ACI ASIA-PACIFIC & MIDDLE EAST
AIRPORTS COUNCIL INTERNATIONAL

ACI ASIA-PACIFIC & MIDDLE EAST
GREEN AIRPORTS RECOGNITION

Green Airports Recognition 2026

CLIMATE CHANGE ADAPTATION

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INTRODUCTION AND ACKNOWLEDGEMENTS

Green Airports Recognition (GAR) celebrates its tenth anniversary in 2026, continuing to promote environmental excellence by recognising Airports Council International Asia-Pacific & Middle East (ACI APAC & MID) airport members who have achieved outstanding accomplishments in climate resilience and adaptation.

Building and maintaining resilient infrastructure is crucial alongside efforts to decarbonise assets. Climate change is already impacting airports worldwide; extreme rainfall has disrupted aerodrome operations at airports in the Middle East and Asia-Pacific. Intensifying weather patterns and extreme events are expected to continue, despite global net-zero commitments. The Intergovernmental Panel on Climate Change (IPCC) has also urged governments to prioritise adaptation to mitigate severe climate effects.

Airports are uniquely positioned to lead and showcase climate adaptation efforts, particularly as they face increasing physical impacts of climate change. As extreme weather events and climate-related disruptions become more frequent, there is an increasing need for airports to proactively assess risks and implement adaptation measures.

In response to increased requests from airports for a climate resilience study, ACI APAC & MID initiated a Study on Climate Adaptation Approach for APAC MID airports (2025-2026) to develop a comprehensive climate adaptation approach and practical tools for airports in the region. The common climate hazards identified by airports include sea level rise, extreme temperatures, drought and desertification, wildfires, changes in precipitation, extreme rainfall and flooding, storms and lightning strikes, changing wind patterns, tropical storms, icing and snowfall variations, and fog pattern changes.

Airports can collaborate with key stakeholders, including airlines, ground handling service providers, insurers, and local communities to implement innovative adaptation strategies that enhance resilience and safe operations. The Green Airports Recognition 2026 offers airports in the Asia-Pacific and Middle East regions a chance to demonstrate outstanding accomplishments in climate resilience and adaptation.

According to the ACI APAC & MID Environmental Survey 2025[1], shows that the aviation industry takes climate change adaptation seriously. Almost all airports (99%) report being prepared for extreme weather to some degree. This high level of awareness is a very encouraging starting point.

However, a closer look at the data reveals while many airports answered "Yes" to having plans in place, their detailed notes show they are often just in the early stages. For example, only 40% (46 airports) feel they are "fully prepared," while the majority, 59% (68 airports), are only "partially

[1] The Survey received responses from 115 airports in 24 countries/regions till December 2025.

prepared." We see a similar trend with global financial reporting standards. About 76% of airports stated they adopted Task Force on Climate-related Financial Disclosures (TCFD) or International Financial Reporting Standards Foundation (IFRS) frameworks, but only about 16% (19 airports) have fully completed the adoption process.

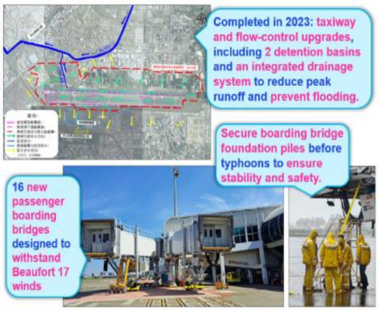
These findings highlight exactly why ACI's Study on Climate Adaptation Approach project was necessary. The industry has great intentions and has taken the first steps, but there is a clear gap in deep, finalised execution. The study will provide the guidance airports need to move from basic awareness to true, standardised climate adaptation by doing the assessment from the tools developed. The recognition initiative this year was aimed at gathering best practices of airports' climate adaptation to complement the Study.

GAR 2026 received 33 submissions from airports across the Asia-Pacific and Middle East regions, highlighting innovative initiatives focused on climate change adaptation and resilience. Projects addressed climate risks such as flooding, coastal erosion, and extreme weather through a range of measures including resilient infrastructure, advanced modelling, nature-based solutions, and integrated risk management strategies.

These initiatives demonstrate the aviation sector's growing commitment to strengthening operational resilience and sustainable airport infrastructure in response to increasing climate impacts. Following the evaluation process, four outstanding projects were recognised with Platinum awards across four passenger traffic categories, representing leading climate adaptation practices among airports in the region.

Hong Kong International Airport (HKG)
Category: Over 40 million passengers per annum
Hong Kong International Airport conducted comprehensive flood resilience studies using advanced climate modelling aligned with IPCC scenarios. The project assessed seawall overtopping and drainage system performance under future climate conditions, supporting long-term infrastructure planning and real-time stormwater monitoring to strengthen climate resilience.

Auckland International Airport (AKL)
Category: Between 15–40 million passengers per annum
Auckland Airport delivered the Northern Airfield Climate Resilience Project, upgrading stormwater infrastructure and introducing New Zealand's first Coupled Wetland Biofilter. The system improves flood resilience while providing high-efficiency stormwater treatment through nature-based solutions.



Kaohsiung International Airport (KHH)

Category: Between 5–15 million passengers per annum

Kaohsiung International Airport implemented the "Building a Disaster-Resilient Airport" project, upgrading drainage systems and strengthening infrastructure against extreme weather. The measures proved effective during Typhoon Krathon in 2024, enabling rapid operational recovery without major damage.

Nadi International Airport (NAN)

Category: Less than 5 million passengers per annum

Nadi International Airport launched the Wailoaloa Mangrove Restoration Project, planting over 8,300 mangrove seedlings to protect its coastal boundary from erosion and storm surge. The initiative uses nature-based solutions to enhance climate resilience while supporting biodiversity and community engagement.

ACKNOWLEDGEMENT OF PARTICIPATING AIRPORTS

The 33 participating airports demonstrated a strong commitment to enhancing **climate resilience and sustainability** within airport operations. By submitting their projects and sharing their experiences, they contribute valuable knowledge and practical examples that foster collaboration and continuous improvement across the airport community. Their efforts reflect the spirit of the Green Airports Recognition programme and its objective of encouraging innovation and best practices across the region.

FLOOD/STORMWATER MANAGEMENT

Auckland International Airport
Northern Airfield Climate Resilience Project

In 2025, Auckland Airport completed the Northern Airfield Climate Resilience (NACR) Project, delivering a major stormwater upgrade and New Zealand's first Coupled Wetland Biofilter (CWB) - an innovative, nature-based stormwater pond. This marks the first project delivered from the Stormwater Masterplan, which takes a holistic, nature-based approach and uses climate risk modelling to guide long-term infrastructure development.

The upgrade includes 4.4km of oversized pipes, some up to 2.4 metres in diameter, expanding the 150km stormwater network to manage flows from over 100 hectares in the airside Midfield catchment area. This reduces pressure on existing systems and boosts resilience in the International Terminal catchment.

The CWB is designed to hold and treat large water flows from extreme weather events. Its footprint is three times smaller than a traditional pond, and its innovative three-stage system combining sediment capture, wetland filtration, and biofiltration, achieves triple the treatment performance of conventional ponds. Supported by 22,600 plants, it sets a new benchmark for nature-based stormwater treatment. The design considers future climate conditions, including sea-level rise, potential saltwater intrusion, and changing rainfall patterns.

As the gateway to New Zealand, Auckland Airport has a responsibility to ensure we are ready for the impacts of a changing climate. The Auckland Region was tested in early 2023 when a month's worth of rain fell in just a few hours, overwhelming stormwater systems and leading to flooding in the International Terminal. In response, Auckland Airport revisited climate modelling under a RCP8.5 scenario, refreshed the Stormwater Masterplan, brought forward planned stormwater upgrades, and incorporated lessons from the events, to rescope and deliver the NACR upgrades.

By integrating climate adaptation into infrastructure planning, the NACR project strengthens operational reliability, protects the Manukau Harbour and demonstrates Auckland Airport's commitment to innovation and environmental stewardship.

Project Graphics

A view of the Coupled Wetland Biofilter, the equivalent of 14 Olympic sized swimming pools, with the Manukau Harbour in the background	Stormwater infrastructure being installed as part of the Northern Airfield Climate Resilience project, with pipes reaching 2.4m in diameter
	
One of the upsized stormwater pipes that was installed as part of the Northern Airfield Climate Resilience Project – some are up to 2.4 metres in diameter	Location of Midfield catchment area and Coupled Wetland Biofilter within Auckland Airport precinct
	

Chhatrapati Shivaji Maharaj
International Airport Mumbai

Chhatrapati Shivaji Maharaj International Airport
Climate Change Adaptation

Operating in a high-density tropical coastal zone, Mumbai International Airport (MIAL) faces intensifying climate extremities. Our IPCC AR6- aligned **Climate Risk Assessment, employing CMIP6 downscaled projections,** projects a critical **82–87% increase in flood levels by 2030**, from the current 10-year return-period levels of 0.76 m. To safeguard against these compounding threats, MIAL has embedded an **Adaptation Strategy through integrated nature-based solution.**

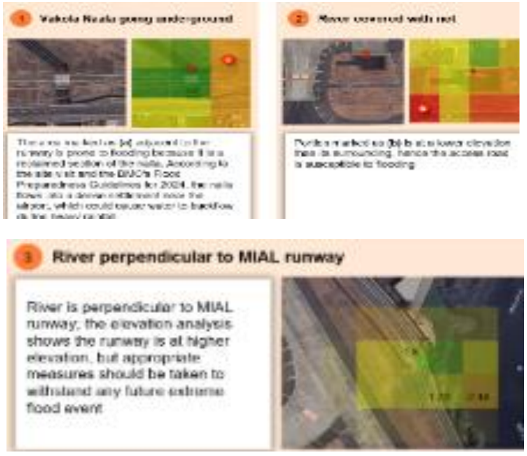
- **Hydrological Resilience -** We transformed the airport's drainage into a "Sponge Infrastructure" designed for future **50-year peak flow**. Utilising **HEC-RAS hydraulic modelling**, we executed a "Source-to-Sea" intervention targeting the Mithi River (flowing 400m under Runway-09/27) with extensive bank protection. We re-profiled **Shraddhanand Nala** and installed **highway drains** to divert external flow.
- The upgraded Storm Water Management system has been meticulously designed to account for the anticipated design runoff and is capable of handling the most severe runoff scenario calculated, which amounts to 261 m3/s, project by 2030.
- Critical infrastructure, including outfall points, runway and apron have been set at elevations that take into account the projected future High Flood Level (HFL). Through elevation modelling, it has been determined that there will be negligible inundation in critical operational areas.
- Further, we integrated **high-capacity stormwater sumps providing 2,600 m³ of rain water storage, along with 101 recharge pits, to buffer peak runoff and ensure uninterrupted operations during record rainfall events. These measures** supported **19.59 ML of annual recharge** and **reduced flood risk,** ensuring future **operational resilience.**

This integrated framework delivered:

- Prevented flood-induced revenue losses of **INR 1.09 Cr/day**
- This also lead to the prevention of direct revenue loss on account of 100% operational of Cargo & Fuel Farm Operations and no impact on Non-Aero Revenue
- Protected upstream adjacent communities from backflow flooding

Project Graphics

Flood Exposure Assessment through Elevation Modeling (Covering critical points within MIAL; Flood Risk data output table)



Flood Exposure Assessment through Runoff Calculation (Worst case scenario projection)

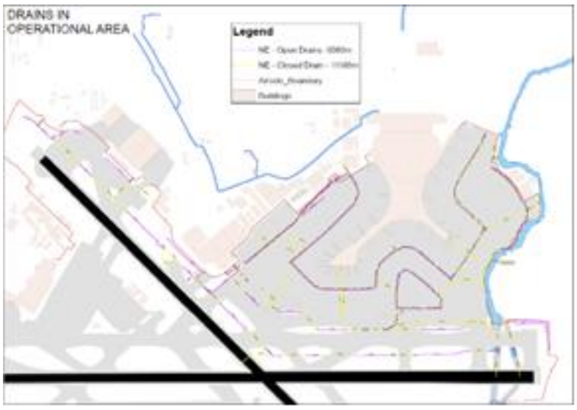
Runoff Calculation

	Historical (1995-2014)	SSP1 – 2.6			
Year		2030	2050	2080	2100
Max. 1-day rainfall (10-year return level)	420 mm	485 mm	513 mm	595 mm	660 mm
Runoff (m^3/s)	226	259	266	269	274
% increase in runoff	-	14	18	19	21
	Historical (1995-2014)	**SSP2 – 4.5**			
Max. 1-day rainfall (10-year return level)	420 mm	480 mm	501 mm	530 mm	545 mm
Runoff (m^3/s)	226	258	269	285	293
% increase in runoff	-	14	19	26	30

	Historical (1995-2014)	SSP5 – 8.5			
Max. 1-day rainfall (10-year return level)	420 mm	485 mm	513 mm	595 mm	660 mm
Runoff (m^3/s)	226	261	276	320	355
% increase in runoff	-	15	22	42	57

Flood resilience infrastructure (Recharge pits)

Flood resilience infrastructure (Storm Water drainage with recharge pit and RWH ponds)



Cochin International Airport
OPERATION PRAVAH

Kerala experienced an unprecedented flooding in August 2018, the worst since 1924, following continuous and abnormally high rainfall from June to mid-August. With 42% excess precipitation (2346 mm against the normal 1649 mm), and the opening of 35 dams, major rivers, including the Periyar and its tributaries, overflowed, devastating 13 of 14 districts. Cochin International Airport, located within the Periyar basin and adjacent to Chengalthodu, was severely impacted—runways, taxiways and terminal buildings were submerged, compound walls collapsed, and operations were suspended for 15 days (14–28 August 2018). Losses exceeded Rs 220 crore, affecting infrastructure, electrical systems and the solar power plant. A similar event in 2013 had already indicated the need for permanent mitigation.

