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Eco-airport management strategies toward Sustainable Development Goals (SDGs) : A case study of Haneda International Airport

Ketwalee Kositkanawuth[1*], Roypim Laotrakul[2],
Department of Environmental Engineering, Faculty of Engineering, KMUTT[1],
Aviation Personnel Development Institute Kasem Bundit University[2]

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Abstract

This study examines Haneda Airport's (HND) eco-airport management initiatives within the broader context of sustainable development goals (SDGs) pursued by ICAO and the aviation industry. By analyzing Haneda's Environmental, Social, and Governance (ESG) targets as outlined in its strategic roadmap (2020-2050) and annual report (2024), this research assesses how HND's structured approach to eco-projects aligns with the United Nations' 17 SDGs. The study highlights HND's role in bridging gaps which are essential for achieving these ambitious goals. A critical focus is placed on reducing CO_2 emissions, as the report noted a 5% increase in 2024, suggesting the need for realistic and actionable steps toward achieving emissions targets. The Greenhouse Gas Observations of Biospheric and Local Emissions from the Upper sky (GOBLEU) technology is explored as a potential partner in HND's sustainability efforts. Regarding to Japan's national goal of reducing greenhouse gas emissions by 46% by 2030.Leveraging GOBLEU is a possibility to enhance operational efficiency while minimizing environmental impact in order to reduce CO_2 emissions and to be sustainable airport in line with global aviation sustainability practices.

Keywords: Haneda airport, Eco-airport, Sustainable, SDGs, Reducing Carbon Emission

*Corresponding Author: Email: ketwalee.kos@kmutt.ac.th

Introduction

In 2024, Haneda International Airport (HND) was recognized as the fifth busiest airport in the world (Hunter, 2024). Leading the rankings are Hartsfield-Jackson Atlanta International Airport (ATL), followed by Dubai International Airport (DXB), Dallas/Fort Worth International Airport (DFW), and Heathrow Airport (LHR) in London. Even though it is considered one of the busiest airports, it was awarded the title of the cleanest airport in the world (SkyTrax, 2024). Therefore, the airport has been ranked among the top 5 best airports globally, which is an accomplishment unmatched by any other airport in the busiest airport rankings. Beyond its efficiency, HND is distinguished as an eco-airport, which actively implements measures to conserve the environment as well as promote a healthy atmosphere in and around its premises. These efforts are in line with the guidelines of the International Civil Aviation Organization (ICAO) and Japan Civil Aviation Bureau (JCAB), under the supervision of Japan's Ministry of Land, Infrastructure, Transport, and Tourism (MLIT).

HND, Tokyo International Airport, built in 1931 to support Japan's growing demand for air transportation and to be Tokyo's aviation hub. Its location strategically essential for connecting capital and domestic regions also worldwide international destinations. As one of the world's busiest, HND handle over 78.4 million passengers in 2023. It plays a critical role in Japan's economy, supporting tourism and driving business growth. Also, HND is one of the leading Eco-Airport where prioritizes sustainability through innovative energy-saving technologies, waste management, and environmental conservation. As well as a vital part of Japan's social infrastructure, facilitating mobility, fostering regional integration, and aligning with government initiatives to promote green transportation and disaster preparedness. (Arba, 2024)

Background

HND, eco-airport, stands out for its diligent efforts to maintain high service standards and quality. This success illustrates that sustainability could become the cornerstone of future efficiency, innovation, and quality in the aviation sector. Meanwhile, ICAO plays a mandatory role

in the global aviation industry, aligning its efforts with the Sustainable Development Goals (SDGs) to focus on global impacts of aviation. This alignment has encouraged member countries to actively participate and support the development of aviation stakeholders. This ensures that processes and businesses advance effectively, yielding positive returns on investment. A key of this progress is implementation of ICAO's standards and recommended practices (SARPs) by member countries. ICAO commitment on the SDGs has driven countries to strive toward these goals. The No Country Left Behind (NCLB) initiative exemplifies ICAO's dedication to assisting states in implementing SARPs (ICAO, 2024). The initiative's primary objective is to ensure that SARP implementation is harmonized globally, enabling all states to reap the socio-economic benefits of safe and reliable air transport. NCLB also advances ICAO's efforts to address Significant Safety Concerns (SSCs) identified through its safety oversight audits, along with other objectives related to safety, security, and emissions. Aviation development encompasses a broad spectrum of activities, including infrastructure enhancement, human resource development, training, and capacity-building. The ultimate aim of these efforts is to establish a safe and efficient air transport foundation within a state, one that aligns with ICAO's SARPs and strategic objectives for the global air transport network. Once ICAO-compliant air transport connectivity is achieved, it facilitates expanded tourism and supports local and regional socio-economic development. This connectivity opens up numerous opportunities for local citizens, businesses, and producers to access foreign supplies and markets, while also providing significant benefits for governments and societies through improvements in medical transport, emergency response, and cultural exchange (ICAO, 2024). This study aims to explore management strategies that have driven HND to succeed efficiently and thrive in a highly competitive and demanding environment, as well as its alignment with United Nation's SDGs.

