INTERNATIONAL JOURNAL OF INTERDISCIPLINARITY IN THEORY AND PRACTICE
ITPB - NR.: 27, YEAR: 2025 – (ISSN 2344 - 2409)

CHALLENGES IN IMPLEMENTING GREEN TECHNOLOGIES IN AIRPORT INFRASTRUCTURE

Martina Koščáková [1], Peter Koščák [2], Lucia Melníková [3], Patrik Šváb [4]

Abstract: *This paper addresses the issue of implementing green technologies within airport infrastructure and analyzes the main barriers hindering their broader application in practice. The article aims to identify and classify the obstacles to the ecological transformation of airports and to propose possible solutions that may contribute to a more sustainable development of the aviation sector. The article firstly defines the concept of green technologies and presents their typology according to areas of application. Then, based on the method of multiple case studies, it examines six selected airports in terms of identified barriers, the level of sustainability, and applied solutions. The results show that the most common barriers include high initial investment costs, complex permitting processes, low economic return, limited professional capacity, and insufficient inter-institutional coordination. Based on these findings, the article formulates proposals focused on legislative changes, financial incentives, human resource development, and support for innovation.*

Key words: Green technologies, airport infrastructure, sustainability, decarbonization, smart solutions.

1 INTRODUCTION

The issue of the ecological transformation of airports has gained increasing importance in recent years in connection with the efforts to decarbonize aviation and mitigate the environmental impacts of transport infrastructure. Airports, as energy-intensive and complex operations, face the challenge of reducing their carbon footprint, optimizing resource use, while ensuring safe and efficient operations. Despite technological progress and the availability of ecological solutions, however, in practice there are still a number of obstacles that prevent their wider application.

The topic of this paper is relevant not only from the perspective of climate policy, but also in view of new regulatory frameworks, such as CORSIA or the RE100 initiative, as well as airport operators' commitments to sustainability. The problem addressed in the article lies in identifying the main barriers to the implementation of green technologies and in finding factors that contribute to their successful or unsuccessful application.

The article uses a qualitative case study method to analyze the main challenges in implementing green technologies at airports. The selection of cases includes international airports of different sizes and geographical areas (Incheon, Schiphol, Changi, Cochin, Galapágy and Douala), with an emphasis on diverse technological approaches and levels of environmental transformation. Data were collected from available literature, professional reports, research projects and publicly available sources. The acquired knowledge was synthesized into thematic areas that form the basis for identifying barriers and formulating recommendations.

2 CONCEPT OF GREEN AIRPORT

Green technologies represent solutions aimed at protecting the environment, using resources efficiently and promoting sustainable development [1]. They aim to minimize the negative impacts of human activities, respond to global challenges such as climate change, resource depletion and growing energy demand [2]. The development of these technologies is accompanied by increasing investments, especially in areas with a high ecological footprint, such as transport and aviation.

Green technologies bring several benefits to airports. They reduce costs, increase energy efficiency and strengthen social responsibility and reputation. Airports, as complex operational units, are among the most environmentally burdened infrastructure facilities, due to their high consumption of energy, water, fuels and materials [3]. The implementation of ecological solutions is therefore becoming a strategic priority for modern airports.

Technologies can be categorized by area of application [4]:

- Energy – renewable sources, increasing efficiency.
- Water – recycling, rainwater harvesting, energy-saving systems.
- Waste – sorting, recycling, composting, circular models.
- Transport – electrification, hydrogen, non-motorized mobility.
- Construction – green roofs, recycled materials, smart buildings.

2.1 Green innovations as part of sustainable aviation development

The aviation sector is a major contributor to greenhouse gas emissions, which is of growing public and regulatory concern [3]. In response to these challenges, international organizations such as ICAO and IATA have set strategic goals aimed at decarbonizing and promoting environmentally sustainable operations. These initiatives are in line with selected UN Sustainable Development Goals that promote responsible resource use, climate protection, and greening of transport [5, 6].

