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# Route to Sustainability in Latin America and the Caribbean

# Executive Summary

The transition to sustainable aviation in Latin America and the Caribbean presents a complex challenge that demands a multidisciplinary approach to reduce CO2 emissions while maintaining the accessibility of air transport. This document outlines the current state of aviation in the region, the necessary steps for decarbonization, and the associated costs.

## Climate Change and Its Impact on the Aviation Industry

The document examines how climate change affects aviation, including extreme weather events and their influence on operations and costs.

## Aviation Emissions and the Latin American Context

It highlights the aviation sector's contribution to global CO2 emissions and the efficiency improvements achieved in recent years.

## Recent Decarbonization Initiatives

The report discusses operational and technological advancements in Latin America, such as fleet renewal, that have reduced emission intensity.

## Costs of Achieving Decarbonization

Projected costs for transitioning to sustainable aviation are detailed, including global and regional investment requirements.

## Impact on Airfare Prices

The analysis explores how additional costs, driven by the adoption of sustainable aviation fuel (SAF) and other technologies, could affect ticket prices.

## Challenges and Recommendations

This section offers critical recommendations for advancing sustainable aviation in the region:

- Promoting multiple pathways to decarbonization: Emphasizing a diversified strategy that includes SAF production, operational efficiency improvements, and the development of new technologies.

- Establishing a regulatory framework with clear and consistent goals: Policies should align with global emissions reduction commitments. Recommendations include implementing carbon schemes to offset emissions, providing fiscal incentives instead of cost-increasing mandates, and ensuring transparency in carbon credit usage under the CORSIA program.

- Ensuring sustainable growth to enhance regional competitiveness: Aviation is essential for economic development and connectivity in the region. SAF has significant potential to create jobs and stimulate economic activity.

- Specific recommendations for SAF development:
  - Collaborative investment funds.
  - Promoting infrastructure investment.
  - Developing a favorable regulatory environment.
  - Supporting innovation in feedstock development.

## Annexes

The document includes four annexes that complement the main analysis by providing detailed insights into critical aspects of decarbonizing the aviation sector in Latin America and the Caribbean:

- Annex 1: Focuses on the current state of SAF and projections through 2050, detailing demand and supply forecasts and advancements in production methods.

- Annex 2: Explores carbon reduction mechanisms, such as carbon credit markets, to mitigate residual emissions that cannot be fully addressed through SAF or technological improvements. It also highlights daily prices for eligible credits under CORSIA, noting that there are currently no CORSIA-eligible credits based in the region.

- Annex 3: Provides an analysis of the current and future state of aviation fuel in the region, projecting demand and production of traditional aviation fuel through 2050.

- Annex 4: Examines fleet renewal and cabin densification efforts in the region, emphasizing the introduction of more modern and efficient aircraft, as well as increased seating capacity per aircraft to optimize fuel usage and reduce emissions

# Introduction

## Historical Context of Air Traffic in Latin America and the Caribbean

Over the past five decades, the aviation industry in Latin America and the Caribbean (LAC) has seen remarkable growth, multiplying passenger numbers 18-fold from 18 million in 1970 to over 324 million in 2023. This growth outpaces the global average, which increased 14 times during the same period (Figure 1).

Despite challenges such as the Latin American debt crisis in the 1980s, the Mexican peso crisis in 1994, the 9/11 attacks, SARS, and the COVID-19 pandemic, the region has demonstrated resilience. After a 60% drop in passenger numbers during the pandemic, the LAC aviation industry rebounded with a 6.2% increase in 2023 compared to 2019.

This growth underscores the critical role of aviation in connecting the region, facilitating tourism, business, and cargo transport—all essential drivers of economic development.

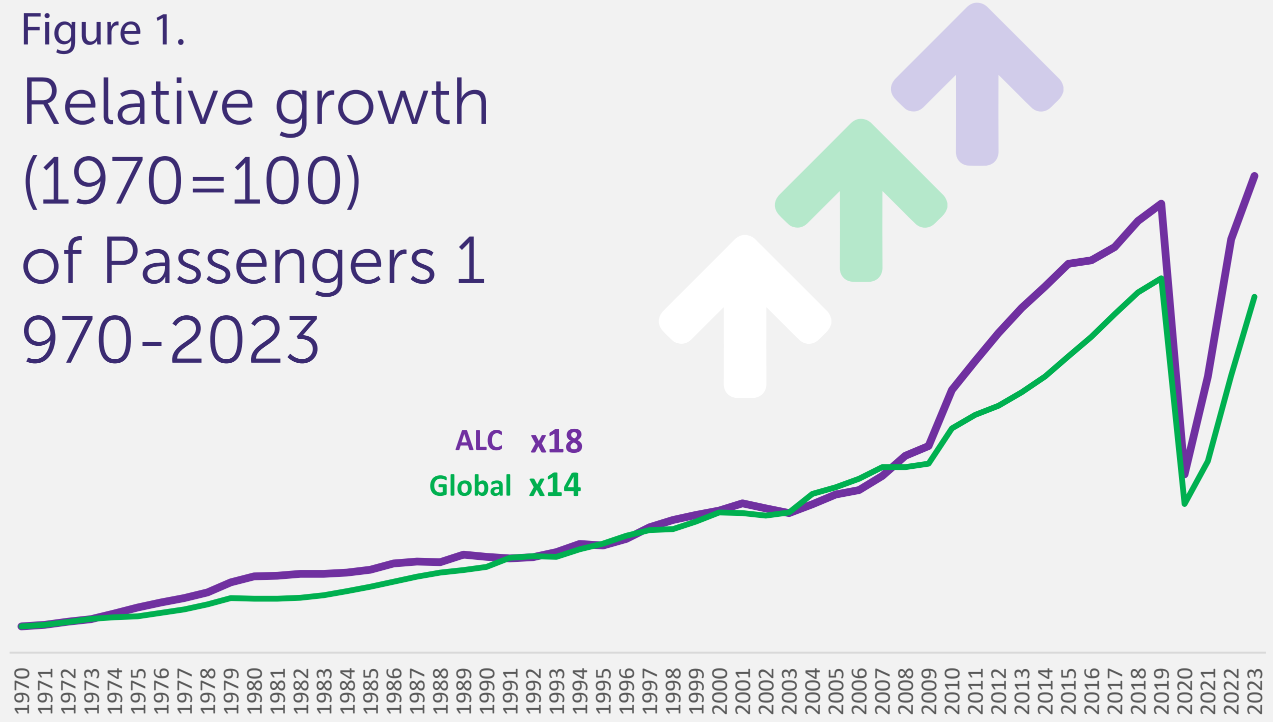
However, air transport penetration, measured as trips per capita, remains low at 0.64 trips, compared to more than 2 in regions like the U.S. and the EU, highlighting significant growth potential (ALTA).

The aviation industry contributes significantly to GDP and employment in Latin America and the Caribbean, supporting 8.3 million jobs and generating $240 billion. This represents 2.9% of regional employment and 3.6% of GDP. These jobs include 722,000 direct roles in airlines and airports and 6.9 million indirect jobs generated by the supply chain and tourism [1]. In many areas, air transport is indispensable for accessing essential services, such as healthcare in urban regions. In places with no alternative transportation options, air connectivity is crucial for economic development and social inclusion.

As the region continues to grow, addressing the sustainability challenges associated with this expansion becomes a pressing priority.

Figure 1.

Relative growth (1970=100) of Passengers 1970-2023



The number of passengers carried by airlines in Latin America and the Caribbean has grown 18-fold, rising from 18 million in 1970 to over 324 million in 2023, outpacing the global average growth rate.

Source: ICAO, ALTA

# Objective

The purpose of this document is to provide reliable data to support a comprehensive decarbonization strategy for the aviation industry in Latin America and the Caribbean. This strategy encompasses large-scale production and cost reduction of sustainable aviation fuels (SAF), the implementation of operational efficiencies, the development of new technologies, and the use of carbon offsets. The initiative aims to balance environmental goals with the need to ensure access to air transport in a region characterized by low penetration and limited alternative transportation options.

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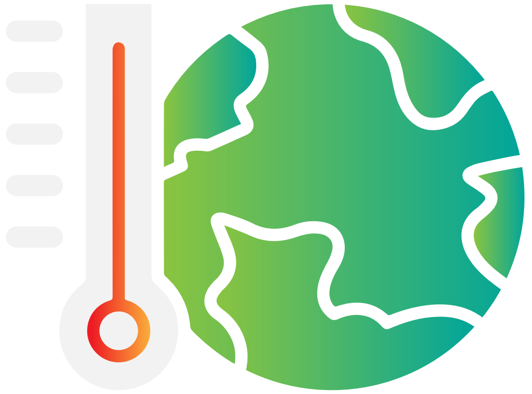
# Climate Change and Its Consequences for the Aviation Industry



The aviation industry faces a dual challenge: advancing decarbonization while adapting and building resilience to the effects of climate change. Climate change poses a significant threat to ecosystems, economies, and global societies. According to the Intergovernmental Panel on Climate Change (IPCC), the continued rise in global temperatures will lead to severe weather events, rising sea levels, and disruptions to natural and human systems.

Extreme weather events, such as storms, floods, wildfires, and extreme temperatures, have direct repercussions on society, infrastructure, and aviation operations. In 2022, extreme summer temperatures in the United Kingdom caused runway melting, forcing key operational suspensions [2]. Similarly, in April 2024, high temperatures at Mexico City International Airport compelled airlines to restrict aircraft weight due to reduced air density, which impacts takeoff performance [3]. Additionally, extreme flooding, such as the events that temporarily closed Porto Alegre Airport's control tower, further demonstrate these challenges [4]. These adverse weather conditions not only disrupt daily operations but also increase operational costs and accelerate the deterioration of airport infrastructure.

Climate change has also intensified the frequency and severity of clear-air turbulence (CAT). Recent studies reveal that the annual duration of CAT has risen significantly over the past four decades, particularly over the North Atlantic, where its duration increased by 17% between 1979 and 2020. This affects passenger comfort and accelerates aircraft wear and tear [5]. Storms not only cause delays and diversions but also impact cruising efficiency, fuel consumption, and CO2 emissions. In the Pan-American region, weather-related turbulence incidents have increased in recent years, according to the Regional Aviation Safety Group – Pan America (RASG-PA) annual report [6]. Although not currently classified as High-Risk Categories, severe weather events, including turbulence, have been the most common cause of incidents in the region over the past five years. In 2022, turbulence-related accidents accounted for 43% of reported incidents.

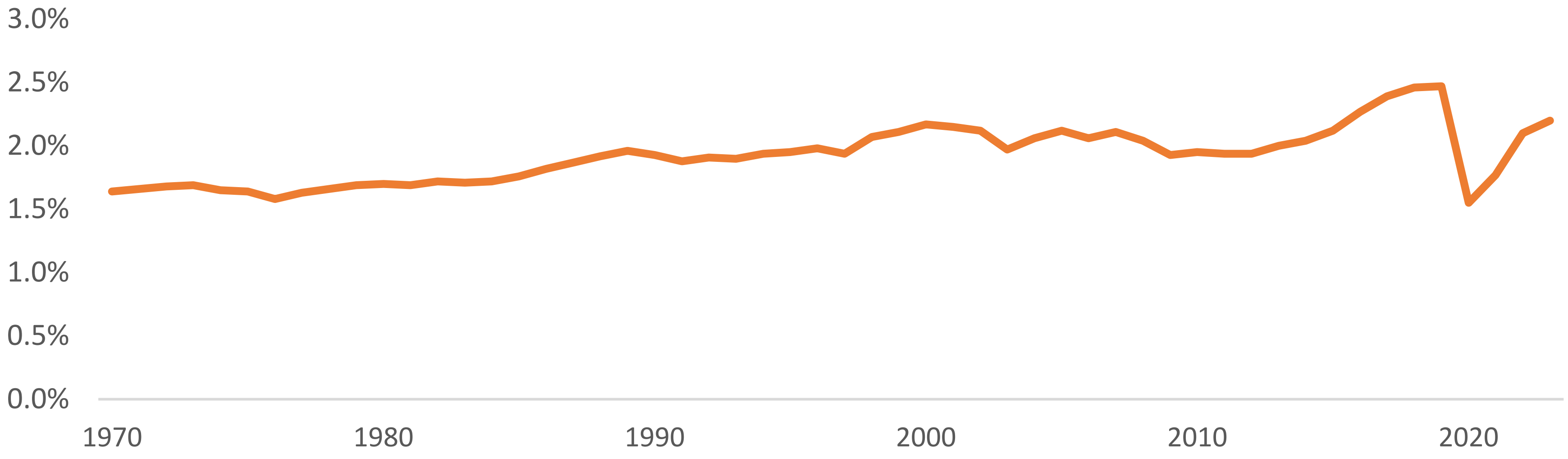
Projections indicate that the impacts of climate change will continue to grow, affecting various sectors, including aviation. According to a 2021 EUROCONTROL study [7], severe weather already causes up to 7.5% of air traffic management delays in Europe. With an estimated 16 million annual flights by 2050, this pressure is expected to increase. Additionally, rising sea levels could threaten more than two-thirds of low-lying coastal airports, potentially resulting in temporary closures with estimated daily costs of €18 million for major airports and €3 million for medium-sized airports.

Changes in jet stream patterns also present new challenges, as variations in high-altitude wind speed and direction can increase fuel consumption and flight times. In 2019, airlines flew over one million additional kilometers to avoid major storms, resulting in the consumption of an extra 6,000 tons of fuel and the emission of more than 19,000 tons of CO2 [7].

Despite air traffic increasing 14-fold since the 1970s, the decade when air transport deregulation began, aviation's contribution to total CO2 emissions has risen by less than 1 percentage point (Figure 2). This is largely due to significant technological advancements and efficiency improvements. Over this period, numerous innovations in aircraft and engine design have enabled more effective fuel use, mitigating the environmental impact of the industry's rapid growth.

Figure 2.

Aviation emissions as % of total



Source: Global Carbon Budget, EIA, ALTA Estimates

In 2023, the aviation industry emitted approximately 867 million tons of CO2 [8], with 43% originating from domestic flights and 57% from international flights. Despite a nearly 40% increase in traffic, measured in Revenue Passenger Kilometers (RPK), total emissions rose by only 18% between 2013 and 2023. This demonstrates the industry's efforts to enhance operational efficiencies and reduce its environmental footprint amidst significant growth.

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# Airline Industry Emissions and the Latin American Context

## Aviation emissions

Among the 25 countries with the highest aviation-related CO2 emissions, only two are from Latin America and the Caribbean: Brazil and Mexico. Together, their total emissions accounted for 2.6% of global aviation emissions accumulated between 2013 and 2023 [8] (Figure 3).

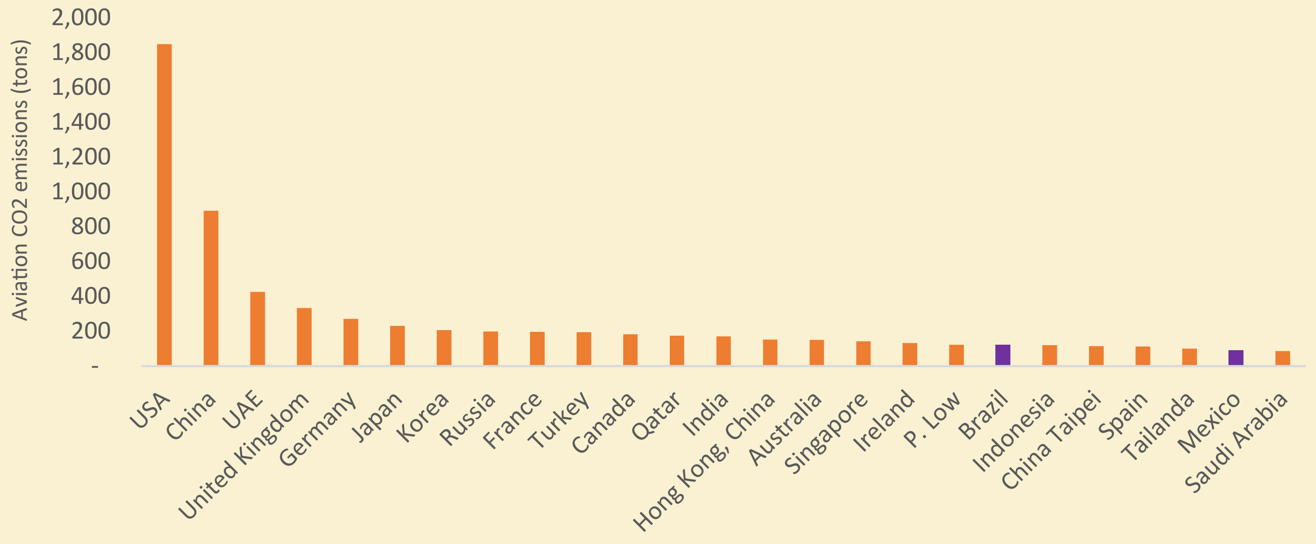
In total, airlines based in the region were responsible for 4.8% of cumulative CO2 emissions during the same period [8]. In contrast, the Asia-Pacific, North America, and Europe regions collectively accounted for 83.4% of total accumulated emissions. This disparity highlights the need for region-specific approaches to mitigate aviation's environmental impact, recognizing that contributions to global aviation emissions vary widely across regions.

The difference in emissions also underscores the importance of tailoring policies and technologies to each region's unique characteristics. Such an approach would address the realities, capacities, and potential of different regions while striving for an equitable reduction of emissions across the global aviation sector.

According to internal estimates provided by S&P Global for this study, aviation emissions in Latin America and the Caribbean are projected to grow at an average annual rate of 0.9% between 2024 and 2050, representing a 32% increase compared to 2023 levels (Figure 4). These projections are based on a scenario that considers the post-COVID-19 rebound in energy demand within a complex geopolitical and macroeconomic context.