Objectives

1. To analyze the efficiency of HND 's eco-airport system and its continuous improvements.
2. To examine HND 's current support contributes to UN SDGs.

Scope of the Article

This article focuses on the following areas:

HND Sustainability and Environmental Initiatives: Evaluating HND's efforts in maintaining an eco-friendly airport environment, including its strategies for reducing CO_2 emissions during March 2020 – March 2024 and its implementing sustainable practices. Examining how HND adheres to ICAO's Standards and Recommended Practices (SARPs) and supports the UN SDGs and UN commitment-carbon emissions reduced by 45% by 2030 and reach net zero by 2050.

Definitions Used in the Article

1. Eco-Airport: An airport that implements measures to minimize environmental impacts, focusing on sustainability and the health of the surrounding environment. This includes initiatives such as energy conservation, waste reduction, and eco-friendly infrastructure development.
2. Reducing CO_2 Emission: The process of decreasing the amount of carbon dioxide released into the atmosphere by airport operations. This includes strategies like improving energy efficiency, utilizing renewable energy sources, and adopting green technologies.
3. SDGs (United Nations Sustainable Development Goals): A collection of 17 global goals set by the United Nations to address various challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice. Airports contribute to these goals by adopting sustainable practices and promoting economic growth.

Results and Analysis

HND's eco-airport management could provide valuable insights into the external factors influencing its sustainability goals. The airport responds to environmental challenges such as climate change, air pollution, and waste management. Aligning with global environmental

standards and implementing resource-efficient practices will be crucial for maintaining Haneda's eco-airport status. (Ministry of Land, Infrastructure, Transport and Tourism, 2014)

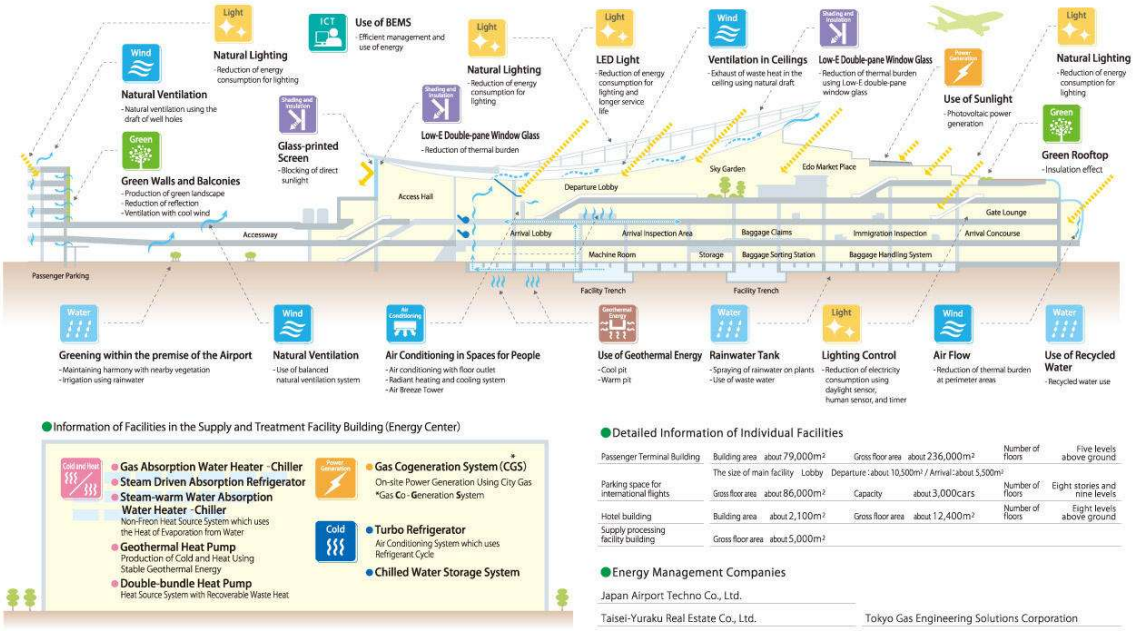

Figure 1 Overview of Energy conservation and CO_2 reduction of Haneda Airport International Passenger Terminal (terminal, n.d.)

