New airport infrastructure for clean energies

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Introduction

Following the call from the Intergovernmental Panel on Climate Change's (IPCC) to reach net zero carbon emissions by 2050, Airports Council International (ACI) World conducted a study on the feasibility of a long-term carbon goal (LTCG) for the airport industry. This LTCG study was carried out in 2019-2020 and engaged with ACI regions and airport leaders worldwide.

As a result, in June 2021, global ACI member airports committed to reach net zero carbon emissions by 2050, urging governments to provide the necessary support in this endeavour[1]. The LTCG study also included some of the key actions than can help accelerate decarbonisation, such as encouraging renewable energy transitions, promoting the regional grid decarbonisation, deploying viable onsite renewable energy systems, implementing energy efficiency measures, and electrifying airport infrastructure.

Airports are embracing technology and innovation to eliminate their scope 1 and 2 emissions, from installing LED lighting, fixed electrical ground power, and electric charging stations to investing into photovoltaic systems, electric ground support equipment, vehicles running on renewable fuels, or energy microgrids. In this article, two airports describe some of the initiatives they are taking to integrate clean energy into their operations.

While airports do not have control over many of the sustainability, technical or safety aspects of clean energy sources that are different to conventional aviation fuel, they can play a key role in their enablement by facilitating the availability of sustainable alternative sources of energy onsite, including addressing the challenges associated with new entrants to the aviation market and innovative propulsion methodologies. Understanding interdependencies and fostering collaboration through partnerships can help airports to be more resilient, and to promote a positive transformation of the aviation ecosystem and improve the services that they provide[2].

ACI Initiatives

To support its members in understanding the possible impacts and requirements that clean energies may have on infrastructure and operations, ACI World released a whitepaper on sustainable energy sources for aviation, from an airport perspective.

The document provides an overview of the most important considerations for airports in terms of supply chain, safety, storage, processes, infrastructure, and equipment requirements, for three types of alternative fuels:

1. Drop-in sustainable aviation fuels (SAF)
2. Hydrogen (H2) aircraft (for combustion or for electricity generation through a fuel cell) and;
3. Electric battery-powered aircraft

Impacts of these clean fuels may include:

- Improvements in local air quality

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1 Net zero by 2050: ACI sets global long term carbon goal for airports, 8 June 2021. Online: https://aci.aero/2021/06/08/net-zero-by-2050-aci-sets-global-long-term-carbon-goal-for-airports/

2 RESOLUTION #2 Sustainable development of the aviation ecosystem, 24 November 2021. Online: https://aci.aero/wp-content/uploads/2021/11/ACI-Resolution-2-WAGA-2021.pdf