Figure 3.

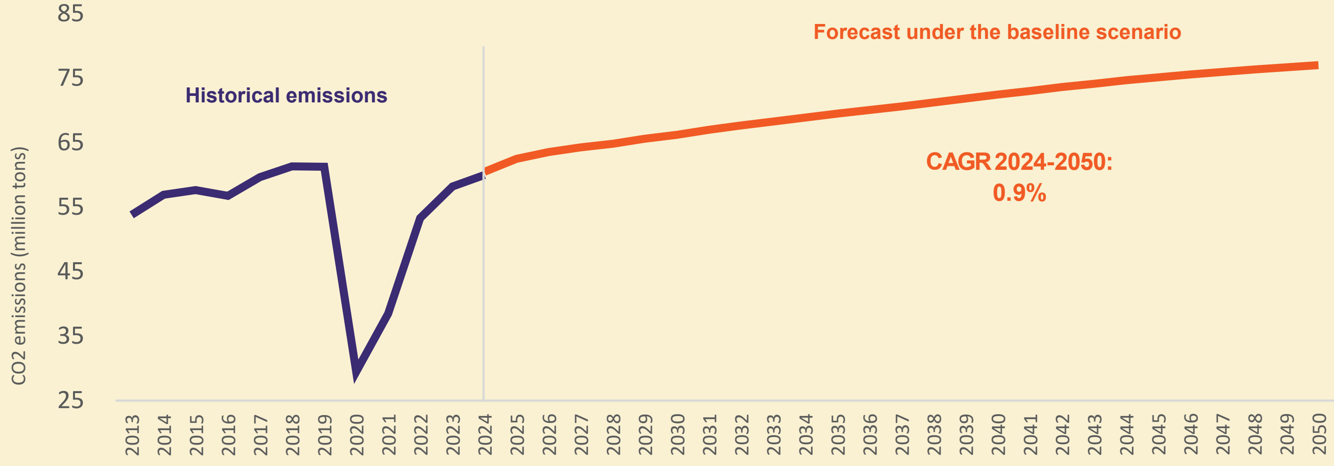
Top 25 Cumulative Aviation Emissions by Country 2013-2023



Source: OECD

Figure 4.

Forecast of Emissions for the Aviation Industry in Latin America (2013-2050)



Fuente: S&P Global Commodity Insights. © 2024 S&P Global

# Recent Decarbonization Initiatives in the Latin American and Caribbean Airline Sector

*Through operational improvements, fleet renewal, technological innovation, and a strong commitment to efficiency, the aviation industry in Latin America has successfully reduced its emissions intensity over the past decade. As shown in Figure 5, from 2011 to 2023, fuel consumption per 100 Revenue Passenger Kilometers (RPK) decreased by 28%, achieving an average annual efficiency rate of over 2%.*

The latest generation of aircraft consumes 15% to 20% less fuel than previous models, significantly contributing to reductions in CO2 emissions. Airlines that are members of the Latin American and Caribbean Air Transport Association (ALTA) have successfully lowered the average age of their fleets by 18%. Compared to airlines in developed markets like the United States and Europe, ALTA member fleets are 37% and 22% younger, respectively. For a more detailed analysis of fleet renewal and cabin densification initiatives aimed at reducing the carbon footprint, refer to Annex 4 at the end of this document.

Efficiency improvements by airlines in Latin America and the Caribbean have enabled them to increase their share of the global market while simultaneously reducing their contribution to total emissions (Figure 6).

Figure 5.

Fuel consumption per 100RPK

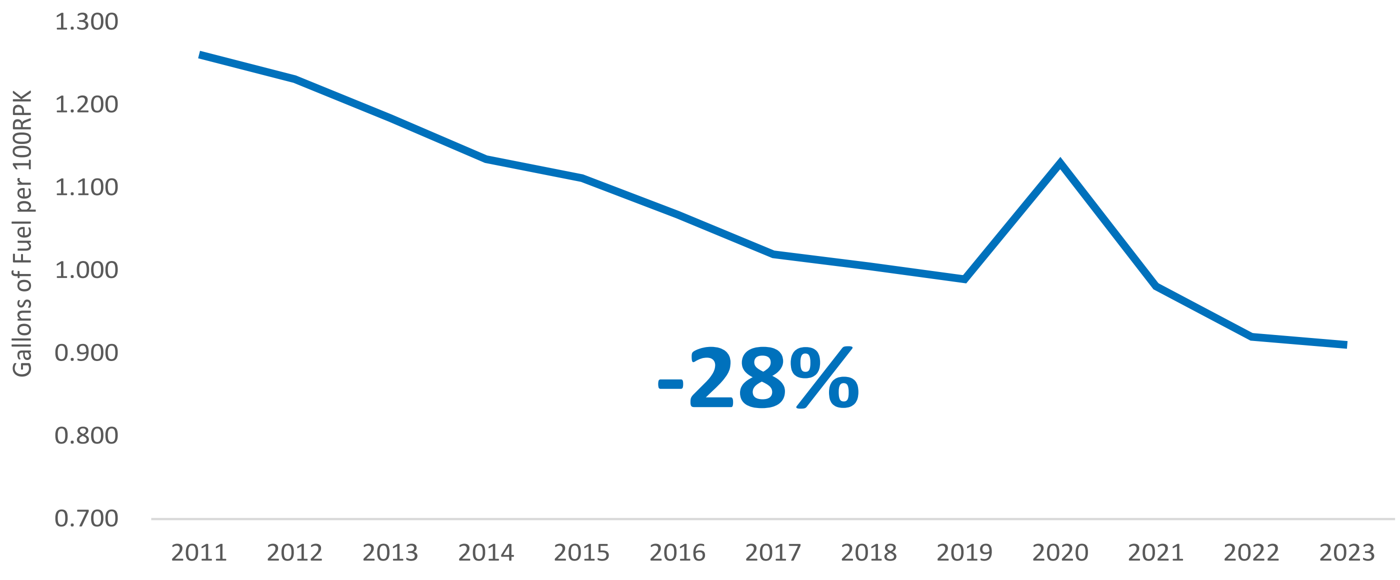
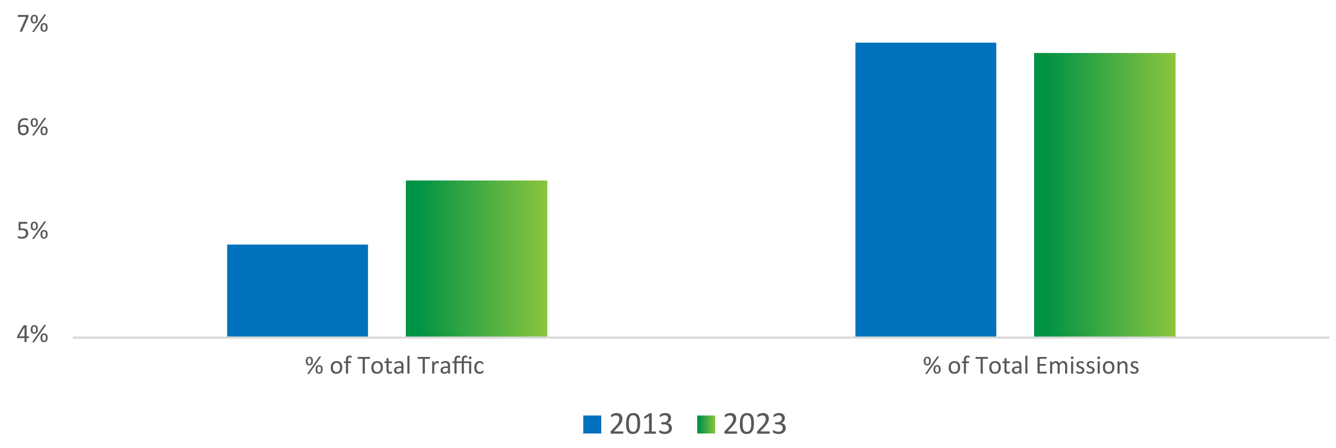


Figure 6.

Share of LAC airlines in total traffic and emissions (2023 vs. 2013)



Source: ICAO, IATA, ALTA analysis with OECD data

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# Decarbonization strategies in aviation

# Decarbonization strategies in aviation

The aviation industry faces the significant challenge of achieving net-zero emissions by 2050. The Waypoint 2050 report, developed by the Air Transport Action Group (ATAG) [8], outlines a comprehensive vision and possible scenarios to meet this goal. Below are the key decarbonization strategies and scenarios described in the report:

## Key Decarbonization Strategies

### Operational and Infrastructure Improvements

- Route optimization and air traffic management: Enhancements in route efficiency and air traffic management can significantly reduce emissions and are quicker to implement than aircraft-level technological innovations.

- Airport efficiency: Emerging technologies in airports and navigation systems will contribute to operational efficiencies and emission reductions. Measures such as electric gates, reduced taxiing times, and the use of auxiliary power units are critical, although many depend on government and stakeholder involvement.

### Carbon Reduction and Offset Measures Outside the Sector

- Carbon offsets: In the short term, carbon offsets serve as a complementary measure while technologies and sustainable aviation fuels (SAF) are developed. In the long term, carbon capture and storage will be essential to managing residual emissions that cannot be eliminated.

- CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation): Developed by ICAO, CORSIA is a pioneering global framework to limit net CO2 emissions growth from 2020. It relies on purchasing carbon credits to offset emissions exceeding baseline levels, stabilizing emissions while long-term decarbonization technologies are developed.

In Latin America and the Caribbean (LAC), CORSIA faces challenges due to the limited availability of eligible carbon credits, constraining airlines in their ability to meet scheme requirements. This highlights the need to develop local carbon credit projects recognized by CORSIA.

### Technological Innovation

- Next-generation aircraft: Fleet modernization with more fuel-efficient aircraft, advanced engines, and lighter materials can reduce fuel consumption by 15-20% per generation.

- Alternative propulsion systems: Electric, hybrid, and hydrogen propulsion are expected to play a pivotal role, particularly for short- and medium-haul flights. These technologies will require substantial investments and coordinated efforts across the industry.

### Sustainable Aviation Fuels (SAF):

- Large-scale deployment of SAF: SAF can reduce CO2 emissions by up to 80% compared to conventional fuels. Annual SAF demand is estimated at 330-445 million tons by 2050, requiring investments of up to $1.45 trillion (Waypoint 2050).

- Feedstock diversification: SAF can be produced from various sources, including non-food crops, waste, and fuels derived from recycled CO2 and low-carbon electricity.

### Regulatory Measures:

- Financial and fiscal incentives: Rather than imposing quotas, policies should encourage investment in sustainable technologies through subsidies, tax credits, and preferential financing for alternative fuel innovation. These incentives can accelerate the transition to sustainable aviation while maintaining airline competitiveness.

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# Decarbonization strategies in aviation

## Decarbonization Scenarios

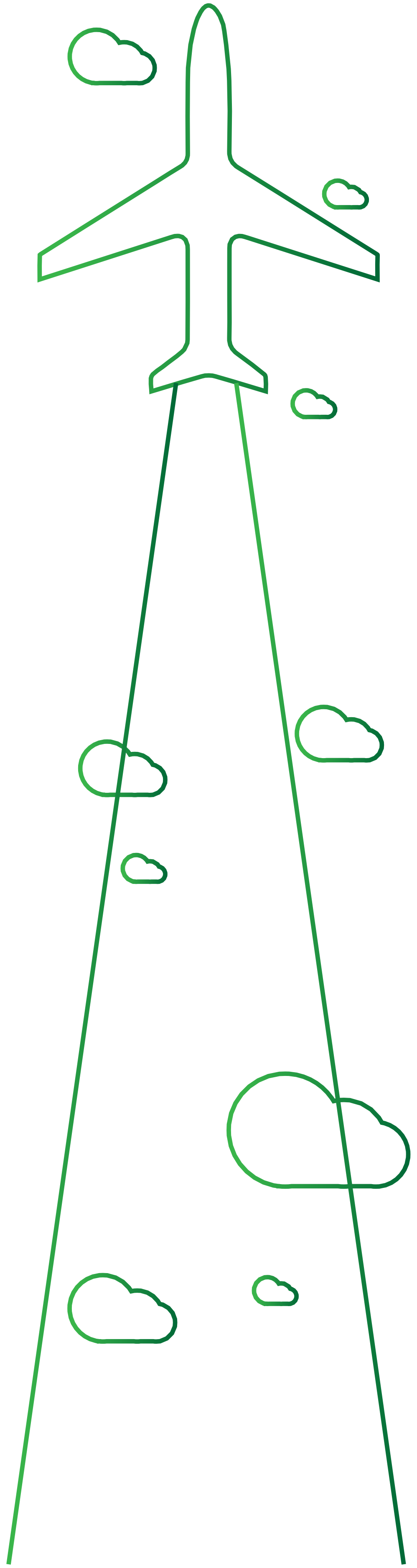
The ICAO Long-Term Aspirational Goal (LTAG) report [10] presents three integrated scenarios exploring how aviation can reduce CO2 emissions over the long term:

### Scenario IS1:

- Traffic growth: Based on medium traffic growth forecasts. Annual emissions are projected at 950 MtCO2 by 2050 and 1,420 MtCO2 by 2070.
- Technological developments: Relies on conventional aircraft configurations (tube and wing) with incremental efficiency improvements.
- Operational improvements: Limited operational efficiency gains with slow adoption of technologies like the Aviation System Block Upgrades (ASBU).
- Fuels:
- Biomass SAF: 19% of energy use by 2050, requiring $480 billion in investment.
- Waste-based fuels: 8% of energy use, requiring $710 billion.
- LTAG-LCAF (low-carbon liquid fuels): 7% of energy use, requiring $50 billion.
- Carbon offsets: Cumulative emissions from 2021 to 2050 will reach 22 GtCO2, with heavy reliance on carbon offsets.
- Costs: Relatively low investment in advanced technologies, with $2.3 trillion required for offsets by 2050.

### Scenario IS2:

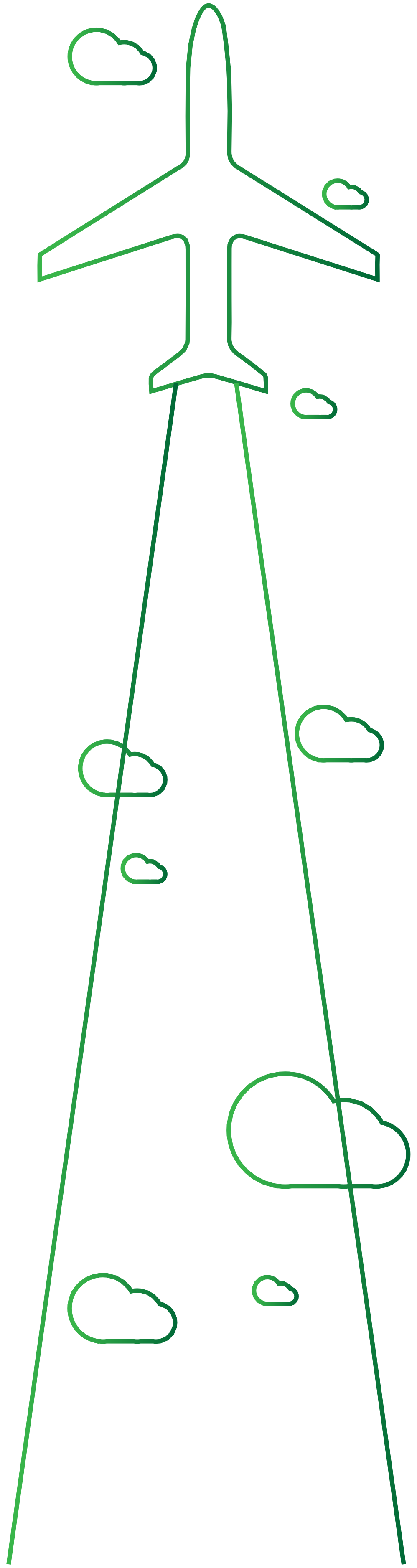
- Traffic growth: Medium growth, with annual emissions projected at 495 MtCO2 by 2050 and 600 MtCO2 by 2070.
- Technological developments: Introduces Advanced Concept Aircraft, significantly improving energy efficiency.
- Operational improvements: Moderate deployment of operational optimization technologies.
- Fuels:
- Biomass SAF: 53% of energy use by 2050, requiring $1.2 trillion.
- Waste-based fuels: 19% of energy use, requiring $1 trillion.
- LTAG-LCAF: 28% of energy use, requiring $105 billion.
- Carbon offsets: Cumulative emissions reduced to 17 GtCO2, with offset costs of $230 billion.
- Costs: Higher investment in advanced technologies and SAF, with lower offset costs.



## SCENARIO IS3:

- Traffic growth: Despite traffic growth, annual emissions drop to 200 MtCO2 by 2050 and 210 MtCO2 by 2070.
- Technological developments: Hydrogen-powered aircraft and other radical innovations are key, transforming airport and energy infrastructure.
- Operational improvements: Aggressive adoption of advanced technologies in ground and air operations.
- Fuels:
- Biomass SAF: 42% of energy use, requiring $950 billion.
- Waste-based fuels: 46% of energy use, requiring $1.7 trillion.
- Atmospheric CO2 SAF: 10% of energy use, requiring $460 billion.
- Hydrogen: 2% of energy use, requiring $55 billion for fuel and an additional $125 billion for airport infrastructure.
- Carbon offsets: Cumulative emissions drop to 12 GtCO2, with minimal reliance on offsets due to widespread adoption of clean technologies and alternative fuels.
- Costs: Requires the highest investment, up to $4 trillion by 2050, but significantly reduces operational costs through minimal reliance on offsets.

These scenarios highlight the pathways available for aviation to achieve net-zero emissions by 2050, emphasizing the need for regional collaboration, innovation, and strategic investment to meet this ambitious goal



# Costs of achieving decarbonization

The transition to net-zero aviation will entail significant global costs.