Recognising CIAL's importance as Kerala's primary aviation gateway and a critical link for tourism, economic activity, and disaster response, CIAL engaged M/s KITCO to conduct a comprehensive hydrological and infrastructural study. The objective was to design sustainable measures to prevent future flooding at the airport and surrounding regions.

Based on the recommendations, Operation Pravah was initiated as an integrated, multi-component flood mitigation project aimed at improving water diversion, increasing drainage efficiency, and restoring natural flow channels. Major interventions included rejuvenation of the 3.5 km diversion canal, improvements to canals in neighbouring panchayats (Sreemoolanagaram, Kanjoor, Nedumbassery and Chengamanad), and construction of new diversion channels, regulators, aqueducts, and RCC stormwater drains. Bridges, culverts and vented cross bars across Chengalthodu and other linked streams were reconstructed or newly built. Significant upgrades to Chengalthodu North and South, the Nayathode–Moonuthodu stretch and Kaithakaduchirathodu enhanced the hydraulic capacity of more than 24 km of waterways. Elevated roads and approach improvements further strengthened resilience.

Collectively, these works improved water conveyance, reduced flood vulnerability, restored natural drainage patterns, and ensured uninterrupted airport operations, contributing to enhanced regional disaster preparedness.

Project Graphics

Diversion canal- before & after construction	AP Varkey road bridge site- before & after construction
	
Kuzhippalam bridge site- before & after construction	CIAL drainage layout with flow direction & water level marking location
	

Hong Kong International Airport
HKIA Flood Resilience Studies

Given that Hong Kong International Airport (HKIA) is situated on reclaimed land near the sea and its flat elevation, it faces various flood risks, especially during extreme weather events such as typhoons and heavy rainfall. HKIA has taken significant steps to enhance its flood resilience, particularly by proactively conducting flood-related studies that consider future climate change.

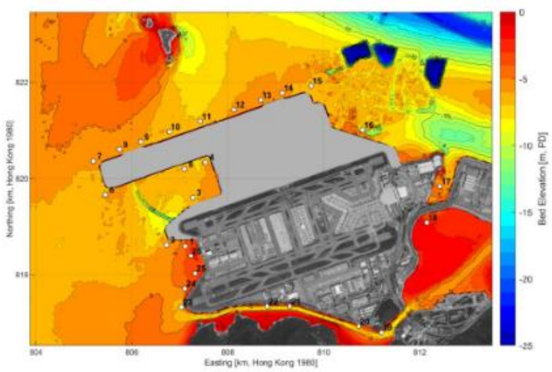
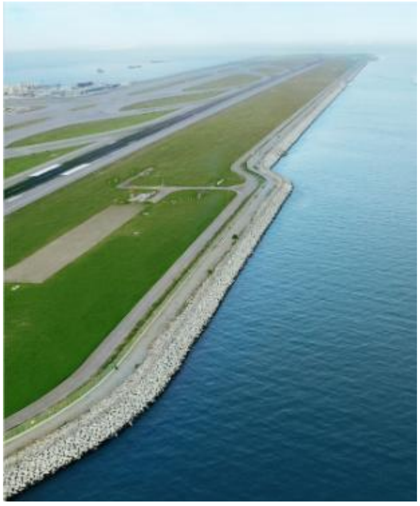
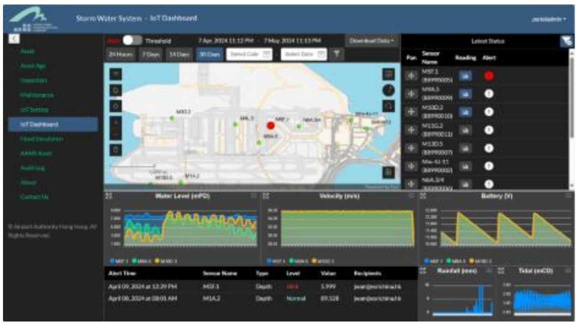
The HKIA Flood Resilience Studies included two linked components. The Seawall Study focused on evaluating extreme water levels and wave conditions along the airport's perimeter under diverse future climate change projections. Through sophisticated data analyses and numerical modelling techniques, the study provided critical insights into the potential impacts of climate change on HKIA's coastal defences. Subsequently, the Drainage Study meticulously examined the airport-wide drainage system's performance under normal circumstances and extreme weather events, incorporating data on sea level rise, heavy rainfall, and tidal surges/overtopping from the Seawall Study. By simulating flood risks from both the land drainage system and coastal defence using a unified hydraulic model, the studies provided a holistic view of potential flood scenarios, overcoming limitations of traditional assessment methodologies and enabling more effective flood management strategies.

The studies adopted Intergovernmental Panel on Climate Change (IPCC)'s worst-case climate scenarios (initially AR5 RCP8.5 and H++ scenarios in 2021 and later AR6 low-confidence scenario SSP5-8.5 in 2023) and downscaled data from Hong Kong Observatory to assess compounded flood risks across 2030, 2050 and 2100.

Flood maps for different scenarios were produced to enable AAHK's Executive to make pragmatic decisions on structural and non-structural adaptation measures (e.g. drainage infrastructure upgrades vs. monitoring initiatives) as part of an overarching balanced approach to flood management.

The studies confirmed that HKIA's current infrastructure is resilient until at least mid-century. Key enhancements implemented include IoT sensors for real-time stormwater monitoring using cutting-edge software and updated emergency management procedures.

Project Graphics

HKIA has taken significant steps to enhance its flood resilience as it is a coastal airport located on reclaimed land also on flat and low-lying elevation.	Twenty-six locations along the perimeter of the HKIA were assessed for overtopping as part of the Seawall Study using scenario-based modelling with bespoke data.
	
The seawall at HKIA helps reduce the risk of damage or disruption from climate change impacts.	An IoT dashboard visualises Storm Water Network assets and IoT sensors on a 2D map view, enabling the display of multiple IoT data points and alerts from the sensors, such as rainfall data, tidal data, water level, velocity, and battery status.
	

Indira Gandhi International Airport
Climate resilient airport stormwater drainage using watscan tool

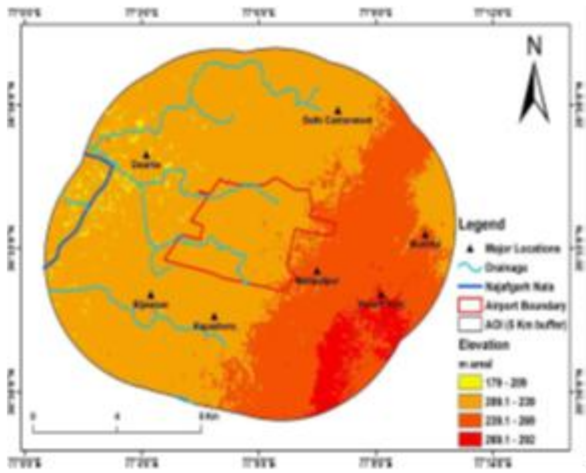
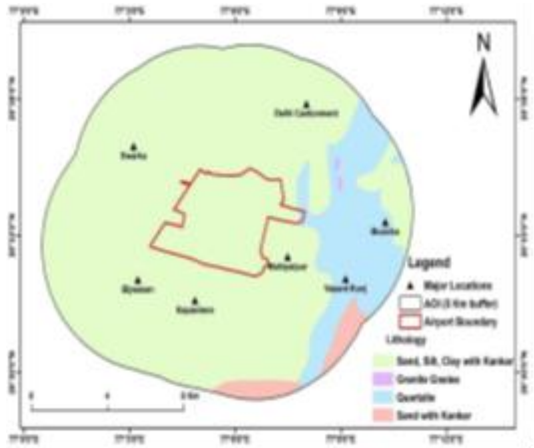
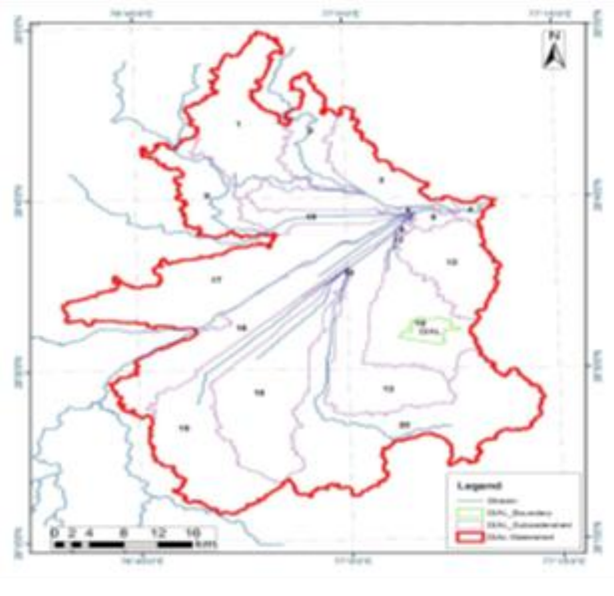
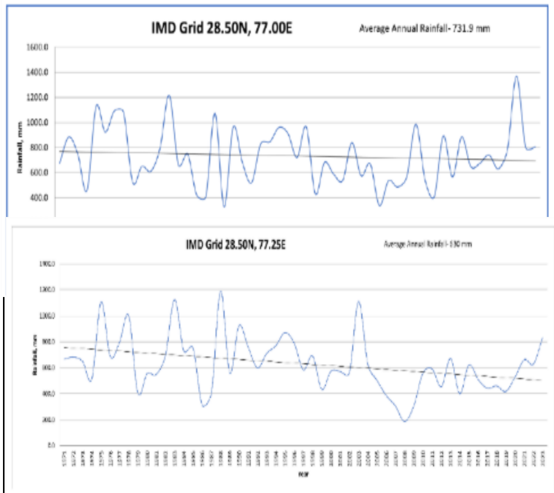
DIAL has implemented a climate change adaptation initiative aimed at strengthening stormwater drainage resilience, guided by a comprehensive water study and the WATSCAN tool developed by the Confederation of Indian Industry. Over the past few years, Delhi has faced increasingly high-intensity rainfall events, including cloudburst-like episodes and prolonged monsoon spells. These have intermittently caused waterlogging in and around the airport, leading to temporary operational disruptions and flooding of peripheral roads, exposing vulnerabilities in drainage infrastructure.

The WATSCAN study assessed rainfall intensity–duration trends, surface runoff patterns, drainage catchments, soil, groundwater levels, and aquifer behaviour across the airport and its surroundings. Findings highlighted rising hydrological pressure from extreme precipitation, limited infiltration capacity in areas, and high groundwater tables in certain zones, all of which constrained stormwater discharge during peak monsoon events. Hydrogeological analysis emphasised the need to balance rapid runoff evacuation with groundwater protection and recharge.

Based on these insights, DIAL management agreed to invest in a high-capacity, climate resilient stormwater drainage system along runway 28/10. A ~4km long, 10-20m wide-drain was constructed within airport premises to connect with the city drain, supported by strengthened pumping capacity and improved off-airport connectivity through joint planning with external stakeholders. This drain can discharge 70 m3 of water/second during peak rains, complemented by other drainage networks. Key interventions included desilting of primary and secondary drains, enhanced stormwater corridors, and pumping systems engineered to manage extreme rainfall flows. Design measures also ensured prevention of backflow, minimized waterlogging duration, and safeguarded critical airside and terminal infrastructure in line with aviation safety requirements.

The upgraded system is further supported by 746 harvesting pits and 9 million litres of storage capacity, aligning with broader water resilience goals. Collectively, this WATSCAN-informed initiative demonstrates a scalable, replicable model for aviation hubs managing climate-induced flood risks while ensuring uninterrupted airport operations.

Project Graphics

Physiography and Drainage in Aera of Interest (5KM of Airport)	Lithology of the area of interest (5KM of Airport)
	
Delineated DIAL Watershed showing DIAL Location, major drainages, and the administrative boundary	IMD average rainfall data
	

Jenderal Ahmad Yani International Airport
Airside Flood Mitigation Project

Jenderal Ahmad Yani International Airport (SRG) serves Semarang, Central Java, Indonesia. Its coastal location makes it vulnerable to climate risks, including tidal flooding, extreme rainfall, and land subsidence. Geodetic and governmental studies report that land subsidence in northern Semarang averages 9–10 cm per year. These risks have directly impacted airport operations, resulting in major incidents on February 6, 2021, December 31, 2022, and March 14, 2024. On these dates, runway flooding from extreme rainfall and high tides disrupted flights and led to temporary closures.

The Airside Flood Mitigation project is structured in three phases: planning (2021–2022), construction (2024–2025), and future optimization (2026 and beyond).

Key components of the project include:

1. Build a 1,169-meter-long, 90-centimeter-high embankment wall integrated with the airside perimeter fence to protect airport infrastructure from tidal flooding.
2. Construct a suction basin and install new flood pumps to rapidly remove water from the airside and prevent runway flooding.
3. Repair and expand the airside open channel to improve drainage and reduce water accumulation during heavy rainfall. Install pumps to enhance system efficiency and reliability during flood events.

This project will strengthen the following areas:

1. Airport operational reliability during extreme weather
2. Repair and expand the airside open channel to improve drainage and reduce pooling during heavy rain.
3. Upgrade existing flood pumps to improve system efficiency and reliability during flood events.

Additionally, the airside flood mitigation system is complemented by a previously implemented landside Water Management System (2020–2021), which ensures a reliable raw water supply for terminal operations and stabilizes water levels in landside retention ponds during tidal fluctuations.

This project demonstrates Jenderal Ahmad Yani International Airport's proactive commitment to long-term climate resilience, sets a standard for sustainable operations, and supports the continued growth and safety of Indonesia's aviation industry.