The path to sustainable aviation includes reducing emissions, managing resources efficiently, protecting biodiversity, and strengthening social responsibility. As key points of aviation infrastructure, airports play a significant role through the implementation of innovation and green technologies.

Green innovations are tools for optimizing energy consumption, reducing environmental burdens, and increasing operational efficiency [7]. They include, for example, renewable energy sources, green transport, energy-efficient buildings, intelligent control systems and the circular economy. Their integration contributes not only to reducing the carbon footprint, but also to improving the competitiveness and image of airports.

2.2 Types of green technologies at airports

Green technologies play a key role in reducing the environmental footprint of airports and transforming them towards sustainability. Their implementation requires an integrated approach across energy, water, transport, construction and waste management:

- **Green airport concept** - A green airport integrates sustainable solutions into daily operations, using renewable resources, intelligent energy management systems (BMS), environmentally friendly building materials and taking passenger comfort into account. Airports such as Schiphol, Galapagos and Changi have implemented green roofs, natural ventilation and LEED/BREEAM certifications [3, 4, 7].
- **Renewable energy sources** - Solar energy is the most widespread solution. it is used for lighting, air conditioning, charging electric cars. Cochin Airport (India) is the first fully solar airport. Schiphol has installed panels on parking areas, Incheon on the roofs of terminals [8]. Wind turbines are a complement in areas with suitable conditions. Geothermal energy is used in temperate zones - e.g. at Oslo Airport. Biomass and biogas are important in regions with available organic material [9].
- **Energy efficiency** - Airports are optimizing consumption with LED lighting, intelligent HVAC systems, and smart grids. Schiphol uses sensors to control lighting and ventilation according to operational load. Incheon reduced costs by more than 2 billion KRW (~1.4 million EUR) in 2023 thanks to a big data-based system [10].
- **Sustainable water management** - Changi recycles wastewater for technical purposes, has implemented low-flow sanitary facilities, and uses rainwater within the terminals. Incheon reused over 3.2 million tonnes of water in 2023 [11]. The Rain Vortex in Singapore is a unique feature that combines the water cycle, architecture, and ecological design [12].
- **Green infrastructure** - Green roofs reduce heat islands and retain precipitation. Baltra Airport (Galapagos) uses green roofs and recycled building materials, fulfilling the requirements of the protection of a natural park [13]. Changi has interior tropical gardens, green facades, and vertical vegetated walls that improve the microclimate and well-being of passengers.
- **Green transport** - Airports are electrifying internal transport - Schiphol and Incheon operate fleets of e-vehicles and buses. Hydrogen technology is being tested, especially for energy-intensive services. Incheon operated hydrogen buses in 2023 and prepared the first LNG/H_2 station directly on site [10]. Cycle paths, pedestrian zones and public transport are also being introduced. Schiphol has cycle paths for employees and a direct train connection to the city, which significantly reduces the burden on cars.
- **Sustainable Aviation Fuels (SAF)** - SAF allows for CO_2 reductions of up to 80%. The UK is introducing a mandatory 10% SAF share from 2025. Schiphol plans 14% by 2030, Changi has used over 1.25 million liters in collaboration with Singapore Airlines. Incheon is testing SAF with a share of 2–4% [4, 14].
- **Waste management and circular economy** - Schiphol sorts 40 types of waste and aims for <1% non-recycled waste by 2030. Changi has introduced sorting stations with graphic instructions for passengers [15]. Composting of bio-waste is being tested on-site. At Galapagos, 80% of the material from the original terminal was recycled during the construction of the new facility [13].

2.3 Areas of green technology application

Green technologies are playing an increasingly important role in the ecological transformation of aviation infrastructure. They are applied in various areas of airport operations, from energy production and management, water and waste management, to transportation, building solutions and digital systems. The following table provides an overview of the main areas of use of these technologies along with specific examples of their application at selected airports.

Table 1. Areas of application of sustainable technologies

Area	Application
Energy	Solar panels, wind turbines, geothermal systems
Water	Wastewater recycling, rainwater harvesting
Transport	Electric vehicles, hydrogen buses, SAF
Waste	Separation, composting, recycling
Building solutions	Green roofs, passive buildings, eco-friendly materials
Digital systems	Consumption prediction, digital emission management

These measures reduce the ecological footprint and increase operational efficiency.