## Global Decarbonization Costs

According to the Waypoint 2050 report by ATAG [9] and ICAO's LTAG analysis [10], the global costs of transitioning to net-zero aviation are broken down into key categories:

## Costs for Aircraft Operators:

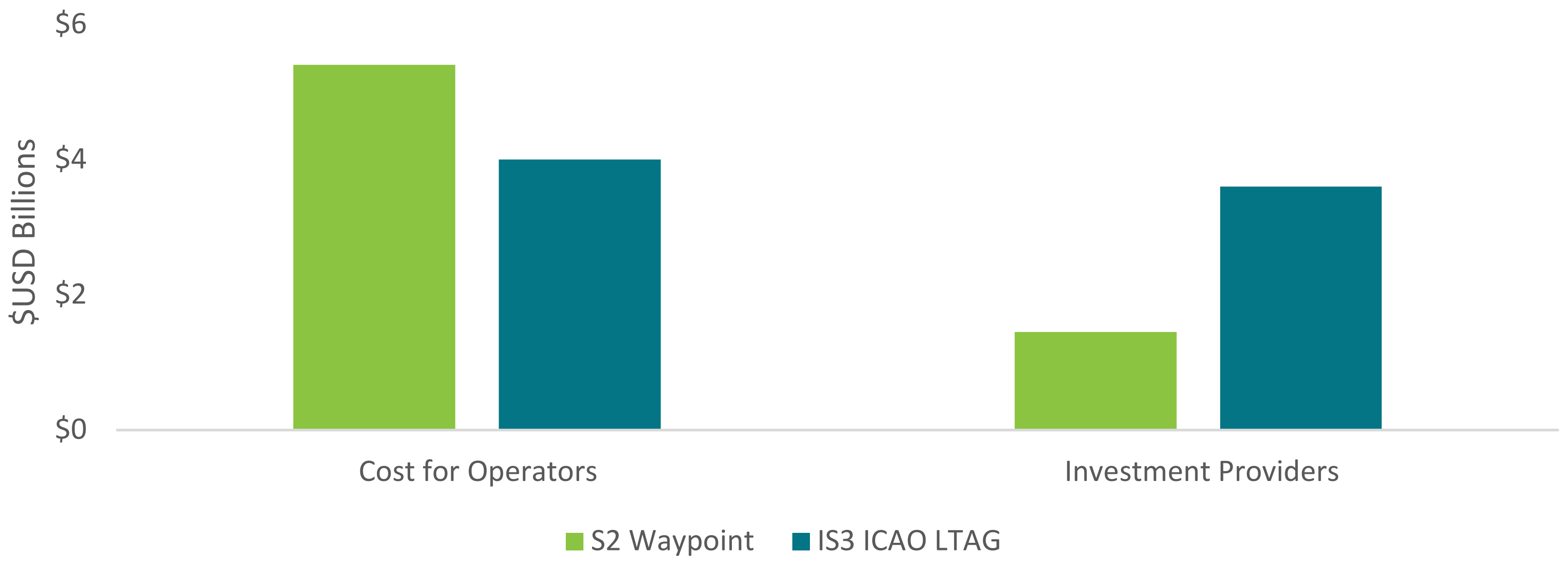
- Global Investment in Waypoint 2050 Scenario S2: Up to $5.3 trillion from 2020 to 2050.
- Global Investment in ICAO LTAG Scenario IS3: Up to $4 trillion from 2020 to 2050.
- Global Annual Average: $170 billion (Waypoint 2050) and $130 billion (ICAO LTAG).

## Investments by Suppliers (OEMs and Fuel Providers):

- Global Investment in Waypoint 2050 Scenario S2: Up to $1.45 trillion from 2020 to 2050.
- Global Investment in ICAO LTAG Scenario IS3: Up to $3.6 trillion from 2020 to 2050.
- Global Annual Average: $50 billion (Waypoint 2050) and $120 billion (ICAO LTAG) (Figure 7).

Figure 7.

Global Decarbonization Costs and Investments



## Other Costs or Investments:

Waypoint 2050:
Includes non-recurring costs for OEMs (investments in new aircraft programs), government research and development investments, airport-related costs (hydrogen operations and infrastructure), and expenses for air navigation service providers (ANSPs) to implement operational measures.

ICAO LTAG:
Similar to Waypoint 2050 but places greater emphasis on measures outside the sector to bridge the gap toward net-zero emissions.

# Costs of achieving decarbonization

## Proportional Costs for Latin America and the Caribbean

Assuming Latin America and the Caribbean (LAC) accounts for approximately 6% of global air traffic — a share projected to remain constant until 2050 — proportional costs for the region can be estimated based on Waypoint 2050 and ICAO LTAG scenarios. However, this is a conservative approach as the region's lack of infrastructure significantly increases SAF implementation costs.

For example, in Colombia, Ecopetrol's SAF production at the Reficar refinery will involve substantial transportation costs to Bogotá, adding both expenses and emissions. Additionally, importing advanced technology and the region's higher tax rates further elevate costs, penalizing SAF project development and operational expenses.

While this analysis assumes costs proportional to 6% of global traffic, the reality is that LAC may face higher costs due to these additional barriers. For simplicity, the costs are presented as follows:

### Costs for Aircraft Operators:

- Waypoint 2050 (S2): US$318 billion from 2020 to 2050.
- ICAO LTAG (IS3): US$240 billion from 2020 to 2050.
- Average Annual Cost: US$10.2 billion (Waypoint 2050) and US$7.8 billion (ICAO LTAG).

These costs include investments in SAF production, new aircraft technology, operational and infrastructural improvements, and carbon offset measures. Annual average costs are expected to be lower in the initial years and increase later as traffic and fuel usage grow.

Costs for Aircraft Operators:

- Cost Proportional to the Global Cost of Waypoint 2050 (S2): US$318 billion from 2020 to 2050.
- Cost Proportional to the Global Cost of ICAO LTAG (IS3): US$240 billion from 2020 to 2050.
- Proportional Annual Average: US$10.2 billion (Waypoint 2050) and US$7.8 billion (ICAO LTAG).

These costs encompass investments in SAF production, the development of new aircraft technologies, operational and infrastructure improvements, and carbon offset measures. Notably, average annual costs will be lower in the initial years and increase in later years as traffic and fuel usage grow. Collaboration among governments, airlines, energy providers, and other key stakeholders will be essential to finance and implement this transition toward sustainable, net-zero aviation in the region.

The analysis and cost estimates focus on Waypoint 2050's Scenario 2, which prioritizes the widespread adoption of sustainable aviation fuels (SAF) and includes costs associated with decarbonizing domestic aviation. This focus is particularly relevant given that approximately 55% of air traffic in Latin America and the Caribbean is domestic.

The emphasis on SAF stems from the challenges of isolating and quantifying the incremental costs of technological improvements in aircraft. Aircraft transaction prices are not publicly available, complicating the estimation of how these improvements affect total costs. Additionally, the relationship between the acquisition costs of new aircraft and the fuel savings they might offer is difficult to determine. While new technologies, such as hydrogen-powered aircraft, may involve additional upfront costs, these could be offset by lower operational expenses.

Both the Waypoint 2050 and LTAG analyses indicate that SAF will be the primary source of emissions reductions before 2050. For this reason, the analysis focuses on the costs and benefits of increasing SAF use to meet net-zero emissions goals. This approach allows for a clearer and more quantifiable evaluation of the financial and operational impact of transitioning to more sustainable aviation.

### SAF Price Assumptions

Based on ICAO/CAEP projections, the Waypoint 2050 analysis incorporates the following SAF unit price assumptions:

- Waste- and biomass-based fuels:
  - 2020: Approx. $1,220 per ton.
  - 2050: Approx. $1,460 per ton.
- Waste gas-based fuels:
  - 2020: Approx. $3,650 per ton.
  - 2050: Approx. $1,700 per ton.
- Power-to-liquid fuels derived from atmospheric CO2:
  - 2020: Approx. $4,250 per ton.
  - 2050: Approx. $1,280 per ton.

It is important to note that the projected prices assume maximum state and governmental support. These price projections, based on the LTAG report, are used to estimate the costs of transitioning to SAF and its impact on airline operating expenses.

To provide context, the average price of jet fuel in Latin America and the Caribbean over the past year was approximately $890 per ton. This means that, depending on the type of SAF used in the future, SAF prices could be 40% to 350% higher than the average price of conventional jet fuel during the same period.

This comparison highlights the economic challenge posed by the transition to SAF, emphasizing the critical need for supportive policies and subsidies to facilitate this shift and minimize its impact on connectivity.

# Impact on airline ticket prices

The adoption of Sustainable Aviation Fuels (SAF) is a key strategy for reducing CO2 emissions, but it will also entail additional costs that could affect ticket prices and connectivity. Ticket prices are influenced by various factors, including competition, operating costs, demand, and government policies. While fares have decreased since the deregulation of the 1970s, this reduction has not been uniform across all routes.

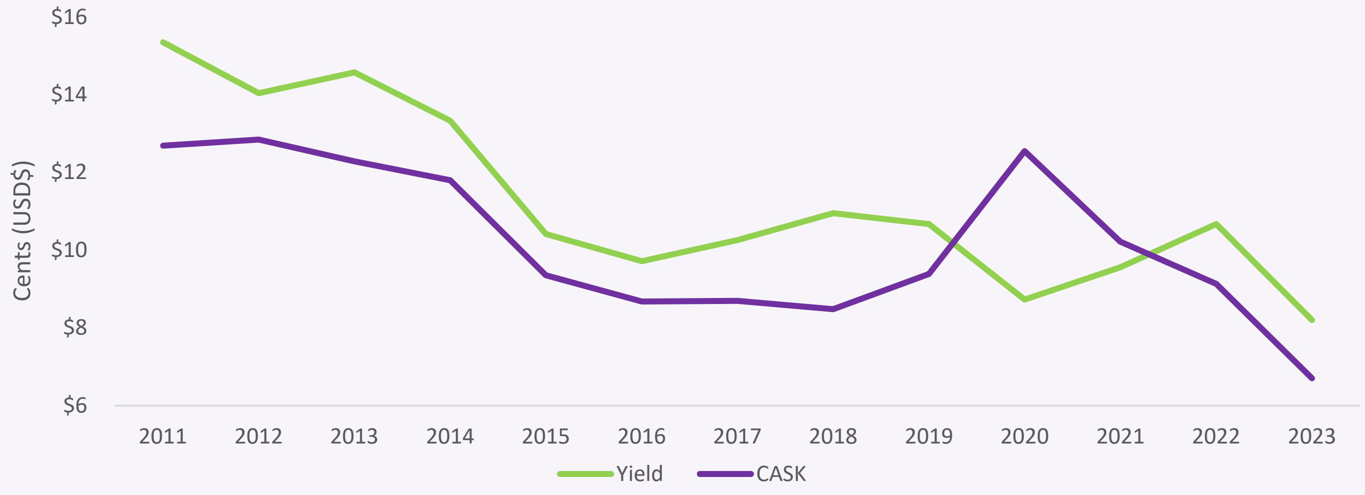
Historically, new technologies and increased efficiency have enabled airlines to lower operating costs, which in turn has contributed to reducing ticket prices. In a competitive environment with narrow profit margins, airlines in Latin America and the Caribbean have achieved significant cost reductions. Since 2011, their CASK (Cost per Available Seat Kilometer), which measures operating cost per kilometer offered, has decreased by 46.6%. Simultaneously, Yield, the revenue generated per passenger per kilometer flown, has dropped by 47.72% in real terms (Figure 8).

This nearly linear relationship between CASK and Yield provides insights into how fares might evolve with future increases in operating costs, highlighting the potential implications of SAF adoption for ticket pricing and regional connectivity.

# Impact on airline ticket prices

Figure 8.

## Evolution of CASK (cost per available seat-km) and Yield (revenue per passenger-km) for LAC airlines, inflation-adjusted.



Source: ALTA analysis based on airlines' financial statements

This trend is not limited to Latin America and the Caribbean but is observed globally. According to IATA, over the past five decades, the global aviation industry has seen a remarkable decline in real unit costs, which have fallen more than fourfold, along with a nearly sixfold reduction in real Yields. This decrease has been driven by technological advancements, such as the introduction of jet engines and digital systems, as well as significant regulatory changes. Despite various macroeconomic shocks, continuous improvements in operational efficiency and intense competition have sustained this cost reduction trend, which is expected to continue in the future.

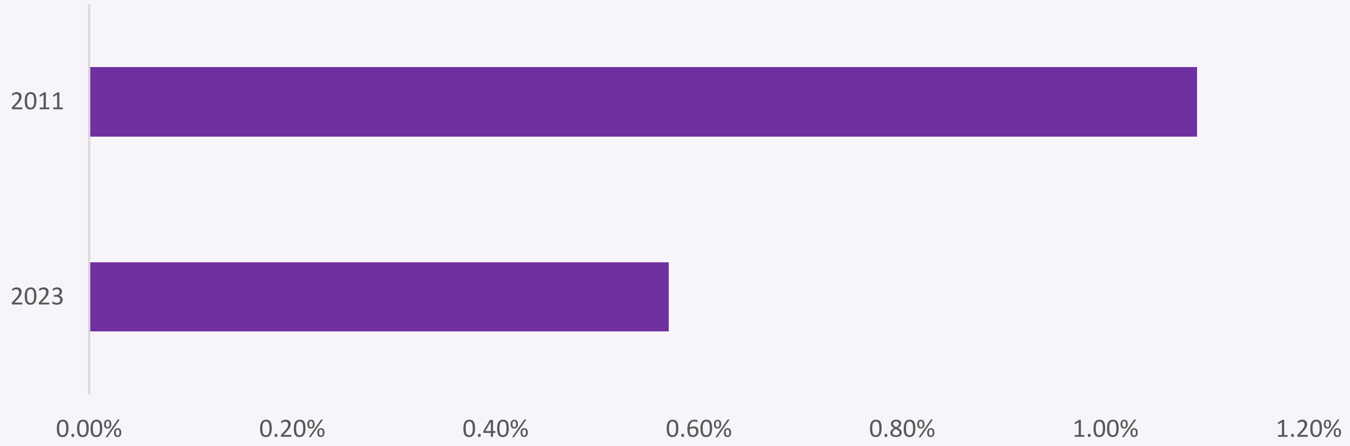
Thanks to cost reductions and operational efficiency gains, flying in Latin America is more affordable today than in 2011 (Figure 9). To measure this affordability, the average fare for each year was compared to GDP per capita adjusted for Purchasing Power Parity (PPP). This ratio reflects the portion of passengers' income allocated to flying, and its decline indicates improved affordability in relative terms, driven by increased incomes, reduced real fares, or a combination of both.

In Latin America, per capita income has risen by 7.2% since 2011, while average real fares have decreased by more than 40%. However, it is important to note that while regional affordability has improved, the impact of fare reductions varies across countries due to differences in income levels, wealth distribution, and costs associated with air transport. These factors influence passengers' ability to access air travel in different markets.

The figure below illustrates the average flight fare for Latin America and the Caribbean, calculated using the Yield for each year and an average stage length of 1,500 kilometers. In 2011, the Yield adjusted to 2021 prices was 13.26 cents, while in 2023, it dropped to 7.29 cents. This decline demonstrates that, despite operating costs, the real cost of flying has decreased, enhancing affordability and promoting connectivity.

Figure 9.

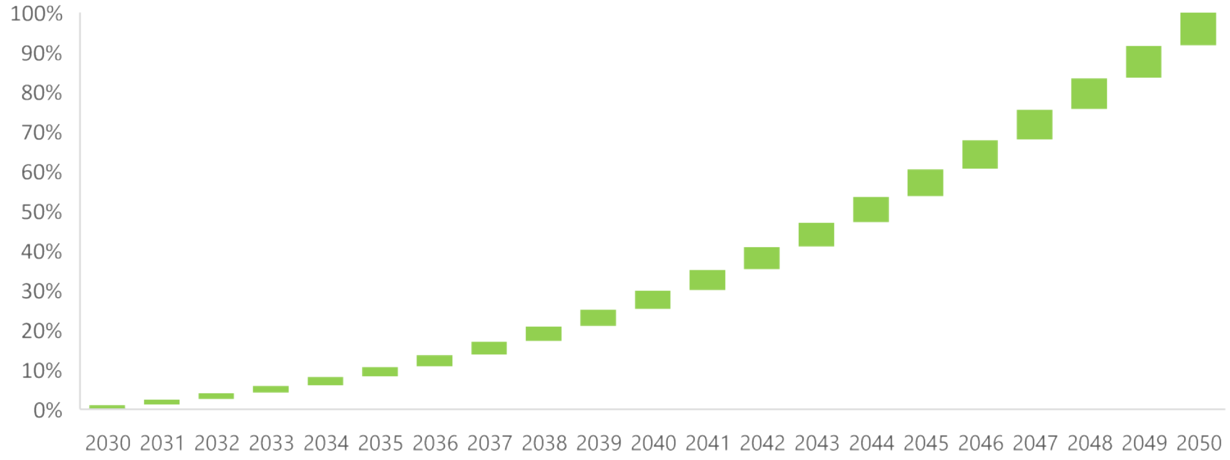
## Average fare as a percentage of GDP per capita (PPP, 2021 $ prices)



## Estimated increase in air fares

Figure 10.

Distribution of the annual percentage of total extra costs per SAF adoption



The transition from fossil fuels to SAF entails an increase in operating costs. Based on figures from the Waypoint 2050 study by the Air Transport Action Group (ATAG), outlined in previous sections, the total estimated additional cost for Latin America and the Caribbean under Scenario S2 is $318 billion USD for the period 2030–2050 (calculated proportionally based on traffic share).

