Holistic Airport Decarbonisation from Ground to Air

By OLGA Project

Introduction

Airports are pivotal nodes in the global transport network, and their environmental footprint is both significant and complex. Attaining ICAO's Long-Term Global Aspirational Goal (LTAG) for international aviation climate objectives requires systemic, integrated solutions. that span the full scope of airport operations. The **OLGA (hOListic & Green Airports)** project – co-financed by the European Union under Horizon 2020 – was launched to address this challenge head-on.

OLGA provides a comprehensive, real-world demonstration of how airports can advance decarbonization efforts across landside, terminal, airside, and energy management domains. Utilizing Paris-CDG and Milan-Malpensa, Zagreb and Cluj airports as demonstration sites, OLGA functions as a living laboratory for the development and innovative technologies and cross-sector collaboration. From hydrogen production to smart mobility platforms, digital emission monitoring, and sustainable construction, the project demonstrates that a greener airport is not just an aspiration, but an achievable path forward.

This paper summarizes OLGA's principal innovations, key outcomes, and the insights gained throughout the initiative, emphasizing how the project aligns with ICAO's long-term environmental vision and provides replicable frameworks for airports worldwide.

Innovations Across the Project

Redefining Landside Access

Multimodality and Traffic Flow Optimisation Tool

As part of the OLGA Project, Ericsson Nikola Tesla (ENT) is working on a multimodality and traffic flow optimisation tool. This innovative solution uses telecom data and machine learning to generate high-resolution insights into passenger behavior, travel patterns, and transportation demand. Data analysis ranges from 15-minute intervals to broader seasonal trends. With an impressive accuracy rate exceeding 97% when compared with traditional survey methods, the tool offers airports and airlines a powerful decision-making framework. It not only identifies unmet demand from underserved regions – presenting clear opportunities for new route development – but also enables continuous assessment of operational changes to enhance mobility and the overall passenger experience. This marks a significant step forward in aligning airport operations with real travel demand and fostering more efficient, sustainable air transport systems with the principles outlined in ICAO's *Airport Planning Manual (Doc 9184)* and the *Global Air Navigation Plan (GANP)* regarding surface access and landside operations.

Airside Decarbonisation: Sustainable Operations in Action

APU Substitution

FIGURE 1: "APU Substitution" initiative.

Air France, SAS, Groupe ADP, and SEA have collaboratively implemented the "APU Substitution" initiative at Paris Charles de Gaulle Airport, with successful replication at Milan Malpensa Airport by SAS and SEA. This forward-thinking effort is aimed at reducing the environmental footprint of aircraft ground operations by replacing the use of Auxiliary Power Units (APUs) with fixed external power and air conditioning systems (PCA and ACU) at gates. By powering aircraft on the ground through these cleaner, quieter alternatives, the initiative significantly lowers fuel consumption, CO_2 emissions, and noise pollution during turnaround operations.

Tested under real-world operational conditions – including peak traffic periods and diverse weather scenarios – the project has demonstrated tangible environmental and operational benefits. Key achievements include a reduction of 1.259 tonnes of CO_2 emissions, savings of 478 tons of fuel – with emission reductions, calculated in alignment with methodologies – and a decrease in APU operating time by over 3,000 hours, all while maintaining operational safety and efficiency. Strategic gate selection, optimised infrastructure placement, and dedicated coordination teams ensured the project's success. The initiative reflects a strong commitment to sustainability, and its proven impact has prompted further investment by Air France to expand APU substitution coverage across all long- and medium-haul operations at CDG. This model offers a scalable, impactful solution to reduce aviation's ground-level emissions and support greener airport ecosystems.

TaxiBot to Allow Engine-Off Taxiing

FIGURE 2: TaxiBot.

As part of ongoing efforts to advance sustainable aviation, the OLGA Project has supported the implementation of the TaxiBot – a semi-robotic, hybrid diesel towing vehicle designed to tow aircraft from the gate to a runway-adjacent area without the need for engine power. The task developed in collaboration with Groupe ADP, Air France, and SAS, represents a significant innovation in ground operations, aimed at reducing CO_2 and NO_x emissions, decreasing fuel consumption, minimising engine wear, and easing taxiway congestion while ensuring compliance with ICAO Annex 14 operational safety standards and Annex 16 Volume II noise requirements. By enabling engine-off taxiing, the system also contributes to lower noise levels, creating a quieter and more sustainable airport environment.

Between November 2023 and February 2024, a dedicated trial phase was carried out using one TaxiBot and four specially modified Airbus A320 aircraft. The system completed 38 missions during departure operations, showcasing its operational feasibility in real-world

conditions. The final evaluation report will detail the environmental, economic, and operational impacts of the project. Early results indicate strong potential for broader deployment, reinforcing the role of innovative technologies like the TaxiBot in transforming airport ground operations and supporting global sustainability goals.

Terminal Innovations: Building Energy-Efficient Infrastructure

Improved Energy Consumption at Airport Passenger Pre-Boarding Bridge

FIGURE 3: Advanced screen-printed glazing installed.

In its ongoing pursuit of enhanced energy efficiency and passenger comfort, Groupe ADP, in partnership with Immoblade, has launched an innovative project to improve thermal performance in airport passenger pre-boarding bridges. These spaces, often constructed with extensive glazing and limited insulation, have historically posed challenges in maintaining comfortable indoor temperatures, particularly during peak summer and winter periods. The project involves replacing traditional single-glazed units with advanced screen-printed glazing aligned with the design principles outlined in ICAO Doc 9184, Airport Planning Manual, Part 1. This glazing is designed to passively regulate solar gain throughout the year – maximising heat retention in winter and minimising heat entry in summer.