Implementing green technologies allows airports to use resources more efficiently, reduce emissions, and their overall environmental footprint. Their application covers a wide range of areas – from renewable energy sources and water recycling systems, through green transport to sustainable building solutions and smart consumption management.

An example of a comprehensive approach is Hyderabad Airport in India, which has achieved 25% energy savings and 30% water savings compared to the standard. It uses exclusively recycled water for air conditioning, irrigation and flushing, smart lighting, and charging stations for electric vehicles. Similarly, Boston Logan Airport has reduced energy and water consumption by using reflective roof membranes, automatic lighting, rainwater harvesting, and recycled building materials [16]. These examples confirm that investments in green solutions bring not only environmental but also economic benefits.

3 IMPLEMENTATION OF SUSTAINABLE TECHNOLOGIES AT SELECTED AIRPORTS

Successful implementation of sustainable solutions manifests itself in a variety of ways, from technological innovation to strategic planning. A comparison of the level of implementation of environmental measures at five successful airports by thematic area is presented in Table 2.

Table 2. Comparison of sustainable solutions at selected airports

Area / Airport	Incheon (KR)	Changi (SG)	Schiphol (NL)	Galápagos (EC)	Cochin (IN)
Renewable Energy	Planned hydrogen infrastructure + PV	Solar panels, water-powered A/C	Rainwater, planned geothermal energy	65% wind + 35% solar energy	100% solar energy
Energy Efficiency	Big data management, predictive systems	LED, magnetic chillers, sensors	LED, smart lighting, CO_2 sensors	Passive ventilation, natural lighting	LED, energy-efficient devices
Carbon Neutrality (Goal)	No target	By 2050 (Scope 1+2)	By 2030	Minimal carbon footprint	—
SAF	Pilot projects with 2–4% SAF share	1.25 million liters/year in cooperation with SIA	14% SAF by 2030	Not implemented	Not implemented
Waste Management	Sorting, circular support	89% sorting, e-waste, composting	40+ waste types, compost, construction waste	80% recycled materials in construction	Composting, sorting, plastic film pressing
Water Saving	Smart water management and monitoring	Rainwater collection, efficient fixtures	Rainwater, irrigation	Closed water cycle	12 million liters/year, bioponds
Climate Adaptation	Flood protection, digital monitoring	5.5 m above sea level, retention tanks	Green zones, water management	Resilience to high temperatures and humidity	Floating solar panels, water retention ponds
Certifications	ISO 50001, digital energy platform	ISO 14001, ACA L3, Green Mark Platinum	ACA L3+, local initiatives	LEED Gold – world's 1st eco airport	ACA L3+, UN Champions of Earth

The table compares the environmental measures of five airports – Incheon, Changi, Schiphol, Galapagos and Cochin – in eight key areas. While Cochin and Galapagos excel in energy self-sufficiency, Incheon and Schiphol focus on smart systems and technical optimization. Changi emphasizes integrated construction and building management. The approaches also differ in the area of certifications, which range from standards such as LEED or ISO to specific regional awards.

The level of implementation of green technologies at airports varies depending on economic, technological and political conditions. To better understand these differences, we compare six international airports in terms of the success of their sustainable solutions in areas such as energy, transport, water, waste and climate strategy.

Based on these findings, a visualization was prepared that compares the level of implementation of green solutions at selected airports according to their degree of success (Figure 1).