To realistically distribute this additional cost over time, a logistic curve was used—a mathematical model commonly applied to represent the gradual adoption of new technologies [11][12]. This model captures the acceleration of cost increases as SAF adoption progresses, peaking around 2050. The logistic curve ensures that annual costs are distributed progressively, starting modestly in 2030 and gradually increasing, reflecting a phased and realistic adoption of this new technology.

Figure 10 illustrates the percentage distribution of the total $318 billion USD additional cost during the 2030–2050 period, calculated using the logistic curve. This approach provides a clear representation of how SAF adoption impacts costs over time, aligning with the expected gradual scale-up of this sustainable technology.

For the purposes of this document, the aim is to quantify how airfares might increase as a result of decarbonization compared to the current scenario. Key assumptions include the rate of air traffic growth and an average annual reduction of 2% in both fuel-related and non-fuel CASK. Given the inherent complexity of accurately forecasting future impacts, a model based on references from prior studies in the field of air transport economics has been adopted.

Wang et al. [13] explored how operating costs, specifically Cost per Available Seat Kilometer (CASK), influence airfares. The authors highlight that an increase in total CASK tends to raise airfares, especially in markets where airlines can pass these costs on to passengers. Fuel-related CASK has a significant influence on Yield, as fuel constitutes a major share of operating costs, while non-fuel CASK has a more limited impact.

Wang et al. concluded that airfares are particularly sensitive to changes in fuel costs, with regional variations reflecting differences in market structure and demand elasticity. These findings emphasize the importance of considering regional contexts when analyzing how operating costs might affect airfares.

Using a similar methodology, a multiple linear regression model was implemented to analyze the relationship between Yield and the various components of CASK in the context of Latin America and the Caribbean. This model explores how additional operating costs due to decarbonization might translate into airfare increases.

The model developed in this document is based on historical data on CASK and Yield for the period 2004–2023. These data were collected by the Latin American and Caribbean Air Transport Association (ALTA) from financial reports published by its member airlines, supplemented with proprietary analyses conducted by ALTA.

# Impact on airline ticket prices

## Estimated increase in air fares

## Model methodology

To analyze the relationship between operating costs and Yield, a multiple linear regression model was implemented. This type of model quantifies the impact of multiple independent variables on a dependent variable, in this case, Yield (revenue per passenger-kilometer). The formula for the model is as follows:

$$\text{Yield} = \alpha + \beta 1 \times \text{CASK} + \beta 2 \times \text{CASK (ex-fuel)} + \beta 3 \times \text{CASK (fuel)} + \varepsilon$$

Where:

- $\alpha$ is the model constant, representing the value of Yield when all independent variables are zero.
- **β1, β2 y β3** are regression coefficients that indicate the expected change in Yield for each unit change in CASK, CASK (ex-fuel), and CASK (fuel), respectively.
- $\varepsilon$ is the error term, capturing the variability in Yield that is not explained by the included variables.

## Model results:

The multiple linear regression model generated the following results:

- **Total CASK:** Coefficient of 1.0583 ($p < 0.001$), indicating that an increase in CASK is significantly associated with a rise in Yield. For every additional unit of CASK, Yield increases by approximately 1.06 units.

- **Fuel-related CASK:** Coefficient of 0.7045 ($p = 0.037$), suggesting that an increase in fuel costs has a substantial impact on Yield. This highlights the critical importance of fuel as a major component of CASK.

- **Non-fuel CASK:** Coefficient of 0.3538 ($p = 0.157$). While the effect is positive, it is not
- \statistically significant in this model, indicating that increases in non-fuel costs may have a smaller or less direct impact on airfares.

The model achieves an R-squared of 0.923, meaning that 92.3% of the variability in Yield is explained by changes in total CASK, fuel-related CASK, and non-fuel CASK

## Yield Projection Under Decarbonization Scenarios

To understand how the adoption of Sustainable Aviation Fuel (SAF) could impact airfares, two scenarios were analyzed using the developed regression model: one without SAF adoption and another with progressive SAF adoption, adjusting CASK values accordingly (Figure 11). The additional costs of SAF were derived from the logistic curve (% proportional to the total costs outlined in the ATAG Waypoint 2050 study) for each year starting in 2030.

### Current Scenario:

In this scenario, projected CASK values exclude additional costs associated with SAF adoption. The results indicate that under standard operating conditions, Yield would experience a gradual decline over the 2023–2050 period. This decrease is attributed to expected improvements in operational efficiency and reductions in non-fuel operating costs.

### Assumptions in this scenario include:

- A 2% annual reduction in both fuel-related and non-fuel CASK.
- Stable future prices for conventional fuel.
- A 3% annual increase in capacity.

### Scenario with Aggressive SAF Adoption:

The second scenario incorporates the impact of SAF costs into CASK. By including additional SAF costs (based on annual increments from 2030, as calculated in the Waypoint 2050 study), the projected Yield is consistently higher compared to the current scenario.

### Findings:

- The higher Yield reflects the transfer of additional decarbonization costs to passengers.
- As SAF adoption accelerates, especially post-2030, Yield increases proportionally.
- This highlights the sensitivity of airfares to rising operational costs associated with sustainable fuel adoption

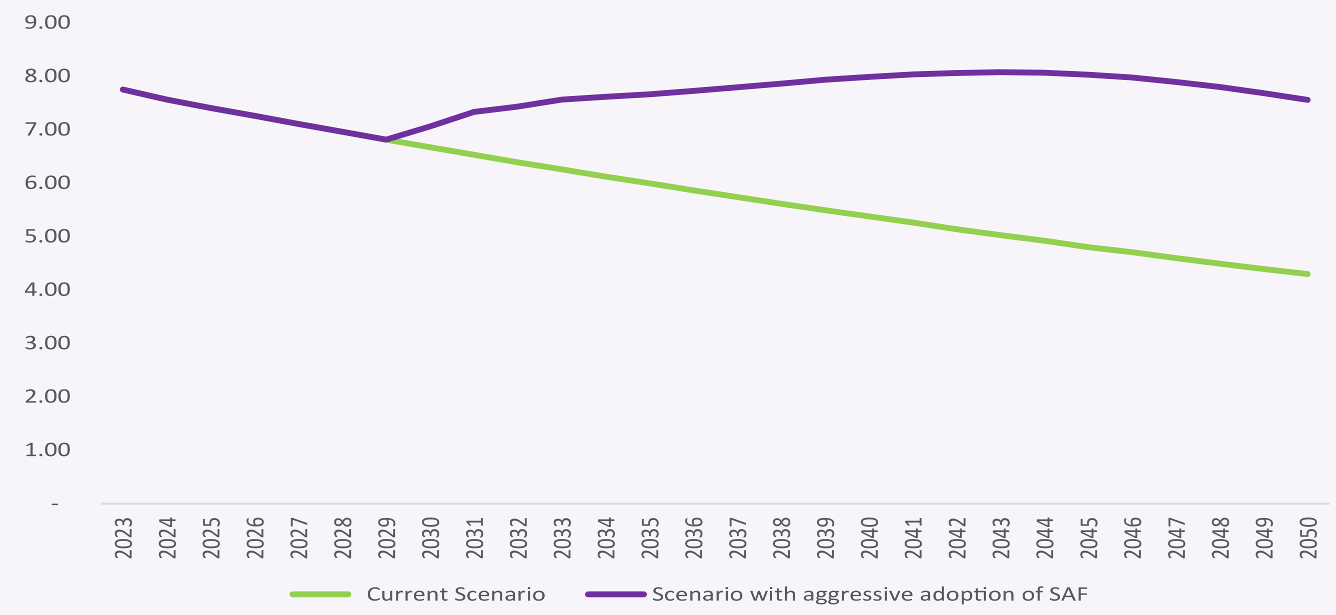
ALTA

# Impact on airline ticket prices

## Estimated increase in air fares

Figure 11.

Comparison of revenues per passenger-kilometer according to decarbonization scenarios



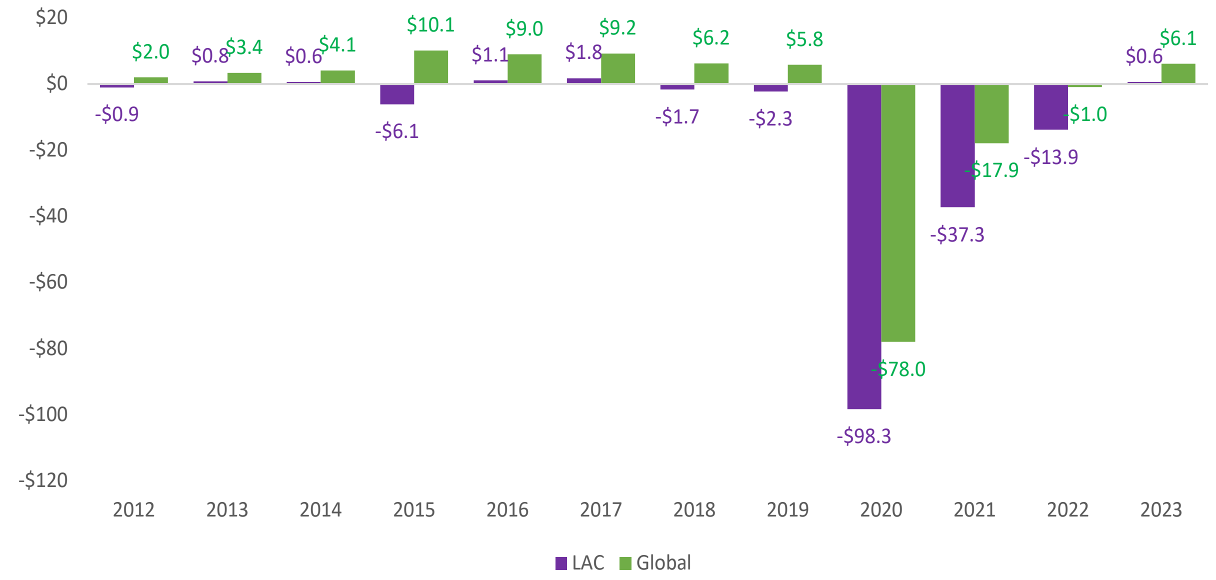
The difference between the two scenarios highlights the economic impact that decarbonization could have on airfares. It is important to note that these projections are based on the assumptions and variables described earlier. Additionally, these assumptions do not account for potential increases in carbon prices in the coming years, instability in jet fuel prices due to geopolitical conflicts, additional costs from carbon offsets (such as those associated with CORSIA or other offset schemes), or financial and operational costs related to climate risks. All these factors could significantly affect airline operating margins, even without SAF adoption.

This model has been simplified to compare a scenario without decarbonization variables—other than fuel efficiency improvements—against a scenario with SAF adoption. However, it does not consider potential costs of inaction on climate change.

It is also important to consider that airlines in Latin America and the Caribbean are already operating under constrained profitability, as reflected in the evolution of net profit/loss per passenger compared to the global average (Figure 12). This demonstrates that any increase in operating costs, such as those associated with decarbonization, would significantly impact the ability of airlines in the region to maintain competitiveness and affordability.

Figure 12.

Net profitability per passenger



In recent years, airlines in the region have reported low profit margins, and in some cases, more pronounced losses compared to their global counterparts. In this context, any increase in costs, such as those associated with SAF adoption, would not only pose an additional challenge but would also make it inevitable to pass these extra costs on to passengers to maintain economic viability.

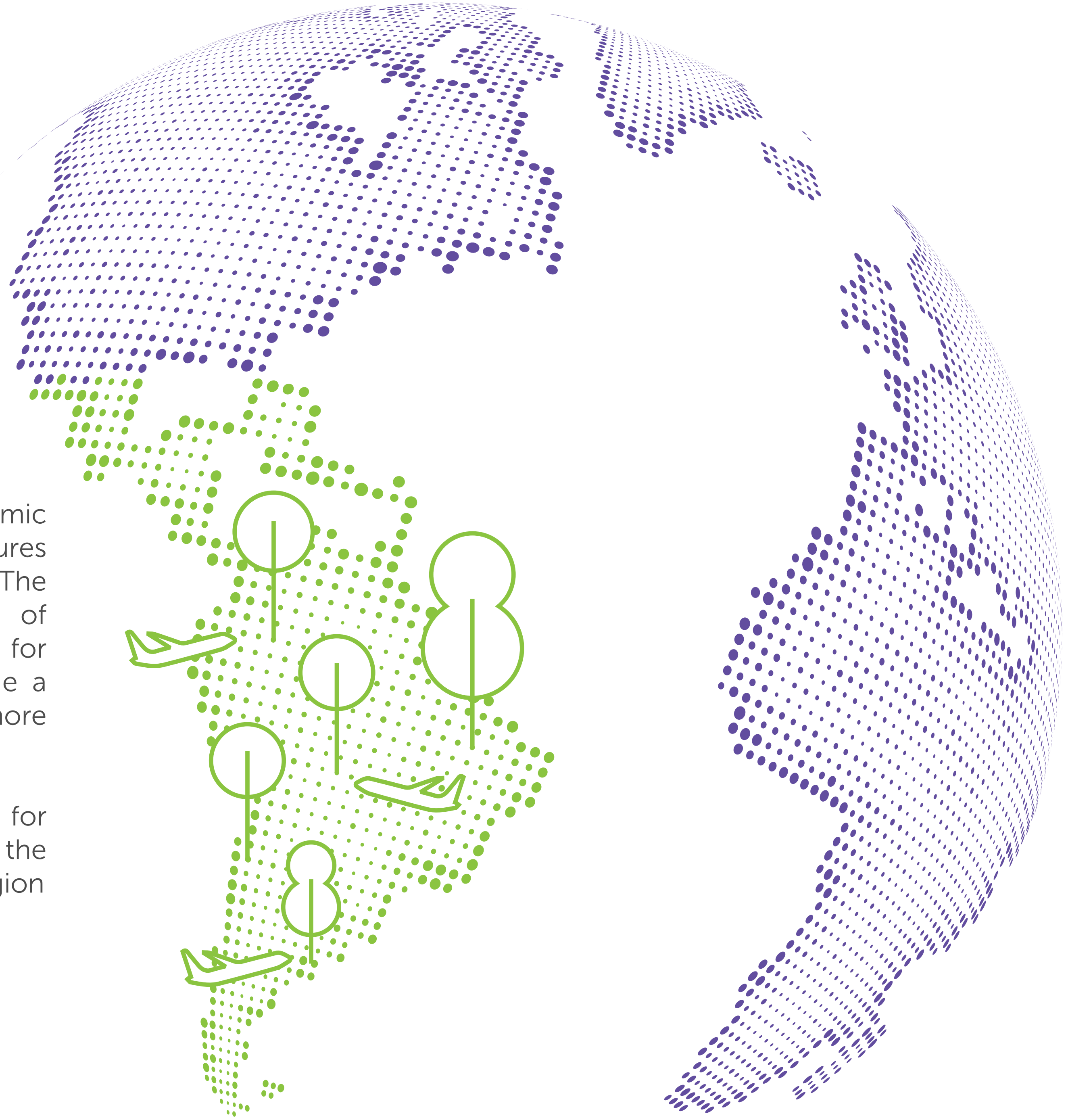
A comparison with the global average reveals that airlines in the region often have less capacity to absorb additional costs without adjusting fares. This underscores the need for a pricing strategy that accurately reflects rising operating costs while ensuring the sustainability and competitiveness of airlines in Latin America and the Caribbean

# Challenges and Recommendations for Achieving Decarbonization and Enhancing SAF Price Competitiveness

In line with this document's goal of promoting a collaborative approach to achieving sustainable aviation objectives while maintaining the accessibility and affordability of air transport in Latin America, this final section outlines recommendations and actions to facilitate these goals.

The challenge of decarbonizing aviation in Latin America and the Caribbean is substantial, particularly given the region's unique geographical and socioeconomic characteristics. However, these features also present significant opportunities. The region's vast biodiversity, abundance of natural resources, and growing need for improved regional connectivity provide a strong foundation for transitioning to more sustainable aviation.

Below are some recommendations for actions that would support the decarbonization of the sector in the region



# Challenges and Recommendations for Achieving Decarbonization and Enhancing SAF Price Competitiveness

## 1. Fostering multiple paths to decarbonization:

Achieving net-zero carbon emissions in aviation is a complex challenge that requires a diversified approach. In Latin America, it is essential to adopt a strategy that explores and maximizes all available pathways to reduce emissions in the sector.

This includes the active promotion of Sustainable Aviation Fuels (SAF), which have the potential to drastically reduce CO2 emissions. The region's abundance of natural resources positions it favorably to lead global SAF production. Key examples include:

- Brazil: As one of the largest palm oil producers in the world, Brazil could supply up to 34% of global SAF needs by 2030. The country also has extensive expertise in biodiesel production from sugarcane [14].
- Mexico: With access to feedstocks like jatropha [15], algae, and used oils, Mexico has significant potential to scale SAF production.
- Colombia: Its robust palm oil and sugarcane production positions Colombia well to leverage these resources for advanced biofuels [16].
- Chile: With the potential to become a major producer of green hydrogen, Chile is poised to be a leading global exporter by 2040 [17].
- Peru and Ecuador: Both countries have significant availability of agricultural residues that can be utilized for SAF production.

In addition to SAF development, operational efficiency improvements should be prioritized across airlines, airports, and air traffic management. Measures such as route optimization can deliver immediate emissions reductions.

Finally, fostering the development of new technologies, such as electric or hybrid aircraft, and implementing market mechanisms like carbon offsets are crucial to addressing emissions that cannot be eliminated through other means (see Annex 2)

## 2. Establish a regulatory framework with clear and consistent goals:

The transition to sustainable aviation in Latin America requires a robust regulatory framework that provides legal certainty and encourages long-term investment. Public policies must be consistent and aligned with global commitments to reducing greenhouse gas emissions. It is crucial that these policies not only focus on decarbonization but also consider their impact on economic growth and the accessibility of air transportation.