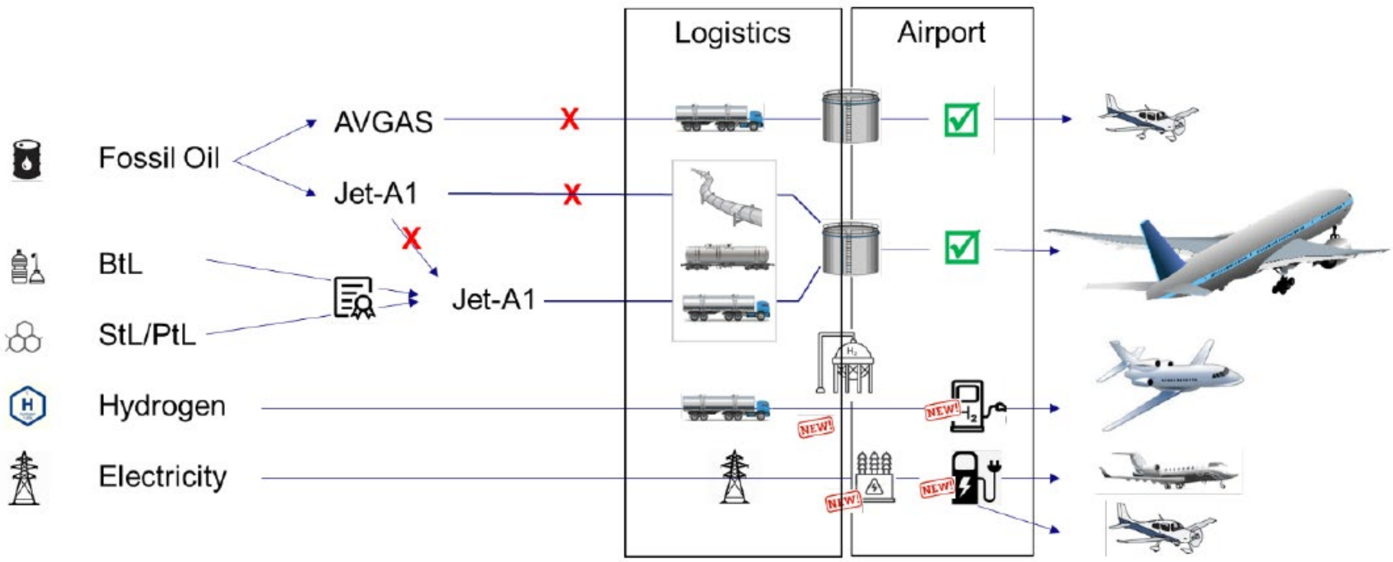


FIGURE 1: Energy options for civil aircraft propulsion. Courtesy of Zurich Airport.

- Changes in turnaround time
- Changes to equipment and procedures
- New infrastructure (buildings, ground, mobile, energy)
- Specialised training needs
- Changes in supply chains
- Other hazards related to hydrogen fuel at airports
- Aircraft/airport compatibility and ground operations
- Cost considerations
- Gaps identified
- Opportunities for airports and case studies

As is the case for any anticipated change, airports need to coordinate and engage with all stakeholders at an early stage, including with neighbouring communities. This will be essential to ensure a successful integration and the acceptance of the new technologies (Figure 1).

To increase awareness and understanding, ACI further looked at the integration of hydrogen aircraft into the air transport system, in partnership with the Aerospace Technology Institute (ATI). The study, which is from an airport's operations and infrastructure perspective, provides a comprehensive overview of the potential impacts that hydrogen aircraft could have. More specifically, it explores the following elements:

- The hydrogen supply chain (infrastructure to deliver hydrogen to the airport and to store it, and to transport it within the airport)
- Hazards and safety considerations
- Passenger perception
- Physical properties of LH2 vs Jet A-1 and hazards

Engaging early, addressing common questions, identifying knowledge gaps, challenges and opportunities, and sharing key learnings among the aviation industry, governments, and other stakeholders, are all essential steps to advance the development and potentially, the adoption of novel technologies such as hydrogen-powered aircraft.

Further research and analysis of all alternative sources of sustainable energy and their impact on airports operations and infrastructure (Figure 3) will continue as more data becomes available.

A publication on Sustainable Aviation Fuels (SAF) from an airport perspective is to be published in 2022.[3]

Groningen Airport Eelde

Groningen Airport Eelde (GRQ) is the international airport of the Northern-Netherlands, home of the KLM Flight Academy and Cirrus Sales, main European dealer of

3 https://store.aci.aero/product-category/environment/

Challenges		Advantages	
Ramp traffic and vehicle congestion	Infrastructure Costs	Less infrastructure	Boil-off recovery (up to 96%)
Truck emissions (GHG, AQ)	Maintenance Costs	Lower capital cost	Lower operating cost
Potential losses during transfer[4]	Leak detection	Commercially available	Potentially safer
Heat source if truck has IC engine (ignition source)	Development timelines & permitting	Minimal permitting	Faster delivery

FIGURE 2: Challenges and advantages of truck and pipeline distribution inside the airport