(TIAT, 2024)

An overview of ESG analysis (E, S, G) on HND's eco-management strategies is listed below (Figure 1).

Environmental (E) analysis:

- Prioritize to Energy Efficiency: HND uses LED (Light-emitting diode) lighting and renewable energy sources including a mega solar installation. A 1,050 kW (Kilowatt) of solar panels have been installed on the rooftops of the terminal buildings to generate power for the airport and reduce CO_2 emissions. Additionally, natural ventilation system releases air near the ceiling, which is heated by direct sunlight through a hollow section in the large ceiling.

This design reduces radiation heat from the ceiling and significantly lowers the cooling load, aiming to sustainably decrease electricity consumption (TIAT, 2024).

- Prioritize to Waste Management: HND has programs for waste separation and recycling, ensuring effective waste management practices. For example, shopping bags are made of renewable materials; plastic straws at directly managed stores have been eliminated; disposed milk cartons from lounges have been recycled to toilet paper. Besides, the airport has launched "Reduce Food Loss" campaign, as well as reducing general waste by utilizing fully automated vanishing-type food waste disposers. (Mid-Term Business plan FY22-FY25, 2022). Even though the amount of waste at the airport (all terminals) increased from 6155 to 9118 tons from Fiscal Year (FY)2022 to FY2023, respectively, recycled waste increased from 2317 tons to 3730 tons. The recycled rated also effectively increased from 37.9% to 40.9% (Haneda Japan Airport Terminal, 2024).
- Prioritize to Green Spaces: HND features green areas integrated into its architecture, helping to reduce the heat island effect and improve the overall environment around the facility. While Haneda's infrastructure is efficient, it handles large volumes of fuel-dependent traffic, making it challenging to offset emissions without a significant reduction in flight numbers or a shift to lower-emission technologies. The airport's CO_2 emission impact is also amplified by high-frequency short-haul flights within Japan, which tend to have a larger emissions footprint per mile compared to long-haul flights due to the higher fuel use during takeoff and landing phases (Massy-Beresford, 2024).
- Prioritize to Carbon Footprint Reduction: HND, according to Japan airport terminal (JAT) group, CO_2 emission report shows that airport carbon emissions reduction scope (ACER) in scope 2, indirect emissions from airport-purchased energy toward generation in electricity, steam, heating, or cooling, has been reduced (Federal Aviation Administration, 2024), has been improving energy efficiency and reducing CO_2 emissions by combining the latest energy conservation technologies with natural energies (light, wind, heat, water, and vegetation) while reasonably and efficiently using energy supplies and energies (Mid-Term Business plan FY22-FY25, 2022).

For ACER Scope 1, direct emissions from airport-owned or controlled operation, and scope 2, HND has been implementing measures to reduce its carbon emissions, such as optimizing aircraft taxiing and landing procedures to minimize fuel consumption. However, CO_2 emission from the JAT group at HND increased by 5% compared to FY2013 (Mid-Term Business plan FY22-FY25; Haneda Japan Airport Terminal 2024)

Airport Tracker by Overseas Development Institute (ODI), in partnership with Transport & Environment and the International Council on Clean Transportation, highlights CO_2 emissions and air pollution data for major global airports, including HND where significant contributions to aviation-related CO_2 emissions due to its high traffic volume (Massy-Beresford, 2024). Besides, HND was ranked as the 9th most polluting airports in Asia-Pacific region in 2019 (Airport Tracker, 2024), primarily due to its extremely high passenger and cargo traffic, dense flight schedules, and its strategic position as a central hub for both domestic and international flights (Gençsü, 2021). These factors result in substantial emissions from aircraft during both takeoffs and landings, which are particularly carbon-intensive phases of flight. The high frequency of flights, combined with Tokyo's metropolitan location, means that Haneda is a significant contributor to regional air pollution.

