Advancements in the Eco-Airport Toolkit e-Collection

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Introduction

Airports are essential global connectors, facilitating the movement of people, goods, and services while driving local economies and fostering regional development. As air travel continues to grow, airports face increasing pressure to balance operational demands with environmental sustainability. To meet this challenge, airports worldwide are embracing innovation, integrating social, environmental, and economic strategies to enhance their operations. Climate-resilient infrastructure and advanced technologies are enabling airports to drive progress in sustainability, ensuring long-term efficiency and environmental stewardship.

Eco-Airport Toolkit

Sustainability in airport operations is no longer a "nice-to-have" but has become an essential requirement. Recognizing the urgency and amplifying the benefits of innovation, ICAO established a dedicated task group to identify and share examples of airport environmental leadership at airports globally. This Eco-Airport Toolkit task group operates under Working Group 2 – Airports and Operations, within ICAO's Committee on Aviation Environmental Protection (CAEP). The Eco-Airport Toolkit e-collection, a series of concise publications accessible on ICAO's Environment website, is designed to ensure the fast dissemination of valuable insights. These papers provide practical, ready-to-use information to support the planning and implementation of airport infrastructure projects that deliver significant environmental benefits.

To date, 13 e-publications have been published on the website, each focused on a specific case study of environmental planning and at airports. This report will cover the publications developed and approved at the CAEP/12 and CAEP/13 Meetings:

CAEP/12 cycle	CAEP/13 cycle
Climate Resilient Airports	Innovation and Technology in Airport Sustainability
Water Management at Airports (including glycol management)	Environmental Impact of Unmanned Aircraft Operations at and around Airports
Air Quality Management	Addressing Single-Use Plastics: An Overview for Aviation
Sustainable Surface Access	Cleaner Energies at Airports
	Greenhouse Gas Management (GHG) and Mitigation at Airports

1. Climate Resilient Airports

As climate change intensifies, airports must adapt to extreme weather events, rising temperatures, and evolving environmental conditions to ensure safe and efficient operations. Key climate risks include flooding, storm surges, extreme heat, shifting precipitation patterns, strong winds, desertification, and biodiversity changes. To address these risks, airports can integrate resilience strategies into master planning, conduct climate risk assessment to identify vulnerabilities, and collaborate with stakeholders including airlines, municipalities, and emergency management agencies to develop coordinated adaptation measures. The publication includes other useful references, such as ICAO's Climate Change Synthesis which outlines nine primary climate impacts that can affect airports, and case studies from Canada, Mexico, France, the Netherlands, and beyond.

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2. Water Management at Airports

Water is a vital resource, and effective management is essential for airport sustainability. Airports must not only use water responsibly but also manage stormwater, mitigate flooding, and ensure clean water returns to the environment. Early planning can prevent future environmental risks. Many airports implement approaches such as Integrated Water Resources Management (IWRM) or the Water Sensitive Airport framework to reduce impact and costs. Implementing Water Safety Plans (WSPs) is crucial for ensuring the safety of drinking water from the source to the aircraft. A WSP includes system assessment, operational monitoring, and management and communication procedures to consistently ensure the safety of the drinking-water supply. Key strategies include limiting pollutants, managing de-icing fluids, preventing spills, and investing in on-site treatment systems to maintain water quality. Successful examples of effective airport water management can be found worldwide, including in Malaysia, China, India, Cambodia, Canada, Brazil, Spain, Portugal. These cases highlight best practices that contribute to sustainable airport operations while safeguarding water resources.

3. Air Quality Management

Air quality is a key environmental concern for airport operators, with emissions stemming from various sources such as aircraft engines, auxiliary power units (APUs), ground support equipment (GSE), on-site power generation, fuel storage and handling, and vehicular traffic within airport premises.. While air quality is often regulated at the national or local level, airports can proactively manage emissions through comprehensive air quality management plans, and emissions inventory are a key part of it. Innovations in airport terminal heating and cooling, water management, and waste treatment also have a positive impact on reducing pollutant emissions. Explore case studies from Turkey, Australia, India, China, the Netherlands, and beyond to see successful airport air quality initiatives in action. Additionally, resources such as the ICAO Document 9889: Airport Air Quality Manual provides valuable guidance on effective air quality management, emission reduction strategies, and regulatory compliance.

4. Sustainable Surface Access

Surface access is a critical element of airport operations, but it also presents environmental challenges, including air pollution, noise, and water runoff. As such, it is a key component of airport master planning, encompassing terminal access, parking, rental car facilities, and strategies to address capacity constraints. To reduce congestion and emissions, airports are implementing innovative solutions, using advancements in digital technology and sustainable materials, and strengthening public transport connectivity, for instance. Explore successful case studies from Belgium, the United Kingdom, the United States, France, Switzerland, and Colombia, showcasing how airports are enhancing surface access sustainably and efficiently.

5. Innovation And Technology in Airport Sustainability

Airports worldwide are evolving into innovation hubs, fostering collaboration between technology experts, entrepreneurs, and research institutions. As aviation strives for net-zero emissions by 2050, airports are at the forefront of pioneering solutions, demonstrating that innovation is a cultural shift towards sustainable and forward-thinking operations. From renewable energy projects and electric or autonomous vehicles to hydrogen fueling stations and waste-to-energy initiatives, airports play a crucial role in testing, scaling, and implementing groundbreaking solutions to reduce carbon emissions and enhance operational efficiency. These innovations not only support global environmental targets but also strengthen airport resilience in the face of climate change. Beyond technology, innovation in airports drives economic growth, workforce development, and stronger stakeholder engagement. The publication highlights successful case studies from the U.S., Europe, Groupe ADP, and Canada, showcasing some of the most impactful advancements in airport innovation and technology.