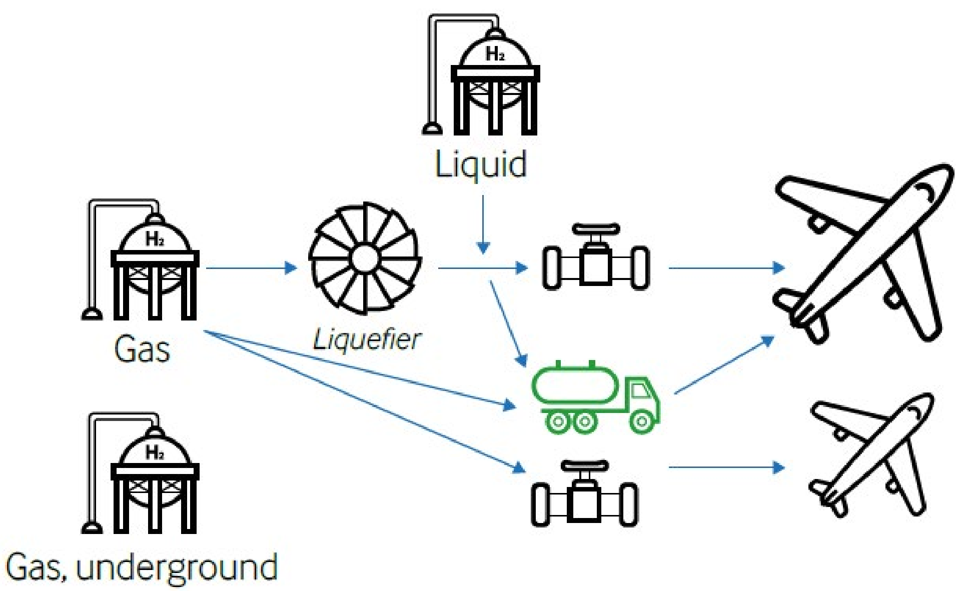


FIGURE 3: Hydrogen supply chain inside the airport

FIGURE 4: Groningen Airport Eelde

Cirrus Aircraft. GRQ is essential to the University Medical Center Groningen's organ transplant-flights and trauma-helicopter. GRQ is also a popular point of departure for holiday charters and business jet operators.

NXT Airport Initiative - GRQ has a strong focus on innovation, sustainability, and education. Its NXT Airport programme includes many projects focussing on electric flying (infrastructure) (Figure 5), eVTOL development, drones, solar-energy, hydrogen application, and education - over 300 students' study at GRQ.

Hydrogen Valley Airport - At GRQ, Europe's first 'Hydrogen Valley Airport' will be developed (Figure 6). The full-scale hydrogen ecosystem will involve production of green hydrogen, distribution, and utilisation. The starting point is its existing 22MW solar park, the largest airside solar field in operation at any operative commercial airport, with 63.000 solar panels. The airport is located in Europe's first Hydrogen Valley, which is being built by the Fuel Cells and

FIGURE 5: Projects on electric flying (infrastructure) at Groningen Airport Eelde

Hydrogen Joint Undertaking (FCH-JU) and is supported by the HEAVENN project of the New Energy Coalition and a €9 Billion Hydrogen regional Investment Agenda.

The four- to five-year project includes research, development and realisation of an electrolyser by utilising the solar park

FIGURE 6: Hydrogen Valley Airport

to produce green hydrogen onsite - a trailer-fill installation that enables filling of mobile storage. This will enable both the onsite and offsite distribution of green hydrogen, including a hydrogen refuelling station that serves both land- and airside vehicles. In this station, the Fuel Cell Electric Vehicles (FCEV) -and at a later stage airplane- can be fuelled, leading to emission-free ground handling operations.

The switch towards green hydrogen, in combination with the application of green electricity, will ensure the demonstration of full decarbonisation of airport operations.

To effectively use the regional zero-emission infrastructure, connections will be made to the regional hydrogen distribution system already in place, developed under various EU supported projects (TSO2020, DJEWELS). The interrelation with the HEAVENN project and the integrated production and green hydrogen therein can contribute to the robustness and operational excellence of the GRQ Hydrogen Valley Airport system, facilitating the ramp up and scale up of uptake of green hydrogen solutions.

Using the operational experiences of the zero-emission GRQ Hydrogen Valley Airport scalable ecosystem testbed will enable other airports to make no regret choices in the implementation of green hydrogen solutions and avoid unnecessary delays in reaching the ambition to zero emissions operation.

