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Aviation Emissions Control - Impact and Opportunities, 2023 - A Global and Regional Analysis: Focus on Trends, Opportunities, Key Regulations, Markets, and Products - Analysis and Forecast, 2022-2042

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Abstracts

Aviation Emissions Control Overview

The global emissions from commercial aviation amounted to 865.72 MMT of CO2 in 2021, and it is expected to grow at a CAGR of 3.03% and reach 1,203.42 MMT of CO2 by 2032. The medium-haul and short-haul flight segments are expected to be the highest contributors owing to their increasing demand and newer airport hubs being established for domestic and regional air travel. The ecosystem of aviation emissions control comprises aircraft manufacturers, subsystem manufacturers, and airline operators.

Market Lifecycle Stage

Trafditionally, fleet renewals to more fuel-efficient aircraft and transition to more efficient narrowbody aircraft have been key in the industry's strategy toward emissions control and emissions intensity reduction. However, as the effort of all industries to decarbonize and reduce emissions is becoming a priority, revolutionary solutions such as electric and hydrogen propulsion and low-emissions jet fuels and their development programs are being accelerated by both private participants and government organizations. In the most likely scenario of emissions, the adoption of SAF and fleet renewals is key to the incremental reduction in aviation emissions. However, a high reduction in emissions can be achieved by bringing the technology readiness of green aviation to market for at least short-haul flight demands with eventual growth to include medium-haul flight

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segments.

Impact

The increasing demand for medium-haul flights and short-haul flights is driving the emissions from these segments. The growth to 2019 levels of flight demands and above by around 2029 is expected to decelerate the emissions control measures and their adoption in order to respond to the scale of passenger flights.

Furthermore, the slow pace of the maturation of technologies and the low availability of SAF feedstock for sustained commercial flight operations is expected to cause a bottleneck in the decarbonization efforts of the industry.

Market Segmentation:

Segmentation 1: Emissions Analysis by Fleet-Flight

Narrowbody Long-Haul Flights

Narrowbody Medium-Haul Flights

Narrowbody Short-Haul Flights

Widebody Long-Haul Flights

Widebody Medium-Haul Flights

Widebody Short-Haul Flights

Turboprop Medium-Haul Flights

Turboprop Short-Haul Flights

Regional Jet Long-Haul Flights

Regional Jet Medium-Haul Flights

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Regional Jet Short-Haul Flights

Based on Fleet-Flight, the global aviation emissions from commercial flights will be the highest from narrowbody medium-haul flight operations, followed closely by widebody long-haul emissions. Both segments are important for global connectivity and contribute significantly to the aviation industry's revenue from commercial flights. Aircraft and engine manufacturers are investing in research and development of green propulsion technologies, such as hydrogen and electric propulsion, for entry into the market in the next decade to keep commercial flights sustainable in the future.

Segmentation 2: Emissions Analysis by Scenario

Scenario 1: No Emissions Control

Scenario 2: Optimistic Scenario

Scenario 3: Ideal Scenario

Scenario 4: Most Likely Scenario

Emissions from the no emissions control scenario (Scenario 1) are the highest and are based on the current emissions control technologies and measures projected on the flight forecasts. Scenario 2 is optimistic, with wide adoption of SAF frequent fleet renewals bringing down the emissions significantly by 2042. Emissions from the ideal scenario (Scenario 3) are the lowest and are heavily focused on maturation as well as the adoption of electric and hydrogen propulsion for high-volume flight operations. The emissions reduction possible in this scenario is the highest, with the 2042 emissions reducing to below 2022 levels, even with monotonically increasing flight demands in all segments. The most likely scenario (Scenario 4) factors in realistic levels of adoption of SAF and late emergence and maturation of technologies. The industry is expected to prioritize demand and high frequency heavily, given the contraction in volume during COVID and the slow recovery. Emissions are above those for scenario 2 (optimistic scenario) and below that for no emissions control scenario.

Segmentation 3: Flight Demand Analysis by Fleet-Flight

Narrowbody Long-Haul Flights

Narrowbody Medium-Haul Flights

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Narrowbody Short-Haul Flights

Widebody Long-Haul Flights

Widebody Medium-Haul Flights

Widebody Short-Haul Flights

Turboprop Medium-Haul Flights

Turboprop Short-Haul Flights

Regional Jet Long-Haul Flights

Regional Jet Medium-Haul Flights

Regional Jet Short-Haul Flights

Based on Fleet-Flight, demand for medium and short-haul flights is expected to increase significantly. Newer routes, as well as higher frequencies on dense international and domestic routes, are expected as the global aviation industry recovers from the COVID-induced contraction in demand. The short-haul international flight segments are seen to grow significantly, with neighboring countries strengthening their connectivity and increasing the number of airports domestically. Asia-Pacific short-haul routes to and from nations such as India, China, and Singapore are expected to contribute significantly to the growth in flight demands from this segment.

Segmentation 4: e-VTOL Aircraft Production by Range

50 Km or less (500Km)

Based on Range, manufacturers of eVTOL of ranges greater than 500 Km will have the highest production annually. Since eVTOL is very low emissions, their adoption in critical segments of air transport, such as short-haul travel, will improve their uptake significantly while reducing the subsequent emissions from all other modes of transport. The 201-500 Km range of eVTOL will witness high demand as well for low passenger capacity air travel long-distance intracity operations. The solution can eventually be scaled for at least low-capacity short-haul international flights with scheduled operations

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from the current airport infrastructure.