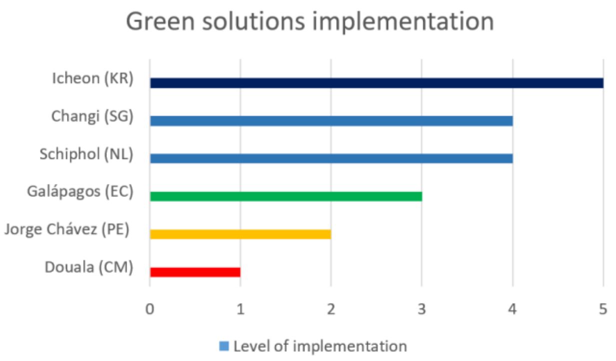

Figure 1. Comparison of implementation level by success

The chart shows six international airports on a five-point scale of success (1 = low, 5 = high). Incheon (Korea) and Changi (Singapore) airports achieve the highest scores thanks to smart systems, climate strategies, and high energy efficiency. Schiphol (Netherlands) Airport stands out for its long-term planning and circular economy. At the other end are Jorge Chávez (Peru) and Douala (Cameroon), where environmental measures lag behind due to legislative, financial and institutional barriers. Galapagos Airport (Ecuador) is an example of a smaller airport with an emphasis on renewables, eco-design and carbon neutrality.

4 RESULTS

The introduction of green technologies at airports is accompanied by various challenges that can slow down their implementation. These obstacles mainly concern technical, legislative, financial and organizational areas. This chapter identifies the main factors that affect the success of the ecological transformation in practice.

Technical and infrastructural constraints

The introduction of ecological technologies, such as renewable energy sources (RES), brings significant benefits to airports, but in practice it often encounters technical, spatial and institutional barriers. Their extent depends on the level of infrastructure readiness, the age of the terminals and the available resources.

Many airports were built before the introduction of environmental standards, and therefore their modernization requires fundamental construction and technological modifications. There is a lack of preparation for intelligent systems - suitable electrical installation, data connections or space for the installation of smart technologies. Implementing advanced solutions (e.g. smart grids, digital twins, predictive analytics) requires not only system reconfiguration, but also staff retraining and process digitalization [10].

Limited space on the site, inappropriate building configuration or safety restrictions, for example when installing solar panels or wind turbines near airport operations, are also common problems. In addition, RES are unstable and require complementary technologies – battery storage, backup systems or intelligent consumption management [17].

According to the analysis, the most serious obstacles were identified as: outdated infrastructure, lack of preparation, technical limits and lack of space, the need for digital transformation and the instability of RES.

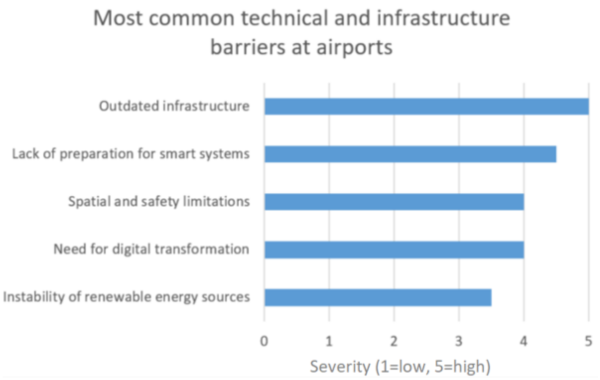

Figure 2. Most common technical and infrastructure barriers at airports

Despite these challenges, there are successful examples:

- **Incheon** has implemented predictive consumption management with significant savings [10],
- **Changi** is optimizing consumption through intelligent cooling management [14],
- **Galapagos** is using recycled materials, passive design and local resources, enabling sustainable operations even in an environmentally sensitive environment [13].

The level of technical maturity and readiness for digital transformation thus fundamentally affect the scope and speed of green modernization of airports.

Legislative and regulatory barriers

The implementation of green technologies at airports often encounters legislative ambiguity and inflexible regulatory frameworks. In many countries, clear rules for renewable energy, green construction or green operations are lacking, which causes legal uncertainty and delays in permitting processes. Furthermore, the lack of uniformity in legislation between countries makes it difficult to make a coordinated transition to sustainable infrastructure.