Project Graphics

Embankment Wall	Flood pump and Suction Basin
	
Drainage Chanel	Water Management System
	

Kaohsiung International Airport
Science-Based Climate Adaptation to Build a Disaster-Resilient Airport

Located along the Northwest Pacific typhoon corridor, Kaohsiung International Airport faces recurrent compounded climate risks, particularly typhoons, accompanied by extreme rainfall due to its unique geographic position. To address these escalating risks, the airport launched the "Building a Disaster-Resilient Airport" project in 2021, aligned with Taiwan's National Climate Change Adaptation Action Plan, with the objective of strengthening operational resilience.

The project is structured around the TCFD framework, informed by IPCC climate science, and assessed using the ACI Climate Adaptation Tool. Accordingly, the airport implemented climate adaptation measures across infrastructure and operational management, including:

- **Resilient Infrastructure:** An investment totalling USD 77.7 million, representing 60% of annual capital expenditure, focused on upgrading taxiway drainage and stormwater retention systems, reinforcing roof waterproofing, and replacing passenger boarding bridges with new-generation units capable of withstanding Beaufort scale 17 winds (approximately 109 knots). In parallel, the new terminal development entails an additional USD 2.81 billion investment, incorporating elevated foundations, flood barriers, and sponge city design principles to reduce flood and windstorm risks at a system level.
- **Robust Management Systems**: A cross-departmental emergency response and facility inspection mechanism has been established, complemented by climate risk insurance to ensure precise and effective implementation of adaptation measures.

The effectiveness of this strategy was decisively demonstrated in October 2024, when Typhoon Krathon made a direct landfall in Kaohsiung, bringing destructive winds reaching Beaufort scale 17 and catastrophic rainfall.

While severe flooding and infrastructure damage occurred across the city, the airport achieved zero flooding in terminals and runways, zero damage to critical electrical systems and boarding bridges, and zero casualties. Operations were fully restored on the same day, successfully avoiding an estimated USD 14.4 million in potential asset losses.

Kaohsiung International Airport has demonstrated through real-world experience that proactive climate adaptation can deliver a safe, sustainable, and resilient replicable benchmark for climate-resilient airports worldwide.

Project Graphics

<table>
<tr><td>Integrate TCFD Framework to Identify and Analyze Potential Climate Risks at Airport Locations</td><td>Conduct Regular Disaster Drills and Environmental Training, Provide Passengers with Thunderstorm Alert System Information</td></tr>
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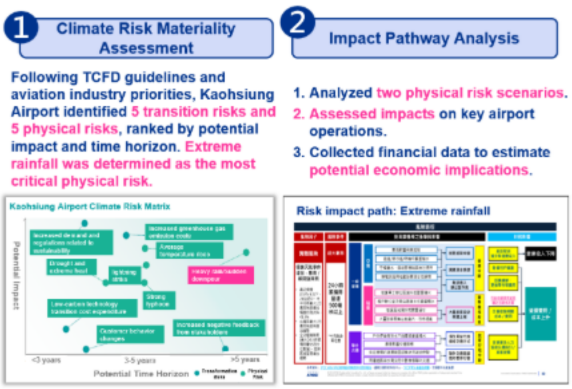

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<tr><td>Plan and Implement Adaptation Measures and Infrastructure Improvements for Critical Airport Facilities</td><td>Evaluate Actual Climate Disasters and Airport Adaptation Performance</td></tr>
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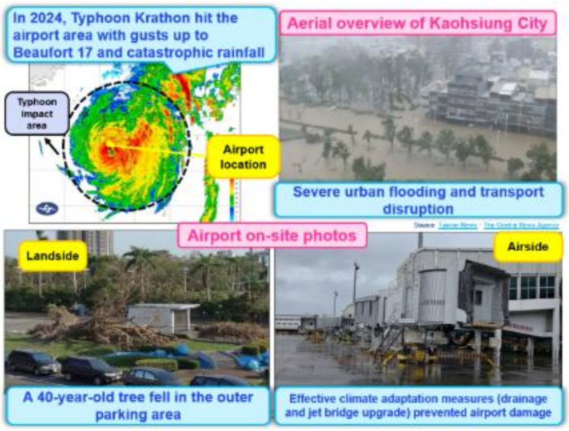

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Melbourne Airport

Future-Focused Stormwater Management Driving Resilient Airport Development

Melbourne Airport has embedded climate adaptation into infrastructure planning by implementing mandatory, airport-wide stormwater standards that establish a national benchmark for climate-resilient aviation infrastructure.

Responding to intensified rainfall events affecting Australian airports and updated Australian Rainfall & Runoff (AR&R) guidelines, Melbourne Airport adopted the SSP2-4.5 climate scenario—the "middle of the road" pathway aligned with IPCC's 2.7°C temperature projection and endorsed by the Australian Government Department of Climate Change, Energy, the Environment and Water. This science-based approach ensures infrastructure designs reflect internationally recognised climate projections.

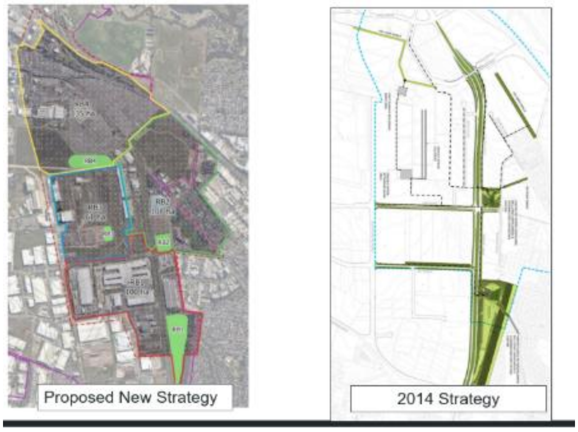
The airport implemented a risk-based adaptation framework differentiating between asset lifecycles: critical airside infrastructure (runways, taxiways, aprons) must withstand 20–40% rainfall intensity increases by 2100, whilst landside and business park developments accommodate 14–27% increases by 2060. This proportionate approach optimises capital expenditure while safeguarding operations against flood-related disruptions.

Since mandatory enforcement in January 2025, tangible outcomes include raised finished surface levels for the Third Runway preventing future inundation; upsized stormwater trunk infrastructure protecting new developments; and increased capacity of retarding basins across the airport estate. These preventative measures avoid extensive damage and costly emergency repairs from extreme weather events, eliminating operational downtime and protecting revenue-generating assets from flood-related degradation.

The project delivers co-benefits, including best-practice water quality improvements through new attenuation devices, protecting downstream ecosystems and communities. The risk-based methodology provides a replicable framework for airports globally facing similar climate vulnerabilities.

By integrating climate resilience into early design, Melbourne Airport demonstrates how infrastructure expansion can proceed without compromising operational capacity or commercial viability. The project establishes evidence-based, mandatory stormwater and flood resilience requirements across all business units, ensuring operational continuity during extreme weather, supporting regulatory compliance, and enhancing protection for neighbouring communities and ecosystems—positioning the airport as a leader in climate-ready infrastructure planning.

Project Graphics

<table>
<tr><td>Melbourne Airport’s uplifted Retarding Basin Strategy in response to Climate Change</td><td>Annandale Basin Reserve shows amenity as open space with walking tracks for Airport Business Park workers</td></tr>
<tr><td>
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<tr><td>Completed Annandale Basin Reserve on handover</td><td>Completed Sharps Road Retarding Basin (Sediment Ponds).</td></tr>
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Narita International Airport
Adaptation Strategies for Severe Typhoon and Heavy Rain Impacts

In 2019, a major typhoon caused prolonged suspension of train and bus services connecting to Narita Airport, resulting in up to 16,900 passengers stranded inside the airport at peak times. Power outages also disabled monitoring systems for the aviation fuel pipeline facilities. Although aircraft operations were not disrupted, the fuel pipeline was halted for three days. Furthermore, subsequent heavy rainfall caused flooding in parts of the aviation fuel pipeline facilities, requiring significant restoration costs.

In response to these damages, Narita International Airport Corporation (NAA) launched a climate change adaptation project aimed at enhancing resilience during disasters, with the concept of ensuring passenger and facility safety, mitigating damage, maintaining airport operations, and accelerating recovery. In terms of passenger safety, the large number of stranded passengers was regarded as an issue. To keep this number below a certain level and ensure smooth flow control, it was necessary to monitor not only aircraft and airports but also ground transportation providers such as railways and bus companies. Therefore, NAA held extensive consultations with numerous stakeholders and established Emergency Response Headquarters to decide on landing restrictions. Assumptions on the number and duration of stranded passengers were also revised, stockpiles of supplies were increased, and waste reduction was considered.

To mitigate damage and ensure stable operation of the fuel facilities, which are critical to airport operations, power outage and flooding countermeasures were identified as key issues. Locations at risk were identified, damage mitigation and emergency response measures were examined, and necessary construction work was carried out.

With the completion of the multi-year phased construction work and the donation of surplus stockpiled supplies to food banks, the project concluded all its phases in March 2025. As a result, in recent years, the airport has been able to maintain operations without incurring major damage or functional shutdowns.

Project Graphics

Passengers Stranded at Narita Airport Due to Typhoon Faxai	Emergency Supplies for Stranded Passengers (Sleeping Bags, Bread, Rice, Rice Cookies, Water, Diapers, Liquid Milk, Baby Food)
	
Staff Moving by Boat Due to Flooding Inside the Facility	Temporary Flood Barriers Installed at Narita Airport
	

Tahiti Faa International Airport
Riprap for waterflow deviation in the East Canal

Tahiti Faa'a International Airport, built in the 1960s on a lagoon area, has experienced significant urban development around its infrastructure over the past decades. This land artificialization, combined with intense rainfall and cyclonic events, has led to recurrent flooding in the urban area and on the airport site.

To mitigate these risks, a canal was created to drain rainwater coming from the heights of Faa'a. However, despite annual dredging, its historical design did not allow efficient water flow evacuation: after heavy rains, flooding times could reach 6 days, impacting operational continuity.

The project led by the airport operator aims to strengthen the airport's climate resilience by improving the hydraulic capacity of the existing system. The works involve diverting the four main streams feeding the canal to optimize flow direction and reduce pressure on sensitive areas. A planting program of native species (Acrostichum aureum, Ipomoea pes-caprae) is planned to maintain the stability of the north bank of the East Canal.

This initiative is part of a proactive approach to climate change adaptation, ensuring the safety of infrastructure and users while preserving the continuity of air operations. It illustrates the airport's commitment to anticipating environmental risks and implementing sustainable solutions.

Project Graphics

<table>
<tr><td>Example of situation after a heavy rainfall event in February 2024. Satellite view</td><td>Works were carried out during airport operations over a period of 12 weeks</td></tr>
<tr><td>
</td><td></td></tr>
<tr><td>Project progress update as of December 2025</td><td>Location plan of the East Canal work zones and construction vehicle access</td></tr>
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</table>

Taif International Airport
Climate-Resilient Expansion

The Taif International Airport Development Project represents a landmark example of climate-resilient airport infrastructure in an extreme environmental context. Located in a region increasingly exposed to extreme heat, water scarcity, and climate variability, the project integrates climate change adaptation as a core design principle rather than a secondary consideration. The development includes the delivery of a new passenger terminal and associated airside and landside infrastructure, significantly increasing capacity while safeguarding long-term operational continuity under future climate scenarios. The project responds to rising passenger demand driven by domestic tourism and seasonal Hajj and Umrah traffic while ensuring the airport remains functional, safe, and comfortable during extreme weather events.

Key adaptation-driven outcomes include:

- Heat-resilient design, incorporating high-reflectance roofing, advanced thermal insulation, shaded circulation areas, and optimized building orientation to reduce heat stress, cooling demand, and energy vulnerability during peak summer conditions.
- Water resilience strategies addressing regional scarcity through efficient fixtures, reduced potable water demand, and durable waterproofing systems designed to withstand intense rainfall events.
- Infrastructure robustness, with critical electrical, ICT, and mechanical systems elevated and protected to ensure uninterrupted airport operations during climate-related disruptions.
- Energy resilience and flexibility, supported by optimized HVAC systems, enhanced building envelope performance, and emergency backup power readiness.
- Low-carbon and future-ready mobility, including electric vehicle charging infrastructure to support the transition to sustainable ground transport.

By embedding climate adaptation across planning, design, and construction, Taif International Airport demonstrates how airport expansion can simultaneously enhance capacity, protect assets, and future-proof operations. The project strengthens regional connectivity, supports economic growth, and sets a benchmark for climate-adaptive airport development in arid and high-temperature environments.

Project Graphics

Parking shades	Roof waterproofing 1
	
Roof waterproofing 2	EV charges
	

INFRASTRUCTURE & ASSET RESILIENCE

Biju Patnaik International Airport

Climate-Resilient Runway Operations through CAT-II Airfield Ground Lighting at Bhubaneswar Airport

Biju Patnaik International Airport, Bhubaneswar has implemented a critical climate change adaptation initiative by upgrading its runway lighting infrastructure from a conventional Category-I halogen-based Airfield Ground Lighting (AGL) system to a fully compliant Category-II LED-based AGL system, enabling safe aircraft operations during low-visibility conditions down to 350 metres Runway Visual Range (RVR).

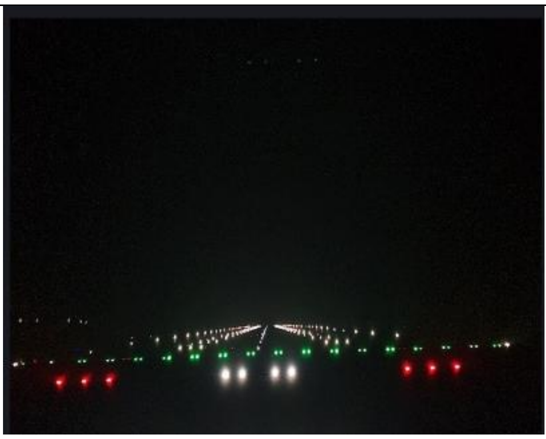
Airports in eastern India are increasingly exposed to climate-driven weather variability, including dense fog, heavy rainfall, high humidity, and changing seasonal patterns that adversely impact visibility and disrupt flight operations. Recognising low visibility as a growing operational risk, Bhubaneswar Airport proactively strengthened its airside infrastructure to ensure operational continuity, safety, and resilience under adverse meteorological conditions.

