It is also being driven by adoption in adjacent industries with emerging applications notably in automotive, space and maritime.

Nonetheless, the capital expenditure required to develop renewable energy projects means that the cost of hydrogen as a fuel remains prohibitively high. Overall, there are positives and negatives to using hydrogen as a jet fuel with the primary challenges sitting around production and storage capacity.

The industry is however making strides with established original equipment manufacturers (OEMs) such as Airbus and emerging low-emission specialists like Zeroavia launching H2 planes. Partnerships will be key to accelerating the developments of the field and engine manufacturers have a significant role to play too; Pratt & Whitney and CFM International are, for example, both launching hydrogen-specific solutions. Airlines are also getting in on the act with United, Alaska and Connect all exploring the potential of H2 propulsion systems in the US and in Europe Icelandair is working with Heart Aerospace to deploy hydrogen.

Electric propulsion offers similar advantages to hydrogen in terms of reduced CO2 emissions but also promises to open up new short haul routes and destinations.

Here, ***all-electric*** aircraft are an option as are ***hybrid*** fuel and electric planes. As with hydrogen, the nascent industry consists of multiple different stakeholders all of which will need to play a role for electric aircraft to take off extensively.

There are certain prerequisites for electric's widespread commercial use which notably include the need to radically improve batteries' power-to-weight ratios. A recognised system of for certifying electric propulsion will also be key while many upgrades in airport infrastructure will also have to follow suit.

There are currently four main all electric platforms globally which are supported by a number of industry wide initiatives while almost all major airlines have all electric deployment plans including EasyJet. Over time, its use is expected to extend from commuter to longer haul routes as tech improves and the cost differential versus conventional jet fuel reduce. Greater efficiency will notably be supported by the development of blended wing planes which merge the fuselage and wing into a single structure.

Sustainable aviation fuels (SAFs) beyond hydrogen and electric include biofuels.

As with hydrogen, their development is being led by engine manufacturers such as Rolls Royce which successfully demonstrated SAFs on a Boeing in 2021. GE Aviation has similarly partnered with NASA to create sustainable engines for single-aisle aircraft and is working to improve fuel efficiency.

More broadly, IndiGo was the first Indian airline to publish a sustainability report in 2021 which speaks to the industry's growing focus on the environment. Ethiad's Greenliner is similarly a test bed for other novel "green" innovations.

In the longer term, the aviation industry is looking to the space sector for inspiration in respect to alternative and sustainable forms of fuel. Nuclear thermal propulsion is not a new idea but it is becoming a reality. Its development is expected to be accelerated by the advent of deep space missions where conventional and emerging fuels are currently insufficient.

Actions in the air are being matched by plans on the ground to make the industry more sustainable with Changi Airport, for example, auditing its CO2 reduction efforts.

Broadly, initiatives split into three main groups with noise compensation programs and the hosting of organic farms among the emerging ***social*** provisions. From an ***environment*** point of view, the use of green buildings and renewable energies are a key part of many operators' strategies. Finally, the delivery of facilities for Vertical Take Off and Landing (VTOL) operations can boost an airport's ***economics*** and also integrate it into surrounding city areas.

Indeed, increased investment in and production of electric eVTOL aircraft is expected to pave the way for **urban air mobility** (UAM) adoption.

The market will be boosted by the promise of improved sustainability as well as reduced congestion in the context of continued and accelerating urbanization. UAM use cases include the emergency services but eVTOLs are primarily intended for cargo and in particular passenger transport.

As for hydrogen and electric aircraft, a number of challenges – notably, the lack of UAM specific infrastructure – will need to be overcome for greater uptake. Airports will therefore be pivotal to building the Urban Air Mobility market and stand to benefit from their investments through the generation of extended and new aero and non-aero revenues streams.

The provision of connections to rail and other transport modes will also be key with key players in the European UAM market include URBANV (Italy) which plans to begin operations between Rome Fiumicino and Termini as early as 2024.

This report examines innovations across new fuels and other areas, including UAM, and analyses the contribution that the aviation industry can make to emission reductions.

INTRODUCTION

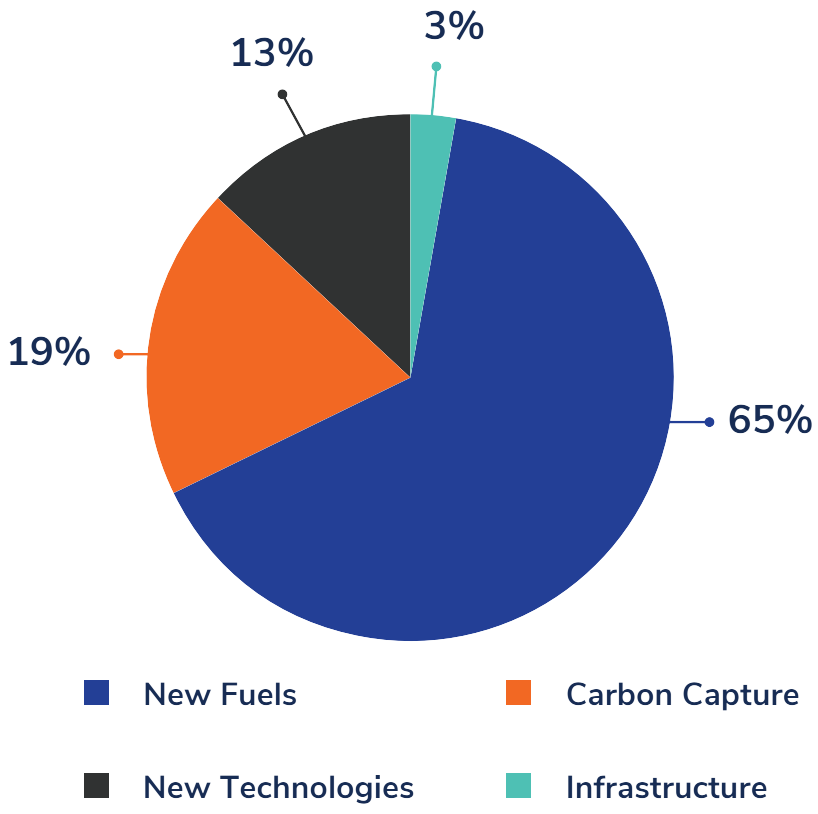
Commercial aviation makes up ~3% of all CO2 globally and without emissions control efforts this percentage is expected to continue to rise

