Improving efficiency of Wizz Air's taxi fuel planning

Jaime Romero Waldhorn, Fuel Efficiency Manager at Wizz Air tells how the adoption of a machine learning and data driven solution has brought about greater taxi fuel efficiency

In the fast-paced world of aviation, where environmental concerns, regulatory demands, and cost efficiency converge, fuel consumption remains a key priority. Recognizing this, Wizz Air, continuously seeks innovative solutions to enhance fuel efficiency and reduce costs. This article explores how Wizz Air has leveraged advanced technologies such as Big Data and Artificial Intelligence to address the challenge of optimizing taxi fuel planning. Specifically, it highlights the integration of StorkJet's machine learning-powered statistical taxi fuel solution, which has delivered significant savings and reduced CO_2 emissions.

These advancements highlight the role of data-driven solutions in transforming aviation sustainability and efficiency.

WIZZ AIR: LEADER IN SUSTAINABLE AVIATION

Established in 2003, Wizz Air has become the most sustainable[1] European airline with a fleet of over 200 Airbus A320 and A321 aircraft. The airline operates more than 800 routes across Europe, North Africa, Central Asia and the Middle East, connecting nearly 200 destinations in 52 countries. Wizz Air is renowned for its commitment to sustainability, with one of the youngest fleets in the industry, averaging 4.4 years of age. Wizz Air's dedication to environmental responsibility is reflected in its low CO_2 emissions per passenger kilometer, making it a leader in sustainable aviation.

Sustainability is a core value deeply embedded in Wizz Air's culture, encapsulated in the Wizz Cares program, which focuses on four pillars: People, Environment, Economy, and Governance. This comprehensive strategy ensures that Wizz Air not only delivers affordable travel but also actively contributes to environmental awareness and social responsibility. Notable initiatives include investments in sustainable aviation fuel, a carbon offsetting program, the integration of paperless flight decks and the utilization of advanced fuel efficiency and management programs.

Last but not least, Wizz Air has been recognized for its excellence and safety, being named one of the world's top five safest airlines by airlineratings.com and awarded the title of 2020 Airline of the Year by Air Transport World.

PARTNERING WITH STORKJET: A TAILORED APPROACH

Since 2019, Wizz Air has been collaborating with StorkJet to enhance its operational efficiency and sustainability efforts (figure 1). This partnership focuses

Figure 1

on leveraging StorkJet's advanced tools and technologies, including FuelPro, AdvancedAPM and FlyGuide, to optimize fuel consumption and improve overall operational performance from all possible aspects. This collaboration has been playing a crucial role in driving Wizz Air's commitment to operational excellence and environmental considerations.

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Challenges in Taxi Fuel Planning

Accurate taxi fuel planning is a common challenge in the aviation industry due to the variability of airport operations, weather conditions, seasonality and air traffic control procedures. Overestimating taxi fuel leads to unnecessary costs and increased emissions due to extra weight being carried, while underestimating could pose risks to operational safety. These inefficiencies impact airlines globally. For Wizz Air, the existing methods for managing taxi fuel often overestimated the necessary amounts, compromising the efficiency and reliability needed for informed decision-making. To draw attention to the situation before the integration, the charts below, covering the period from January to December 2023 inclusive, are provided.