The project involved comprehensive upgrading of critical runway lighting systems, including runway edge lights, runway centreline lights, touchdown zone lights, threshold and runway end lights, turn pad lights, and approach lighting systems, in accordance with DGCA CAR and ICAO Annex 14 requirements for CAT-II operations. The introduction of LED-based systems ensures stable photometric performance, faster response times, and high reliability during extreme weather events such as fog, intense rainfall, and fluctuating ambient conditions.

By enabling CAT-II operations, the airport has significantly reduced weather-related disruptions, diversions, and cancellations, thereby enhancing safety, maintaining airport accessibility during adverse climatic conditions, and improving the resilience of critical aviation infrastructure. While energy efficiency and reduced maintenance are ancillary benefits, the primary objective of the project is climate adaptation, ensuring safe, reliable, and continuous runway operations in the face of increasing climate uncertainty.

This initiative demonstrates Airports Authority of India’s proactive approach to climate resilience, offering a scalable and replicable model for airports facing similar climate-induced visibility challenges across the Asia-Pacific and Middle East regions.

Project Graphics

CAT-II Airfield Ground Lighting at Bhubaneswar Airport	CAT-II compliant Runway Centreline Inset lights at Bhubaneswar Airport
	
LED ground-lights at Bhubaneswar Airport	CAT-II Elevated Approach Lighting at Bhubaneswar Airport
	

Kansai International Airport
Building airport resilience in the face of disruptive climate events

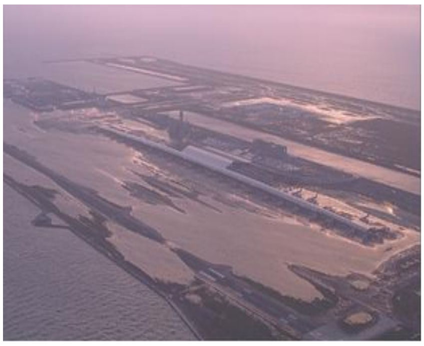
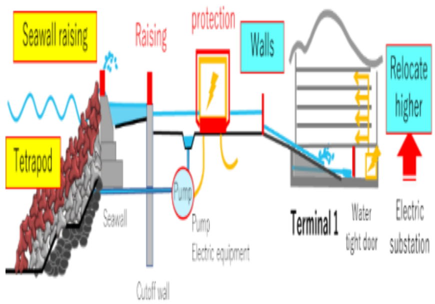
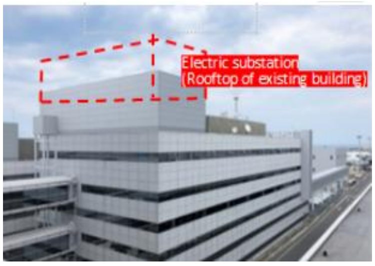
Airports worldwide are increasingly vulnerable to climate change, and Japan—frequently struck by summer typhoons—is no exception. Kansai International Airport, constructed offshore using wave forecasts derived from post-1950 oceanographic data and Japan's most advanced civil and port engineering, faced unprecedented flooding during Typhoon Jebi on September 4, 2018. Storm surges and towering waves halted runway and terminal operations, revealing a disaster far beyond conventional engineering assumptions. Climate change is reported to be intensifying typhoons, and Jebi was a striking example of this reality.

Drawing on this experience, we initiated an airport resilience project that went beyond mere restoration, focusing on readiness for disasters exceeding previous assumptions. The strategy was built on three pillars: prevention, mitigation, and recovery. This included revising seawall height standards (Prevention) based on recent typhoon data, including Jebi, and implementing systems to minimize damage (Mitigation) and enable swift restoration (Recovery).

Securing consensus with government and stakeholders was essential, and half of the ¥54 billion project cost was covered by government-backed funding.

Completed in roughly two and a half years, the project reinforced Kansai International Airport to endure typhoons on par with Jebi. Even in the rare event of flooding, critical facilities remain safeguarded, and measures are in place for rapid restoration of airport operations. This initiative embodies "resilience and adaptation to climate change through robust infrastructure," greatly enhancing the airport's reliability as a vital transportation hub.

Project Graphics

Flooding caused by Typhoon Jebi	Airport resilience strategy.
	
Raising seawalls and installing wave-dissipating blocks (Prevention)	Relocating electrical equipment above ground (Mitigation)
Before  After 	Before  After 

Kempegowda International Airport Bengaluru
Climate Change Adaptation project

Bangalore International Airport Limited's (BIAL) Sustainability Vision is to "Touch lives by nurturing a sustainable future through initiatives that drive economic, social, and environmental transformation. We drive our sustainability journey through six strategic pillars: Water Stewardship, Net Zero Carbon Emissions, Community-Aligned Noise Management, Circular Economy, Sustainable Procurement, and Sustainable Mobility. These pillars are strengthened by three foundational values: Corporate Social Responsibility (CSR), Behavioural Change and Compliance. Together, they embody our vision, mission, and values—shaping a green future.

Globally, climate change events are becoming more pronounced, with evident weather incidents that vary from extreme heat, intense rainfall, and fluctuating wind patterns across the various geographies, further poising direct and indirect challenges to airport infrastructure and operations. Comprehending this, BLR Airport prioritises climate change, considering as an escalating risk to airport operations, infrastructure, stakeholder expectations, and long-term strategic resilience. These events underscore the need to build robust adaptive capacity across our operations.

We have undertaken a comprehensive climate risk assessment aligned to the global frameworks, asset-specific scenario modelling to understand challenges and opportunities for diverse operations. We are implementing a holistic climate mitigation and adaptation roadmap through multiple initiatives with the guidance of global standards and structured governance mechanism.

This climate adaptation project was implemented as part of BIAL's comprehensive climate adaptation roadmap, addressing climate change related flash floods caused by high intensity rains in the airport and simultaneously reducing emissions & enhancing water security for the city. Landscaping with native vegetation and permeable surfaces further supports stormwater infiltration and biodiversity.

Collectively, these interventions enhance long-term flood management for airport operations by ensuring reliable, diversified, and climate-resilient water sources and reducing vulnerability to hydrological variability and climate extremes.

We had validated our interventions through a detailed Climate Risk assessment study in line with the global framework.

Project Graphics

RWH Ponds & Flood Control	RWH Ponds & Flood Management
	
RWH Ponds across airport	RWH Ponds & Flood Management
	

Mactan-Cebu International Airport
KIDLAT

As climate change intensifies global weather volatility, airports face an increasing frequency of severe thunderstorms, posing significant risks to aviation safety and operational continuity. Over the past 15 years, Cebu experienced two (2) Super Typhoons, nine (9) Typhoon landfalls, and more than 2,000 Thunderstorm advisory days, creating a high-risk operating environment.

In response, Mactan-Cebu International Airport (MCIA) implemented **Project: KIDLAT** (Kybernetics and Injunctions During Lightning and Thunderstorms) as a climate change adaptation initiative. With MCIA's leadership commitment to data-driven risk management and long-term resilience planning, Project: KIDLAT (vernacular term for lightning) enhances climate resilience by enabling proactive management of lightning-related hazards.

At its core is the Biral BTD-300 Thunderstorm Detector, utilising quasi-electrostatic operating principle capable of detecting all forms of lightning—including cloud-to-cloud and intra-cloud—up to 83 km away with a negligible false alarm rate. And it can provide a warning of potential overhead lightning risk before the first strike occurs. With an investment of £8,841.70, the system is able to minimize unnecessary operational shutdowns and avoid costly cascading flight delays.

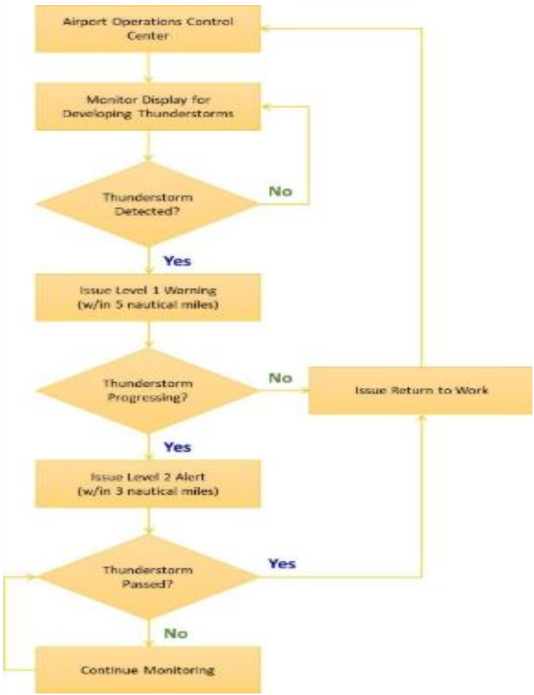
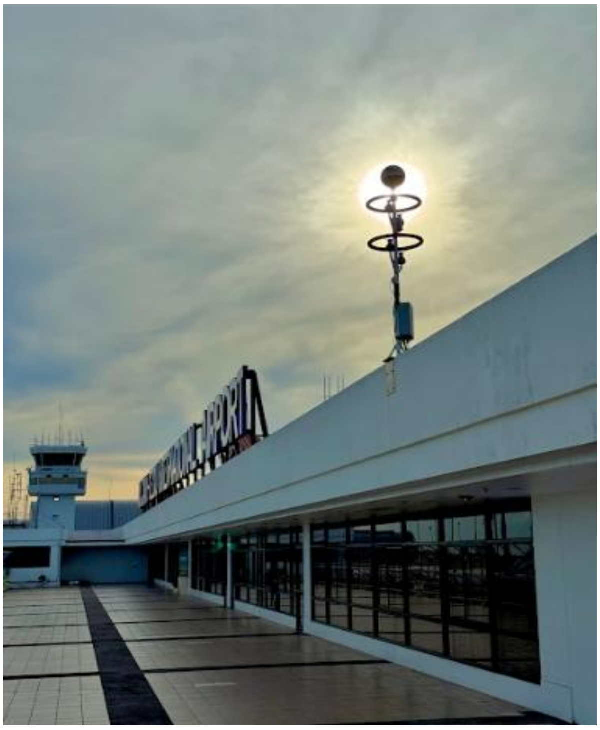
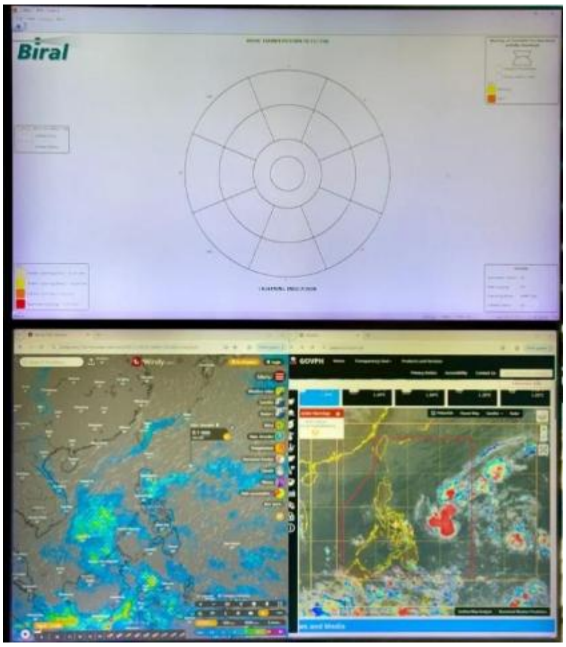
Since its implementation, MCIA has recorded zero (0) lightning-related incidents, delivering high safety returns.

The Project enhances resilience and safety:

- **Proactive Risk Management:** By alerting operators prior to lightning generation, the airport can suspend hazardous ground activities *before* the danger arrives.
- **Operational Efficiency:** Its high precision reduces "false alarm" downtime, and operations can resume sooner, minimizing delays that ripple through flight schedules.
- **Asset Protection:** Early detection safeguards sensitive navigation equipment, ground infrastructure, and personnel from sudden electrical surges and strikes.

Project: KIDLAT provides a replicable model that involves coordination among airport operations, air traffic control, ground handlers, emergency services, and technical teams to define operational thresholds for suspension and resumption of airside activities while maintaining high throughput without compromising the well-being of passengers or ground crew.

Project Graphics

<table>
<tr><td>Process flow for the activation of the Thunderstorm and Lightning Alert System</td><td>Installed thunderstorm detector in both Terminals 1 & 2</td></tr>
<tr><td>
</td><td></td></tr>
<tr><td>Network interface that is supported by local weather monitoring systems</td><td>Installed lightning shelters at the ramp for the affected ground crew</td></tr>
<tr><td>
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Queen Alia International Airport
Aspirating Smoke Detection (ASD) system

This project demonstrates Airport International Group's (AIG) commitment to environmental excellence, operational reliability, and innovation through an energy-efficient upgrade of the electrical rooms serving the North Runway. Previously, dust infiltration caused an average of two false fire alarms per year, triggering unnecessary discharges from the CO_2 and FM200 suppression systems. Each activation required refilling up to 440 kg of FM200 and 225 kg of CO_2, wasting resources, generating avoidable emissions, and increasing operational costs. To avoid false releases, the system was disabled ten times for a total of 20 days, temporarily reducing fire protection coverage. Available extinguishing agents in the affected locations include 821 kg FM200 in the North /South substation and 1,435 kg FM200 plus 540 kg CO_2 in Vaults 3&4 and the CUP area.