Installed at Paris Charles de Gaulle Airport, the new glazing system operates with a variable solar factor, effectively reducing the cooling demand by more than 50% during summer months. Moreover, initial results indicate a 2.5-fold reduction in the number of hours where indoor temperatures exceed 26°C, contributing to a more pleasant passenger experience. Beyond comfort, this passive solution requires no additional energy to function and integrates seamlessly into existing infrastructure, making it a cost-effective, low-maintenance strategy for sustainable airport design. This initiative highlights how smart materials and design can significantly enhance operational efficiency and environmental performance in airport environments.

Solar Installation on Passenger Bridge

FIGURE 4: Solar Installation on Passenger Bridge.

In partnership with Groupe ADP, DGAC, and ITW GSE, the project combines custom-designed, anti-glare photovoltaic (PV) panels with a next-generation of Electric Ground Power Unit (eGPU) powered by Nissan car battery technology. The aim of this innovation is to harness renewable energies to generate the electricity needed by aircraft during ground operations, enabling them to remain electrically autonomous while parked on the stand.

This setup enables aircraft to receive clean, 400Hz power during turnaround operations, significantly reducing reliance on diesel-powered Ground Power Units (GPUs) and eliminating the use of onboard APUs both of which are major contributors to carbon dioxide (CO_2) emissions and noise emissions in the airside environment. The system operates as a closed-loop energy solution, prioritising solar power and switching to the conventional grid only when necessary, with no feedback into the grid itself.

Although the initial design had a larger carbon footprint, subsequent material and design optimizations can improve its environmental performance over time, especially in regions with high grid-related emissions and high solar incidence. Additional operational benefits include the PV panels serving as a solar shield, thereby reducing thermal load within the Passenger Boarding Bridge (PBB) and lowering cooling energy demand. The installation, covering a 36m^2 roof area, the system is set for a one – year test

phase starting in April 2025. Recent regulatory updates in France promoting renewable infrastructure further enhances the replicability of this initiative across European airports. This project represents a critical advancement towards cleaner, quieter, and more energy-efficient ground operations, aligning with ICAO's environmental objectives for sustainable airport development.

Clean Energy Transition: H2 and SAF

Sustainable Aviation Fuel (SAF)

SAF is derived from renewable sources such as used cooking oil (UCO) and agricultural waste, and while it emits similar levels of CO_2 during combustion, it can reduce total life-cycle emissions by up to 75% due to its sustainable production methods. SAF is fully compatible with existing aircraft and infrastructure, requiring no modifications, and can be blended directly with conventional jet fuel.

However, because SAF is injected into a shared, undifferentiated fuel distribution system, it becomes nearly impossible to physically trace which flights use SAF. To address this, OLGA, in collaboration with Air France, Attributes and Groupe ADP has developed a blockchain-based proof-of-concept tracking tool aligned with ICAO Global Framework for Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other Aviation Cleaner Energies. This innovative platform ensures full traceability of SAF volumes throughout the value chain, from feedstock origin and sustainability certifications (e.g. ISCC EU) to the allocation of SAF to specific flights. The tool generates digitally verified certificates, guaranteeing accurate accounting and preventing double counting of emissions reductions.

The first successful use case demonstrated the system's capabilities: 445 tons of ISCC EU-certified SAF, made from UCO feedstock and achieving 30% GHG savings, were digitally allocated to the takeoff phase of 1,470 medium-haul and 840 long-haul flights departing Paris Charles de Gaulle during the Paris 2024 Olympic & Paralympic Games. A second deployment is planned for the Milano-Cortina 2026 Winter Games, where SAF will be used to decarbonize two flights between CDG and Milan Malpensa. This initiative represents a major step toward scalable, verifiable SAF deployment, supporting both climate targets and the future of sustainable aviation.

System Intelligence: Monitoring, Measuring, and Optimising

OLGA's Dashboard for Sustainable Decision-Making

As part of OLGA's cross-cutting Work Package 6 (Cross-cutting aspects), an interactive dashboard has been developed to serve as a forward-looking decision-support tool for airport environmental teams, public authorities and other key stakeholders. This innovation addresses a significant gap in current environmental tools by integrating, within a single platform, data from air quality monitoring stations, detailed emission inventories (including road traffic, Ground Support Equipment (GSE), and aviation), and advanced atmospheric dispersion models. The platform integrates real-time data and emissions inventories to support decision-making by airport operators.

The dashboard empowers users to explore and compare scenarios involving infrastructure developments, regulatory policies, or technological innovations – such as GSE electrification, low-emission zones, enhanced public transport, or Sustainable Aviation Fuel (SAF) deployment. By linking emissions from specific sources to their effects on air quality, it facilitates source apportionment and helps quantify the actual environmental benefit of each initiative.

The tool was developed using real operational data and piloted at Paris-CDG, Cluj, Milan and Zagreb airports.

It synthesizes inputs from several OLGA work packages, acting as the systemic link between technical innovations and measurable environmental outcomes. Designed for transparency and replicability, the dashboard transforms complex data into intuitive visualizations, fostering shared understanding and informed action among diverse stakeholders. This innovation illustrates OLGA's holistic approach to airports and supports long-term environmental planning, connecting today's operational decisions with tomorrow's cleaner and healthier airport environments.