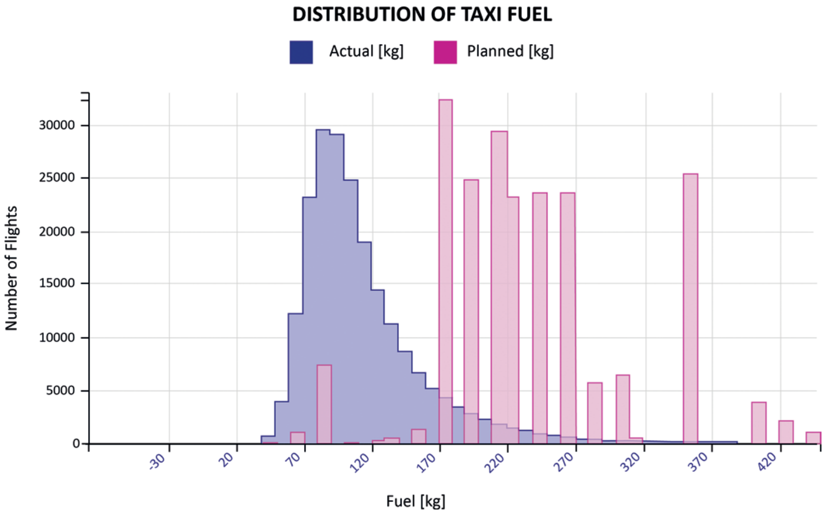

Figure 2: Histogram Distribution of Taxi Fuel for Wizz Air — 2023 (before integration)

The above chart (figure 2) is a histogram showing the distribution of actual fuel usage derived from QAR (Quick Access Recorder) data and the planned taxi fuel parsed from OFP (Operational Flight Plan) data. As can be seen, the planned fuel values are significantly higher compared to the actual distribution, indicating an overestimation in the planned fuel. Consequently, these challenges have driven Wizz Air to actively pursue a more effective and reliable solution to optimize taxi fuel planning and ensure both efficiency and safety.

The Solution: AI and Big Data integration

To address this challenge, Wizz Air partnered with StorkJet, a leader in aviation fuel efficiency solutions, to develop a sophisticated approach using advanced technology. The StorkJet Taxi Fuel API (Application Programming Interface) leverages historical QAR data and integrates machine learning (ML) models to provide precise taxi fuel consumption predictions customized for the specific conditions of each operation. By continuously learning from operational feedback provided by QAR data, the model can take into account seasonality, aircraft type, preferred runway, weather conditions, and the preferred percentile for the

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calculation. Additionally, as StorkJet claimed, the API is fully customized based on Wizz Air's technical architecture and operational needs. The API has several query parameters that can be adjusted with each query, such as percentile input, fallback logic, and output units. This flexibility helps to adapt the solution to Wizz Air's evolving needs and decisions. In addition to that, the API has the capability to provide outputs as either fuel quantity or taxi time in various units, which can be configured in the query. This flexibility allows the solution to adapt easily to changes in the fuel planning software without requiring any modifications at the software level.

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RESULTS: SIGNIFICANT FUEL SAVINGS AND ENVIRONMENTAL IMPACT

Wizz Air Setup

For the initial configuration, StorkJet requested a set of parameters to ensure the outputs were tailored and relevant to the specific operational context and requirements of Wizz Air. Subsequently, internal arrangements were made to seamlessly integrate the Taxi Fuel API outputs into the flight planning system. Queries are scheduled to be sent to the API at 4 AM UTC for daily processing.

Although it can be customized later in the query, Wizz Air integrated a setup using the 95th weighted, seasonal percentile for fuel consumption calculations. The 95th percentile is a metric indicating the value below which 95% of all observed taxi fuel consumption values fall. In other words, the 95th percentile

represents an amount of fuel that is sufficient to cover at least 95% of all taxi fuel burn observations, ensuring that the planned fuel accounts for nearly all potential scenarios and minimizes the risk of underestimation. This percentile is used instead of the average to ensure a more conservative comparison, while also enabling identification of inefficiencies in historical flight plans.

StorkJet's solution stands out for its speed in adapting to the changes in QAR fuel consumption. Thanks to ML (Machine Learning) algorithms, it requires just a one day to observe the major change in actual taxi fuel due to the factors such as apron, taxiway or runway closures.

