

2020 JET FUEL INNOVATION REVIEW

Airline Industry Innovation,
Operations and Fleet Planning,
Fuel Procurement and Sustainability

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Prepared by:

cargo facts 
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Royal Media Group
8 West 38th Street, Suite 901
New York, NY 10018

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1. Summary

Fuel represents the largest single cost for the airline and air cargo business. Many airlines impose fuel surcharges to recover costs and hedge against short- to medium-term fluctuations in fuel price. While many companies take a good look at their fleet composition and operational practices to reduce their fuel consumption, there has also been increased interest in sustainable aviation fuels and carbon offset programs, driven in part by impending regulation of greenhouse gas emissions and customer preferences, as well as the desire to be “doing the right thing.”

We find that there is potential for significant upside from investment in software solutions to improve flight operations and fuel management. We find that although some airlines are investing in innovation, the industry is not putting enough focus on this area.

This report contains our assessment of how the airline industry is handling the topic of fuel, fuel innovation and related issues. Our analysis is complemented by the findings from an industry survey that Jet Fuel Innovation News and Cargo Facts Consulting conducted between November 2019 and January 2020, which received approximately 220 responses from a range of passenger and cargo airlines, as well as other industry participants. Approximately 95 respondents were airlines.

Airlines that responded included a mix of passenger, charter and cargo airlines, operating both regionally and internationally. Specific airlines that responded include Atlas Air, Endeavor Air, Etihad Airways, Qatar Airways, EasyJet, FedEx, Cargolux, ASL Aviation, Lufthansa Cargo, Southwest Airline, Astral Aviation, Avianca, Air Transat, United Airlines, and American Airlines, among others.

The report is divided into three broad sections:

- Fleet and operational practices (Chapter 2), in which we cover programs to increase the fuel efficiency of flights and ground operations as well as how fuel factors in fleet planning decisions
- Fuel procurement, hedging and surcharges (Chapter 3), in which we cover what the industry is doing to reduce the risk of fuel price volatility
- Innovation, Sustainable Aviation Fuels and Emissions (Chapter 4), in which we cover the increasing level of interest and action with regard to running environmentally more sustainable operations.

These topics and more will also feature at an upcoming Jet Fuel Innovation Summit conference, hosted in the Four Seasons Houston on 6-7 April 2020. See <https://www.jetfuelinnovation.com> for more information and to register.

2. Fleet and Operational Practices

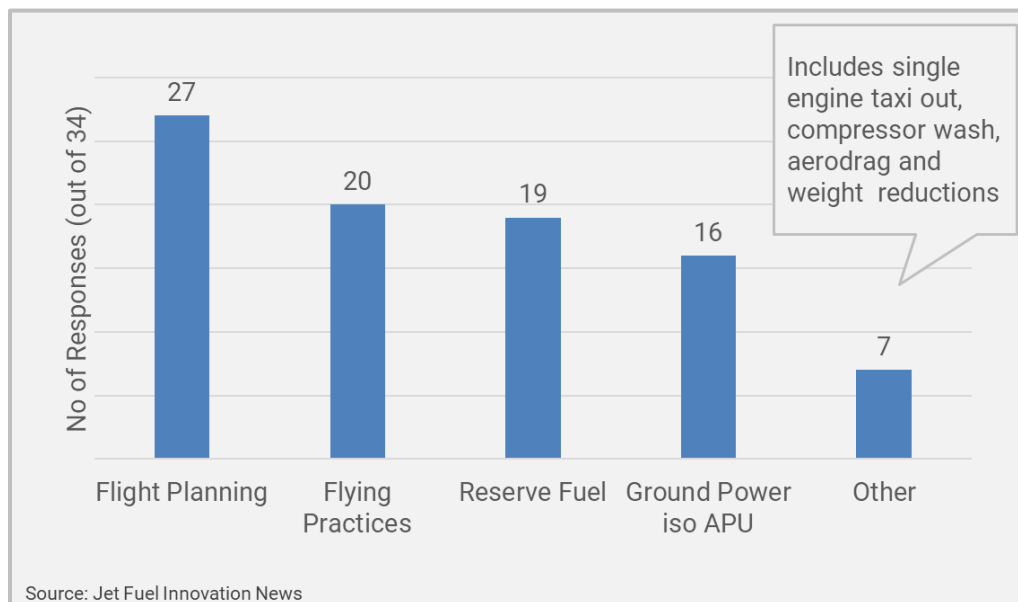
Key Findings:

- As carriers acquire new and more efficient aircraft, per seat or tonne fuel consumption is going downwards. However, revenue potential and capabilities are more important factors in aircraft choice than fuel.
- Airlines are partnering with space and other aviation organizations to develop programs designed to increase fuel efficiency by reducing flight time, avoiding weather events, traffic and airspace constraints.
- The most common ground programs to reduce fuel consumption are efficient engine wash initiatives, changes in engine landing and taxiing procedures and lower auxiliary power unit (APU) usage.

2.1 Programs to Increase Fuel Efficiency of Flight Operations

Most airlines that participated in our recent survey stated that they had programs to increase the fuel efficiency of their operations, while a small minority said they did not. Airlines that do, tend to focus on a multitude of measures, including flight planning, encouraging fuel saving flight practices, management of reserve fuel minima, and use of ground power rather than the auxiliary power unit (APU), where practical (see Figure 1).

Figure 1 - Operational Programs to Increase Fuel Efficiency



Approximately two thirds of the airlines that responded also indicated that they provide incentives to flight crews to improve fuel efficiency. Close to 80% stated that they have programs in place to increase the efficiency of their ground operations.

Airspace constraints, flight routes and runway approaches are important areas of activity for operators and this is where we have seen investments in improved flight planning systems and tools. The goal of optimizing routes and utilizing diverse approach procedures where practicable are areas where the flight crew can take advantage of fuel and emissions savings. Some examples include the Continuous Descent Approach (CDA), Optimized Descent Approach (CDA) and TASAR (Traffic Aware Strategic Aircrew Requests).

Congested airports have started looking at “greener” aircraft approaches and airlines have been applying Continuous Descent Approach (CDA) procedures in which the airplane follows a continuous descent path with minimal flight destabilization. This technique aims to reduce fuel consumption, air emissions and noise levels at airports like London Heathrow and Amsterdam Schiphol. In the United States, a similar technique called Optimized Descent Profile (OPD) has been authorized by the FAA, allowing the development of arrival procedures with vertical profiles optimized to facilitate a continuous descent without level segments based on the performance of the aircraft under current flight conditions. This approach is used in Miami, Atlanta, Los Angeles and Boston among others.

Airlines in the United States are continuously working with NASA to optimize flight paths in real time. The program, known as TASAR (Traffic Aware Strategic Aircrew Requests) and its software application TAP (Traffic Aware Planner) are designed to improve the process in which pilots request altitude and flight plan modifications due to changing flight conditions. These changes have the objective of reducing flight time and increase fuel efficiency. Analysis show flight time savings of one to four minutes and fuel savings between 50 and 500 lbs. per flight depending on the aircraft type and performance. TAP considers wind speed and altitude with the goal of minimizing headwinds and fly at the most efficient altitude. Having real-time wind data allows the crew to perform a descent in a way to minimize thrust inputs.

2.2 Programs to Increase Fuel Efficiency of Ground Operations

Carriers are also showing their commitment on the ground and have put programs in place to reduce fuel usage in the tarmac. Most airlines are replacing their ground support equipment with electric alternatives with the goal of reducing fuel not just supplied to aircraft but also to vehicles.

Another measure across the largest operators worldwide has been the reduction in the use of the APU (Auxiliary Power Unit) which is used to supply the aircraft to supply energy to start running and prioritizing the use of pre-conditioned air and ground power when available. Moreover, airlines have stated that their pilots are instructed to use idle reverse thrust instead of full reverse thrust during landing and on the ground. Some operators are taking this further and switching off one engine and reducing engine speed while taxiing if the airport and aircraft conditions allow it from a safety perspective.

Engine-washing procedures are meant to keep components clean in order to maintain performance in the air and extending the useful life of the engine and we have seen operators making changes on their own engine washing programs; the goal here is to reduce the water usage in the washing process by implementing a closed-loop system in which water used is being collected and recycled while cleaning the compressor and fan in a single process.

