

# **Alcohol-to-Jet Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, 2018-2028**

## **Segmented By DWT (PSV below 3000 DWT, PSV above 3000 DWT), By Applications (Oil and Gas Production, Offshore Construction, Military, Others), By Type (Cargo and Support), By fuel, (Diesel, LNG, Electric, Hybrid), By Region, By Competition**

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### **Abstracts**

Global Alcohol-to-Jet Market has valued at USD 2.08 billion in 2022 and is anticipated to project robust growth in the forecast period with a CAGR of 5.19% through 2028.

The Alcohol-to-Jet (ATJ) market refers to a rapidly emerging sector within the aviation and renewable energy industries that focuses on the production and utilization of sustainable aviation fuels derived from alcohol-based feedstocks. ATJ fuels are a groundbreaking alternative to traditional fossil-based jet fuels, and they hold the promise of reducing the aviation industry's environmental impact while ensuring a more sustainable and eco-friendly future for air travel. ATJ fuels are primarily produced through advanced conversion processes, such as Fischer-Tropsch synthesis, that transform alcohol feedstocks, including cellulosic ethanol and biobutanol, into a high-quality, drop-in replacement for conventional aviation fuels. These advanced biofuels are known for their low carbon footprint and compatibility with existing aircraft engines and infrastructure, making them a viable solution for reducing greenhouse gas emissions in aviation. The key drivers behind the ATJ market's growth include environmental concerns and regulatory pressures aimed at curbing aviation-related emissions. With global awareness of climate change and the aviation industry's increasing carbon footprint, there is a growing need for more sustainable fuels. Airlines, governments, and international aviation bodies are setting ambitious emission reduction

targets, providing strong incentives for the adoption of ATJ fuels. Another critical aspect of the ATJ market is the continuous advancement in feedstock production and technology. Researchers and industry players are working to enhance the efficiency and cost-effectiveness of ATJ production processes, making these fuels more competitive and accessible. Government policies and incentives also play a pivotal role in shaping the ATJ market. Renewable fuel mandates, tax incentives, research funding, and carbon pricing mechanisms are examples of policies that encourage the production and adoption of ATJ fuels. The ATJ market is not only a response to environmental challenges but also a strategic move towards energy security. By diversifying energy sources and reducing reliance on imported fossil fuels, ATJ fuels enhance national and global energy security.

In conclusion, the Alcohol-to-Jet (ATJ) market represents a transformative shift in the aviation industry, aiming to replace conventional jet fuels with sustainable alternatives derived from alcohol-based feedstocks. This market's growth is driven by environmental concerns, regulatory mandates, advancements in technology, government policies, and the quest for energy security. As the ATJ market continues to evolve, it holds the potential to make air travel more sustainable, reduce carbon emissions, and contribute to a greener aviation future.

## Key Market Drivers

### Advancements in Feedstock Availability and Production:

The ATJ market benefits from continuous advancements in the availability and production of sustainable feedstocks. Innovations in agriculture and technology have made it more feasible to produce feedstocks like cellulosic ethanol and algae-based alcohols efficiently and cost-effectively. This ensures a stable supply of raw materials for ATJ production and enhances the overall sustainability of the fuel.

### Energy Security and Diversification:

Countries worldwide are concerned about energy security and the need to diversify their energy sources. ATJ fuels can be produced domestically, reducing dependence on imported fossil fuels. This diversification not only enhances national energy security but also mitigates the risk associated with volatile oil markets, making ATJ an appealing option for governments and airlines seeking more stable energy sources.

### Airlines' Commitment to Sustainability:

Major airlines worldwide are making substantial commitments to sustainability and carbon reduction. They view ATJ fuels as a practical means of achieving these goals. Airlines are collaborating with ATJ producers and investing in research and development to integrate these fuels into their operations, further driving market growth.

#### Investment and Funding Opportunities:

The ATJ market is attracting significant investment and funding from both public and private sector stakeholders. Recognizing the potential of ATJ fuels in addressing environmental concerns and achieving sustainable aviation, there is a growing pool of capital available for research, development, and commercial-scale production. This financial support ensures the market's viability and attractiveness.