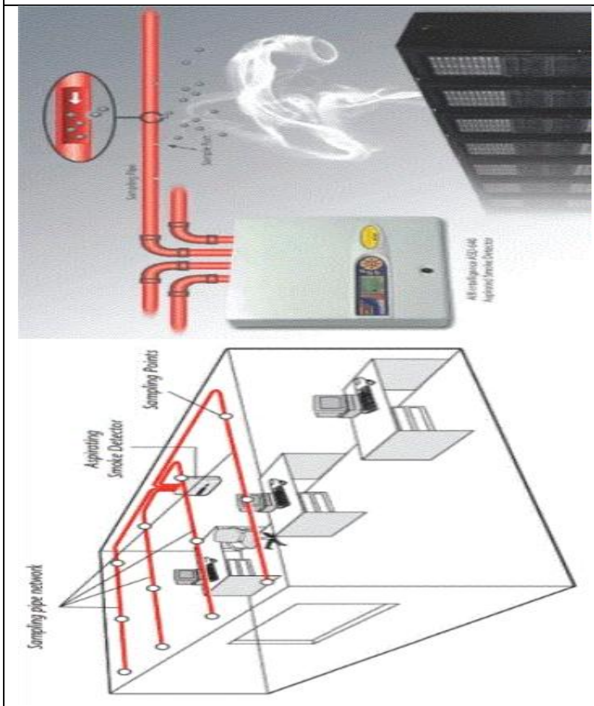
To resolve this recurring issue, AIG installed an Aspirating Smoke Detection (ASD) system equipped with laser particle analysis, CMOS imaging, and multi-photodiode sensing. Fully compliant with NFPA 72 standards, the ASD can detect smoke particles as small as 0.45 microns, enabling accurate differentiation between dust and smoke. Preventing false activations reduces refilling cycles, safeguards critical infrastructure, and ensures continuous fire protection uptime.

The solution further integrates high-efficiency cooling units using R454, a low-global warming potential refrigerant with over 75% lower GWP than legacy gases. These units support free-cooling mode for up to four winter months, using naturally cool outdoor air to maintain indoor temperatures without mechanical cooling. This reduces electricity consumption, operational costs, and refrigerant-related climate impact, supporting AIG's decarbonisation targets.

Designed for climate resilience, the combined system maintains accuracy and cooling performance during frequent dust events, supporting uninterrupted operations.

By pairing advanced detection technologies with sustainable cooling improvements, this project establishes a regional benchmark for low-carbon, climate-ready airport infrastructure while reducing emissions, enhancing safety performance, and strengthening AIG's leadership in responsible environmental management.

Project Graphics

<table>
<tr><td>Aspirating System</td><td>Package Unit</td></tr>
<tr><td>
</td><td></td></tr>
<tr><td>Aspirating System – Panels</td><td>Aspirating system – Network</td></tr>
<tr><td></td><td></td></tr>
</table>

Sharjah International Airport
Water Proofing Project at Sharjah Airport buildings

The roof waterproofing and thermal enhancement project at Sharjah Airport was planned and implemented as a proactive climate adaptation measure to address the increasing impacts of climate change on airport infrastructure—specifically higher rainfall intensity and rising ambient temperatures experienced in recent years. Recurrent water leakages recorded between 2019 and 2024, particularly following extreme rainfall events, together with elevated heat gain through roof structures, highlighted the urgent need for resilient building envelope upgrades.

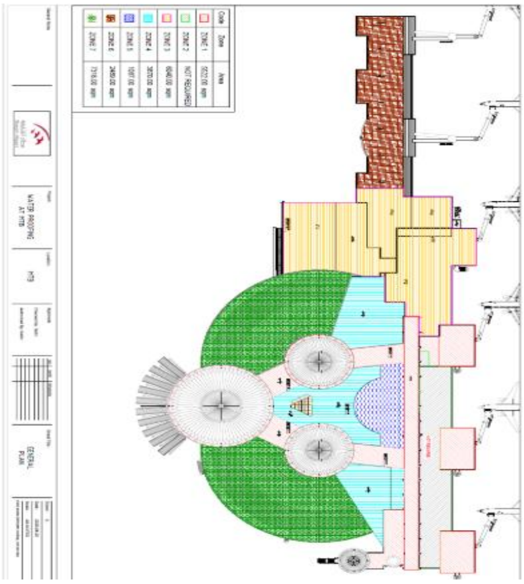
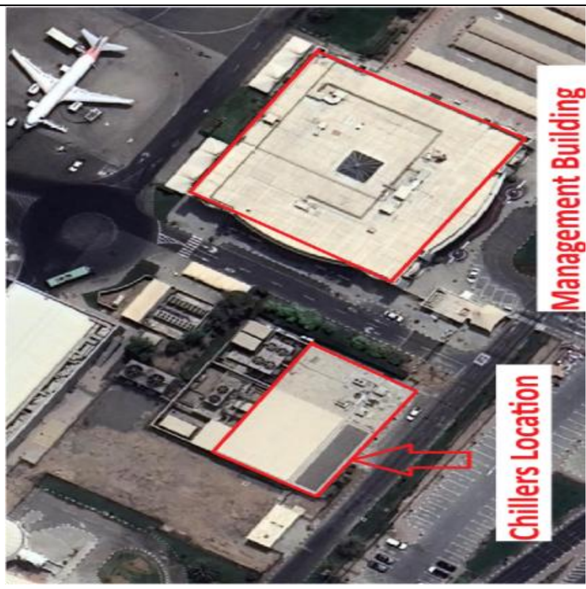
Periodic inspections, post-rainfall assessments, and repeated maintenance complaints raise the need for an adaptation measure. Critical leakage zones included roof slabs, parapet wall interfaces, hidden gutters, and mechanical, electrical, and HVAC penetrations. These issues posed risks to structural integrity, passenger safety, airport operations, and the reliability of critical systems such as electrical panels, IT equipment, HVAC units, and ceiling installations. In response, a CAPEX-funded project was executed in accordance with Sharjah Airport Authority tender procedures, covering airside and landside facilities and involving key stakeholders including Police, Commercial Department, and Sharjah Aviation Services.

The project successfully restored roof membranes, repaired damaged substrates, and improved drainage performance, eliminating water ingress across all affected buildings. This significantly enhanced operational reliability, reduced maintenance requirements, improved safety compliance, and protected high-value assets.

In parallel, reflective coatings and upgraded waterproofing systems delivered substantial thermal performance improvements, as confirmed by independent thermal imaging studies. Roof surface temperatures were reduced by 17–18°C on sandwich panel roofs and 5–7°C on RCC roofs, directly reducing heat transfer into buildings. These measures lowered cooling loads, improved indoor thermal comfort during extreme summer temperatures exceeding 45°C, reduced HVAC energy consumption, and extended equipment life.

The project delivered long-term climate resilience, operational continuity, energy efficiency, and cost savings, strengthening the airport's ability to adapt to increasing rainfall and rising temperatures while safeguarding critical infrastructure.

Project Graphics

Project Location Map -1	Project Location Map-2
	
Roof area before the project	Project Image
	

Singapore Changi Airport
Runway and Taxiway Resilience against Climate Stressors

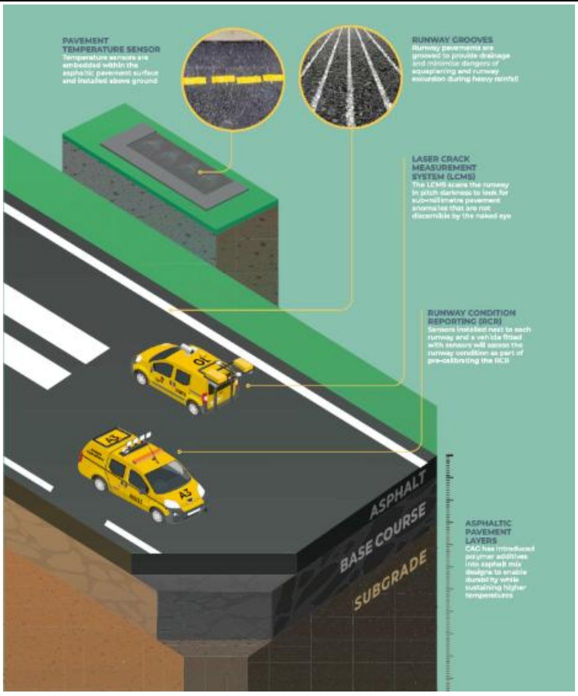
The combined effects of rising temperatures and more frequent tropical storms have raised concerns about runway integrity and operational safety. Recognising that aircraft and passenger safety is of utmost importance, Changi Airport Group (CAG) committed significant resources to strengthen pavement resilience against climate stressors. Working closely with academia, regulators, and industry experts, CAG advanced asphalt mix designs to withstand higher temperatures, heavier aircraft loads, and demanding gear configurations. Polymer additives and high-performance grade binders have been incorporated into Changi Airport's runways and taxiways, ensuring durable performance under extreme conditions and safeguarding uninterrupted operations.

To deepen resilience, CAG launched a dedicated research programme and invested in advanced technologies for early detection and predictive maintenance. Embedded temperature, stress, and strain sensors were installed in new pavement layers to monitor structural performance and validate design assumptions under live aircraft loads. Complementing this, CAG deployed a Laser Crack Measurement System (LCMS), which uses high-precision lasers to detect sub-millimetre anomalies invisible to the naked eye. Digital mapping of pavement surfaces supports predictive analytics and machine learning, enabling proactive interventions before minor defects escalate into potholes. Annual runway profiling further optimises ride comfort for diverse aircraft types.

The project delivered cost savings and tripled coverage during maintenance windows. Beyond cost, these innovations improve inspection precision, reduce unplanned repairs, minimise operational disruptions, and most importantly, ensure aircraft and passenger safety. Combined with temperature monitoring, these measures allow proactive adaptation—such as upgrading asphalt mix designs when thresholds are exceeded—ensuring Changi's runways remain resilient against rising temperatures and heavier traffic demands.

Following its success, the project is now in full implementation and offers a scalable model for other airports facing similar climate challenges. These technologies and practices have been embedded into CAG's long-term pavement management strategy and can be adapted globally to strengthen airfield resilience.

Project Graphics

Advanced technologies at Changi Airport enhance runway resilience through heat monitoring, grooved surfaces, and laser-based crack detection	Temperature sensors are embedded within the asphaltic pavement surface and installed above ground
 	
Collaborative effort between CAG, contractors, and technology partners in advanced runway monitoring for climate-resilient operations	Laser Crack Measurement System scans Changi Airport's runway at night to detect micro-cracks for predictive maintenance and enhanced safety
	

Zayed International Airport
North Runway (13L/31R) Rehabilitation and Airfield Stabilisation Programme

Abu Dhabi Airports has successfully completed the North Runway (13L/31R) Rehabilitation and Airfield Stabilisation Programme at Zayed International Airport, securing long-term safety, operational reliability, and climate resilience for one of the UAE's most strategically important aviation assets. The programme addressed lifecycle pavement performance, surface friction, subsurface stability, and increasing exposure to extreme weather conditions through a comprehensive, forward-looking engineering approach.

The initiative strengthened climate resilience by enhancing stormwater performance, improving airfield grading, reducing flood and ponding risk, and protecting runway integrity during increasingly intense rainfall events. In parallel, the rehabilitation incorporated heat-resilient pavement solutions to address prolonged exposure to high regional temperatures, supporting long-term performance under future climate conditions. These measures directly support safe operations, minimise environmental degradation, and reduce emissions and resource use associated with repeated emergency maintenance.

Innovation was a core feature of the programme. A data-driven methodology combined advanced pavement engineering, targeted geotechnical stabilisation, hydrological resilience planning, and climate-informed material selection. Polymer-modified bituminous surfacing was utilised to improve pavement durability, rutting resistance, and thermal performance under heavy aircraft loading and elevated temperatures, enabling a shift from reactive maintenance to proactive climate adaptation.

Strong corporate governance and leadership commitment guided the programme from planning to completion. Delivery was undertaken in close collaboration with regulatory authorities, airport operations, technical specialists, and contractors, ensuring alignment with ICAO and GCAA standards while maintaining airport functionality.

Beyond infrastructure reinforcement, the programme delivers lasting social and economic value by safeguarding continuous aviation connectivity, supporting national mobility and commerce, and strengthening Abu Dhabi's resilience to future climate uncertainties.

Project Graphics

Runway Overview & Project Area

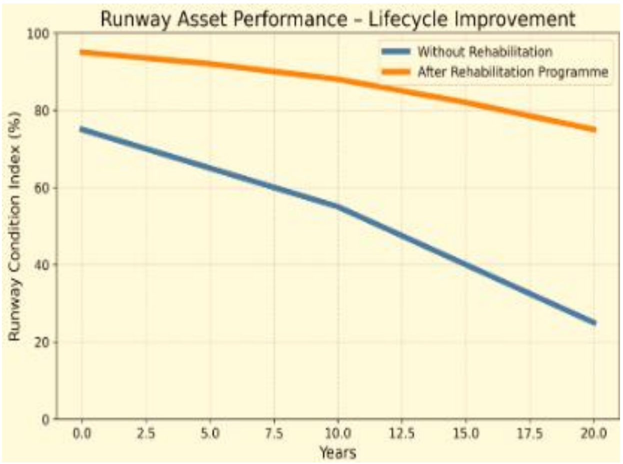
Figure 1-1: North Runway Rehabilitation Limit of Works

Existing Condition & Need for Intervention

gure 2-1. Images showing pavement surface distresses as reported by ADAC I

Figure 2-2. Runway pavement surface condition as reported by ADAC FM.