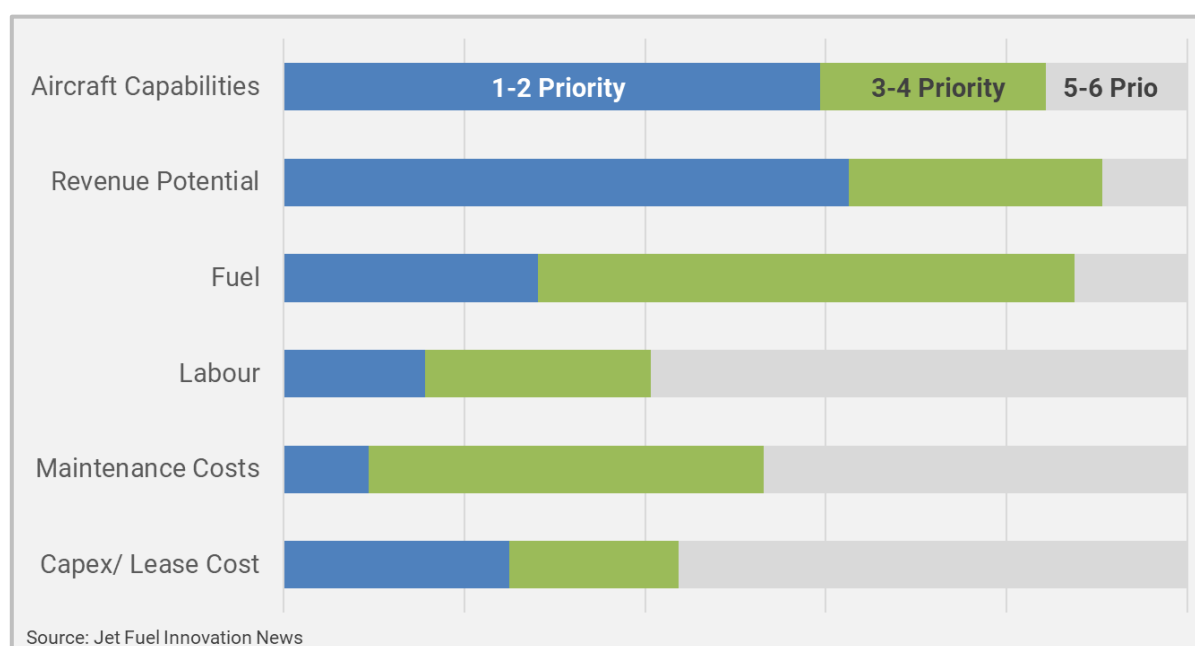
2.3 Fleet Planning

Many carriers are bringing quieter and more efficient aircraft to their fleets, replacing the older units and therefore, reducing the CO₂ and NO_x emissions. New generation aircraft such as the

Airbus A350 or Boeing 787 are replacing the older four engine-aircraft types such as the Airbus A340 and Boeing 747. In the short and medium haul, the Airbus A320 NEO family and Boeing 737 MAX have started to replace the A320 CEO and Boeing 737 NG types. It is important to note that the newer generation of aircraft cut the sound footprint by half as well, an indication that operators are targeting noise in addition to greenhouse gas emissions. Airlines report an increase in fuel efficiency when older generation aircraft are retired, and new delivered aircraft replace them and this is observed when measuring the ASMs (Available Seat Miles) or ASKs (Available Seat Kilometers) generated per one gallon of fuel.

In terms of aircraft fleet decisions, although fuel is important, the airlines surveyed indicated that aircraft capabilities and revenue potential were the main drivers of fleet strategy (see Figure 2)

Figure 2 - Drivers of Fleet Strategy



The volatility of fuel prices affects all the performance of all airlines but those that own aircraft with four-engines such as Emirates, Lufthansa, Singapore Airlines, British Airways and Qantas are critically impacted due to their higher wing weight, smaller fan diameter and consequent high fuel consumption. Airlines worldwide have moved from large aircraft to smaller twinjets that provide the passenger demand, belly freight capacity and ETOPS range required to meet the route requirements and maintain high load factors.