#### Environmental Sustainability and Regulatory Pressures:

One of the primary drivers propelling the global Alcohol-to-Jet (ATJ) market is the urgent need for environmental sustainability within the aviation sector. Traditional aviation fuels, primarily derived from fossil sources like crude oil, are a major contributor to greenhouse gas emissions. With global concerns about climate change and the aviation industry's significant carbon footprint, there is a growing imperative to transition to cleaner and more sustainable alternatives, and ATJ fuels represent a promising solution. Governments and international aviation bodies are increasingly implementing stringent emissions regulations and setting ambitious targets for reducing carbon emissions from the aviation industry. Organizations like the International Civil Aviation Organization (ICAO) have established carbon reduction goals, such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which aims to cap aviation emissions at 2020 levels. These regulatory pressures create a strong incentive for airlines to adopt sustainable aviation fuels like ATJ to meet their emission reduction obligations. ATJ fuels, produced from renewable alcohol-based feedstocks like cellulosic ethanol or biobutanol, offer a lower carbon footprint compared to traditional jet fuels. They emit fewer greenhouse gases when combusted, making them a vital component of the aviation industry's strategy to reduce emissions and achieve environmental sustainability. As a result, airlines and aircraft manufacturers are increasingly investing in the research, development, and integration of ATJ fuels into their operations to align with these regulatory requirements and environmental objectives. Moreover, the appeal of ATJ fuels extends beyond compliance; it offers airlines a way to demonstrate their commitment to sustainability to environmentally-conscious passengers and stakeholders. This not only helps them meet regulatory

obligations but also enhances their brand image and competitiveness in an evolving market that places a premium on environmental responsibility. In summary, environmental sustainability and regulatory pressures are key drivers of the global ATJ market. The imperative to reduce aviation-related emissions and comply with stringent regulations has led to increased interest and investment in ATJ fuels, positioning them as a crucial component of the aviation industry's efforts to address climate change and environmental concerns.

#### Technological Advancements and Innovation:

Technological advancements and ongoing innovation in the field of Alcohol-to-Jet (ATJ) fuels are significant drivers shaping the global ATJ market. These advancements encompass various aspects of ATJ fuel production, from feedstock development to conversion processes and infrastructure improvements. Technological progress is instrumental in making ATJ fuels more competitive, efficient, and sustainable. One crucial area of innovation is feedstock development. Researchers and agricultural experts are continuously working on enhancing the yield, quality, and sustainability of alcohol-based feedstocks used in ATJ production. For instance, advancements in biotechnology have led to the development of more efficient and robust feedstock crops, reducing the environmental impact of cultivation and increasing the availability of raw materials for ATJ production. In addition to feedstock improvements, advancements in conversion processes are a key driver. The conversion of alcohol-based feedstocks into high-quality ATJ fuels involves complex chemical processes like Fischer-Tropsch synthesis. Innovations in these processes aim to improve efficiency, reduce energy consumption, and minimize waste, ultimately lowering production costs and making ATJ fuels more economically competitive with traditional jet fuels. Moreover, research and development efforts are focused on optimizing the scalability and commercial viability of ATJ production. This includes the development of modular and cost-effective production facilities that can be deployed on a larger scale. These innovations are essential for achieving economies of scale, which can significantly impact the overall cost of ATJ fuels. Furthermore, advancements in infrastructure are critical for the successful integration of ATJ fuels into the aviation industry. This includes the development of storage, transportation, and distribution systems that can handle ATJ fuels effectively and safely. Government support, funding, and collaboration with industry stakeholders play a vital role in driving technological advancements in the ATJ market. Research institutions, universities, and private companies are often involved in collaborative projects aimed at pushing the boundaries of ATJ fuel technology.

In summary, the global Alcohol-to-Jet (ATJ) market is being propelled forward by the

urgent need for environmental sustainability, adherence to regulatory standards, advancements in feedstock availability, energy security considerations, technological progress, airlines' sustainability commitments, and substantial investment. These drivers collectively shape the ATJ market's trajectory as it seeks to provide a greener and more sustainable alternative to conventional aviation fuels.