- Prioritize to reduce emissions, HND needs to focus on carbon emissions, which have continued to rise due to several factors listed below:
    1. Increased Air Traffic: HND consistently expands its operations to handle more flights and passengers in order to meet rising demand. Increased air traffic leads to higher fuel consumption and associated emissions, especially during takeoff, landing, and taxiing.
    2. Aircraft Type and Age: Many airlines still operate older aircraft models which have higher fuel consumption and emissions compared to newer, more fuel-efficient models. The process of transitioning to more eco-friendly fleet is slow and costly for airlines.
    3. Ground Operations: Airport operations, beyond just flights, also contribute to emissions. This includes ground transportation, power consumption for airport

infrastructure, and fuel use for vehicles servicing aircraft. Some airports are exploring renewable energy sources and electric ground vehicles, but their adoption is gradual.

4. Economic Recovery Post-Pandemic: The demand for air travel surged after the pandemic-related restrictions were eased. Haneda, being one of Japan's busiest airports, is operating at high capacity, which has an inevitable impact on emissions despite ongoing sustainability efforts.
5. Limited Carbon Offset Programs: While offset programs help mitigate emissions, their scope and impact may still be insufficient for large-scale operations like HND. Also, some carbon offset programs require more time to yield effective carbon reductions. Improvements like adopting renewable energy for airport facilities, increasing the use of electric ground vehicles, and promoting next-generation aircraft could help; however, significant changes require time and investment to implement across such a large and busy airport like HND.

- GOBLEU: HND is using GOBLEU carbon-reduction strategies that could be particularly impactful. This would likely integrate HND's eco-initiatives, such as energy-efficient lighting, photovoltaic systems, and eco-friendly ground vehicles. At the same time, it would enhance emissions monitoring and optimize energy use across airport facilities. GOBLUE's advanced analytics and AI-driven monitoring can support Haneda in real-time CO_2 emissions tracking, making it easier to identify operational inefficiencies and emissions hotspots. A key part of GOBLUE's approach in reducing emissions focuses on optimizing gate allocations, aircraft taxiing, and vehicle routes. At HND, one of the world's busiest airports, improving these areas could reduce fuel wastage and emissions, especially during peak operational times. By pairing GOBLUE's capabilities with Japan's CCS (Carbon Capture and Storage) advancements, the airport could explore capturing CO_2 emissions from high-traffic zones, then either storing or converting them as part of Japan's national decarbonization plans (Suto, 2024; Japan, 2024; JOGMEG, 2024)

Social (S) analysis:

- Prioritize to Safety and Security: HND places high importance on passenger safety and security, utilizing advanced security systems and regularly conducting emergency drills. HND has upgraded its security infrastructure to improve efficiency and ease passenger flow through innovative technology. For instance, its “Face Express” biometric system uses facial recognition with automated gates at check-in and boarding, significantly reducing wait times and minimizing physical interactions, which helps to ease congestion at checkpoints. Additionally, uses a wait-time prediction system that employs 3D stereo-visual sensors to monitor passenger movements, analyze crowd data, and provide real-time wait-time updates at various security stages. This system optimizes congestion management and creates a seamless, secure travel experience, ensuring quick and efficient processing for high volumes of travelers. These upgrades underscore HND’s dedication to combining security with convenience, positioning it as a global leader in airport efficiency while enhancing the passenger experience. (Collin Aerospace, 2021)
- Prioritize to Accessibility: HND is designed to be inclusive, with barrier-free facilities and multilingual services to accommodate diverse passengers, including those with disabilities.
- Prioritize to Community Engagement: HND engages with the local community through initiatives such as cultural events and educational tours, enhancing its relationship with the surrounding areas.

HND's mid- term business plan for FY22-FY25 in relation to the SDGs is shown in Table 1:

Table 1 HND strategies alignment with SDGs (Japan Air Terminal Co.,Ltd, 2023)

Categories	*Initiatives*	*Relevant to stakeholders*	*SDGs to be contributed*
Environment	- Reduction of CO_2 emissions	- Partner Global Environment	
	- Introduction of eco-friendly materials and merchandise Waste reduction /resource recycling	- Partner Global Environment	
Social	- Enhanced terminal functionality - Assurance of safety and security - Use of digital technologies	- Customers Partners - Employees Local communities Common	
	- Creation of interaction - Benefit-sharing with local communities	Customers Partners Local Communities	
	- Transformation of workforce into a group of real professionals - Improve employee engagement	Customers Employees	
	- Promotion of diversity and inclusion - Implementation of human rights due diligence	Customers Partners Employees Local Communities Common	
Governance	- Ensuring of thorough compliance - Strengthening of sustainability governance	Customers Partners Employees shareholders, and investors Common	
	Strengthening of risk management systems/ Cybersecurity	Customers Employees shareholders, and investors Common	