The competitive market and expansion of low-cost airlines in short-haul markets also has an impact in the legacy carriers that have seen their load factors reduced in regional markets. An example is how Korean Air has chosen to put their modern Airbus A200 aircraft for domestic flights to Japan and China. This allows the airline to maintain a decent capacity supply in low-demand routes while significantly reducing fuel consumption. The A220 generates 23% less GHG emissions per flight and 12% less per seat when compared to Korean Air existing Boeing 737-800s.

We see a lot of aircraft with winglets installed; these have aerodynamic benefits that improve the airplane performance, reducing drag and increasing lift. This means that aircraft can be deployed in longer routes and carry more payload while allowing a steeper climb with less drag during take-

off; this performance improvement is key in airports located at high altitude such as Quito, Mexico City or Denver. These days, there are winglets of different forms and shapes and they have become standard equipment for the newer generation aircraft such as the Airbus A350, Boeing 737 MAX or Boeing 787 and airlines have demonstrated how winglets extend engine life and reduce overall maintenance costs.

Airlines are cutting down on weight carried onboard by optimizing the amount of food and water loaded on each flight and using lightweight cargo containers based on the previously planned load factor and flight distance. Other weight reductions include changes in the aircraft galleys and lighter seats.

3. Fuel Hedging, Surcharges and Procurement

Key Findings:

- Many carriers make use of financial instruments to hedge against the risk of short-term fuel price increases.
- Those airlines that alternatively or additionally impose surcharges stated that these were generally effective in recovering increased fuel costs.
- Predictably, when it comes to fuel procurement price is the number one factor that drives fuel supplier relationships.
- Our survey found that coverage and payment terms are also important when choosing a fuel supplier, but additional services or availability of sustainable aviation fuel options are not.

3.1 Fuel Hedging

Only about half of the airlines surveyed stated that they made use of hedging to counter short to medium term fuel price fluctuations for a portion of their forward fuel consumption. The amount of fuel consumption hedged over the coming 12 months varied between 5% and 24% with a median value of 10%.

Some airlines choose to develop fuel price hedging plans to avoid fluctuations that have affected the financial performance of airlines over the recent years. Competition in the market, declining airfares and rise in fuel prices have led to an increased burden of fuel costs and financial losses across a number of air carriers in the world. We observe that operators that choose to participate in hedging strategies also utilize several financial derivative instruments on long and short-term basis as a form of insurance against potential fuel price increases.

Carriers understand the risk associated with hedging and not hedging and the strategies for this keep changing on a quarterly or annual basis depending on the jet fuel market outlook, economic and geopolitical conditions. Airlines may decide to increase and the decrease the fuel hedging percentage considering the costs associated with different strategies and the exposure to cash collateral requirements included in agreements with fuel suppliers. For an airline like Southwest, a change in one cent per gallon can impact the fuel expense by over \$20 million in 2020, excluding impacts related to the fuel derivative instruments held at the time. Financial derivative instruments in commodities such as refined products like heating oil and unleaded gasoline can also become useful in decreasing its exposure to the high volatility of jet fuel prices. Carriers have shared how they enter into short-term timeframe agreements for this type of commodities that offer additional protection.

Airlines must monitor the fast-changing jet fuel prices and ensure an oversight system is in place to manage hedging strategies in such dynamic market.

3.2 Fuel Surcharges

Fuel surcharges are charged to passengers or freight customers to partially cover the rise in cost associated with increases in the price of fuel. This practice started around in the early 2000s when world oil prices spiked but with when fuel prices dropped, the airlines maintained these fees and simply changed the name into “domestic, carried-imposed or international surcharge”. Some countries have prohibited this practice and airlines operating in those countries are not allowed to add fuel surcharges to flights with origin in that country.

These fees tend to be confusing and unpredictable. They vary between carriers, seasonality, fleet type and revenue stream. For instance, the surcharge amounts imposed by airline programs to their partners is very unpredictable and these can differ from one partner airline to another and it also varies depending on the routing and award type. Mileage plan members find this circumstance difficult when planning for an award airfare because the cash component is not clearly shown until the end of the booking process.