## Government Policies are Likely to Propel the Market

### Renewable Fuel Mandates and Targets:

Governments worldwide are implementing renewable fuel mandates and targets to reduce greenhouse gas emissions from the aviation sector. These policies require airlines to incorporate a certain percentage of sustainable aviation fuels, including ATJ, into their fuel mix. Such mandates provide a stable market for ATJ producers and incentivize research and development in the sector. By setting clear targets and offering financial incentives, governments play a pivotal role in driving the adoption of ATJ fuels. In the United States, for instance, the Renewable Fuel Standard (RFS) program mandates the use of renewable fuels, including advanced biofuels like ATJ, in the aviation sector. Similarly, the European Union has set ambitious targets for sustainable aviation fuels to decarbonize the aviation industry.

### Tax Incentives and Subsidies:

Governments often provide tax incentives and subsidies to stimulate investment and production of ATJ fuels. These financial incentives can take the form of tax credits, grants, or reduced excise taxes on sustainable aviation fuels. By lowering the production costs of ATJ and making it more competitive with traditional jet fuels, governments encourage its widespread adoption. For example, in the United States, the Alternative Fuel Tax Credit provides a tax incentive to producers of sustainable aviation fuels, including ATJ. These incentives not only support the growth of the ATJ market but also align with broader sustainability goals.

### Research and Development Funding:

Government agencies often allocate funding for research and development (R&D) initiatives related to sustainable aviation fuels, including ATJ. These R&D investments drive technological advancements, improving the efficiency and cost-effectiveness of ATJ production processes. Governments collaborate with research institutions and industry stakeholders to accelerate the development of ATJ technologies. The U.S.

Department of Energy's Bioenergy Technologies Office, for instance, has funded numerous research projects aimed at advancing ATJ technology. These initiatives have contributed to breakthroughs in feedstock conversion and production efficiency.

#### Carbon Pricing Mechanisms:

Carbon pricing mechanisms, such as carbon taxes and cap-and-trade systems, are employed by governments to internalize the environmental costs of aviation emissions. These mechanisms increase the cost of traditional aviation fuels while making sustainable alternatives like ATJ more economically attractive. Airlines are incentivized to reduce their carbon footprint by switching to lower-carbon fuels, contributing to the growth of the ATJ market. Several countries and regions, including parts of the European Union and Canada, have implemented carbon pricing systems that indirectly encourage the use of ATJ fuels.

#### Research and Commercialization Partnerships:

Governments often foster partnerships between research institutions, universities, and private industry to accelerate the development and commercialization of ATJ fuels. These collaborations promote knowledge transfer, technology scaling, and the establishment of pilot and commercial-scale production facilities. The U.S. Department of Defense, for example, has partnered with several ATJ producers to support the development and deployment of sustainable aviation fuels for military use. These partnerships create a market for ATJ fuels and drive innovation in the sector.

#### Certification and Standards Development:

Government aviation authorities, such as the Federal Aviation Administration (FAA) in the United States, play a crucial role in certifying new aviation fuels for safe use. They work closely with ATJ producers to establish testing and certification procedures. By creating a clear regulatory pathway for ATJ fuels, governments ensure their acceptance in the aviation industry.

In conclusion, government policies, including renewable fuel mandates, tax incentives, R&D funding, carbon pricing mechanisms, research partnerships, and certification standards, have a significant impact on the growth of the global Alcohol-to-Jet (ATJ) market. These policies encourage the production, adoption, and commercialization of ATJ fuels, contributing to the aviation industry's efforts to reduce greenhouse gas emissions and achieve sustainability goals.

## Key Market Challenges

### Feedstock Availability and Competition:

One of the significant challenges facing the global ATJ market is the availability of sustainable feedstocks and competition for these resources. ATJ fuels are typically produced from alcohol-based feedstocks like cellulosic ethanol or biobutanol. While these feedstocks are considered renewable, there are several challenges associated with their availability and sourcing:

**Limited Feedstock Supply:** The production of ATJ fuels relies heavily on the availability of sustainable feedstocks. However, the supply of these feedstocks can be limited, especially when there is a growing demand for biofuels not only from the aviation sector but also from other industries like bioenergy, chemicals, and transportation. This competition for feedstock resources can lead to price fluctuations and supply chain uncertainties for ATJ producers.