Although there are transnational initiatives (e.g. European Green Deal, Fit for 55) [18], their implementation depends on national legislation. Schiphol faced restrictions on the installation of wind turbines due to height limits and radar protection [19]. Cochin (India) had to deal with the unclear legal status of land for a solar project [20]. Denver (USA) is struggling with inconsistent standards for hydrogen infrastructure between the federal and state levels [21]. In Douala (Cameroon), environmental initiatives have failed due to the lack of a legislative framework and controls [22].

Technologically advanced countries are no exception – Incheon (Korea), which has committed to 100% renewable energy by 2040 (RE100), is facing lengthy permitting and grid connection procedures for new installations [23].

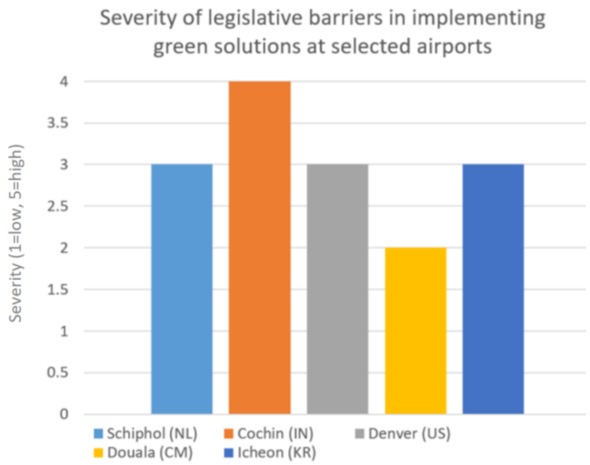

Figure 3. Legislative barriers in implementing green solutions at selected airports

According to the comparative analysis (Figure 3), the highest regulatory barriers are experienced by Cochin, followed by Schiphol, Denver, and Incheon. The rating in Douala is lower, which, however, reflects a lack of oversight and legislative dysfunction rather than enabling conditions. The results confirm that regulatory barriers significantly affect the speed and extent of the green transformation of airports.

Financial and economic barriers

Despite the long-term savings and environmental benefits, green technologies are financially challenging for many airports, mainly due to high initial investments. Barriers are particularly pronounced for small and regional airports with limited budgets and limited access to loans or grants. The absence of economic cost-benefit analyses or the lack of suitable public-private partnership models is also a problem [24].

Without clear incentives or legislative pressure, the transition to green operations is often postponed. An example is Douala Airport (Cameroon), where investment and external resources are lacking [25]. Conversely, Incheon (South Korea) has financed modernization, including smart systems, through public-private partnerships and government grants [26].

High initial investment

Green solutions such as renewable energy, electrification of technology or infrastructure modernization require high capital expenditure, which is a significant barrier, especially for smaller airports with limited budgets. Integrating these technologies often requires modifications to existing systems, careful planning and compliance with standards, which increases the overall cost [24].

Examples show the scale of the investment:

- Incheon (Korea) invested KRW 4.8 trillion (~EUR 4.46 billion) in expansion, including green features [27].
- Changi (Singapore) plans to invest SGD 3 billion (~EUR 2.04 billion) in modernization and environmental measures [28].
- Schiphol (Netherlands) has allocated EUR 6 billion for sustainability and modernization [29].

These investments are seen as strategically necessary not only to protect the environment, but also to maintain competitiveness and meet regulatory expectations.

Poor economic return

Green measures such as solar panels or recycling systems bring environmental benefits, but their economic return is slow and often takes years to materialize. This poses a risk to investors, especially in the absence of external financing, government support or regulatory incentives [24, 25].

An example is Cochin Airport (India), where a solar project for INR 620 million (~US$8.65 million) has a payback period of around six years [30]. The Galapagos Ecological Airport (Ecuador) faces delayed payback due to seasonal fluctuations in demand [24].

The economic efficiency of these solutions also depends on energy prices, frequency of operation, climatic conditions and the degree of digital optimization [10, 24]. Without a long-term vision and support, green technologies remain less attractive for wider application, especially at airports with limited resources.

Coordination and institutional challenges

The deployment of green technologies requires the cooperation of multiple actors – airports, ministries, regulators and private partners. Unclear competencies, poor communication and lengthy permitting processes are common problems.