To achieve this, governments should promote the creation of carbon schemes that include the certification of carbon credits. These credits should be part of a broader approach that enables airlines to effectively offset their emissions while supporting the development of new technologies and scaling SAF production.

Key recommendations include:

- Authorization for Carbon Credits: Governments should issue authorization letters certifying that carbon credits can be used in programs such as CORSIA, ensuring there is no double counting of emission reductions.
- Transparency in CORSIA Credits: Allow airlines to retire credits approved under the CORSIA program, ensuring transparency and alignment with international commitments such as the Paris Agreement and Article 6 principles.

Finally, instead of imposing mandates that could raise costs, public policies should incorporate incentives to make the adoption of these technologies more economically viable. This would enable a more gradual and less disruptive transition for the industry, promoting a sustainable adoption of the necessary measures while safeguarding the region's competitiveness and accessibility in air travel.

## 3. Ensuring Sustainable Growth to Enhance Regional Competitiveness

The development of sustainable aviation in Latin America should be seen not only as an environmental necessity but also as an opportunity to drive economic growth and improve regional competitiveness. Aviation is a key engine of the region's economy, and its sustainable growth is essential to maximizing socioeconomic benefits such as job creation and enhanced connectivity. The development of SAF in the region presents a significant opportunity to generate employment and stimulate economic growth across the supply chain. According to the ICF Fueling Net Zero (2021) study, investments in bioenergy are highly effective at generating employment. Between 2010 and 2019, $151 billion was invested in bioenergy and biofuels capacity, creating 3.58 million jobs in 2020—equivalent to over 23 jobs per million dollars invested. This is substantially higher than other sectors, such as solar energy (2.7 jobs per million) and wind energy (1.1 jobs per million). These figures highlight the immense economic potential of SAF production and expansion in Latin America, both in terms of decarbonization and economic development.

It is crucial that decarbonization measures do not limit access to air transport or increase costs to the point of restricting connectivity. With appropriate collaboration between the public and private sectors, Latin America can lead the adoption of new technologies and SAF production, positioning itself as a global leader in sustainable aviation while maintaining the economic accessibility of air travel. This collaboration should focus on fostering an environment conducive to innovation and the development of solutions that not only contribute to emissions reductions but also promote economic growth and energy security in the region.

# Challenges and Recommendations for Achieving Decarbonization and Enhancing SAF Price Competitiveness

To support the adoption of SAF and guarantee competitive pricing by 2050, the following essential recommendations are directed at airlines, governments, and stakeholders in the SAF ecosystem:

- **Collaborative Investment Funds**
Establish investment funds through collaboration among airlines, airports, investors, lessors, aircraft and engine manufacturers, and large companies committed to emissions reduction. These funds would finance innovative SAF projects in their early production stages.

**Examples include:**

- **Schiphol Airport:** Offers subsidies of up to €500 per ton of SAF and €1,000 per ton of synthetic fuels, with a cap of €2.5 million, requiring SAF usage forecasts for the next year (Schiphol Airport – Charges and Conditions 2022).

- **Heathrow Airport:** Provides subsidies of €533 per ton of SAF, capped at €11.6 million, incentivizing airlines through reductions in NOx emission charges (Heathrow SAF Incentive, 2021).

- **Milan Airports:** Offers up to €500 per ton of SAF, with a cap of €450,000 for 2023 (SEA Milan Airports, 2023).

- **Düsseldorf Airport:** Provides a subsidy of €250 per ton of SAF, with no upper limit, for up to 1,000 tons per refueling (Düsseldorf Airport – Tariff Regulations).

- **Infrastructure Investment**
Encourage long-term infrastructure investments for SAF production, storage, and distribution across Latin America. This includes pilot projects that ensure SAF certification for eligibility under CORSIA, allowing airlines to claim emissions reductions effectively.

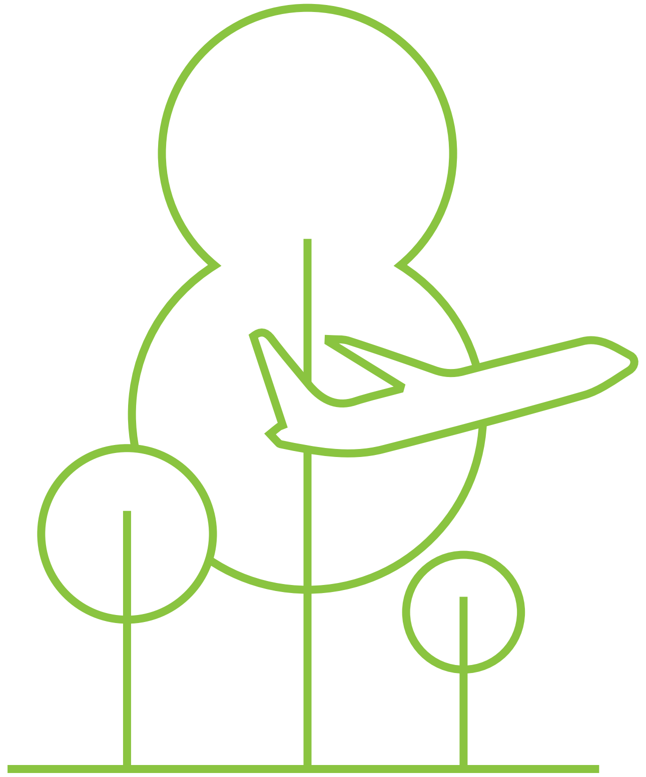
- **Create a Favorable Regulatory Environment**
Latin American governments must establish a regulatory framework that supports SAF infrastructure development by:
  - Streamlining investments.
  - Accelerating permitting processes.
  - Offering tax incentives.
  - Providing clear legal frameworks to reduce investor uncertainty.

Governments should avoid mandates requiring airlines to purchase or use a fixed amount of SAF, as these can increase costs disproportionately. Instead, focus on enabling conditions for voluntary adoption and market-based solutions.

- **Regional Feedstocks and Lifecycle Analysis (LCA)**
Promote the inclusion of regional feedstocks and lifecycle analysis metrics in international frameworks like CORSIA. Recognizing the region's unique resources in global SAF markets will encourage fair trade and boost competitiveness.

- **Support Innovation in Feedstocks**
Establish programs to support the production, research, and development of new SAF feedstocks that are abundant and sustainable in the region. Examples include agricultural and forestry residues. This should include subsidies for farmers and improvements to logistics infrastructure.

- **Renewable Energy Integration**
Increase the use of renewable energy in SAF production processes. Incorporating low-carbon electricity will reduce energy costs and emissions associated with SAF production, further enhancing its economic and environmental viability.



# Annex 1: Current state of sustainable aviation fuels (SAF) and outlook for 2050

Achieving the aviation sector's decarbonization goals by 2050 will require a combination of measures, including adopting Sustainable Aviation Fuels (SAF), new energy technologies, operational optimization, and the use of carbon offsets, among others.

It is important to recognize that each country's characteristics and developmental context vary, necessitating tailored solutions for each market. For instance, carbon offsets can serve as a short-term tool in regions where the adoption of cleaner technologies progresses more slowly, enabling emissions mitigation through projects like reforestation.

While SAF will be a critical component of the decarbonization strategy, it must be combined with other technological and operational solutions, taking into account the diverse developmental contexts across the region. According to the International Civil Aviation Organization's (ICAO) Long-Term Aspirational Goal (LTAG) scenarios, emissions reductions depend on the combined strategies employed:

- Scenario IS1: Projects a 20% reduction in emissions from aircraft technologies, 4% from operational improvements, and 15% from cleaner fuels by 2050.
- Scenario IS2: Anticipates a 21% reduction through new technologies, 6% from operational efficiencies, and 41% from alternative fuels.
- Scenario IS3 (most ambitious): Forecasts a 21% reduction from aircraft technologies, 11% from operational efficiencies, and 55% from alternative fuels such as hydrogen.

This annex focuses on the current state and future outlook of SAF in the region, drawing on data from S&P Global. According to their projections, under current trends, the total supply of SAF in Latin America and the Caribbean is expected to reach 118,000 barrels per day by 2050, with a compound annual growth rate (CAGR) of 18% over the next 25 years (Figure 13). Brazil is estimated to account for at least 60% of this regional supply (Figure 14).

# **Annex 1:** Current state of sustainable aviation fuels (SAF) and outlook for 2050

According to S&P Global, projections for SAF supply in the region (Figure 13) indicate sustained growth in production through 2050. The Hydroprocessed Esters and Fatty Acids (HEFA) production method will remain the most significant, accounting for over 50% of total supply by that year. However, starting in 2030, a notable increase in the share of Alcohol-to-Jet (AtJ) technology is expected, reaching 39.6 thousand barrels per day by 2050.

Figure 13.

## Projected supply of SAF in Latin America (2027-2050)

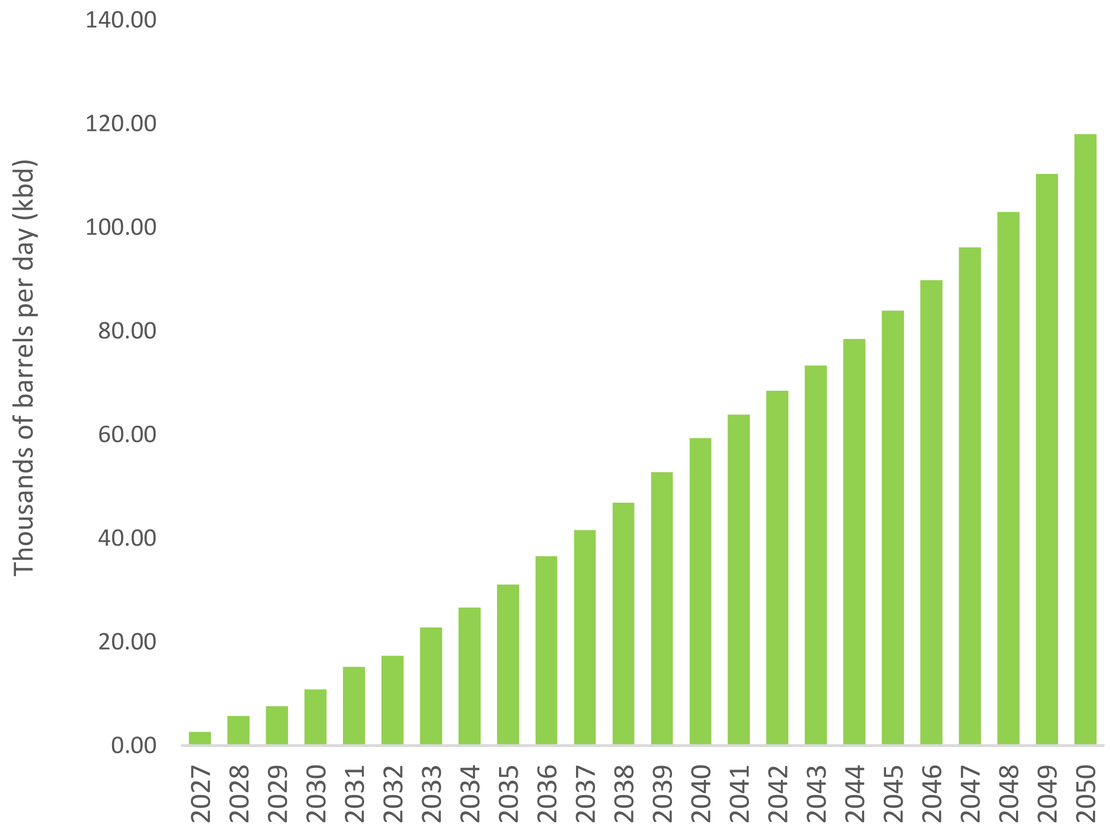
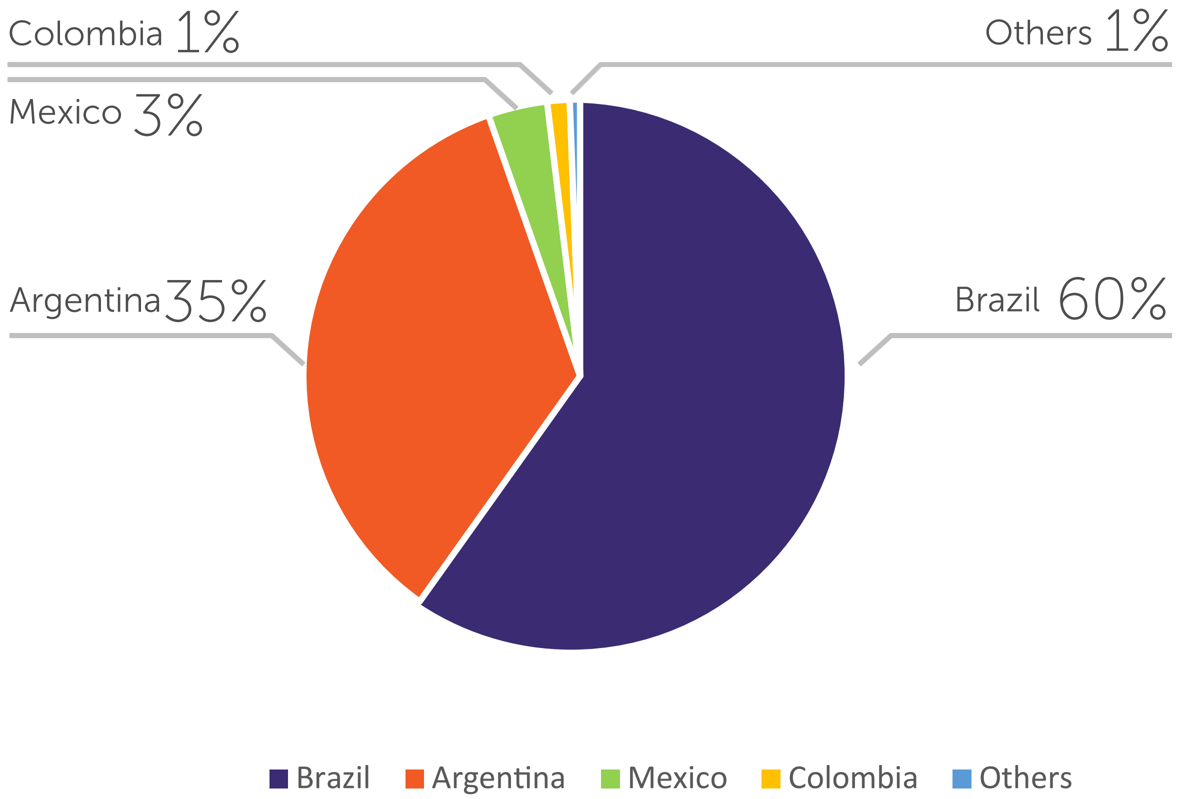


Figure 14.

## Share by country of the total projected supply of SAF in LAC (2050)



Source: ALTA analysis based on S&P Global Commodity Insights. © 2024 S&P.

This growth will be driven by the greater availability of low-carbon intensity feedstocks, such as ethanol, particularly in countries like Brazil, where the sugarcane industry will play a pivotal role in this transition.

This indicates that Latin America will begin diversifying its SAF production sources, reducing its reliance on HEFA. The diversification of production technologies will be essential to meet growing demand while leveraging the region's abundant agricultural and energy resources. As these technologies advance, they are expected to become more accessible and efficient, further supporting the region's capacity to scale SAF production sustainably.

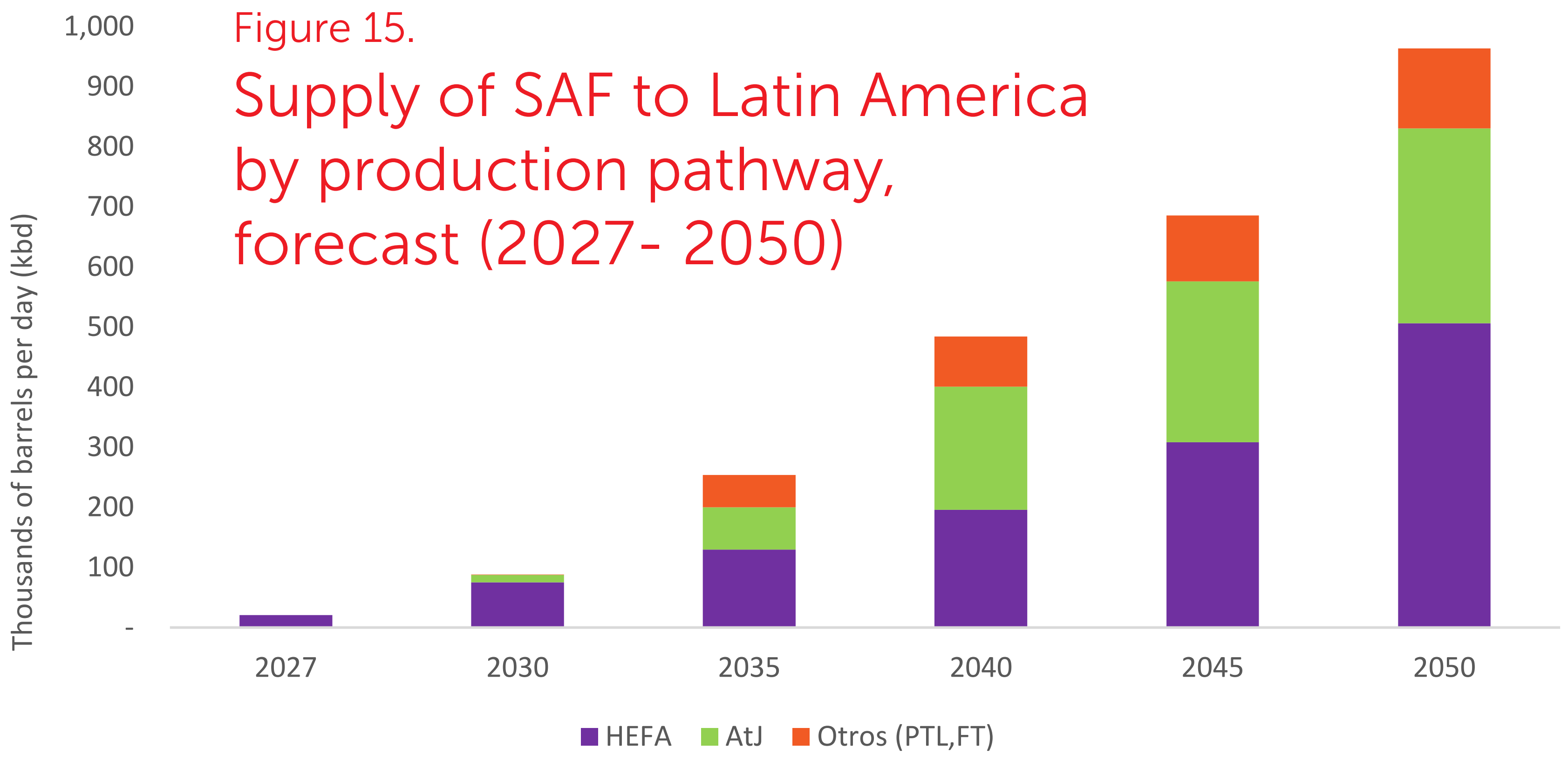
# **Annex 1:** Current state of sustainable aviation fuels (SAF) and outlook for 2050

Currently, SAF produced via the Hydroprocessed Esters and Fatty Acids (HEFA) pathway costs between 2 to 5 times more than conventional fossil fuel (Figure 16). While prices are expected to decline with technological innovations and economies of scale, these costs heavily depend on the production method and the feedstock used. The HEFA process is just one of several pathways for SAF production, and not all face the same conditions. Other pathways, such as biomass gasification or synthetic fuels, may have different cost structures and face unique challenges depending on the resources and capacities available in each region.