Expected Rehabilitation & Resilience Outcome



MULTIHAZARD-RISK MANAGEMENT

Incheon Airport

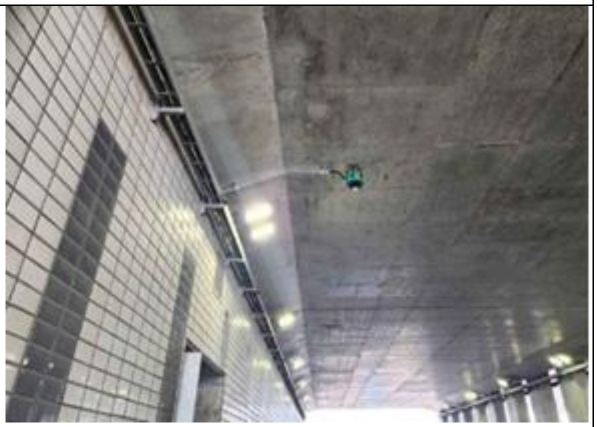
Incheon International Airport
First Climate Change Adaptation Measures (2023-2027)

The "First Climate Change Adaptation Measures (2023-2027)" project by Incheon International Airport Corporation (IIAC) aims to effectively respond to the risks posed by climate change and protect the airport's critical infrastructure. The main projects include the 154kV Triple Power Supply System, Landside Underpass Flood Monitoring System, and Runway 1 Repaving.

- **154kV Triple Power Supply System:** This system, the world's first at an airport and the first in Korea for a single facility, addresses the instability of the power supply caused by climate change and ensures stable power delivery even during extreme weather events. The system was constructed by adding Eulwang Substation and Substation C, both newly built, and interconnecting them, significantly enhancing the airport's power supply reliability. With these additions, the airport now has three external 154kV power lines and three internal substations.
- **Underpass Flood Monitoring System:** In response to the heavy rain flooding incidents in South Korea in 2020 and 2023, which resulted in flooding of the underpass, a real-time water level monitoring system was installed to prevent flooding damage. This system has successfully achieved zero damage despite record rainfall every year.
- **Runway 1 Repaving:** This project strengthens the runway's durability against extreme weather, such as heatwaves and heavy rainfall, ensuring continuous airport operations. With the increasing impact of climate change on runway degradation and flooding, this repaving project was a necessary measure for the airport's sustainable operation.

These projects enhance Incheon International Airport's ability to adapt to climate change, ensuring operational stability and sustainability.

Project Graphics

Geographical location and transmission line of the 154kV Substation	Landside (Aircraft MRO Complex) underpass flood monitoring sensor
	
Repaving the asphalt of the Runway 1 and taxiway	Eco-friendly outdoor garden in Incheon airportTerminal 2
	

King Khalid International Airport
Climate Resilience and Adaptation Program

Located in Riyadh, King Khalid International Airport (KKIA) operates in one of the region's most climate-challenged environments, with rising summer temperatures, frequent heatwaves, and increased climate variability. In response, KKIA implemented a single, integrated Climate Resilience and Adaptation Programme, consolidating infrastructure optimisation, energy efficiency, advanced cooling, and operational resilience under one unified framework.

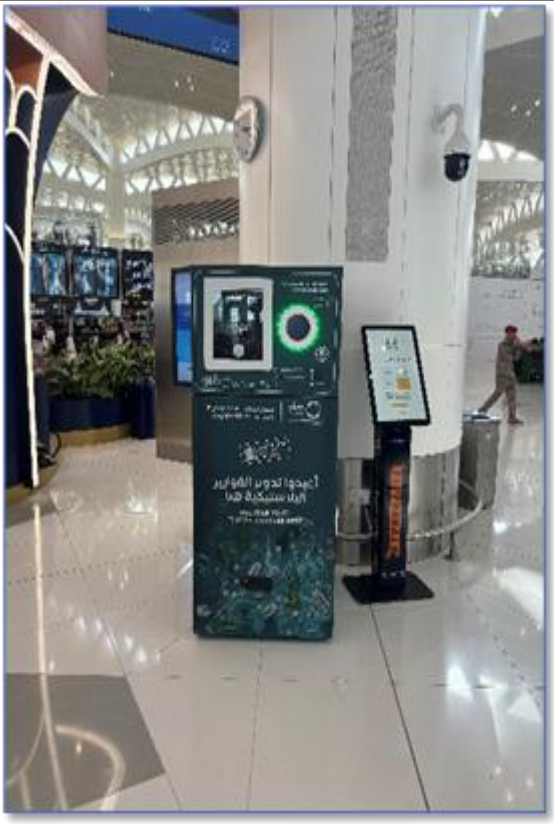
As part of this mega project, Terminals 1–4 were renovated with energy-efficient LED lighting, expanded natural lighting, upgraded HVAC systems, enhanced insulation, and a state-of-the-art Building Management System (BMS) that optimises energy use. Modern energy-efficient travelators, elevators, and escalators further reduce electricity consumption, while new water-refill stations minimize single-use plastics.

Sustainability initiatives include the deployment of recycling vending machines that collected over 150,000 plastic bottles and the recycling of 300 metric tons of materials, complemented by the mandatory use of eco-friendly cleaning agents to reduce harmful emissions. Native landscaping was expanded through an on-site nursery, increasing vegetative cover to mitigate heat-island effects, improve microclimate conditions, and reduce soil degradation. The wastewater treatment plant was upgraded to tertiary level, enabling the reuse of more than 19,000 m^3/day of treated water for irrigation, a practice not widely implemented worldwide.

On the airside, 17 electric apron buses reduced emissions, while maintenance KPIs, LED retrofits, HVAC optimization, and energy audits drove continuous improvements, resulting in an 8.5% reduction in Scope 2 emissions, from 142,369.96 tCO_2e in 2021 to 130,223.25 tCO_2e in 2022 (12,146.71 tCO_2e reduction).

Through this integrated program, KKIA strengthens climate resilience, lowers environmental impact, enhances passenger comfort, and future-proofs airport operations, showcasing a comprehensive, climate positive model for the region.

Project Graphics

Recycling Vending Machine (RVMs)	RAC Nursery & Plantation Activity
	 
Terminal 1	Waste Treatment
	

Rajiv Gandhi International Airport

Adapting for Tomorrow: GHIAL's Climate-Resilient Airport Strategy

GMR Hyderabad International Airport Limited (GHIAL) has consistently demonstrated its commitment to sustainable airport operations with climate resilience strategy and infrastructure development. Recognising the growing challenges posed by climate variability, GHIAL initiated a proactive approach to climate change adaptation at Rajiv Gandhi International Airport (RGIA). In 2013, it installed continuous meteorological parameters monitoring station on the airside, laying the foundation for data-driven climate change adaptation by integrating meteorological monitoring, vulnerability assessments, adaptive infrastructure planning and airport operations.

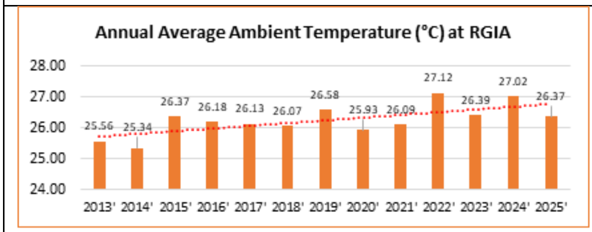
The airport's climate resilience strategy is anchored on three core pillars: continuous monitoring of meteorological data, conducting climate risk assessments, and implementing mitigation measures. Leveraging real-time weather analytics and predictive modelling, GHIAL anticipates and prepares for extreme conditions such as high temperatures, heavy rainfall, and storms. These insights have driven significant infrastructure upgrades, including advanced drainage systems, heat-resistant runway materials, and energy-efficient cooling solutions.

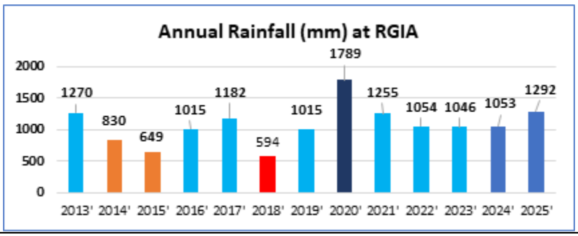
GHIAL has implemented a Climate Resilient Policy and established a core team to conduct area-wise assessments of climate hazards impacting infrastructure and operation in alignment with the Task Force on Climate-related Financial Disclosures (TCFD) framework. This initiative ensures systematic identification, assessment, and disclosure of climate-related risks and opportunities, integrating them into strategic decision-making and financial planning.

This project aligns with UNSDG 13: Climate Action and ICAO vision. It enhances operational reliability while mitigating climate change impacts. The Passenger Terminal Building has achieved USGBC LEED Platinum certification, and GHIAL successfully reduced Scope 1 and 2 emissions by 92% in 2024, achieving Net Zero (Scope 1 &2) well ahead of the target year of 2035 and achieving Level 5 Airport Carbon Accreditation. GHIAL targets for Net Zero Scope 3 by 2050. Through collaboration with airlines, regulatory authorities, and local communities, GHIAL ensures a holistic approach to climate change adaptation. This initiative sets a benchmark for climate resilience within the aviation sector.

Project Graphics

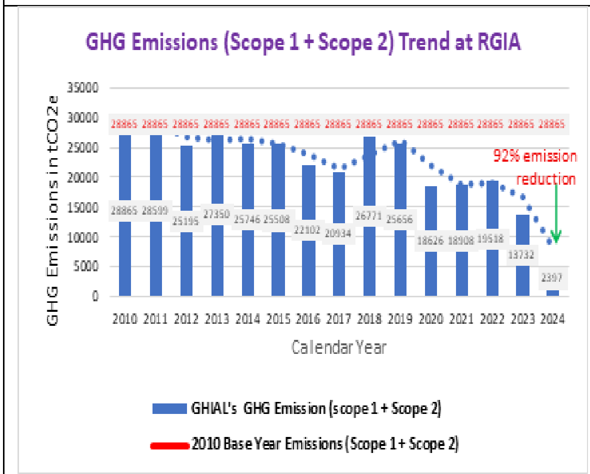
Meteorological Parameters Monitoring at RGIA





Rainwater Harvesting structure at RGIA as climate change adaptation initiative

Maintaining net zero carbon status: Reduction of Emissions



USGBC LEED Platinum certification to the Passenger Terminal Building, recognising it as a climate-resilient infrastructure.

Taoyuan International Airport
Resilient Airport: ISO 14090 Adaptation Governance Project

Taiwan Taoyuan International Airport (TTIA) achieved a historic milestone in September 2025 by becoming Taiwan’s first and only recipient of the ISO 14090 Compliance Certificate. This distinction makes TTIA the sole airport in Asia to obtain this international certification, underscoring its leadership in adaptation governance, risk assessment, responsiveness, and climate resilience, and positioning it as a global benchmark.

Since 2023, TTIA has proactively implemented climate adaptation strategies, becoming the world's first airport to integrate ISO 14090 into its existing ISO management systems. TTIA adopted methodologies from the IPCC AR5 and AR6 reports, ICAO and ACI guidelines, and long-term climate forecasting models, complemented by historical meteorological data from the past decade for the airport region. This comprehensive approach enabled TTIA to establish robust mechanisms for risk assessment, infrastructure resilience, resource allocation, stakeholder engagement, and senior management decision-making to address diverse climate-related challenges, including extreme heat, drought, heavy rainfall and flooding, typhoons and strong winds, sea-level rise, ecological impacts, and epidemic risks.

TTIA has defined and quantified short-, medium-, and long-term adaptation goals and action plans. These include ensuring aircraft performance and operational capacity, safeguarding the continuity of water, electricity, internet, and information systems, maintaining transportation capacity under various disruption scenarios, protecting passenger and staff health and safety, and monitoring ecological conditions.

In addition, TTIA is closely overseeing the development of Terminal 3 and 3rd Runway construction projects with investments exceeding US$5 billion, while incorporating advanced measures such as green energy systems, sustainable building practices, elevated flood control designs, smart life-support systems, and climate impact preparedness.

TTIA has established an inter-departmental adaptation task force for mandating annual reviews of the adaptation system and will continuously update adaptation measures. Annual audits will be conducted by impartial external auditing agencies to ensure the effectiveness of ISO 14090 and the adaptation efforts of TTIA.

Project Graphics

Simulation and Live Drill of Climate Change Adaptation Actions	Education and Advocacy on Climate Change Adaptation for Multiple Stakeholders
	
Major New Construction Projects: Terminal 3 and Runway 3	Obtaining the Nation's First Climate Change Adaptation Management Certificate
	

NATURE-BASED CLIMATE RESILIENCE

Adelaide Airport
Export Park Landscape

The Export Park Landscape Upgrade project at Adelaide Airport transformed one of our key commercial precincts. Completed in November 2025, the project renewed ageing public spaces, improved environmental performance and added modern amenities to elevate space and improve the daily experience of the airport precinct community.

The project focused on sustainable landscape architecture, stormwater management and the creation of an inviting, climate-resilient outdoor environment. Key works included reshaping the detention basin for improved flood resilience, establishing native and drought-tolerant plantings, expanding tree canopy coverage and installing reclaimed-water irrigation to reduce long term water demand. The use of heat-resistant, light-coloured pavements further reduced heat absorption, which supports urban cooling and outdoor comfort.

New shelters, seating, BBQ facilities, accessible paths and event-ready lighting were integrated to encourage social connection and a greater sense of community along with everyday usability. These improvements not only uplift Export Park as an A-grade commercial asset but also provide a resilient foundation for future precinct enhancements.

The project demonstrates how targeted, nature-based upgrades can deliver measurable environmental, social and economic benefits. It supports Adelaide Airport’s long-term sustainability commitments and precinct revitalisation goals.