Incheon (Korea) faced difficult coordination in the construction of hydrogen infrastructure [26]. Changi (Singapore) experienced delays in the installation of solar panels due to the need for multi-level cooperation [31]. At Schiphol (Netherlands), environmental objectives clash with different levels of governance (local, national, EU), which slows down decision-making [19]. In Douala (Cameroon), the green agenda failed due to weak institutional capacity and a lack of project management [32].

The solution is to strengthen inter-institutional cooperation, introduce unified permitting processes and professionalize public management.

Social and cultural challenges

The success of green initiatives also depends on the attitudes of employees, the public and airport management. The challenges include resistance to change, low awareness, passivity and lack of expertise.

Douala faces a lack of interest from staff and a lack of environmental awareness [25]. Cochin (India) initially faced skepticism towards the solar power plant, which was overcome only after positive results and media coverage [30]. The Galapagos succeeded thanks to consistent communication with the community and transparency [24]. Incheon also had to deal with resistance and the need for training when introducing hydrogen buses and solar systems [26].

According to the analysis, resistance to change and lack of expertise, low awareness and passivity, and low awareness of sustainability are among the most significant barriers.

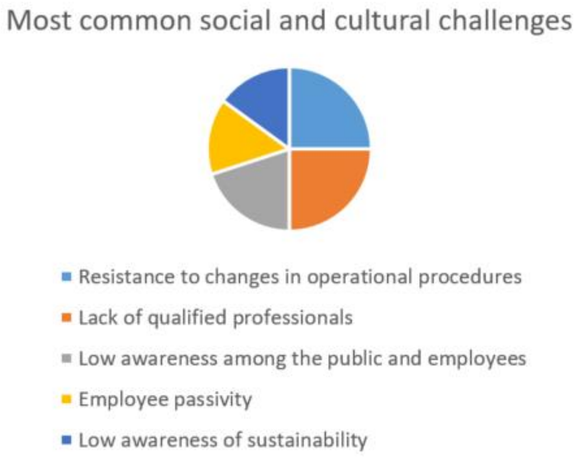

Figure 4. Most common social and cultural challenges

To overcome these challenges, education, internal communication, and active involvement of employees and the public in the transformation process are key.

5 DISCUSSION

The analysis of barriers and case studies shows that the successful implementation of green technologies at airports depends on a complex set of factors that need to be coordinated at multiple levels. It is not enough to focus exclusively on technical innovations – the availability of financial instruments, a functional legislative environment, support for research and innovation, as well as education and engagement of all actors within the airport system are crucial.

Financial mechanisms as the basis of transformation

High initial costs of green technologies, as well as uncertain return on investment, are among the key obstacles to green transformation. Examples from airports such as LAX, Swedavia or Portland International Airport show that instruments such as green bonds, public grants, tax incentives or revolving funds can create a stable environment for investment. Participation of airports in national and transnational support schemes (e.g. Horizon 2020, FAA grants) increases their chances of implementing long-term environmental projects.

Airport modernization as a driver of change

Airports that combine investment with environmental vision and technological innovation are seeing tangible results. Examples from Incheon, Changi, Cochin and Galapagos show different paths to decarbonization, from hydrogen vehicles and predictive consumption management to green construction using local materials. These initiatives prove that eco-efficiency does not have to be the prerogative of highly developed countries – with the right strategy, it can be achieved even in challenging conditions.

Legislative readiness as an accelerator or a brake

Legislative frameworks have a fundamental impact on the speed of technology implementation. The cases of Schiphol, Cochin and Douala show that outdated regulations, lack of standards and uncoordinated governance pose risks even for well-prepared projects. Reforms are needed that simplify permitting processes, create space for new technologies and align environmental, transport and energy policies. The “one-stop-shop” model can significantly contribute to speeding up procedures and reducing bureaucracy.