As production scales up and technologies improve, some inputs, such as renewable electricity, are expected to become more accessible. However, it is crucial to highlight that no single feedstock or production method is universally viable to meet global SAF demand. Regional characteristics and contexts will play a key role in shaping the development and adoption of various production pathways, ensuring that SAF production aligns with local resources and economic conditions

Figure 15.

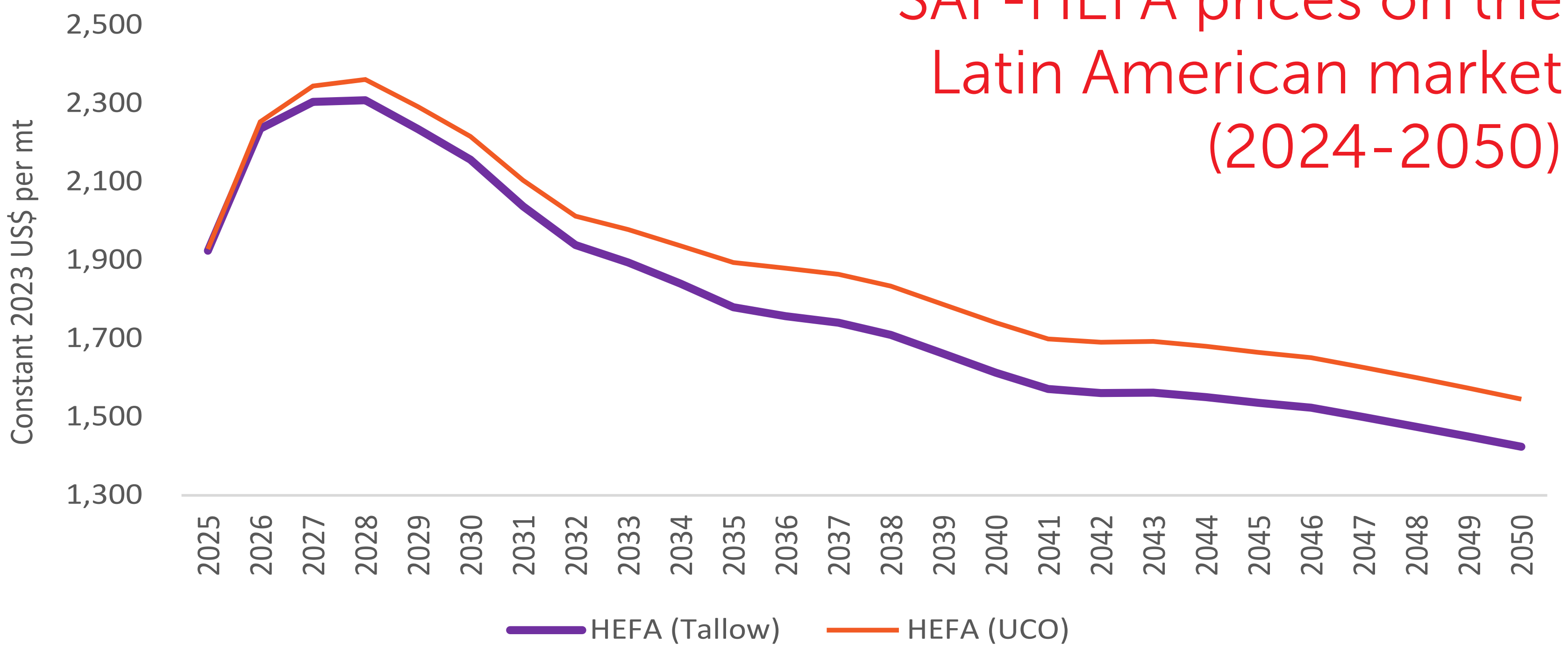
Supply of SAF to Latin America by production pathway, forecast (2027- 2050)



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P. Notes: HEFA: Hydroprocessed Ester Fatty Acids, ATJ: Alcohol-to-Jet, FT: Fischer Tropsch, PTL: Power-to-liquid.

Figure 16.

SAF-HEFA prices on the Latin American market (2024-2050)



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P . Note: The prices shown are calculated using the net-back method from the US. U.S.

# **Annex 2:** Carbon reduction markets and mechanisms

Despite advancements in technology, operational and infrastructure improvements, and the growing use of Sustainable Aviation Fuels (SAF) in the future, residual emissions will persist and cannot be entirely eliminated by 2050. To mitigate these emissions, investment in carbon reduction measures outside the aviation sector will be critical. Annex 2 briefly explores the role of carbon credit markets and highlights the importance of investing in renewable energy as complementary strategies to achieve emissions reduction targets.

- Carbon Offsetting:

Acquiring carbon credits from projects that reduce, capture, or prevent emissions outside the aviation sector. Examples include reforestation, renewable energy initiatives, and methane capture projects.

- Carbon Capture and Storage (CCS):

Supporting technologies that capture CO2 from industrial processes or directly from the atmosphere, storing it underground or repurposing it in other sectors.

- Investment in Renewable Energy:

Financing clean energy infrastructure, such as solar, wind, or geothermal projects, to reduce reliance on fossil fuels in other sectors.

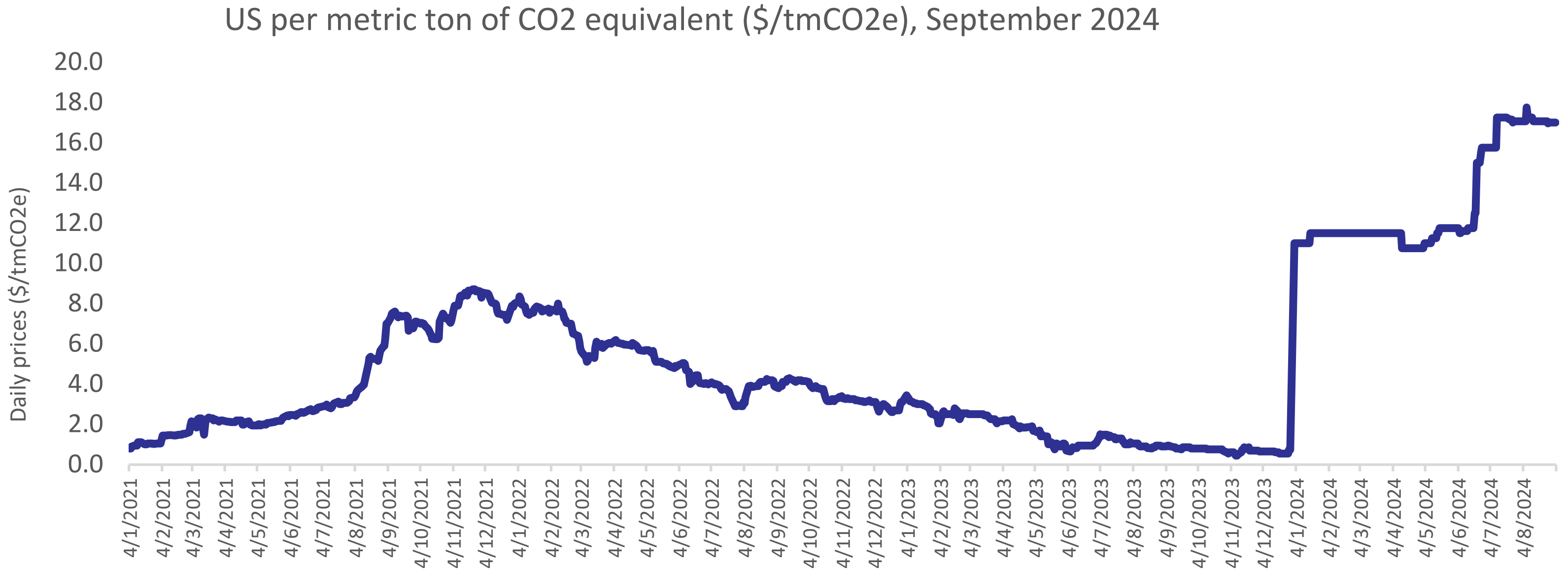
Carbon offsetting, whether through market mechanisms or out-of-sector reductions, can form part of the strategy to achieve industry goals. This approach depends on the cost of available offsets at the time (Figure 17), relative to SAF supply and the price difference between SAF and conventional jet fuel. The voluntary carbon credit market is projected to grow significantly in the coming years, though there is uncertainty regarding the availability and types of offsets that will exist by 2050.

The International Civil Aviation Organization (ICAO) has established the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to limit sector emissions starting in 2021. While airlines are expected to invest in a variety of options to reduce their emissions, a substantial portion of these reductions will likely be achieved through the acquisition of voluntary carbon credits.

As the industry navigates toward its 2050 net-zero goals, a combination of SAF, technological advances, and complementary offset mechanisms will be essential to bridge the gap in emissions reductions.

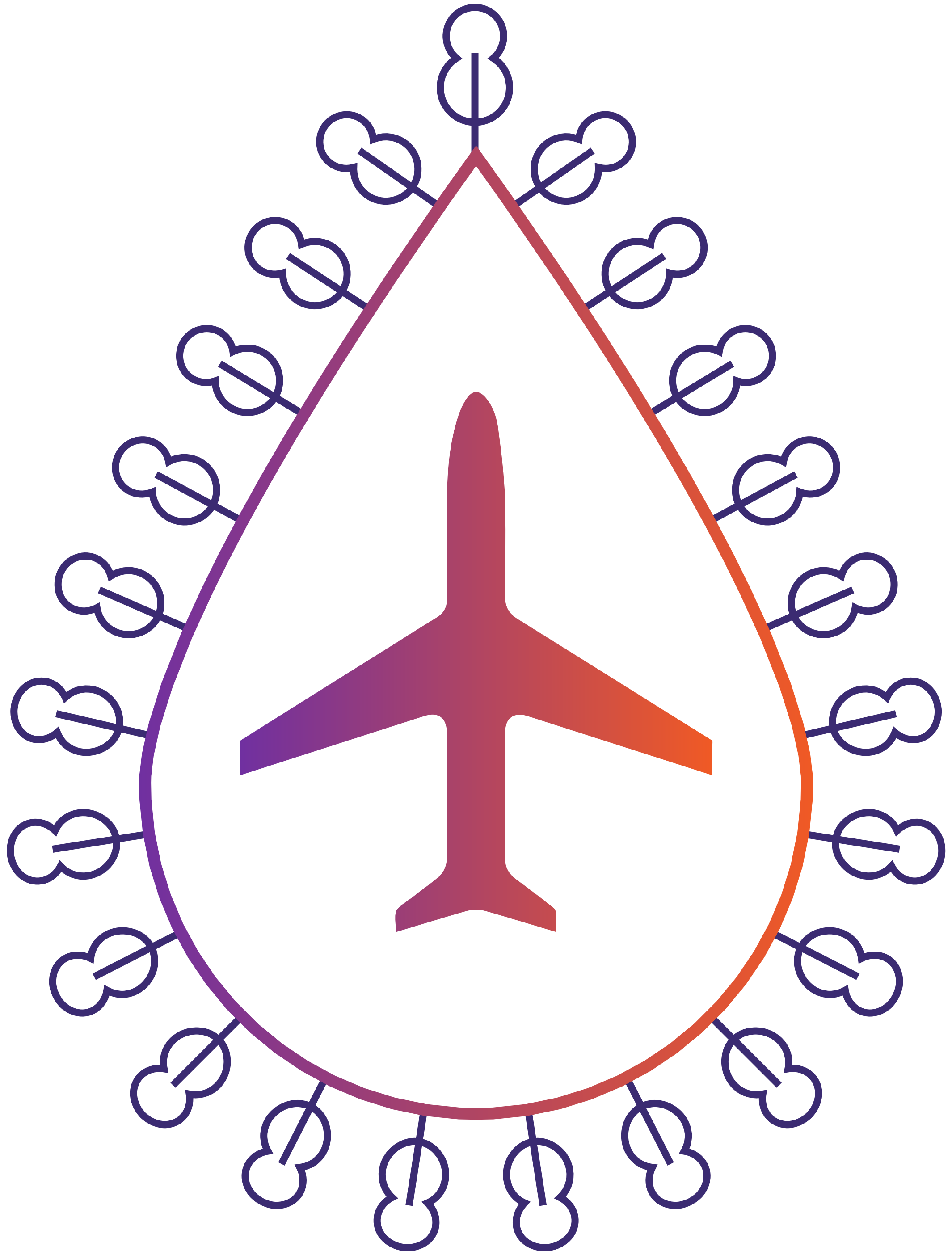
Figure 17.

Daily prices for the market of eligible credits for CORSIA



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P. Note: Platts (CORSIA Eligible Credit) publishes a daily price in ($/ mtCO2e) and represents a minimum of one lot of 20,000 units of tmCO2e each and a maximum volume of 100 lots of 1,000 units of tmCO2e each.

# **Annex 3:** Status of aviation fuel in the region



Latin America continues to be a growing region for the demand for refined products. Demand for traditional fuels such as gasoline, diesel and jet fuel is projected to increase over the coming decades, albeit moderately due to the energy transition and improvements in efficiency. Demand for aviation fuel has not yet reached pre-pandemic levels, but is expected to do so by 2024.

This annex provides a brief analysis of the outlook for the total demand for conventional aviation fuel, as well as the production capacity, consumption and commercial balance of jet fuel in the main countries of Latin America and the Caribbean, with the aim of understanding the challenges and opportunities these countries face in their transition to the production of Sustainable Aviation Fuel (SAF). This information is relevant for identifying the gaps between local production and the growing demand for jet fuel, which highlights the importance of developing alternative sources such as SAF, improving the trade balance and strengthening energy self-sufficiency in the long term.

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# **Annex 3:** Status of aviation fuel in the region

## Total aviation fuel demand in Latin America

Demand for aviation fuels in the Latin American and Caribbean region is projected to reach 583,000 barrels per day (b/d) by 2050. Projected demand in the 5 main markets (Brazil, Mexico, Colombia, Argentina and Chile) will have a compound annual growth rate (CAGR) of 1.38% since 2023, reaching a total close to 421,000 b/d by 2050 (figures 18 and 19).

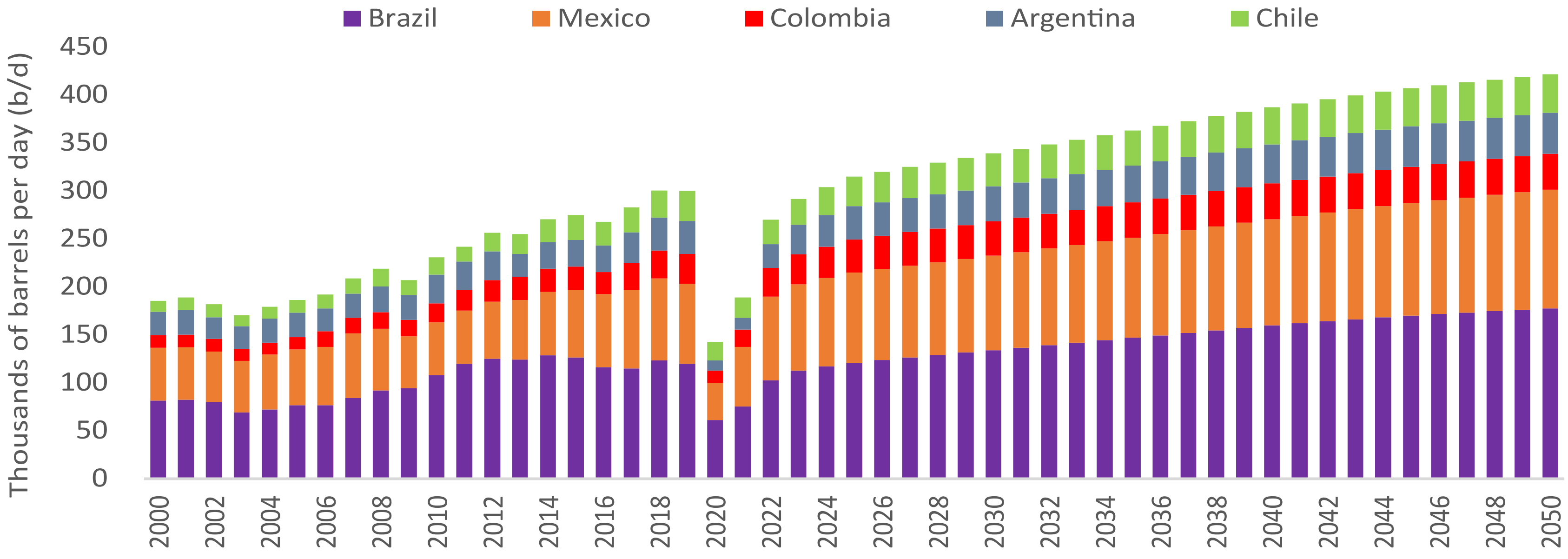
In 2023, according to data from S&P Global, aviation fuel consumption in the main countries of the region was as follows:

- Brazil: 113,000 b/d, with a CAGR of 1.7%.
- Mexico: 90,000 b/d, with a CAGR of 1.2%.
- Colombia: 31,000 b/d, with a CAGR of 0.7%.
- Argentina: 31,000 b/d, with a CAGR of 1.2%.
- Chile: 27,000 b/d, with a CAGR of 1.5%.

