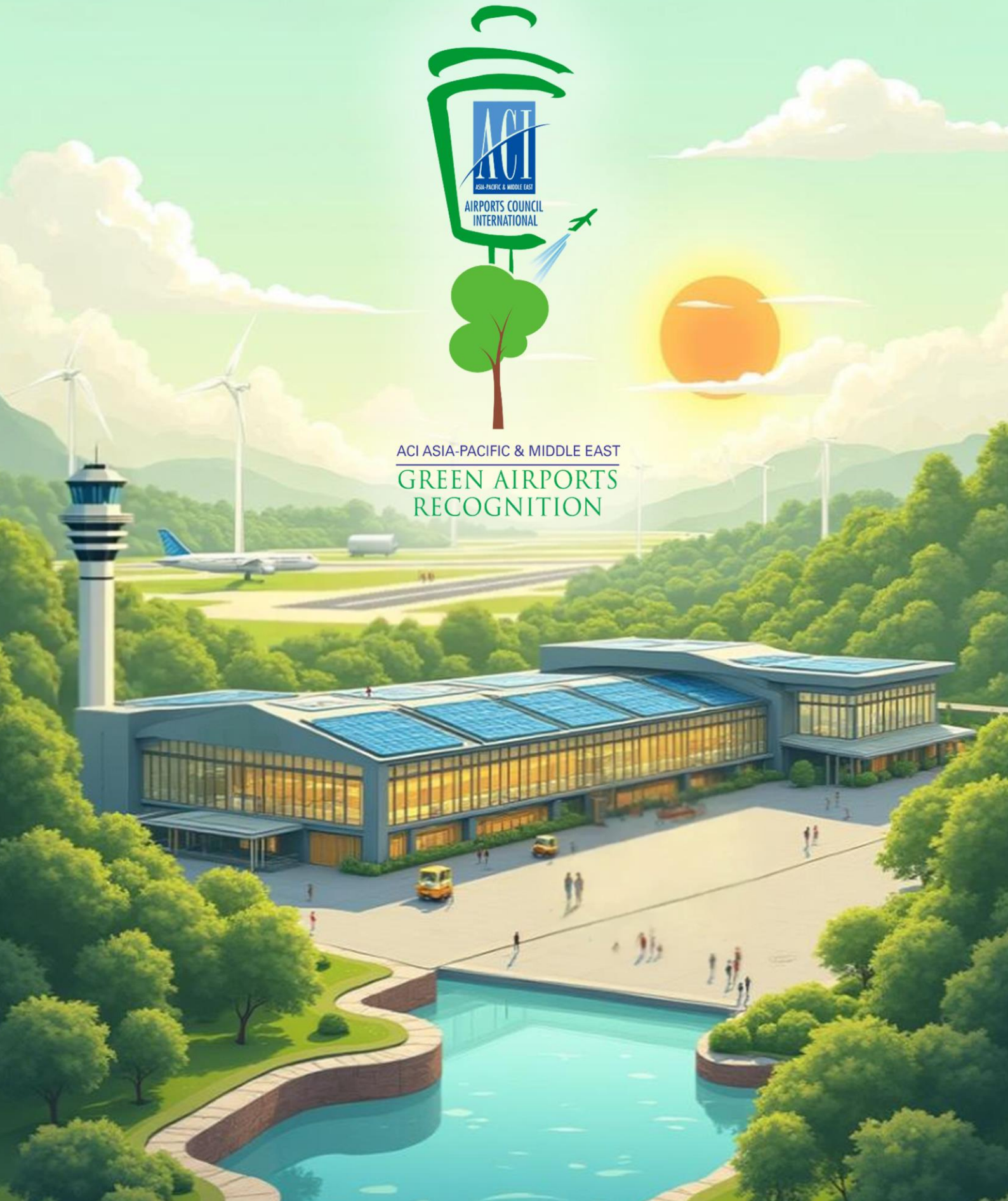
GREEN AIRPORTS RECOGNITION 2025

Sustainable Energy at Airports



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INTRODUCTION AND ACKNOWLEDGEMENTS

The Green Airports Recognition (GAR), established by ACI Asia-Pacific & Middle East (APAC & MID) with support from the ACI APAC & MID Regional Environment Committee, aims to promote environmental best practices, recognise airports with outstanding environmental accomplishments, and minimise aviation's impact on the environment.

The Intergovernmental Panel on Climate Change and the International Energy Agency report that aviation contributes 2-3% of global carbon emissions, and as air traffic grows, aviation's share is expected to rise, especially as other industries decarbonise further.

Airports are leading the aviation industry's global efforts to lower carbon emissions, driving the shift to sustainable energy through initiatives such as renewable energy adoption and operational optimization. To meet the Paris Agreement's goal of limiting global warming to 1.5°C, all sectors will need to reach net zero by 2050. In June 2021, ACI in collaboration with its members, set the "Net Zero By 2050" decarbonisation goal and urged governments to support this effort. In 2022, ICAO adopted a long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050 in support of the UNFCCC Paris Agreement's temperature goal.