Project Graphics

Natural stormwater management for flood resilience	Heat reflecting surfaces used to enhance climate resilience design of social use areas and BBQ
	
Drought tolerant landscape design and planting with recycled water (purple lids) to meet low irrigation needs. Maximum tree canopy retained and enhanced.	Strategic use of green space (lawn) for cooling affect where people gather (irrigated with recycled water)
	

Bahrain International Airport
Bahrain International Airport Bee Farm – Climate-Resilient Biodiversity Enhancement Project

Bahrain International Airport (BIA) has introduced the region's first airport-managed Bee Farm—an innovative nature-based solution that restores ecological value within an aviation environment while maintaining full operational safety. As only the second airport bee farm in Asia, the project sets a new benchmark for biodiversity integration across airport ecosystems.

Located in a secure, access-controlled landside area, the Bee Farm hosts ten beehives supported by a dedicated extraction facility and operated by a licensed local beekeeper. Instead of altering the landscape, the initiative strengthens biodiversity by utilising more than 300 existing Acacia, Sidr, and Ghaf trees, along with resilient wildflower species. Its proximity to the 200,000 m^2 nationally protected mangrove reserve at Dohat Arad further enhances pollinator foraging diversity.

Each hive contains roughly 10,000 bees, introducing an estimated 100,000 pollinators that increase pollination activity across BIA's landscaped areas by 5–10%. Early ecological assessments indicate that supported habitats span nearly 250,000 m^2 of mixed tree and shrub systems. The surrounding mangrove reserve and airport green cover sequester approximately 80–120 tonnes of CO_2 annually, with enhanced pollination helping strengthen biomass health and long-term ecological stability.

Beyond producing up to 100 kg of premium honey annually, the Bee Farm provides meaningful community and educational value. It serves as a platform for environmental workshops, youth programmes, school visits, and guided tours—promoting awareness of pollinator conservation and climate-resilient ecosystems while connecting aviation with environmental education.

The initiative aligns with Bahrain's National Biodiversity Strategy, the Kingdom's net-zero 2060 commitment, SDG 15, and BIA's sustainability goals. By transforming unused airport land into a productive ecological asset, BIA demonstrates a scalable model for airports worldwide—showing how aviation safety, biodiversity, and community engagement can advance together.

Project Graphics

Map showing Bahrain International Airport and the secure Bee Farm location within airport boundaries	The Bee Farm benefits from its proximity to Dohat Arad 200.000m2 mangrove reserve and native flora, enabling premium honey production and biodiversity enhancement
	
Dedicated Honey Extraction Facility: A refurbished cabin designed for hygienic honey processing, PPE storage , and visitors briefings in fenced secure location.	Pilot phase honey sample at Dohat Arad National mangrove reserve.
	

King Abdulaziz International Airport

Climate Resilient Afforestation at King Abdulaziz International Airport Using Terraxy CarboSoil Technology

Jeddah Airports Company (JEDCO) has implemented the Terraxy CarboSoil Initiative as a core climate adaptation project to enhance soil resilience, increase green coverage, and strengthen the airport's environmental sustainability in response to intensifying climate risks. As climate change continues to impact the Middle East—particularly through extreme heat, prolonged drought, and irregular rainfall—JEDCO adopted this nature-based solution to improve landscape sustainability and operational resilience across King Abdulaziz International Airport (KAIA).

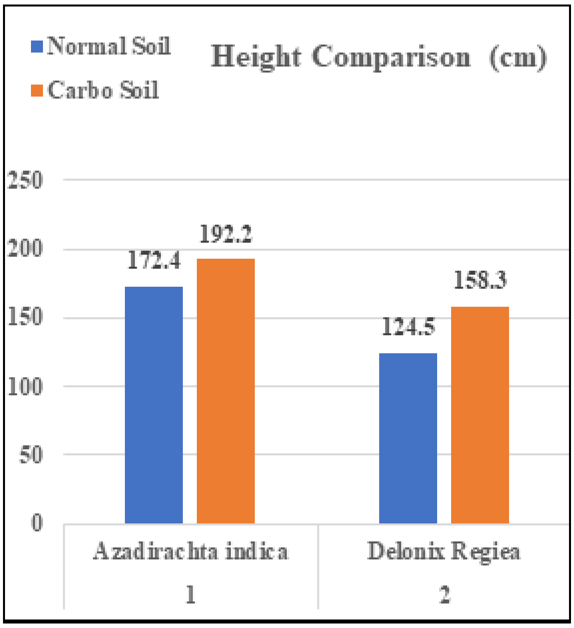
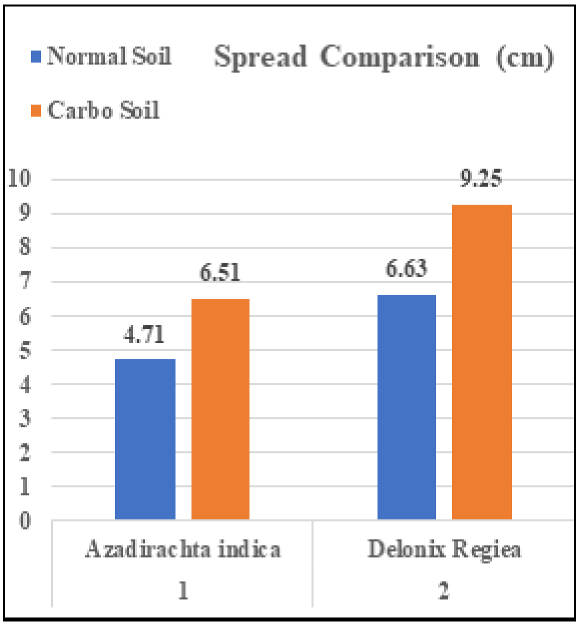
The CarboSoil material is a soil-enhancing, carbon-rich substrate designed to significantly increase water retention, improve soil structure, and support long-term vegetation growth even under harsh climatic conditions. Through this initiative, KAIA implemented CarboSoil in key landscaping zones to boost plant survival rates, reduce irrigation demand, and ensure the sustainability of green areas throughout the year.

The initiative contributes directly to climate resilience by helping the airport withstand higher temperatures, mitigate soil degradation, and reduce water consumption—critical challenges for airports in arid regions. It also advances KAIA's strategic commitments under the Saudi Green Initiative, Vision 2030, and the Airport Carbon Accreditation (ACA) program by expanding green infrastructure and reducing environmental stress on airport land.

Early results show a notable improvement in soil moisture levels and vegetation stability, enabling a more climate-resilient landscape with up to a 30–40% reduction in water usage for treated areas. The initiative supports operational continuity by reducing the impact of heatwaves and drought on airport surroundings while enhancing aesthetic and environmental quality for passengers and stakeholders.

Through the Terraxy CarboSoil Initiative, JEDCO demonstrates leadership in deploying innovative, sustainable, and climate-adaptive solutions, positioning KAIA as a regional model in airport climate resilience and green infrastructure development.

Project Graphics

<table>
<tr><td>Carbo Soil Trial on Site</td><td>Data Recording after 3 months</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Height Comparison after 3
months of Carbosoil Application</td><td>Canopy Spread comparison after 3 months
of Carbosoil Application</td></tr>
<tr><td>
</td><td>
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FIJI AIRPORTS

Nadi International Airport
Wailoaloa Mangrove Restoration Project

Nadi International Airport (NIA) is Fiji's primary international gateway and a critical asset for national connectivity, tourism, trade, and emergency response. The airport's coastal setting increases exposure to climate hazards, including sea level rise, cyclone-driven storm surge, wave action, coastal erosion, and extreme rainfall. In Fiji, coastal flooding is driven by compound processes combining sea level, tides, storm surge, and waves, increasing long-term risk to critical infrastructure.

Fiji Airports (FA) initiated the Wailoaloa Mangrove Restoration Project (WMRP) as a nature-based adaptation measure to strengthen the airport-adjacent coastal perimeter. The initial planting phase was implemented between June 2024 and June 2025, with 8,300 mangrove seedlings planted along vulnerable shoreline areas near the airport. The project is now in an ongoing monitoring and adaptive management phase informed by early performance results.

Mangroves were selected as a "living" coastal buffer that stabilises sediments and attenuates wave energy, helping reduce erosion and coastal inundation exposure at the airport boundary and complementing engineered controls such as drainage and protective works. Monitoring undertaken in December 2025 recorded an overall survival rate of approximately 75.4 percent (6,257 surviving seedlings), which is strong performance for a high-energy coastal environment. Monitoring also identified establishment pressures and improvement actions, including reinforcement planting and species-site matching.

The project demonstrates value for money through a scalable delivery model that combines Forestry-supplied seedlings (for example, at FJD 0.50 per seedling for the June 2025 planting activity) with significant in-kind contributions from airport staff, partners, and community volunteers. The WMRP supports Fiji Airports' sustainability strategy, Airport Carbon Accreditation objectives, national climate adaptation priorities, and the United Nations Sustainable Development Goals, while strengthening the long-term resilience of a major Pacific aviation hub.

Project Graphics

Satellite view of the Wailoaloa Mangrove Restoration Project site,	Fiji Airports staff, families, airline partners, government bodies, and civil society planting mangroves to protect critical airport infrastructure through naturebased solutions and restoring ecosystem for marine life once abundant but lost.
	
Fiji's national airline descends onto NAN Runway 09/27 as FA General Manager Finance plants mangroves ensuring that tomorrow's safe landing starts with each seedlings planted today.	Thriving mangrove saplings now stretch across the restored coastline shows evidence of successful regeneration and strengthened natural resilience through community-led action.
	

Sunshine Coast Airport

Sunshine Coast Airport
Future Proofing Biodiversity Regeneration

Sunshine Coast Airport (SCA) is in the heart of the Sunshine Coast region surrounded by the Wallum Heath, one of the most distinctive and ecologically significant ecosystems within the UNESCO-designated Sunshine Coast Biosphere. This rare landscape faces pressures from urban growth, transport infrastructure, and climate change, making stewardship and regeneration essential.

Aligned with the Airport's Master Plan to 2040 and its designation as a Priority Development Area, the Future Proofing Biodiversity Regeneration project reinforces a long-term commitment to environmental protection. Central to this plan is the creation of a 90-hectare Environmental Precinct: land safeguarded against current and future airport operations, forming a vital link that reconnects the National Park via a north–south Conservation Corridor.

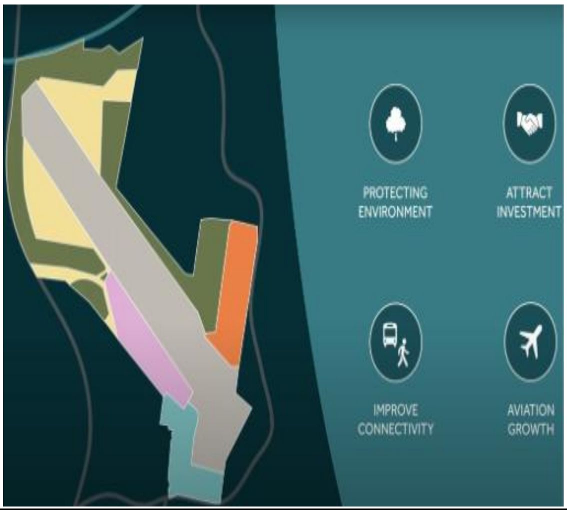
Wallum Heath ecosystems are characterised by nutrient-poor sandy soils, seasonal waterlogging, and a mosaic of heathlands, sedgelands, and wetlands. These conditions support numerous threatened species —whose survival depends on balanced hydrology and periodic low-intensity fire. Recognising this vulnerability, the airport's approach extends beyond sustainability toward full ecological regeneration.

Regeneration efforts have included targeted habitat restoration, water-sensitive design, and ecological corridors with community scenic amenity values that reconnect fragmented landscapes. Revegetation using local Wallum species rebuilds habitat structure and buffers remnant vegetation. Hydrological modelling guides drainage and wetland rehabilitation, ensuring natural water flows remain intact—critical for acid-frog breeding sites.

Controlled ecological burns are planned with Traditional Owners and scientists to reflect natural fire cycles, promote native plant renewal, and prevent overgrowth that could shift the heath's ecological character. These practices blend cultural knowledge with ecological science.

SCA collaborates with Council, airport tenants, Traditional Owners, conservation organisations, and researchers to support long-term monitoring and adaptive management. Together, these measures show how essential infrastructure and ecological integrity can successfully co-exist within a globally recognised biosphere.

Project Graphics

Planning Our Environmental Conservation Area	Planted over 10,000 native trees to improve canopy and wildlife habitat
	
Acid Frogs	Regenerative First Nations controlled fire burn
	

ENERGY & UTILITY RESILIENCE

Chubu Centrair International Airport
Sustainable Energy Supply and Resilience Enhancement for Offshore Airport

Chubu Centrair Airport has established an Energy Center, operated by Centrair Energy Supply Co., Ltd., providing district heating and cooling through natural gas cogeneration. This system generates about half of the electricity used in the passenger terminal building, and waste heat is utilised to supply chilled and hot water throughout the airport, including in-flight catering and cargo facilities.

Global warming has raised seawater temperatures around Japan, intensifying typhoons. Sea levels near the airport are rising by approximately 3.7 millimeters per year. As an offshore airport facing increasing risks of tsunamis and storm surges, we consider climate related risk countermeasures essential.

However, the conventional gas-turbine CGS had issues. It featured a heat-heavy electricity-to-heat ratio of 3:5, and during nighttime low-load periods, unused heat was released as waste steam, averaging 980 tons annually. Furthermore, the startup required both electricity and gas; losing either source made the system inoperable.

Addressing these risks and issues, we upgraded the CGS to a gas-engine type in 2023. Shifting the ratio to 5:3 eliminated waste steam. Additionally, by installing a small generator with Blackout Start (BOS) capability and switching power supply feeds, the CGS can supply electricity and essential air conditioning for people even if external power is lost due to typhoons.

The Energy Center previously had a 0.8-meter flood barrier to prevent seawater intrusion, but we determined this was insufficient given rising climate risks and the facility’s importance. Therefore, we raised the barrier to 1.2 meters and implemented additional flood and storm surge measures for the seawater plant used for the CGS and thermal systems.