Additionally, the fallback logic is set in the query so that when there are insufficient data points, the API checks a wider aircraft aggregation group for estimation. For example, if the query is sent for an aircraft type for a specific period and there are not enough data points for that aircraft type and period, the API checks the bigger group (in this case, ICAO Wake Turbulence Category) for that period to find sufficient data points to make the prediction. If the wider aggregation class is reached and still not enough data points are available, then it returns a predefined default output value. There is also a fallback logic for the airport-runway pair. If there are not enough data points for a specific airport-runway pair, the API checks all data for that airport in that period. If there are still insufficient data points, it returns a predefined default output value. For both fallback methods, as soon as a sufficient sample size is reached, the API automatically reverts back to estimating the statistical value.

Integration

The integration began on January 19th, and a significant improvement was observed almost immediately. The difference between the planned fuel and the 95th percentile of actual fuel consumption (figure 3) dropped from an average of 60 kg to just 15 kg. This sharp reduction highlights the accuracy and efficiency of the StorkJet Taxi Fuel API in optimizing taxi fuel consumption, resulting in substantial fuel savings and more reliable fuel planning for Wizz Air.

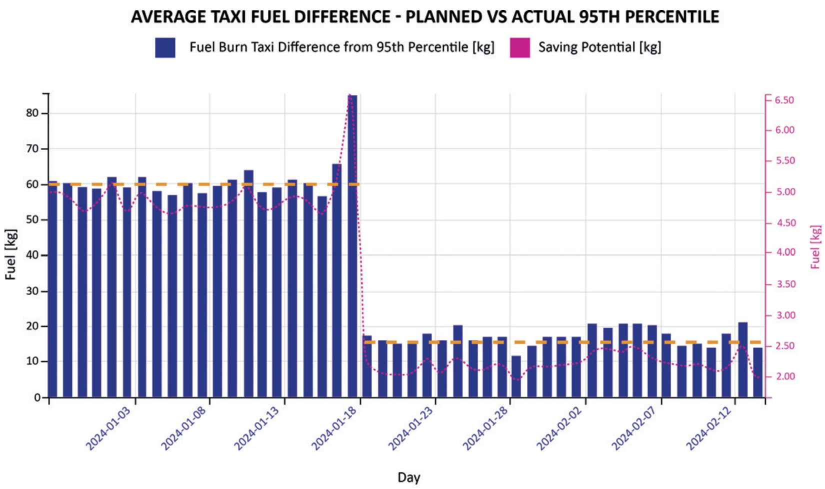

Figure 3: Daily Distribution of Planned vs Actual 95th Percentile Taxi Fuel

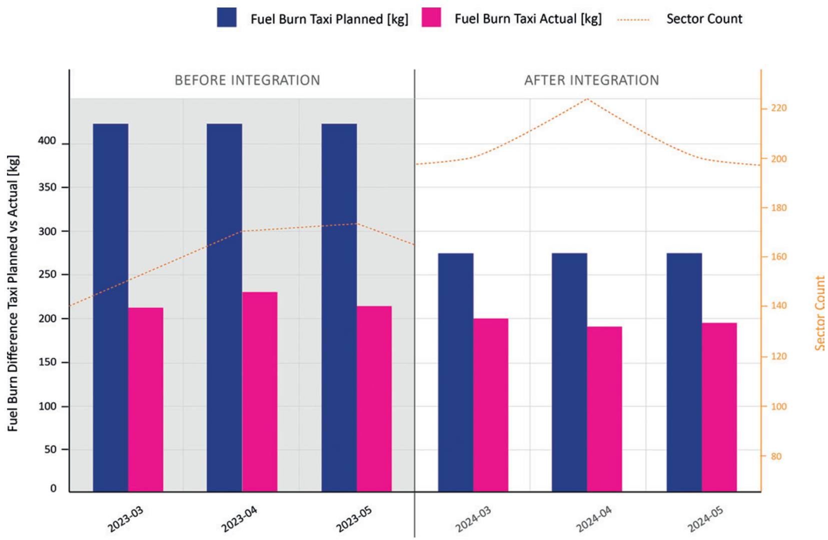

Figure 4: MAD Airport Average Taxi Fuel Distribution — before and after integration

Saving Analysis for MAD

In 2023, Wizz Air had more than 2,000 departures from Madrid-Barajas Airport (MAD) making it an important airport in the Wizz Air network. Madrid-Barajas Airport presents a challenging environment for taxi fuel management due to its high passenger traffic, complicated ATC procedures, and significant seasonality.