Promoting innovation as a strategic priority

Airports offer ideal conditions for testing innovative solutions. Examples from Schiphol (TULIPS project), Incheon (big data energy analysis) and Changi (partnerships with startups) show how research can be linked to practice. The use of mechanisms such as “living labs” or “regulatory sandboxes” accelerates the validation of technologies and reduces the risks associated with their implementation. It is therefore beneficial for airports to create innovation platforms and collaborate with universities and technology partners.

Human factor and organizational culture

Even the most advanced technologies can fail without sufficiently prepared personnel and public support. Case studies from Douala, Cochin and Incheon point to the importance of education, communication and employee involvement in the change process. Vocational training programs, training in new technologies, environmental campaigns and partnerships with academic institutions are key to long-term sustainability.

A comprehensive solution requires inter-institutional coordination

Several examples show that without well-established cooperation between airports, the state, regulators and the private sector, delays and inefficiencies occur. Strengthening inter-sectoral coordination, clear competence frameworks and professional project management are essential for the successful implementation of green solutions.

The green transformation of airports is not only a question of technology, but mainly of the system. It requires a combination of a clear vision, appropriate policies, accessible financing, regulatory predictability and people's involvement. Airports that manage to align these elements become models of sustainable infrastructure and can inspire others across the transport sector.

6 CONCLUSION

Based on a qualitative analysis of six case studies, it was shown that the green transformation of airports is a multi-layered process that requires not only technical innovations, but also changes in legislation, financing and societal approaches to sustainability. The most common obstacles include high initial investment costs, complex permitting processes, low returns on green measures, insufficient professional training of personnel and weak institutional coordination.

The findings showed that the green transformation of airports cannot be addressed in isolation, but requires a systemic approach and multi-level cooperation. The large differences between the analyzed cases indicate that universal solutions do not exist and each region needs its own tailored strategy.

In conclusion, it can be stated that the green airport is not just a goal of technological modernization, but a manifestation of a cultural shift towards responsible, intelligent and sustainable movement. That is why the green transformation should not be seen as a one-time innovation, but as a long-term commitment to the planet, society, and future generations.

REFERENCES

[1] WU, J., Z. D., J., L., G. S. a A. T., 2016. Big Data Meet Green Challenges: Greening Big Data. IEEE Systems Journal, s. 873-887.

[2] JARK, D., 2025. https://www.investopedia.com. 26. január 2025. https://www.investopedia.com/terms/g/green_tech.asp.

[3] LIANG SUN, H. P. X. H., 2021. Short review of concepts and practices in green airports in China. Journal of Physics: Conference Series. https://www.researchgate.net/publication/353529132_Short_review_of_concepts_and_practices_in_green_airports_in_China.

[4] GONZÁLEZ-RUIZ, D. E. R. J., 2017. Green airport infrastructure in Colombia: Opportunities for public-private partnerships schemes. Pertanika Journal of Science & Technology, 25. vyd., s. 37-46.

[5] UNITED NATIONS, 2015.: https://sdgs.un.org/goals.

[6] ICAO, https://www.icao.int/about-icao/aviation-development/Pages/SDG.aspx.

[7] XIONG LI, XIAOQING CHEN a ZIYUN LIU, 2022. https://www.researchgate.net/publication/360878800_Research_on_Construction_and_Development_of_Green_Airport#fullTextFileContent.

[8] AKYUZ, M. A. O. S. M. a K. T., 2019. Energy management at the airports. Rev. Sustainable Aviation. Springer.

[9] GREETING AIRPORTS: Advanced Technology and Operations, 2011. London: Springer.

[10] NILSON, P., 2025. Airport Industry Review. Január 2025. https://airport.nridigital.com/air_jan25/exploring_hydrogen_potential_gse. [Cit. 31. marec 2025].

[11] CHANGI AIRPORT. https://www.changiairport.com/en/corporate/our-sustainability-efforts/environment/water-conservation.html. [Cit. 2. apríl 2025].

[12] SCHIPHOL AIRPORT, https://www.schiphol.nl/en/sustainability/blog/adapting-to-a-changing-climate/. [Cit. 2. apríl 2025].