Kansai International Airport

Kansai Airports operates three airports in Japan: Kansai International Airport (KIX), Osaka International Airport (ITM), and Kobe Airport (UKB). In 2018, KIX was forced to close the airport for 17 days due to the severe damage caused by the high waves triggered by Typhoon Jebi. The rising sea level associated with climate change is a major risk for KIX, an artificial island surrounded by the sea, and we believe that responding to climate change is an urgent matter. Therefore, in March 2021, Kansai Airports declared to achieve zero greenhouse gas emissions by 2050 and is working on activities to reduce the burden on the environment together with the entire airport community. During such activities, the Level 4 (Transformation) of Airport Carbon Accreditation was acquired at three airports in November 2021.

FIGURE 7: Kansai International Airport

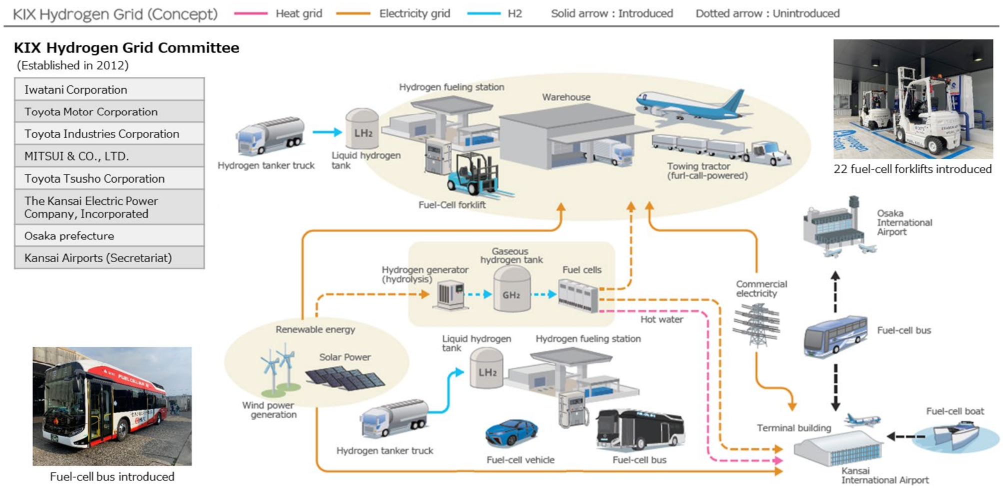


FIGURE 8: Hydrogen grid

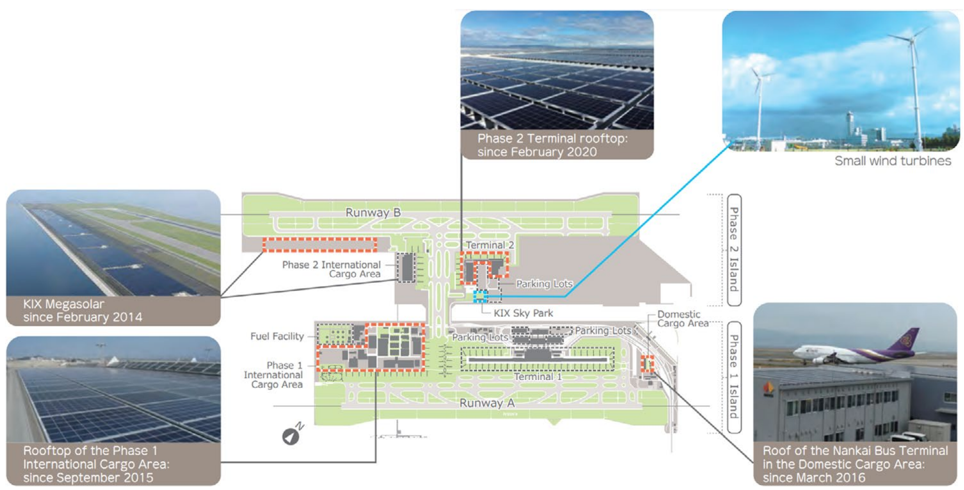


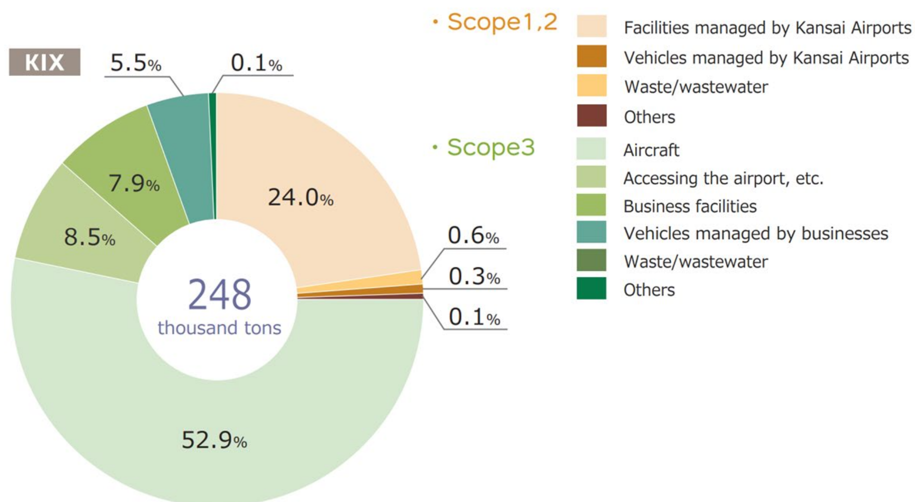
FIGURE 9: Solar power locations

Hydrogen energy - In anticipation of the advent of a hydrogen society, Kansai Airports is working with hydrogen providers, H2 vehicle manufacturers and authorities to promote the utilisation of large-scale hydrogen energy into airport facilities and equipment. This initiative has already been implemented as a "Hydrogen Grid Project" since May 2014.

Currently, there are two hydrogen refueling facilities for vehicles in airside and landside. In addition, fuel cell vehicles (FCV), cargo-carrying Fuel Cell ForkLift (FCFL) and in-airport fuel cell buses (FC buses) are in operation (Figure 8). In particular, FCFL is low noise and exhaust gas-free, which not only reduces environmental impact but also leads to the improvement of the working environment. While expanding hydrogen vehicles, Kansai Airports will work together with aircraft manufacturers, the Japanese government, and international organisations on hydrogen aircraft and necessary infrastructure facilities. In addition, the production and procurement of green hydrogen are major challenges Kansai Airports need to tackle to expand the utilisation of this technology.