To compare the same periods before and after integration (figure 4), we can examine the three-month period from March to June for both 2023 (before integration) and 2024 (after integration). Before the integration, the average planned taxi fuel for Madrid–Barajas Airport (MAD) was 432 kg, whereas the average actual fuel burn was 221 kg.

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Annual Estimated Savings

When projected across all flights, the integration of the StorkJet Taxi Fuel API has resulted in an average fuel saving of 4 kg per flight. For the fleet of Wizz Air, this translates to estimated annual savings of 740 tonnes of fuel, and a reduction of 2,340 tonnes of CO_2 emissions per year.

These annual savings exceed Madrid-Barajas Airport (MAD)'s total fuel consumption for taxi phase during all the year, which is approximately 560 tonnes. This comprehensive integration not only optimizes fuel use during taxi phase but also contributes significantly to cost savings and environmental sustainability, reinforcing Wizz Air's commitment to efficient and responsible aviation practices.

However, it is crucial to examine the safety aspects associated with the integration. Specifically, Taxi Fuel Overburn will be a key indicator in assessing whether the fuel savings achieved through the integration come at any cost to safety or lead to unintended consequences. Therefore, a detailed evaluation of overburn data will help ensure that the benefits of the new system are fully realized without compromising safety standards.

Operational Evaluation — Overburn Analysis

Taxi fuel overburn occurs when the actual taxi fuel consumption exceeds the planned fuel consumption. This scenario can lead to undesirable operational consequences, as accurate fuel planning is crucial for ensuring sufficient fuel for all flight phases, including potential delays and unforeseen circumstances during taxi phase. When overburn occurs, it indicates that the aircraft is using more fuel than anticipated, which can have an impact on:

- **Fuel Reserves:** In extreme cases, taxi fuel overburn can use a significant amount of fuel reserves intended for in-flight contingencies, impacting operational reliability and continuity.
- **Increased Pilot Discretionary Fuel:** Pilots rely on accurate fuel planning to make informed decisions. Persistent overburn can erode pilots' trust in the provided fuel estimates, potentially leading to increased discretionary fuel requests.

Analysis indicates that since integrating the StorkJet Taxi Fuel API, Wizz Air has seen a further reduction in the number of flights experiencing taxi fuel overburn. This enhancement confirms that the integration has not only preserved, but elevated, the already very high safety levels and improved fuel efficiency.

REGULATORY COMPLIANCE

Ensuring compliance with the latest regulatory standards is crucial in the integration of any aviation solution. From an airline perspective, the StorkJet Taxi Fuel API aligns with all relevant regulations and authoritative guidelines, ensuring both safety and efficiency in operations.

The EASA Air-OPS AMC5 CAT.OP.MPA.181 recognizes statistical taxi fuel as a valid method for calculating taxi fuel, provided that the statistical data used is representative and valid. This regulation constitutes a legal basis to the solution and emphasizes the necessity for a robust, data-driven model reflective of actual operational scenarios, which the StorkJet API complies to by utilizing historical QAR data and continuous learning mechanisms.

The framework for the statistical taxi fuel program is further detailed in The ICAO Annex 6, Part 1, Article 4.3.6.6. highlighting the importance of data integrity, continuous review, and validation processes. Additionally, ICAO Doc 9976, Appendix 6 to Chapter 5, furnishes an example of a statistical taxi fuel program. It underscores specific criteria, mitigation measures, and safety risk controls for integration a statistical taxi fuel program. StorkJet's Taxi Fuel API adheres to these guidelines by implementing comprehensive data integrity checks, continuous review processes, and regular validation of methodologies as it is comprehensively explained in API documentation.