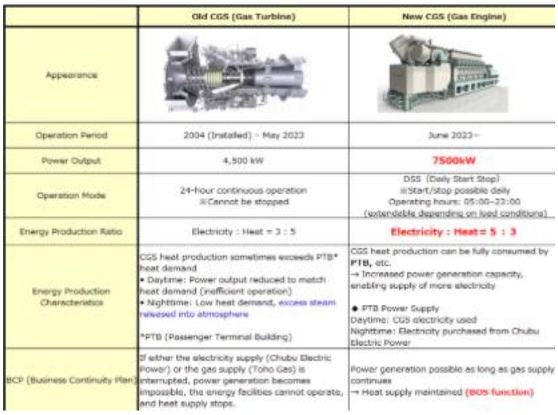
These measures ensure stable energy supply and safe operation even during climate-related disasters.

Project Graphics

Energy Center Supply Destinations

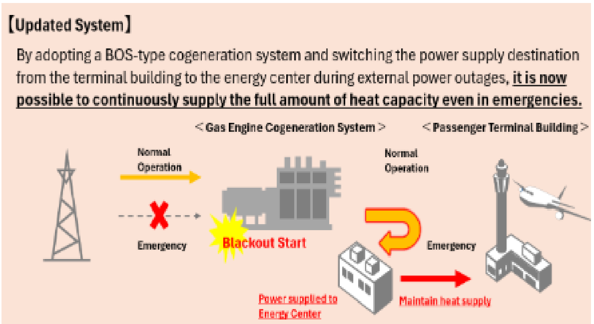
:

Improving Energy Balance (CGS Upgrade)



	Old CGS (Gas Turbine)	New CGS (Gas Engine)
Appearance		
Operation Period	2004 (Installed) – May 2023	June 2023–
Power Output	4,500 kW	7500kW
Operation Mode	24-hour continuous operation ※Cannot be stopped	DSS (Daily Start Stop) ※Start/stop possible daily Operating hours: 05:00–23:00 (extendable depending on load conditions)
Energy Production Ratio	Electricity : Heat = 3 : 5	Electricity : Heat = 5 : 3
Energy Production Characteristics	CGS heat production sometimes exceeds PTB* heat demand • Daytime: Power output reduced to match heat demand (inefficient operation) • Nighttime: Low heat demand, excess steam released into atmosphere *PTB (Passenger Terminal Building)	CGS heat production can be fully consumed by PTB, etc. → Increased power generation capacity, enabling supply of more electricity ● PTB Power Supply Daytime: CGS electricity used Nighttime: Electricity purchased from Chubu Electric Power
BCP (Business Continuity Plan)	If either the electricity supply (Chubu Electric Power) or the gas supply (Toho Gas) is interrupted, power generation becomes impossible, the energy facilities cannot operate, and heat supply stops.	Power generation possible as long as gas supply continues → Heat supply maintained (BOS function)

BCP Enhancement (BOS & Emergency Power)



Protecting Against Seawater Intrusion (Flood Barrier)

Hamad International Airport
Climate Resiliency

Hamad International Airport (HIA) has implemented a structured, phased approach to strengthen climate resilience and energy efficiency across its cooling infrastructure, addressing the growing risks posed by extreme temperatures and rising cooling demand.

The initiative began with the establishment of a robust sustainability and performance baseline through GSAS certifications and audits. Central Utility Plant (CUP) - 4 achieved GSAS Operations Gold, CUP 3 achieved GSAS Arcadia Platinum, and all four Central Utility Plants (CUPs 1–4) underwent Level 2 Energy Audits.

Building on this foundation, HIA implemented a CUP-wide optimisation programme in collaboration with Siemens. Previously, the four CUPs operated independently with fixed loads and limited controls, despite being physically connected through a ring network. The optimisation transformed the system into an integrated, intelligent network using demand flow optimisation logic. Variable speed drives were installed on all major equipment (excluding chillers), individual CUP control logic was introduced, and a central control system dynamically balanced loads across plants. Modulating walls and valves enabled CUPs to adapt based on real-time demand.

As a result, approximately 7,500 TR of latent cooling capacity was unlocked, overall CUP efficiency improved by 20–25%, and system-wide performance reached 0.82 kW/TR across all four CUPs. These gains significantly enhanced operational flexibility, energy intensity, and resilience during peak demand and extreme heat events.

Following optimisation, HIA is conducting a Climate Risk Assessment (CRA) to evaluate long-term climate exposure and validate cooling optimisation as a core adaptation measure. Together, these actions demonstrate a scalable, cost-effective, and climate adaptation pathway for airports operating in extreme climates.

In parallel, multiple airport assets, including the Central Orchard, aviation and cargo facilities, RTBF, North Node Lounge and Hotels, and the Al Mourjan Lounge interiors, achieved GSAS Design & Build and Interiors certifications. This phase embedded best practices in energy management, operations, and governance.

Project Graphics

Hamad International Airport Concourses A,B,C,D,E	Hamad International Airport GSAS Certified Orchard
	
Hamad International Airport Exterior	Hamad International Airport Interior
	

New Plymouth Airport
Te Matakupnega Solar Farm

Te Matakupenga is an airport-based solar generation project at New Plymouth Airport (NPL), delivered to strengthen energy resilience and support the safe, continuous operation of the airport as climate-driven disruption becomes more frequent. The project provides a long-term, locally generated energy solution that reduces exposure to electricity supply interruptions, network constraints, and price volatility.

New Plymouth Airport is increasingly exposed to variable and severe weather, including stronger storm events and periods of electricity network stress. Reliable electricity is critical to airport operations, supporting airfield lighting, navigation and communications systems, terminal operations, security screening, and overall business continuity. Te Matakupenga improves operational resilience by reducing reliance on a single external electricity supply and providing a predictable on-site energy source capable of supporting both aeronautical and terminal functions.

The project was developed, funded, and is wholly owned by Papa Rererangi i Puketapu Ltd, the airport company that owns and operates New Plymouth Airport. Funding was secured through the airport's balance sheet and aligned with long-term sustainability and resilience objectives. Retaining full ownership ensures the benefits flow directly to the airport and its stakeholders, delivering cost certainty, enhanced resilience, and the ability to reinvest energy savings into core infrastructure.

Delivered in partnership with electricity network providers and specialist contractors, Te Matakupenga was constructed entirely within the operational airport boundary under strict safety, security, and environmental controls. In addition to delivering significant decarbonisation benefits, the project represents a practical climate adaptation measure by improving energy reliability and affordability while reducing exposure to supply disruptions during extreme weather events.

Te Matakupenga demonstrates leadership by embedding climate risk into capital planning and asset management and provides a replicable model for regional airports seeking airport-owned solutions that deliver measurable environmental, operational, and community benefits.

Project Graphics

Aerial view of Te Matakupenga solar farm located within the New Plymouth Airport boundary	Commissioning and handover of the Te Matakupenga solar generation system supporting airport energy resilience
	
On airport solar generation integrated with airport operations to improve utility reliability and business continuity	Te Matakupenga with Taranaki Maunga in the background
	

HEAT / THERMAL RESILIENCE

Jaipur International Airport
Integrated Climate Adaptation Programme at Jaipur Airport

Operating in Rajasthan's semi-arid zone, Jaipur International Airport (JIAL) faces intensifying climate extremities. Our IPCC AR6- aligned Climate Risk Assessment, employing CMIP6 downscaled projections, projected critical vulnerabilities - terminal surface temperatures are exceeding 60°C with 6 - 8°C further escalation by 2030/2050. Concurrently, the frequency of heatwave events currently at 75 annually is projected to 117% - 167%. These extremities can place passenger safety and operational continuity at severe risk.

As a part of adaptation measures, JIAL operationalised a comprehensive "Cool-Terminal" ecosystem a pioneering adaptation strategy engineered to decouple internal comfort from external volatility through a Dual-Pillar Resilience Framework:

Thermal Resilience

1. Passive Envelope Hardening (The Thermal Shield):
   To neutralise the >60°C thermal load, we retrofitted Terminal 2 with high-performance Double-Glazed Units (DGU, U-value <1.7 W/m²K) and high-albedo insulated standing-seam roofs (R-value ≥5.5). This passive intervention achieved a verifiable 6–10°C reduction in surface temperatures, creating a robust barrier against the escalating climate.
1. Active Systems Optimisation (The Efficiency Engine):
   Complementing the passive shield, we deployed a precision cooling matrix comprising energy-efficient chillers, 202 high-efficiency AC units (ISEER 5.2), VFD modulation, and HVLS fans. Powered by a 1.8 MWp on-site solar plant (supplying 17% green electricity), this system dynamically optimises cooling based on real-time conditions.

Transformative Impact:

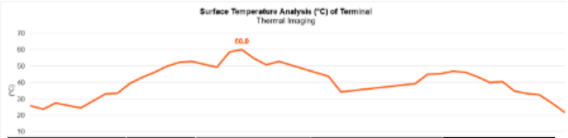
This integrated framework reduced HVAC electricity requirements 35% ensuring optimal thermal comfort despite the intensifying heat. The project delivered verifiable triple-bottom-line value:

- Electricity cost: INR 1.54 Crore in annual electricity cost savings
- Operational: INR 1.24 Crores saved by reducing productivity losses (employee+worker) due to heat stress, taking total operational savings to INR 2.78 Crore.
- Environmental: Reduction 1,262 tonnes of CO_2e annually.
- Resilience: Sustained 6–10°C drop in surface temperatures.

By proactively addressing the CMIP6-projected thermal escalation, JIAL established a scalable global benchmark for climate-resilient aviation infrastructure.

Project Graphics

Heat Stress Vulnerability Assessment across both terminals (Thermal Imaging Map of JIAL Terminals; Heat Stress data output table; HVAC load sensitivity data output table)



	Historical (1995-2014)	SSP1 - 2.6		SSP2-4.5		SSP5 - 8.5	
Indicator		2030	2050	2030	2050	2030	2050
Avg. Annual Max. Temperature (Ambient)	46°C	47.6°C	48.2 °C	47.3 °C	48.4 °C	47.8 °C	48.7 °C
Dangerous WBGT (High Risk No. of Days)	34	73	88	71	96	74	106
Days Exceeding 35°C	156	172	180	171	183	173	194
No. of projected maximum heat wave events	75	91	103	90	107	92	117

HVAC Load Sensitivity Analysis due to Heat Stress

	2030	2050
Avg. Annual Max. Temperature	47.6°C	48.7°C
Temperature exceedance from 35°C threshold	12.6°C	13.7°C
Coefficient of Performance (COP)% reduction	25.2%	27.4%
(%) Increase in Power consumption	17.6%	19.2%

Heat Stress Adaptation measures (Double-Glazed facades; High-Albedo Insulated Roof coatings and Smart monitoring system

Heat Stress Adaptation measures (ISEER 5.2 AC units; VFD modulation)

Heat Stress Adaptation measures (Captive Solar)

Sydney Airport
Urban Heat Island Study

The number of extreme heat days is increasing in Sydney each year. Nine out of ten of the hottest years in Australia have occurred since 2005, and 2023 was one of the hottest years on record. In December 2023 temperatures reached 43.5°C at Sydney Airport, 15°C above average and the highest temperature recorded at the location since records began in 1929.

Urban heat is a growing concern that can significantly impact airport operations globally. It refers to increased temperatures in urban areas compared to rural surroundings, primarily due to human activities.

Sydney Airport commissioned AECOM to deliver a pioneering Urban Heat Island (UHI) study to assess the impact of extreme heat on airport operations, infrastructure, and people.

Using Landsat thermal imagery, the study mapped current and future land surface temperatures (2050 and 2090) across key land uses, including aeronautical pavements, buildings, landscaping, and transport areas.

Findings revealed that Sydney Airport is affected by UHI in several ways:

- Increased demand for power during periods of extreme heat, which could lead to more frequent power failures, resulting in increased generator use and operational costs
- Health risks for outdoor workers, such as fatigue and heat stress from extreme heat
- Reduced comfort in terminals and commercial areas impacting passenger experience

Adaptation actions were identified, including collaborating with airport partners, reviewing operational procedures, design and planning documentation, and developing ongoing plans for measuring and monitoring heat. Insights were incorporated into Sydney Airport's Built Environment Sustainability Standards and preliminary draft Masterplan 2045. Despite impacts, a literature review identified little evidence of other airports (globally and within Australia) conducting detailed urban heat investigations to date. As one of the first UHI studies globally for airports, this initiative sets a benchmark for resilience and sustainability in aviation infrastructure.

Project Graphics

Concrete pavements at Sydney Airport recorded the highest temperatures	Buildings at Sydney Airport recorded some of the highest temperatures
	

Airports Council International

Asia-Pacific & Middle East

Unit 606A, Tower 1, K11 ATELIER 11 SKIES,
6 Sky City Road East, Hong Kong International Airport,
Chek Lap Kok, Lantau Island, Hong Kong

About Airports Council International Asia-Pacific & Middle East (ACI APAC & MID)
ACI APAC & MID is the voice of airports in the region, representing over 600 airport members across Asia-Pacific and the Middle East. Headquartered in Hong Kong, with a regional office in Riyadh, Saudi Arabia, ACI APAC & MID advocates for the collective interests of airports and promotes professional excellence in airport management and operations.

About Asia-Pacific & Middle East Aviation Market
Asia-Pacific and the Middle East are among the world's most dynamic aviation markets, home to nine of the fastest-growing markets globally. According to the latest Economic Impact Assessment, air transport supports 46 million jobs and contributes $1.18 trillion to regional GDP in Asia-Pacific and Middle East. With passenger traffic expected to expand, the aviation sector's direct contribution to GDP is projected to grow annually by 5.1% in Asia-Pacific and 4.5% in the Middle East over the next two decades.

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