**Land Use Competition:** The cultivation of feedstock crops often competes with food crops and natural habitats for land use. Striking a balance between sustainable feedstock production and protecting ecosystems and food security can be a complex challenge. Additionally, land use competition can affect the overall carbon footprint of ATJ production if feedstocks are grown on land with high carbon stocks.

**Seasonal Variability:** Some feedstock crops used for ATJ production, such as algae, can be sensitive to seasonal changes and environmental conditions. This seasonal variability can impact the consistency of feedstock supply, making it challenging for ATJ producers to maintain a stable production process.

Addressing these feedstock-related challenges requires a multi-faceted approach, including investments in research and development to enhance feedstock yield and resilience, the development of sustainable sourcing practices, and efforts to minimize land use conflicts.

### Technological and Cost Challenges:

Another significant challenge in the ATJ market is related to technology and cost factors. While ATJ fuels offer environmental benefits, there are several technological and cost-related hurdles to overcome:

**Production Efficiency:** The conversion of alcohol-based feedstocks into high-quality ATJ fuels involves complex chemical processes, such as Fischer-Tropsch synthesis. These processes can be energy-intensive and require specialized equipment, which can limit the overall efficiency of ATJ production. Improving the efficiency of these conversion processes is crucial to reduce production costs.

**Economies of Scale:** The ATJ market is relatively small compared to traditional jet fuel markets. Achieving economies of scale is challenging, as it may require significant investments in infrastructure and production capacity. Without economies of scale, ATJ fuels may struggle to compete with conventional jet fuels on a cost basis.

**Cost Competitiveness:** The cost of producing ATJ fuels remains higher than that of conventional jet fuels. Airlines and consumers are price-sensitive, and unless ATJ fuels become cost-competitive, widespread adoption may be limited.

**Infrastructure and Distribution:** Existing infrastructure and distribution networks are optimized for traditional aviation fuels. Adapting these systems to accommodate ATJ fuels can be costly and challenging.

To address these technological and cost-related challenges, ongoing research and development efforts are essential. Innovations in process efficiency, scale-up strategies, and cost reduction will be crucial in making ATJ fuels economically viable and competitive with conventional jet fuels.

In conclusion, the global Alcohol-to-Jet (ATJ) market faces challenges related to feedstock availability, competition for resources, production efficiency, economies of scale, cost competitiveness, and infrastructure adaptation. Overcoming these challenges requires a collaborative effort involving government support, industry innovation, and continued research to ensure the growth and sustainability of the ATJ market as a cleaner alternative for aviation fuel.

## Segmental Insights

### Ethanol Insights

The Ethanol segment had the largest market share in 2022 & expected to maintain it in the forecast period. Ethanol has been produced on a large scale for many years, primarily for the beverage and biofuel industries. This well-established infrastructure for



ethanol production makes it readily available and cost-effective compared to some other alcohol-based feedstocks like butanol or methanol. Ethanol production facilities are widespread in many countries, providing a stable source of feedstock for ATJ production. Ethanol is highly compatible with existing ATJ production processes, such as the Fischer-Tropsch synthesis. These processes have been developed and optimized over time, making it relatively straightforward to convert ethanol into ATJ fuel. This compatibility simplifies the transition to ATJ production for facilities with experience in ethanol processing. Ethanol can be derived from a variety of renewable feedstock sources, including corn, sugarcane, and cellulosic biomass. This versatility allows producers to choose feedstock sources based on regional availability, crop suitability, and sustainability considerations. The ability to use diverse feedstock sources enhances the resilience of ethanol-based ATJ production. Ethanol production is often cost-competitive, especially when derived from feedstocks like corn and sugarcane. The economies of scale achieved in the ethanol industry contribute to lower production costs, which can make ethanol-based ATJ fuels more economically viable compared to those based on other feedstocks. Ethanol is generally regarded as a more environmentally friendly feedstock compared to some alternatives. It has a lower carbon footprint when derived from sustainable sources, making it an attractive choice for ATJ production in line with the aviation industry's sustainability goals. Ethanol-based ATJ fuels can help airlines reduce their greenhouse gas emissions. Ethanol has gained widespread acceptance in the aviation industry and has been approved for use in aviation fuels. Regulatory authorities in various countries have recognized the viability and safety of ethanol-based ATJ fuels, providing a clear pathway for their adoption and integration into the aviation sector. Ethanol is a well-known and widely accepted biofuel among consumers and the general public. Airlines may find it easier to promote and market ethanol-based ATJ fuels as a sustainable and environmentally responsible choice, potentially influencing passenger perceptions and preferences.