Finally, the StorkJet Taxi Fuel API is aware of and fully compliant with the third-party requirements of the IOSA Standards Manual under DSP 4.3.5. This standard advises on audit practices and documentation requirements for aircraft operators regarding statistical taxi fuel. StorkJet meets these responsibilities by ensuring that all necessary processes, data verification methods, and safety risk assessments are strictly followed and documented.

Overall, the StorkJet Taxi Fuel API not only ensures compliance with EASA, ICAO, and IOSA standards, but also maximizes operational benefits without compromising safety.

CONCLUSION

In the fast-paced aviation industry, airlines are increasingly prioritizing fuel efficiency and environmental sustainability. StorkJet's advanced Taxi Fuel API addresses these challenges through sophisticated data analysis and machine learning models. By accurately identifying patterns of overestimation and underestimation in taxi fuel planning, StorkJet has developed a solution that

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The Taxi Fuel API brings a shift from overly conservative fuel estimates to more accurate, scenario-specific calculations, encouraging efficient fuel use. Delivering clear and accessible information allows airlines like Wizz Air to make well-informed decisions about fuel allocation. The model's continuous learning from QAR data ensures adaptability to varying factors such as seasonality, aircraft type, and weather conditions.

Wizz Air's experience with the Taxi Fuel API has been overwhelmingly positive. The airline has seen marked improvements in fuel efficiency, particularly at busy airports like Madrid-Barajas, where significant fuel savings per flight underscore the API's effectiveness. Importantly, these savings have been achieved without compromising safety — in fact, the API has contributed to a higher level of operational safety.

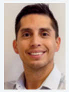
Key takeaways from this integration include:

- **Significant amount of achieved savings;**
- **Elevated level of safety proven by statistics;**
- **Easy to integrate / Customized API specific to the airline's needs;**
- **Easy control over API with query parameters such as percentile, fallback logic;**
- **Compliance with the latest regulations.**

Overall, Wizz Air is highly satisfied with the outcomes of the StorkJet Taxi Fuel API integration. The solution not only meets but exceeds industry standards, making it a valuable tool for any airline looking to improve fuel efficiency and operational performance during taxi phases. Wizz Air's successful implementation serves as a model for others in the industry, demonstrating the potential for advanced technology to drive both sustainability and excellence in aviation operations.

1 *According to the CAPA — Centre for Aviation Awards for Excellence 2022 and 2023, Wizz Air was recognized as the 'Global Environmental Sustainability Airline Group of the Year'.*

JAIME ROMERO WALDHORN



Jaime Romero Waldhorn started his aviation career at 18 with his commercial pilot training followed by a bachelor's degree in Commercial Aviation Engineering. After six years in various positions at LATAM Airlines, he moved to Germany. Since 2018 he has been with Wizz Air where his current role is overseeing the introduction and monitoring of fuel efficiency initiatives. With over twelve years experience in the airline industry, Jaime has made significant contributions to enhancing fuel efficiency and operational performance at Wizz Air.

WIZZ AIR

Wizz Air operates a fleet of 224 Airbus A320 and A321 aircraft and was named Airline of the Year by Air Transport Awards in 2019 and in 2023. Wizz Air has also been recognized as the 'Most Sustainable Low-Cost Airline' within the World Finance Sustainability Awards in 2021-2024, the 'EMEA Environmental Sustainability Airline Group of the Year' by the CAPA-Centre for Aviation Awards for Excellence 2024 and the 'Global Environmental Sustainability Airline Group of the Year' in 2022-2023.

STORKJET

StorkJet helps airlines save fuel and reduce CO_2 emissions by utilizing data coming from the aircraft. With a strong research background, based on reinvesting 60% of the turnover in R&D and four EU research grants, the company developed the most precise aircraft performance models on the market. With this technology, StorkJet has optimized over 6.8 million flights. As a result, their clients save 67 million dollars and reduce CO_2 emissions by 234 thousand tons each year.