With passenger volumes constantly increasing and the number of aircraft forecasted to almost double globally by 2050, emissions grew 2.2% between 2005 and 2010 from 650 million metric tons (mt) to 664, 16.7% between 2010 and 2015 (to 775 mt), and 16.8% from 2015 to 2019 (to 905 mt). The drop in 2021 to 547 mt only resulted from the complete shutdown of the aviation industry which the COVID-19 pandemic caused.

As a response, market participants are working to move to alternative power sources with new fuels potentially contributing 65% to 2050 net-zero targets

Use of innovative aviation fuels is expected to have the most significant impact on the CO2 which stems from the industry. By 2050, collective measures to control emissions – which also include carbon capture and other new technologies as well as infrastructure changes – will save almost 21.2 gigatons of CO2 in comparison to levels that the commercial aviation industry will emit if the regular use traditional fuel continues.

CONTRIBUTIONS TO NET-ZERO CARBON EMISSIONS IN THE AVIATION INDUSTRY BY 2050, GLOBAL



Source: Frost & Sullivan

Alternatives to traditional jet fuel include hydrogen and electricity as well as sustainable substitutes such as synthetic sources and nuclear

The automotive industry has successfully used **hydrogen** as a cleaner alternative to traditional fuels. Various ways to source hydrogen exist, the most common process being steam-methane reforming.

Green hydrogen is the product of renewable energy sources and requires no carbon consumption during all related processes making it a prime contender for alternative aviation fuel whilst *blue hydrogen* relies on a secondary carbon capture process that prevents the release of CO2 into the atmosphere and *grey hydrogen* is the product of fossil fuels.

Battery technology has been upgraded throughout the last decade with short-haul **electric** air travel now close to being a reality. Electric propulsion systems have shown promising results in advanced air mobility.

Conventional jet fuel stems from crude oil whereas **sustainable aviation fuels** (SAFs) come from materials that have been re- or upcycled.

Other alternatives include **synthetic** fuels which are typically liquids that result from processing methanol, coal or syngas via Fischer-Tropsch conversion as well as **nuclear** which is in the concept stage.

Source: Frost & Sullivan

In addition to helping to achieve emissions goals, new fuels offer a long-term economic benefit and allow industry stakeholders to fulfil regulatory obligations

Achieving emissions goals

Governments across the globe are pledging to reduce CO2 with many setting targets to lower emissions by up to half by 2050 if not before. Since the aviation industry makes a significant contribution to air pollution, it is receiving heavy criticism from members of the public and national and international agencies alike which is driving the exploration of new fuels.

Offering economic benefits

Electric engines are also simpler and easier to maintain, repair and overhaul (MRO). Moving to alternative fuel aircraft could help reduce lifetime costs by 60% to 70%. Gas turbine engines need an overhaul every 7,000 to 9,000 hours whereas electric engines are expected to be reviewed about every 20,000 to 25,000 hours which reduces the need for MRO activity.

Fulfilling regulatory needs

Strict standards for CO2 emissions from aircraft are set by the International Civil Aviation Organization (ICAO) and have led airlines and aircraft manufacturers (OEMs) to work on solutions that will help them comply with these rules. The release of greenhouse gas (GHG) requirements for aircraft operating in the United States by the Environmental Protection Agency (EPA) has also put pressure on the industry to reduce emissions.

Hydrogen, electric or SAF-powered aircraft enable the industry to be more environmentally friendly and adhere to these regulations and standards.

In July 2021, the European Commission announced a plan to facilitate its green transition, curb at least 55% of GHG emissions by 2030 and reach its climate neutrality goal by 2050. The ReFuelEU proposal under Fit for 55 encourages SAF production and usage with the European Union expected to mandate every airline departing from airports within the region to refuel a minimum 2% of SAF in 2025, regardless of airline origin or destination. The minimum SAF threshold will increase every 5 years to achieve 63% by 2050.

This report examines innovations across new fuels and other areas and analyses the contribution that the aviation industry can make to emission reductions

AAM	*Advanced air mobility*	**LCC**	*Low-cost carrier*
ASEP	*Air-scooping electric propulsion*	**M**	*Million*
B	*Billion*	**mL**	*Million liters*
CO2	*Carbon dioxide*	**MRO**	*Maintainance, repair and overhaul*
DEP	*Distributed electric propulsion*	**OEM**	*Original equipment manufacturer*
EV	*Electric vehicle*	**PPT**	*Pulsed plasma thruster*
GHG	*Greenhouse gas*	**SAF**	*Sustainable aviation fuel*
H2	*Hydrogen*	**UAM**	*Urban air mobility*
HEFA	*Hydroprocessed esters and fatty acid*	**UK**	*United Kingdom*
kL	*Thousand liters*	**US**	*United States*
Km	*Kilometer*	**VTOL**	*Vertical take off and landing*

ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact

businessdevelopment@intesasanpaoloinnovationcenter.com

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LIVIO VANINETTI
Director of Frost & Sullivan's Italian operations
livio.vaninetti@frost.com

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