About 40% of airlines surveyed said they levied fuel surcharges on their customers. Those airlines that did levy fuel surcharges agreed that surcharges were an effective means of recovering increased fuel costs, effectively dispensing for the need to hedge against fuel price fluctuations.

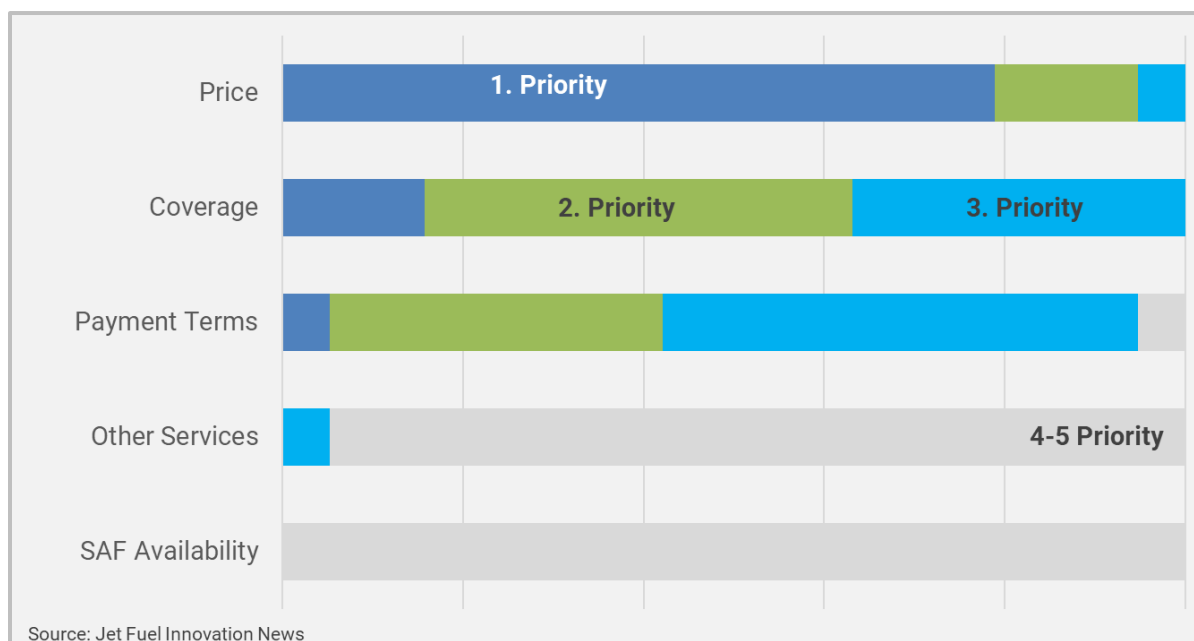
In the past year, we have observed airlines raising fuel surcharges on their international routes, especially on routes that originate in Japan, South Korea, Hong Kong and Singapore. Fuel surcharge strategies depend on jet fuel prices and how airlines establish different pricing thresholds around them. For instance, if jet fuel prices drop below the threshold, no surcharge is collected by the airline. In the US, carriers usually base their price on supply and demand, so any fuel-price savings associated are not passed on to the passengers in the form of lower airfares. Instead, airlines claim to use the savings to buy back stock from shareholders or invest in technology and infrastructure. In general, we have observed that airlines are absorbing fuel surcharges into their basic fares while the fee covers costs beyond the airline’s control such as emissions taxes or air traffic control fees.

3.3 Fuel Procurement, Supplier Relationships and Tankering

Airlines generally deal with a multitude of local and international fuel suppliers. Most indicated that they dealt with between 2 and 10 suppliers but some carriers with internationally dispersed operations reported dealing with 20, 40 or even 100 different suppliers. BP, World Fuel Services and Shell were stated as the fuel suppliers of choice, although local fuel suppliers take on a prominent role depending on the base of the airline's operations.

Price is by far the single most important criteria for choosing a fuel supplier, with geographical coverage and payment terms coming in second and third. Availability of biofuels and other services are not viewed as important in terms of choosing a fuel supplier (see Figure 3).