Governance (G) analysis:

- Focusing on Regulatory Compliance: HND adheres to local and international aviation regulations, maintaining a reputation for compliance and efficiency.
- Focusing on Transparency: The management regularly discloses its environmental impacts, sustainability goals, and progress through reports and public statements.
- Focusing on Risk Management: HND has a robust risk management framework, including crisis management plans for natural disasters and other emergencies.
- Focusing on Diversity and Inclusion: Efforts are made to ensure diversity within the workforce, promoting an inclusive environment for employees of different backgrounds.

HND aims to address 15 from 17 of SDGs, except for SDG 3 (Good Health and Well-being) and SDG 6 (Clean Water and Sanitation). Significantly, HND consists of various companies and employees which lead to complicate plans to support employee's well-being across all ages and demographics, HND has partially aligned with SDG 3, by implementing a variety of health-focused initiatives for travelers and employees, prioritizing safety and wellness through measures such as the ACI Health Accreditation (Haneda Japan airport terminal, 2021). The airport received certification under the Airport Health Accreditation (AHA) program on April 8, 2021 (Japan Air Terminal Co.,Ltd, 2023), awarded for its comprehensive COVID-19 protocols that ensure a clean and healthy environment for passengers and staff. These protocols include extensive sanitation procedures, social distancing practices, and clear communication for maintaining hygiene standards.

On SDG 6, HND has faced challenges in maintaining its water quality and sanitation systems, particularly with incidents that impacted water supply reliability. One significant issue arose in November 2019 when high levels of chloride ions, traced back to a water treatment facility for aircraft washing, contaminated the water supply in Terminals 1 and 2. This led to an interruption in water services for three days, causing disruption for passengers and businesses that relied on tap water for sanitation. The MLIT conducted an investigation, and subsequent reviews highlighted the need for better safeguards to prevent chemical contaminants from entering HND's water supply. However, there's no obvious report about HND's water sanitation since an incident

of high levels of chloride ions in November 2019. (Japan Airport Terminal Co., Ltd., 2020). HND has improved its water quality monitoring and has increased daily inspections for contaminants. Regular water quality checks now include tastings and sanitation tests twice daily to ensure the water is safe for use across the airport's terminals. These measures are part of HND's ongoing efforts to maintain reliable access to clean water and support sanitation, in line with SDG 6.

Mandatorily, HND primarily focuses on SDGs related to climate action (SDG 13), and infrastructure innovation (SDG 9), due to their high energy consumption and carbon emissions. Thus, SDG 6 may appear less prominent in their public reporting. Large transit hubs like Haneda concentrate on these high-impact areas to align their environmental strategies with broader aviation industry sustainability goals. Additionally, HND's recent technologies help reduce water wastage, recycle water, and optimize water treatment, particularly in the area of wastewater treatment and reuse. This reduces overall freshwater consumption and alleviates the pressure on local water resources, which is crucial in urban areas like Tokyo, where water demand is high. HND's approach is consistent with SDG targets such as improving water quality by treating wastewater and enhancing water-use efficiency. Through these measures, HND contributes to both local and global efforts in sustainable water management, demonstrating how large infrastructure facilities can play a role in addressing water scarcity and improving sanitation systems in high-demand areas.

Conclusion

1. Haneda's FY22-FY25 plan addresses 15 of the 17 UN SDGs, excluding SDG 3 and SDG 6. Apart from global goals, the plan also supports the needs of stakeholders and aligns with national sustainability goals.

2. Even though SDG 3 is not explicitly included in HND's FY22-FY25 plan, the airport was recognized for its comprehensive COVID-19 protocols, implementing a range of health-focused initiatives for both travelers and employees. For SDG 6, in 2019, the airport faced challenges with high chlorine levels in its water supply, necessitating close monitoring and regular checks of water quality

3. Although HND aims to reduce CO_2 emissions by 46% from FY2013 levels and achieve net zero by 2050, emissions have been rising, primarily due to the dense flight schedules, as HND serves as a central hub for both domestic and international flights. To address this, the airport adopted GOBLEU technology in 2024 to track CO_2 levels. This will allow for real-time monitoring of CO_2 emissions and identification of hotspots. The impact of GOBLEU on CO_2 reduction still requires ongoing monitoring.