This analysis provides a clear overview of the demand for aviation fuel in the region, which is fundamental to understanding the opportunities for developing SAF and strengthening energy security in Latin America.

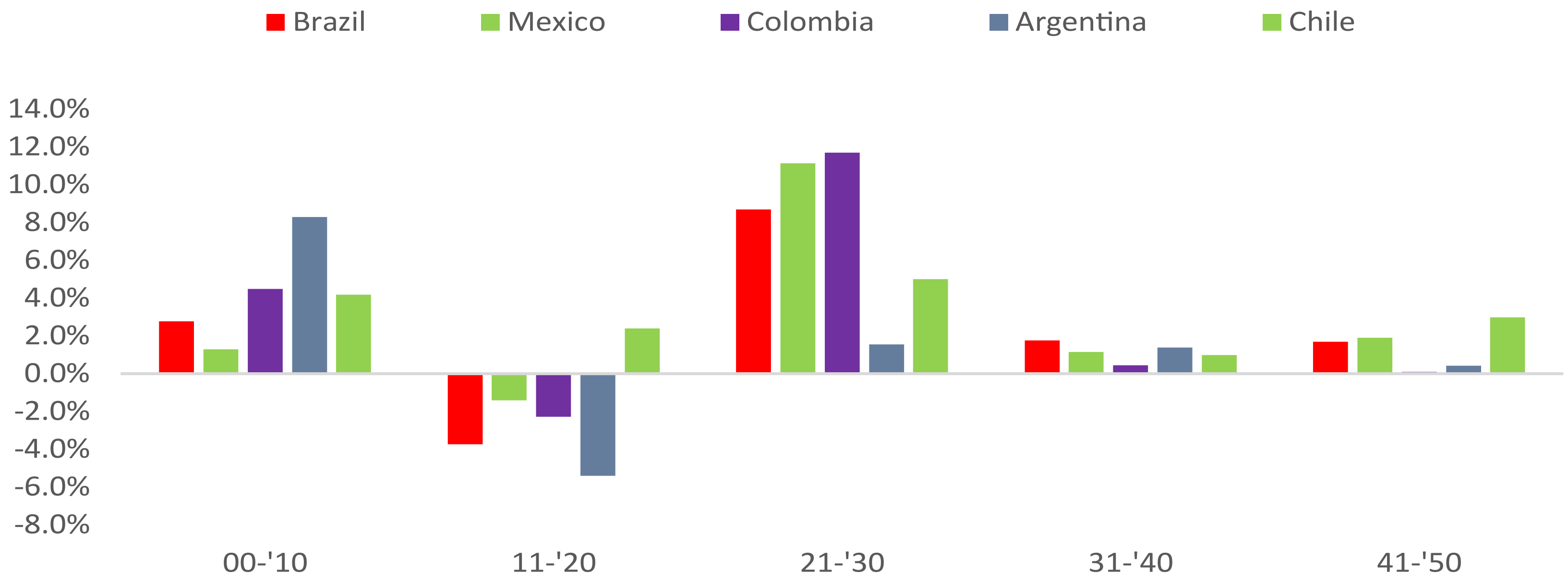
### Figure 18.

### Historical and forecast jet fuel consumption for the main countries in LAC (thousands of b/d)



### Figure 19.

### Average annual growth in jet fuel consumption by country



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P.

# **Annex 3:** Status of aviation fuel in the region

## Aviation fuel production in Latin America

Aviation fuel production capacity in the region will reach 319,000 barrels per day (b/d) by 2050, with a compound annual growth rate (CAGR) of 1.1% from 2023 (graph 20).

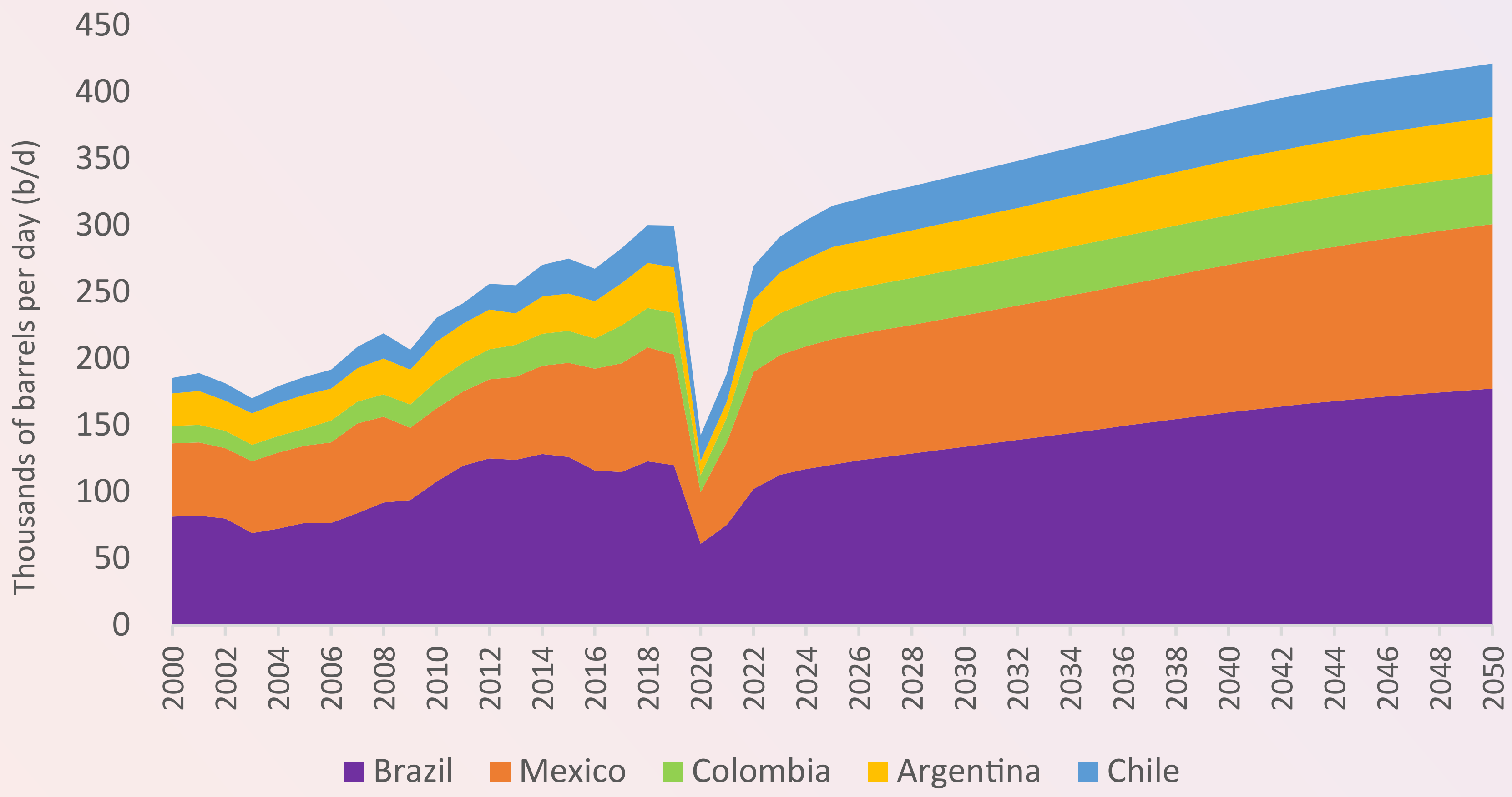
In 2023, according to the same source, the main countries in the region had the following aviation fuel production:

- Brazil: 92,000 b/d, with a CAGR of 1.5%.
- Mexico: 36,000 b/d, with a CAGR of 2.6%.
- Colombia: 27,000 b/d, with a CAGR of -0.1%.
- Argentina: 31,000 b/d, with a CAGR of -0.8%.
- Chile: 13,000 b/d, with a CAGR of -0.3%.

As jet fuel production capacity in most of these countries is not sufficient to meet future demand, the region will continue to depend on imports. This has a direct impact on the region's energy security, exposing it to variations in international prices and possible supply interruptions.

Figure 20.

### Historical and forecast aviation fuel production capacity by country



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P.

# **Annex 3:** Status of aviation fuel in the region

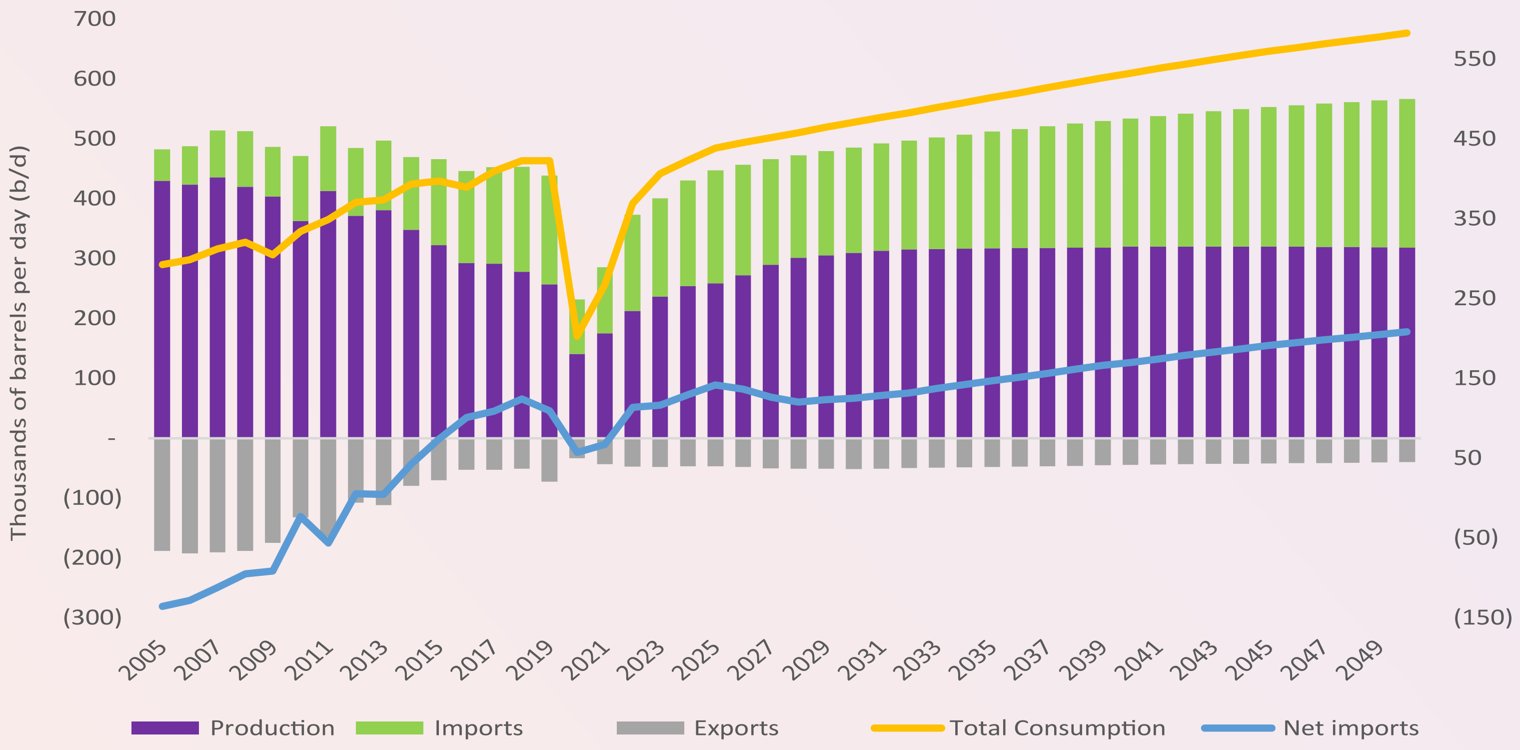
## Historical trade balance and outlook to 2050, by country

Jet fuel consumption in Latin America and the Caribbean will continue on an upward trend over the coming decades, steadily outstripping local production, which shows a growing dependence on imports. This gap between production and demand reflects a vulnerability in energy security, since the region will need to obtain external supplies to cover its needs (Graph 21).

Although net imports will begin to stabilize and decrease towards 2040, this suggests that there is a projection of some improvement in local production, but there will still be a strong dependence on external sources to meet growing demand.

Figure 21.

### LAC jet fuel trade balance and forecast (2005-2050)



Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P.

# **Annex 3:** Status of aviation fuel in the region

The following shows the historical and forecast commercial balance and production of aviation fuel up to 2050 for the region and the main countries in the region (graphs 22-26).

Figure 22.

## Jet fuel balance - Brazil

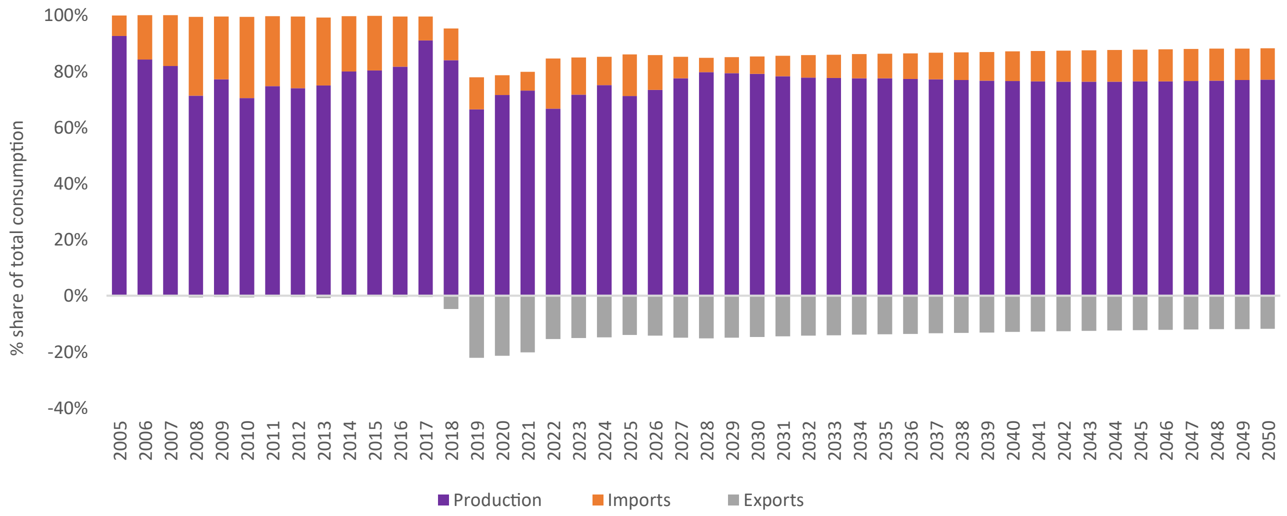


Figure 23.