[13] CORPORACIÓN AMÉRICA AIRPORTS. https://caap.aero/n.php?id=41.

[14] CHANGI AIRPORT GROUP, 2022. https://www.jewelchangiairport.com/content/dam/cacorp/sustainability/sustainable-changi/sustainability-report/CAG%20Sustainability%20Report%20FY2122.pdf.

[15] SCHIPHOL AIRPORT, https://www.schiphol.nl/en/sustainability/sustainability-at-the-airport/waste-separation/.

[16] SACHIN KUMAR, A. M. S., 2024. Renewable Energy Systems. Rohtak, Haryana, India.

[17] ICAO, 2017

[18] EURÓPSKA KOMISIA, 2021. 14. júl 2021. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52021DC0550.

[19] STAY GROUNDED, 2024. 19. september 2024. https://staygrounded.org/schipol_airport_case/.

[20] AIRPORTS COUNCIL INTERNATIONAL (ACI), 2022. https://www.aci-asiapac.aero/advocacy/environment/green-airports-recognition.

[21] INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO), 2022. https://www.icao.int/environmental-protection/Documents/ACT-SAF/ACT%20SAF%20Series%209%20-%20Green%20Hydrogen%20for%20Aviation.pdf

[22] UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP), 2023.

https://www.undp.org/sites/g/files/zskgke326/files/2023-10/undp_africa_2023_africa_sustainable_development_report.pdf.

[23] INCHEON AIRPORT, 2024. Jún 2024. [online]. Available: https://www.airport.kr/synap/skin/doc.html?fn=temp_1729152585926100&rs=/synap/result/bbs/506.

[24] CLEANTECHNICA, 2023. https://cleantechnica.com/2023/02/25/galapagos-airport-environmental-tourism/.

[25] INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO), 2019. https://www.icao.int/environmentalprotection/Documents/EnvironmentalReports/2019/ENVReport2019_pg330-332.pdf.

[26] AIRBUS, 2022. 10. február 2022. https://www.airbus.com/en/newsroom/press-releases/2022-02-airbus-air-liquide-korean-air-and-incheon-international-airport.

[27] AIRPORT TECHNOLOGY, 2017. 24. november 2017.

[28] CHANGI AIRPORT GROUP, 2024. 7. november 2024. https://www.changiairport.com/en/corporate/our-media-hub/newsroom/press-releases.changi-airport-to-invest-3-billion-over-next-six-years-to-strengthen-singapore-position-as-a-global-air-hub.2024.all.html.

[29] AERONEWS JOURNAL, 2024. 2. september 2024. https://www.aeronewsjournal.com/2024/09/schiphol-airports-67-billion-investment.html.

[30] CNN BUSINESS, 2016. 14. marec 2016. https://money.cnn.com/2016/03/14/technology/india-cochin-solar-powered-airport/.

[31] ASIA CARGO NEWS, 2024. 22. máj 2024. https://asiacargonews.com/en/news/detail?id=9670.

[32] ICAO, 2018. https://www.icao.int/environmental-protection/Documents/ICAO-EU%204th%20Seminar/Day%203%20Session%209-3_Solar-ToGate%20Project%20Implementation%20at%20Douala%20Airport%20%20Cameroon%20The%20Experience%20of%20ADC%20SA.pdf.

AUTHORS ADDRESSES

[1] Martina Koščáková, MA, PhD.
Technical University of Košice
Faculty of Aeronautics
Department of Air Transport Management

E-mail: martina.koscakova@tuke.sk

[2] Assoc. Prof. Ing. Peter Koščák, PhD.
Technical University of Košice
Faculty of Aeronautics
Department of Air Transport Management

E-mail: peter.koscak@tuke.sk

[3] Ing. Lucia Melníková, PhD.
Technical University of Košice
Faculty of Aeronautics
Department of Air Transport Management

E-mail: lucia.melnikova@tuke.sk

[4] Ing. Patrik Šváb, PhD.
Technical University of Košice
Faculty of Aeronautics
Department of Air Transport Management

E-mail: patrik.svab@tuke.sk