Figure 3 - Criteria for Choosing a Fuel Supplier



Tankering is the practice whereby airlines uplift more than the required trip and reserve fuel. Higher than necessary fuel uplift has a negative effect on fuel efficiency, but there can be good economic reasons for this. Given large differences in station level fuel costs and availability, minimizing fuel uplift per flight does not necessarily equate to cost efficiency. 80% of airline respondents indicated that they tanker fuel to deal with price differences between locations they fly to.

We find that this practice is not limited to a particular airline or geographic region, although cargo airlines have more flexibility to add additional stops to longer haul routings to benefit from lower fuel prices as well as potentially maximizing payload performance.

4. Innovation, Sustainable Aviation Fuels and Emissions

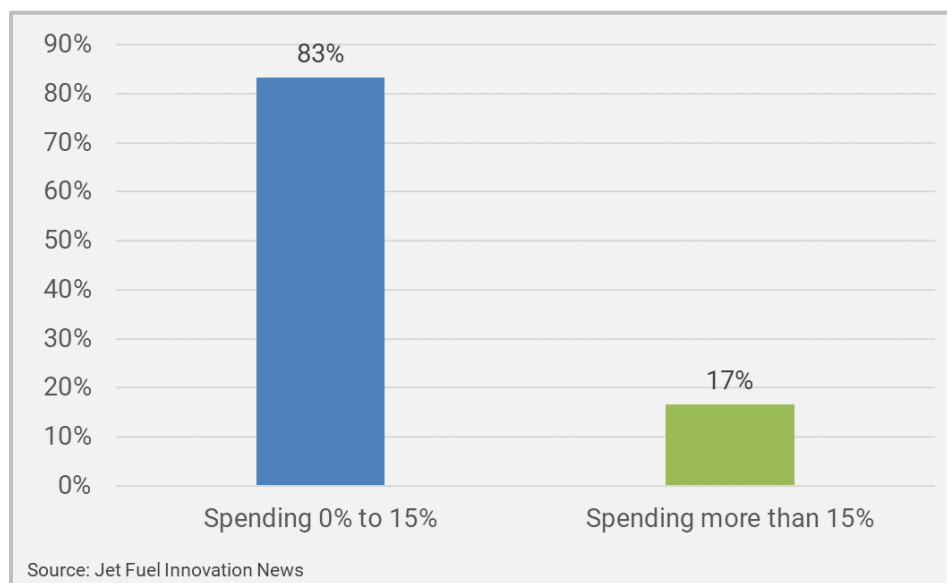
Key Findings:

- Software investments are the focus on fuel related innovation.
- Airlines are setting emission targets to comply with but also get ahead of regulatory requirements.
- Some carriers are using sustainability efforts as a source of competitive advantage, but generally we find that the airline industry is reactive rather than proactive.
- Carriers are supporting partnerships with airports, suppliers and governmental agencies to increase the supply of sustainable aviation fuel that are cost competitive, safe and have a viable production process.

4.1 Innovation

Software for flight management, fuel monitoring and reconciliation appears to be the focus of innovation in the airline business. Of the airlines surveyed approximately half indicated that they were planning to spend more on innovation, technology and startups in the next 12 months. Some of the investments listed include flight planning and performance tools, fuel efficiency software, sustainable aviation fuel use, consolidating software systems with a single vendor and improved compressor wash techniques.

Figure 4 – Percentage of Total Budget Allocated to Innovation



Our survey indicates that about 17% of the companies surveyed allocate more than 15% to their overall budget to innovation, technology and/or startup investment while the remaining 83% of companies invest less than 15% of their budget in innovation and technology.

4.2 Sustainable Aviation Fuel (SAF) Usage

Only about a third of respondents to our survey indicated that they had used or trialed sustainable aviation fuels (SAF), or biofuels. However, among those that have experience with SAF, the vast majority of fuel consumption continues to be covered by conventional aviation fuel.

Carriers recognize that using alternative fuel options can save up between 70-80% CO₂ emissions when compared with the use of conventional fuel. However, not every biofuel is produced the same way so it is important to focus on those biofuels made from raw materials that don't have a negative environmental impact. For instance, palm oil as a raw material has a negative impact and is not sustainable. KLM has been the pioneer in operating commercial flights with sustainable jet-fuel, however, the airline has stated that its use is not widespread because biofuels are sometimes 50% more expensive than conventional kerosene depending on technology and raw material used.