Segmentation 5: by Region

North America - U.S., Canada

Europe - France, Germany, Russia, U.K., and Rest-of-Europe

Asia-Pacific - Australia, China, India, Japan, Singapore, and Rest-of-Asia-Pacific

Rest-of-the-World

Based on region, North America is expected to continue as the highest contributor to aviation emissions in the most likely scenario (Scenario 4). The emissions from Asia-Pacific are expected to increase, while the Europe region's flight emissions will reduce with the regionwide adoption of decarbonization measures such as SAF adoption and intramodal travel.

Recent Developments in Aviation Emissions Control

In February 2022, Embraer S.A., Wider?e Corporation, and Rolls-Royce plc. entered a partnership agreement with the objective of jointly developing green propulsion technology for commercial aviation. The agreement is expected to lead to the development of a potential regional aircraft based on hydrogen and/or electric propulsion. Currently, feasibility studies and conceptual design of the aircraft are underway.

In July 2022, GE Aerospace completed the initial testing phase of its megawatt-class hybrid electric propulsion system designed to power commercial aircraft. The milestone test will take the development toward the integration and certification phases, with the company planning to make the engine available for airframers by 2030 at the earliest.

In June 2022, Airbus and the Japanese government signed an MoU that will develop pathways for the adoption of hydrogen in the Japanese aviation sector. Under the agreement, infrastructure for the use of hydrogen in flights, as well as jet fuel-based ground operations, will be developed.

Demand - Drivers and Limitations

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The following are the demand drivers for Aviation Emissions Control:

Prioritization of Sustainable Aviation Operations and Manufacturing

Innovation at the Industrial Level for Reduction of Fuel Burn and Improved Aircraft Performance

Demand from New Regulatory Standards for Aviation Emissions

The following are the challenges for Aviation Emissions Control:

Growing Demand for International and Domestic Travel

Impact of Complex Regulatory Requirements from Environmental Agencies

Impact of COVID on the Aviation Market

Impact of Economic Slowdown on the Aviation Market

The following are the opportunities for Aviation Emissions Control:

Emerging Technologies in Aircraft Propulsion - Hydrogen and Electric Propulsion, SAF Fuel Compatibility

Evolving Opportunities in Sustainable Aircraft Design

How can this report add value to an organization?

Product/Innovation Strategy: The chapter on estimation and comparative analysis of greenhouse gas emissions from aviation builds on the global fleet and global flight projections to forecast the industry's emissions. Four scenarios of emissions capturing the response of the aviation industry and the corresponding emissions from their operations are presented: No emissions control scenario (scenario 1), Optimistic scenario (scenario 2), Ideal scenario (scenario 3), and the Most likely scenario (scenario 4). Each of them has emissions values from the 12 possible fleet-flight segments

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comprised of four aircraft types (narrowbody, widebody, turboprop, and regional jet) and three flight segments (long, medium, and short-haul) based on emissions control measures in each scenario. This enables aircraft manufacturers and airline operators to understand the tangible impact of decarbonization strategy on various fleet-flight emissions. As such, these participants can assess the impact of the adoption of current and future emissions control measures ranging from SAF adoption to the maturation of liquid hydrogen-based propulsion.

Growth/Marketing Strategy: There is an increased urgency to address the emissions from all industrial sectors and within aviation to reach a net-zero goal by 2050. In order to achieve this, there has been a significant increase in green aviation developments by key players operating in the market, such as business expansion activities, contracts, mergers, partnerships, collaborations, and joint ventures. The favored strategy for the companies has been MoUs and joint-research agreements to strengthen their position as part of the aviation emissions control methods. For instance, in November 2022, major aerospace companies Airbus, MTU AeroEngines, Pratt & Whitney, Collins Aerospace, and GKN formed a global consortium to accelerate the development of next-generation propulsion technology. The key objective is the development of a Sustainable Water-Injecting Turbofan Comprising Hybrid-Electrics (SWITCH), which will substantially reduce emissions in the full operational envelope of the aircraft. The final engine is also expected to be fully compatible with alternative fuels such as hydrogen and SAF.

Competitive Strategy: Key players in aviation emissions control analyzed and profiled in the study involve aircraft manufacturers, subsystem manufacturers as well as airline operators. Moreover, a detailed competitive benchmarking of the players has been done to help the reader understand how players stack against each other, presenting a clear market landscape. Additionally, comprehensive competitive strategies such as contracts, partnerships, agreements, acquisitions, and collaborations will aid the reader in understanding the untapped revenue pockets in the market.

Key Market Players and Competition Synopsis

The companies that are profiled have been selected based on inputs gathered from primary experts and analysis of the company's coverage, product portfolio, and market penetration.

The top segment players leading the market are established players in the aviation emissions control, who constitute 100% of the presence in the market.

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Key Companies Profiled

Company Type 1: Aircraft and Subsystem Manufacturers

- Airbus SE
- Embraer S.A.
- GE Aerospace
- Gulfstream Aerospace Corporation
- MTU Aero Engines
- Pratt & Whitney
- Rolls-Royce plc.
- Safran S.A.
- Textron Aviation Inc.
- The Boeing Company

Company Type 2: Airline Operators

- American Airlines
- Deutsche Lufthansa AG
- Singapore Airlines Group (SIA)
- The Emirates Group
- United Airlines, Inc.

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5 MARKETS - COMPETITIVE BENCHMARKING & COMPANY PROFILES

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