6. Environmental Impact of Unmanned Aircraft Operations at and around Airports

Unmanned aircraft (UA), or drones, are rapidly expanding in use, from aerial surveys to air taxis, are expected to bring broad societal benefits. However, their integration into airspace, particularly around airports, raises sustainability concerns that need to be carefully addressed, especially considering their potential impact on local communities and ecosystems. ICAO recognizes that UAS operations will have environmental impacts, the extent of which depends on factors such as the category and size of the UAS, the type and amount of energy consumed, and the nature and location of the operation . With their rapidly evolving nature, unique operational characteristics, and often proprietary technologies, UA systems differ significantly from traditional aircraft, making it difficult to assess their full environmental impact. While current models produce lower emissions and noise, their increasing operations may present new regulatory and social acceptance challenges. To address these challenges, ICAO's Committee on Aviation Environmental Protection (CAEP) Working Group 2 (WG2) has initiated efforts to understand the environmental impact of UAS operations at and around airports. This includes conducting literature reviews and developing a "State of Play" report to assess current and potential future environmental impacts of UAS operations . Airports are encouraged to integrate UAS considerations into their environmental management systems, including conducting environmental assessments that account for UAS operations. This proactive approach will help ensure that UAS are sustainably incorporated into the aviation ecosystem. Ongoing research will be critical to guide policy and ensure their sustainable incorporation into the aviation ecosystem.

7. Addressing Single-Use Plastics: An Overview for Aviation

The aviation industry relies on a variety of single-use plastics (SUPs) due to their lightweight, cost-effectiveness, and hygiene benefits. However, their widespread use poses significant environmental and regulatory challenges.

Aviation faces several challenges related to SUP usage, recycling, and replacement. Key challenges include inconsistent regulations across regions, supply chain constraints, and limited recycling infrastructure. Airports face difficulties in waste segregation due to tight turnaround times, space constraints in catering facilities, and biosecurity regulations. Additionally, unclear marketing terminology and the absence of a standardized international definition for SUPs create confusion, making policy alignment difficult for aviation stakeholders. Meanwhile, the well-established and cost-effective nature of conventional plastics complicates the transition to sustainable alternatives. Despite these hurdles, airports and airlines are proactively implementing the best practices. The publication provides case studies on these initiatives and strategies to address SUP challenges.

8. Greenhouse Gas Management (GHG) and Mitigation at Airports

Managing greenhouse gas (GHG) emissions is now central to airport planning, with many airports recognizing the benefits of proactive climate action, improving efficiency, reputation, bond ratings, and environmental performance. As low-emission technologies continue to evolve and various funding options become available, airports have numerous opportunities to advance sustainability. A structured approach to assess current emissions, set clear objectives, and implement targeted mitigation strategies is key. Major mitigation solutions include energy efficiencies, operations and systems optimization, and investment in renewable energy and carbon capture solutions. Programs like the Airport Carbon Accreditation (ACA) offer a well-established framework for achieving emissions reductions. Furthermore, ICAO CORSIA CO_2 Estimation and Reporting Tool (CERT) assists airports in developing their emissions inventories and serves as a foundational step toward ACA accreditation.

9. Cleaner Energies

Airports are transitioning from fossil fuels to cleaner energy sources to reduce aviation's environmental impacts by 2050. This document highlights three key areas where airports are taking action: 1) reducing emissions from their operations through measures like electrifying equipment and fleets; 2) decarbonizing purchased energy using market-based instruments like Power Purchase Agreements

(PPAs), Renewable Energy Certificates (RECs) and onsite renewables; and 3) supporting the reduction of aircraft emissions, which make up the vast majority of total aviation-related emissions. During this transition, airports will face considerable challenges due to rising energy demands, and integrating clean energy goals and future needs into master planning, along with stronger cross-sector collaboration, will be key to accelerating progress toward decarbonization.

Future Developments

The Eco-Airport Toolkit e-Collection is an evolving series of concise, practical publications developed by ICAO's Committee on Aviation Environmental Protection (CAEP) Working Group 2 (WG2) to support sustainable airport development. Recognizing the increasing environmental challenges faced by airports, the toolkit showcases real-world examples of environmental leadership worldwide. To date, 13 e-publications cover a range of topics including climate resilience, water and air quality management, GHG emissions, surface access, innovation, unmanned aircraft, single-use plastics, and clean energy transitions. Each publication offers ready-to-use guidance and international case studies, supporting airports in reducing their environmental impact. The toolkit promotes early-stage planning, cross-sector collaboration, and integration of emerging technologies to enhance sustainability. Looking ahead, ICAO plans to expand the e-Collection to address biodiversity, noise, and efficient flight operations, while older resources will be updated to remain relevant. As the aviation sector works toward long-term sustainability and climate goals, the Eco-Airport Toolkit provides airports with actionable strategies and insights to help guide responsible growth.