## Dehydration Insights

The Dehydration segment had the largest market share in 2022 and is projected to experience rapid growth during the forecast period. Dehydration processes have been used extensively in the petrochemical industry for many years. They are well-established and have a proven track record of reliability and efficiency. This maturity gives confidence to ATJ fuel producers and investors that the technology is robust and dependable. Dehydration technology is highly versatile and can be applied to a wide range of alcohol feedstocks, including ethanol, which is one of the most commonly used feedstocks for ATJ production. This versatility allows ATJ producers to choose feedstocks based on factors like availability, cost, and sustainability, without being

limited by the choice of technology. Dehydration processes are known for their high efficiency in converting alcohol-based feedstocks into olefins or synthetic hydrocarbons. These intermediates can be further processed into ATJ fuels. The efficiency of the dehydration step minimizes waste and byproducts, contributing to the cost-effectiveness of ATJ production. Dehydration technology can often be integrated into existing infrastructure, making it more practical for retrofitting or upgrading facilities for ATJ production. This compatibility reduces the capital investment required to enter the ATJ market, facilitating its growth. Dehydration processes can be scaled up for commercial production, allowing for the production of ATJ fuels on a larger scale to meet the demands of the aviation industry. Scalability is crucial for ensuring a stable and consistent supply of ATJ fuels to meet market needs. The hydrocarbons produced through dehydration processes can be refined to meet the stringent quality and performance specifications required for jet fuels. This ensures that ATJ fuels derived from dehydration technology meet the necessary safety and performance standards demanded by the aviation industry. The maturity and reliability of dehydration technology can instill confidence among investors, making it more attractive for funding and investment in ATJ production projects. This financial support is critical for the expansion and growth of the ATJ market.

## Regional Insights

North America had the leading market for ATJ fuel in 2022. The growth of the market in North America is being driven by the increasing demand for sustainable aviation fuels from airlines and aircraft manufacturers in the region. The US and Canada are the major markets for ATJ fuel in North America.

Europe had the second-largest market for ATJ fuel in 2022. The growth of the market in Europe is being driven by the stringent government regulations mandating the use of SAFs in the aviation industry. Germany and the UK are the major markets for ATJ fuel in Europe.

Asia Pacific is the fastest-growing market for ATJ fuel, with a high CAGR in the upcoming years. The growth of the market in Asia Pacific is being driven by the growing demand for air travel in the region and the increasing government support for the development of SAFs. China, India, and Japan are the major markets for ATJ fuel in Asia Pacific.

## Key Market Players

LanzaTech Global

Gevo Inc

SkyNRG BV

Fulcrum BioEnergy Inc

Hypoint Inc

PNNL

Neste Oyj

Marquis SAF

FLITE Consortium

Mitsui & Co. Ltd

## Report Scope:

In this report, the Global Alcohol-to-Jet Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

### Alcohol-to-Jet Market, By Feedstock:

Ethanol

N-Butanol

Iso-Butanol

Methanol

### Alcohol-to-Jet Market, By Product:

Jet fuel

Isooctane

Alcohol-to-Jet Market, By Technology:

Dehydration

Oligomerization

Hydrogenation

Alcohol-to-Jet Market, By Application:

Commercial Aircraft,

Regional Transport Aircraft,

Military Aviation,

Business & General Aviation,

Unmanned Aerial Vehicle

Alcohol-to-Jet Market, By Region:

North America

United States

Canada

Mexico

Europe

France

United Kingdom

Italy

Germany

Spain

Asia-Pacific

China

India

Japan

Australia

South Korea

South America

Brazil

Argentina

Colombia

Middle East & Africa

South Africa

Saudi Arabia

UAE

Kuwait

Turkey

## Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Alcohol-to-Jet Market.

## Available Customizations:

Global Alcohol-to-Jet market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

## Company Information

Detailed analysis and profiling of additional market players (up to five).

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