Solar power generation - Since February 2014, solar panels have gradually been installed at KIX, which currently generate a total of 17,540MWh of electricity per year (Figure 9). We will introduce more solar power generation, mainly for self-consumption. self-consumption.

Accelerating efforts - Scope 3 CO_2 emissions at KIX account for three-quarters of the total CO_2 emissions, therefore joint-efforts with other airport stakeholders, especially airlines, are extremely important (Figure 10). By expanding the above-mentioned use of hydrogen energy and solar power to airport stakeholders, it is aimed to reduce greenhouse gas emissions from three airports. The CO_2 emission reduction by airports is expected along with the promotion of decarbonisation by the Paris Agreement, COP26, and the Japanese government. In Osaka where KIX is located, the World Exposition 2025 will be held under the slogan of *"Designing Future Society for Our Lives"* with the aim of contributing to the achievement of the SDGs and carbon neutrality. Therefore, Kansai Airports would like to accelerate its efforts for hydrogen energy and solar power generation at KIX, the gateway and first pavilion of the Exposition.



Note: Calculation Conditions
- Airport vehicles refer to passenger vehicles and GSE vehicles.
- Waste materials are based on carbon neutrality.
- Emissions from accessing the airport and aircraft are based on estimates.
- Emissions from aircraft are based on the LTO (Landings and Takeoffs: aircraft activity at altitude of 3,000ft and under) cycle stipulated by ICAO.

FIGURE 10: CO_2 emissions at airport as a whole (Fiscal year 2020)