Operators must continue shaping strategies and developing policies for biofuel development while promoting higher usage of sustainable biofuel. A great example of this practice is how British Airways is partnering with Velocys to build a biofuel plant in the UK that will turn household waste destined for landfill into jet fuel. The facility will start operating in 2024 and will be the first of its kind in Europe.

4.3 Greenhouse Gas Emission Reduction and Offsets

Last month, the European Union Commission unveiled a roadmap for the members to reach zero net emissions by 2050. Currently, jet fuel used by carriers does not incur a tax across the European Union so the EU will look closely at tax exemptions in the aviation industry and has estimated that a EU-wide kerosene tax (this excludes the United Kingdom) could generate 13 billion euros annually and lower emissions by 11% across the 27 member states since higher airfares would reduce the number of passengers flying. European airlines are against this threat and claim that this would harm their position in the competitive environment since Middle Eastern carriers don't face the same limitations. This could also mean a reduction in greener alternative investments such as biofuels. Clearly, environmental policies linked to transportation will be critical in the upcoming years.

The aviation industry has committed itself to operational, technology and infrastructure advances to continue the reduction of carbon emissions. In 2016, the International Civil Aviation Organization (ICAO) adopted the Carbon Offsetting and Reduction Scheme for Aviation (CORSIA) to address CO₂ emissions across the aviation industry. CORSIA was created to address the carriers achieve its environmental targets by complementing emission reductions programs in the sector and these include higher usage of biofuel technology and reduction of carbon emissions.

All carriers are taking different measures on how they can achieve greater greenhouse gas emissions and recycling catering waste is seen as a common practice. According to IATA, around 6 million tonnes of waste are generated in aircraft cabins so achieving a universal model on cabin waste would optimize how it is currently managed and potentially recycled. Other efforts to minimize the environmental impact on board the aircraft include the reduction of plastic in different ways for instance, replacing the plastic bag containing the earphones with a paper bag. Iberia states that this initiative resulted in savings of 1,500 kilograms of plastic over the year. Emirates recycles plastic bottles and uses them to make passenger blankets used in economy class on long-haul flights. The use of sustainable blankets prevent that the plastic bottles used onboard end up in landfills while saving energy and emissions in the manufacturing of new plastic materials.

Qantas has recently announced that the group will reduce its net emissions to zero by 2050 and British Airways will offset all carbon emissions for all its UK domestic flights from 2020 by investing in numerous carbon reduction projects designed to offset the emissions created domestically. These programs include tree planting in Asia, Africa and South America and solar energy implementation in the UK.

In terms of offsetting emissions, however, only 50% of airline respondents to our survey indicated that they offset some of their greenhouse gas emissions. A similar portion indicated that they offered offsets to their customers. Some airlines that did not offset their own emissions nonetheless offered these to their customers.

About Cargo Facts Consulting

Cargo Facts Consulting is a specialised air logistics advisory and research firm. Formerly also known as Air Cargo Management Group, we have been in business since 1978. Since 2019, we are based in Luxembourg, with offices in New York and Seattle.

Our clients turn to us for deep advice, data and insights on key aspects that effect product development, marketing, fleet planning and strategy in air logistics. These clients come from across the whole air cargo and express business and include financial institutions and investment firms, leasing companies, government, aircraft manufacturers and conversion companies, airlines, express companies, airports and other service providers.

Our consulting experience spans projects that encompass airline network planning, fleet planning, due diligence, route development, investment assessment, air cargo and express market analysis, and aircraft technology. Our data and forecasts populate financial models related to many facets of the business, and our analysis is used in product development by a wide range of company. We also provide deep analytics for the type of data- and mission-related marketing in the aviation sector.

We strive to be the most knowledgeable and highly valued provider of strategic advice to the global air freight transportation and logistics industry. We provide actionable solutions, not just data and research based on critical needs and business objectives. We facilitate business evolution that yields greater profits and efficiency. And we do so often through long-term relationships that create a deep and more-meaningful dialogue with our customers.

Through Cargo Facts and Air Cargo World, our sister media organizations, we have a unique and high-visibility insight into industry trends and market developments as they happen.

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