## Jet fuel balance— Mexico

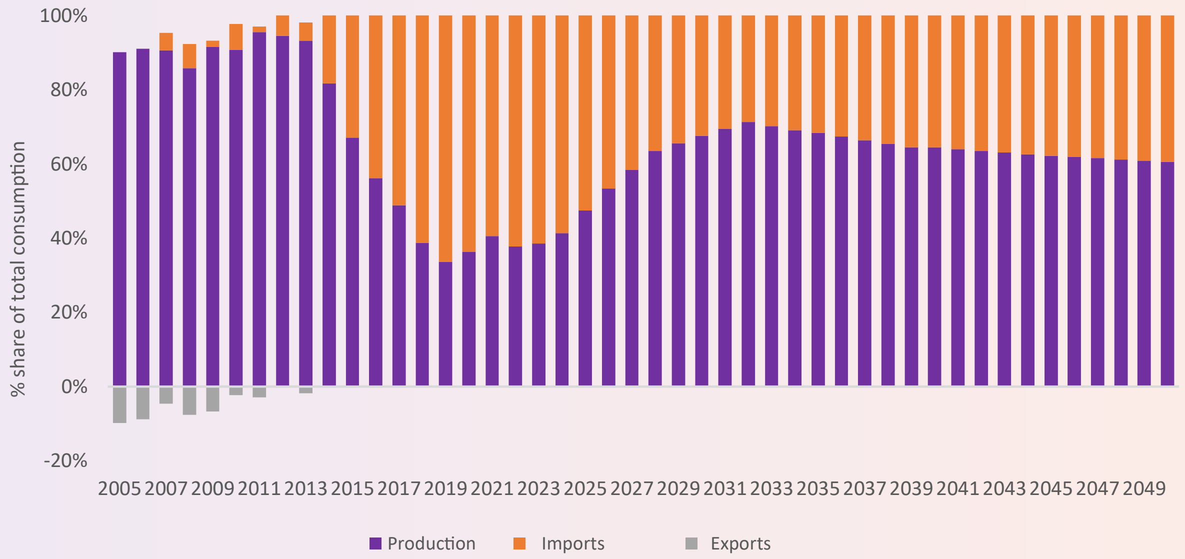
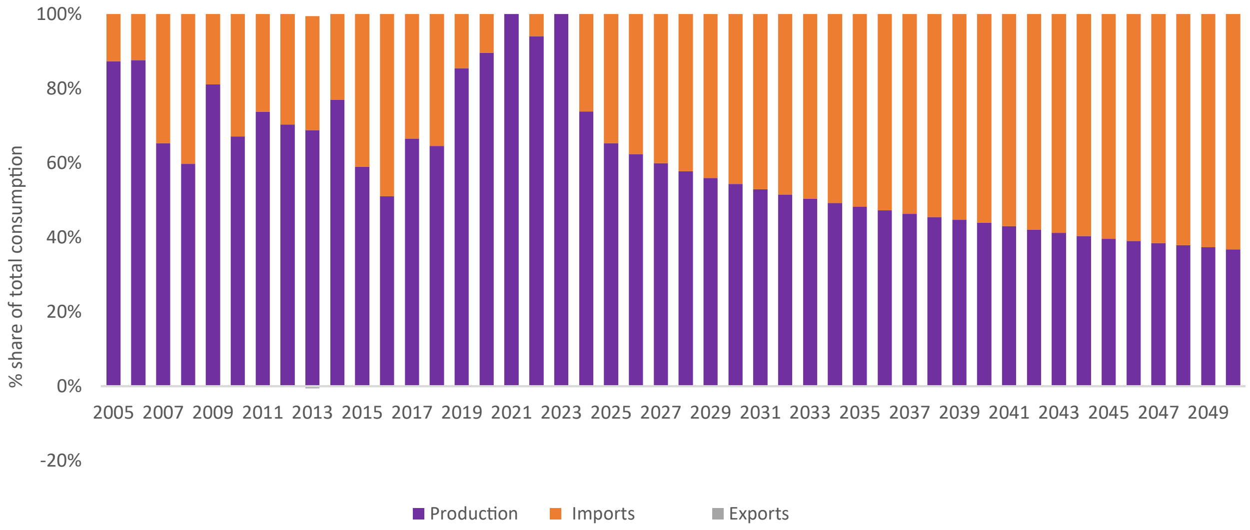


Figure 24.

## Jet fuel balance— Colombia

Figure 25.

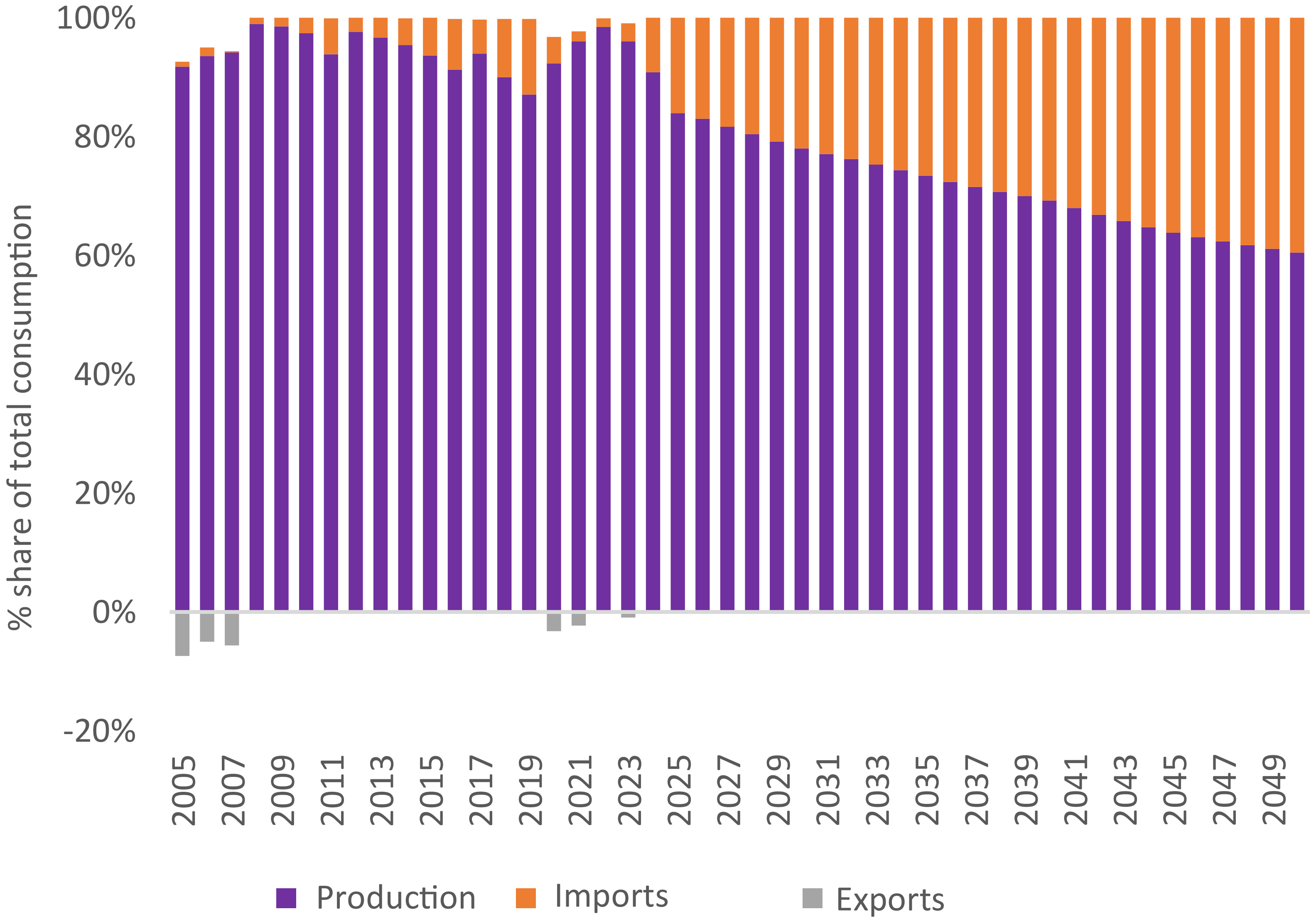
## Jet fuel balance— Chile



## Annex 3:
Status of aviation fuel in the region

Figure 26.

### Jet fuel balance - Argentina



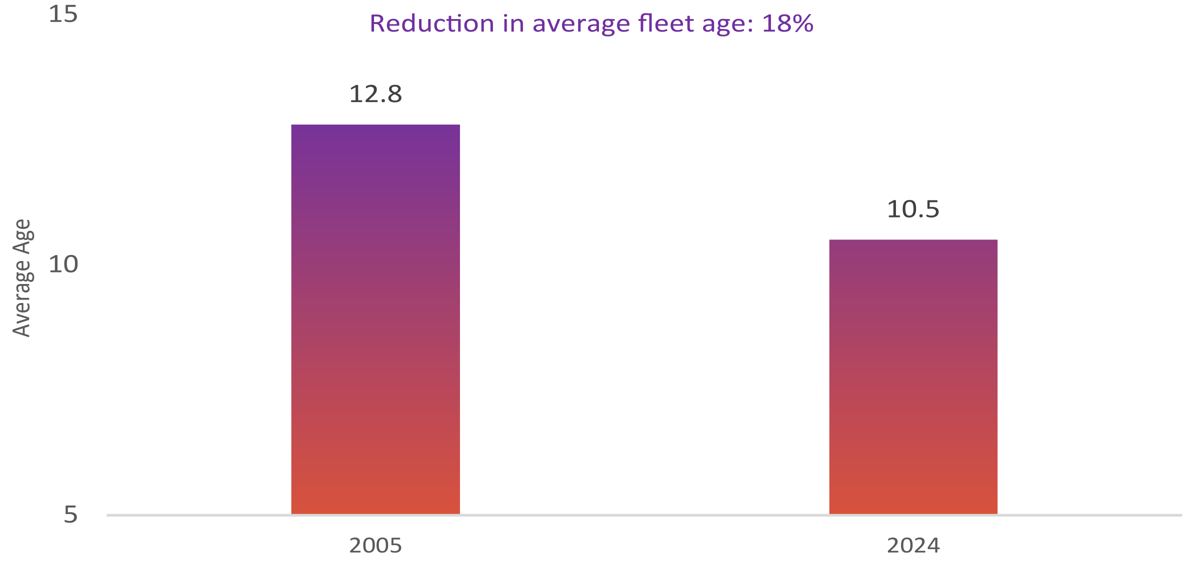
Source: ALTA analysis based on data from S&P Global Commodity Insights. © 2024 S&P.

ALTA

# **Annex 4:** Fleet renewal and cabin densification in the region

Figure 27.

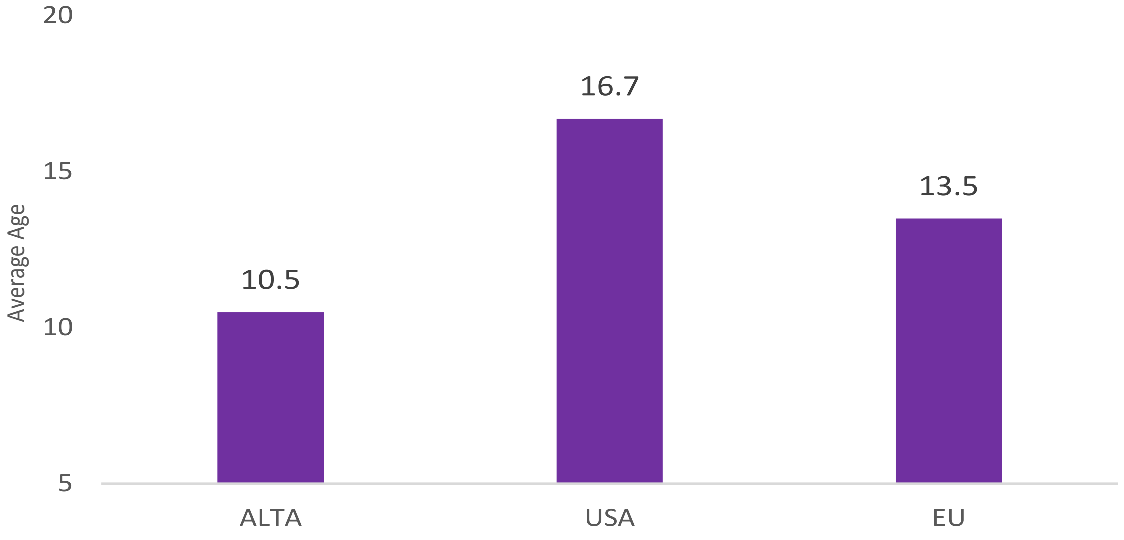
## Average age of fleets (ALTA Airlines)



Source: CIRIUM

Figure 28.

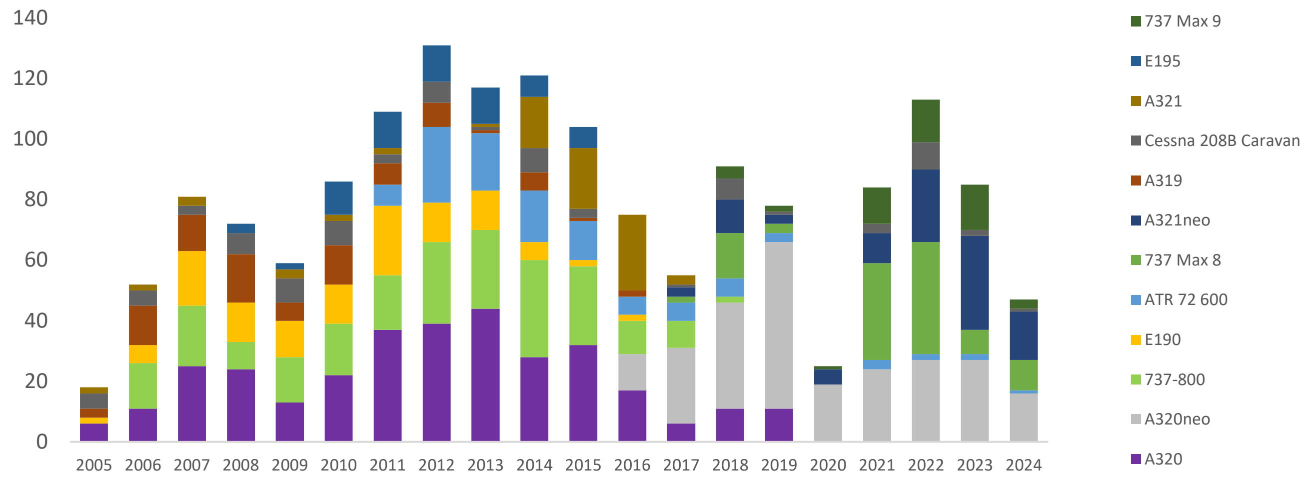
## Comparison of average fleet age (2023)



Source: CIRIUM

Figure 29.

## Graph 29. New aircraft in service in LAC, by aircraft type



Source: CIRIUM

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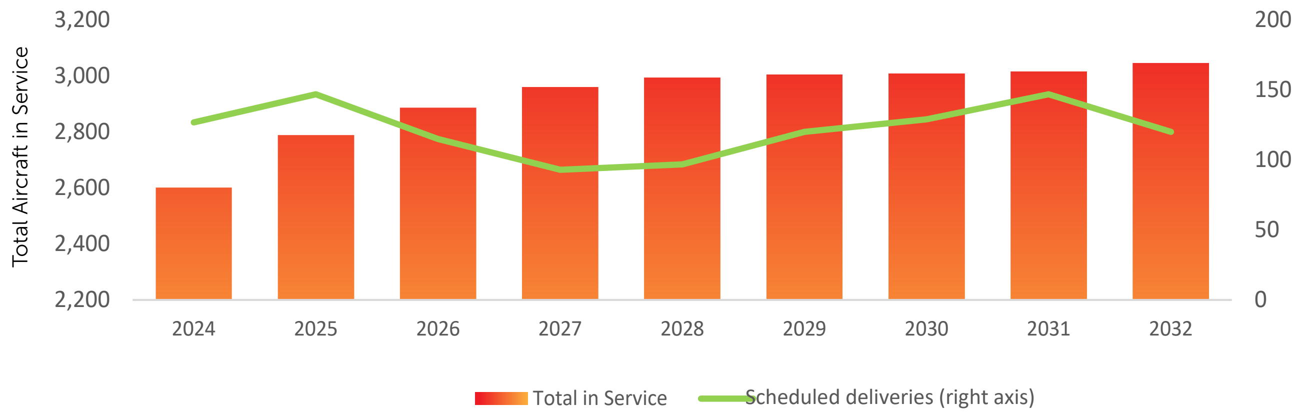
# **Annex 4:** Fleet renewal and cabin densification in the region

Since 2005, ALTA member airlines have added almost 1,300 aircraft to their fleet (Graph 11). In recent years, most of the new acquisitions have been the most modern and efficient versions offered by manufacturers, such as the Boeing 737 MAX and the Airbus A320neo family, which began to be integrated in 2016. Over the next few years, ALTA airlines plan to put more than 1,000 new aircraft into operation, thus ensuring an even more modern and efficient fleet (graph 30).

## Figure 30.

## Scheduled aircraft deliveries in LAC

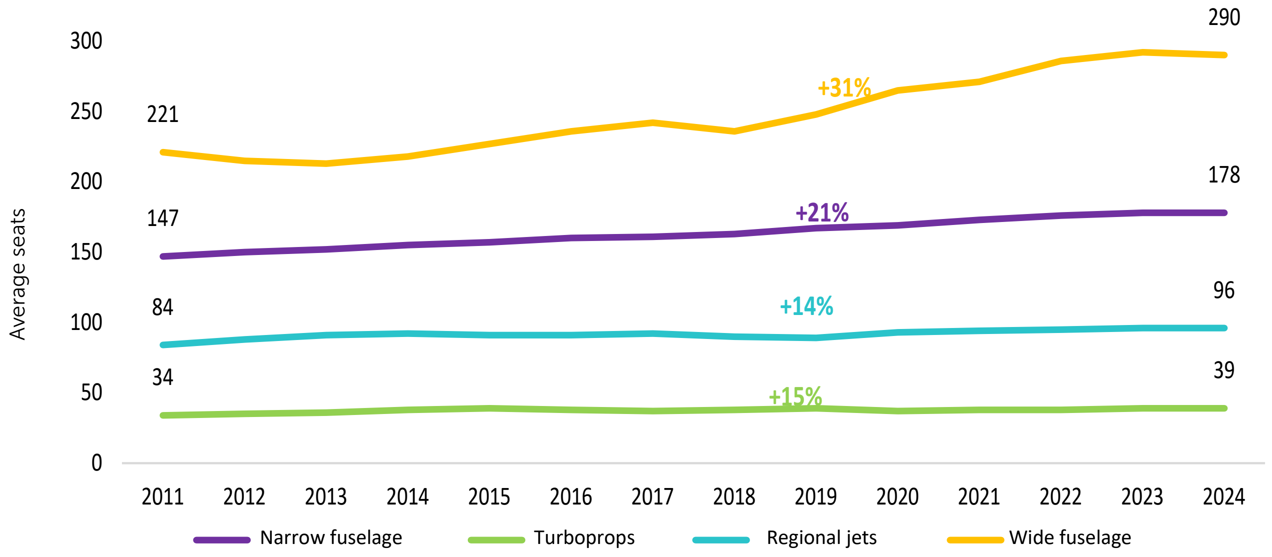


Source: CIRIUM

Similarly, cabin densification measures have been implemented on all types of LAC airlines' aircraft, which has made it possible to increase efficiency per passenger (graph 31).

## Figure 31.

## Cabin densification (average seats per aircraft type)



Source: ALTA analysis based on CIRIUM

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