Suggestion

Haneda Airport's ACER in Scope 1, direct emissions from airport-owned and controlled operations, is increasing toward aircraft takeoffs and landings operations. To address Scope 1 emissions effectively HND should require strengthened collaboration with stakeholders and airlines and aviation authorities with:

1. Potential strategies of adopting modern aircraft.
2. Promoting Sustainable Aviation Fuel (SAF)
3. Government and Policy Support to enhanced aviation laws to address CO_2 emissions more comprehensively.

References

Airport Tracker. (2024, October). *Aviation Emission uncovered*. https://airporttracker.org/

Arba, A. (2024, September 9). *Passenger traffic at Tokyo International Airport in Japan 2014-2023.* https://www.statista.com/statistics/226462/passenger-traffic-at-tokyo-airport/

Collin Aerospace. (2021, July). *Collins Aerospace deploys biometrics solution at Tokyo Haneda Airport.* https://www.collinsaerospace.com/news/news/2021/07/collins-deploys-biometrics-solution-tokyo-haneda-airport

Federal Aviation Administration. (2024). *Carbon Emission Reduction*. https://www.faa.gov/airports/environmental/air_quality/carbon_emissions_reduction

Gençsü, S. P. (2021, September). *The Airport Tracker*. https://cdn.odi.org/media/documents/ODI_Policy_Airport_Tracker_v8.pdf

Haneda Japan Airport Terminal. 2024). *Environment*. https://www.tokyo-airport-bldg.co.jp/en/sustainability/environment/index.html

Haneda Japan Airport Terminal. 2024). *Haneda Airport achieves the ACI Airport Health Accreditation (AHA) for measures against COVID-19 infection*. https://www.tokyo-airport-bldg.co.jp/files/news_release/000010833.pdf

Hunter, M. (2024, April 15). *World Busiest Airports*. https://edition.cnn.com/2024/04/15/travel/worlds-busiest-airports-passengers-2023/index.html

ICAO. (2024, September 1). *No Country Left Behind*. https://www.icao.int/about-icao/NCLB/Pages/default.aspx

Japan Air Terminal Co.,Ltd. (2023, May 11). *Medium-Term Sustainability Plan*. https://www.tokyo-airport-bldg.co.jp/files/en/sustainability/Medium-Term_Sustainability_Plan.pdf

Japan Airport Terminal Co., Ltd. (2020, August 6). https://tokyo-haneda.com/en/information/2020/detail_00185.html

Japan Air Terminal Co.,Ltd. (2022, MAY 12). *Mid-Term Business plan FY22-FY25*. https://www.tokyo-airport-bldg.co.jp/files/en/ir/000012141.pdf

Japan, T. g. (2024). *Burning Garbage, but Reducing Greenhouse Gases.* https://www.japan.go.jp/kizuna/2022/08/burning_garbage.html

JOGMEG. (2024, September 5). *Japan Organization for Metals and Energy Security .* https://www.jogmec.go.jp/english/news/release/news_10_00072.html

Massy-Beresford, H. (2024, 2 22). *Airport Tracker Highlights Pollution, Health Impacts*. https://aviationweek.com/air-transport/airports-networks/airport-tracker-highlights-pollution-health-impacts

Ministry of Land, Infrastructure, Transport and Tourism. (2014, Nov). *Environmental Report.* https://www.icao.int/APAC/Meetings/DGCA51/51-3.5-8%20-%20Airport%20Environmental.pdf

Suto, H., Kuze, A., Matsumoto, A. et al. (2024). *The Greenhouse gas Observations of Biospheric and Local Emissions from the Upper sky (GOBLEU): a mission overview, instrument description, and results from the first flight. Carbon Balance Manage.*

SkyTrax. (2024). *The world best airports.* https://www.worldairportawards.com/the-worlds-top-10-airports-of-2024/

Tokyo International Airport Terminal. (2024). *Environment in TIAT* https://www.tiat.co.jp/en/environment/eco.html

United Nation. (2024, September). *SDGs*. https://sdgs.un.org/goals