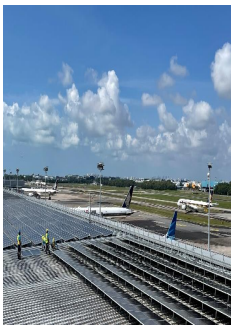
With a significant share of Scope 3 emissions (Part of the emissions that airports cannot control but influence), airports are in a unique position to facilitate this huge effort of climate change mitigation. By collaborating with airlines and ground handling service providers, airports can promote innovative solutions to reduce Scope 3 emissions. Additionally, airports can implement initiatives to reduce aviation's carbon footprint and work toward net zero by adopting renewable energy (e.g., solar, hydrogen, geothermal), implementing eco-friendly operational solutions, facilitating Sustainable Aviation Fuel (SAF) use, and enhancing energy efficiency. By adopting innovative strategies, airports will need to transition to sustainable energy.

According to the ACI APAC & MID Environmental Survey 2023[1], over 70% of responding airports ranked energy management as a top three priority[2], with more than 90% setting energy reduction targets. Also, more than 40% of respondents (58 airports) adopted renewable energy sources (e.g., onsite solar, power purchase agreements), and energy-efficient lighting is widely implemented at most responding airports (125, 95%). Additionally, regional hub airports are showing high interest in sustainable energy sources like Sustainable Aviation Fuel (20%) and Hydrogen (14%). Some leading airports have already switched to on-site solar energy, covering 5-30% of their total energy consumption.

[1] The Survey received responses from 132 airports in 27 countries/regions from August to November 2023.
[2] Top three priorities are Environmental Policy & Management (80%), Carbon Emissions (71%), Energy (70%)

The **GAR 2025** received a record-breaking submission from 39 airports, showcasing successful case studies and initiatives in sustainable energy management at airports. This year's submissions include creative and innovative projects, such as Solar Power Generation, Solar Power Purchase Agreements (PPA) Procurement, Sustainable Ground Operations, Sustainable Aviation Fuel (SAF) initiatives, Net Zero Strategies, Green & Zero-Energy Buildings, and Energy Optimization Initiatives.

Four outstanding projects were highlighted by the judges, including those at **Singapore Changi Airport, Kansai Airport, Christchurch International Airport,** and **Hubballi Airport**. These airports have undertaken innovative environmental initiatives to promote solar energy generation and sustainable aviation fuel, collectively contributing to carbon emission reductions and advancing decarbonisation efforts.



Singapore Changi Airport (SIN): Platinum | Over 38 million passengers per annum (mppa)

With a combined generation capacity of 38 MWp and Singapore's largest single-site rooftop installation, this system powers over 10,000 residential flats annually and reduces 19,000 tonnes of carbon emissions, accounting for approximately 10% of Scope 1 and 2 emissions. The project supports Changi Airport Group's (CAG) goal of a 20% emissions reduction by 2030 and its Net Zero 2050 target, driving further solar innovations.

Kansai Airport (KIX): Platinum | 15 - 38mppa

Since June 2022, Kansai Airport has expanded its Sustainable Aviation Fuel (SAF) initiative by increasing Used Cooking Oil (UCO) collection to 34 airport tenants (68%), collecting 20,000 liters in 2023. The airport aims to reach 80% by 2030. Additionally, three school lunch facilities now contribute to the programme, with plans to collaborate with Osaka and surrounding municipalities on household UCO collection, boosting SAF awareness and decarbonisation efforts.

Christchurch International Airport (CHC): Platinum | 6 - 15mppa

CHC's Kōwhai Park will feature a 168 MWp solar array, covering 400 hectares, with 300,000 solar panels, expected to power 36,000 homes annually. Construction began in 2024, with completion expected in 2026. The project, a partnership with Contact Energy and Lightsource bp, aims to decarbonise both aviation and energy sectors.

Hubballi Airport (HBX): Platinum | Less than 6mppa

Hubballi's 8 MW solar plant spans 118,250 square meters with 22,857 modules. It generated 22.84 million units of electricity, preventing 16,356 tonnes of CO_2 emissions. The ₹31.47 crore ($3.6 million USD) project powers 100% of Hubballi, Belagavi, and Mysuru airports, saving ₹3 crore ($3.44 million USD) annually, and generating ₹1 crore ($1.14 million USD) from surplus energy sales.


ACI Asia-Pacific & Middle East
Green Airports Recognition 2025
platinum
gold
silver
Over 38 million passengers per annum
Singapore Changi Airport
Hong Kong Int. Airport
Sydney Airport
Between 15-38 million passengers per annum
Kansai International Airport
Melbourne Airport
Kempegowda int. Airport
Between 6-15 million passengers per annum
Christchurch Int. Airport
Chubu Centrair int. Airport
Cochin International Airport
Less than 6 million passengers per annum
Hubballi Airport
Wellington International Airport
Darwin International Airport
ACI ASIA-PACIFIC & MIDDLE EAST
GREEN AIRPORTS
RECOGNITION
We would like to thank the panel of judges for their expertise and valuable time, notably:
Mr. Christopher Paling, Senior Lecturer in Environmental Management, Manchester Metropolitan University
Mr. Christopher Surgenor, Editor/Publisher, GreenAir Online
Ms. Jennifer Desharnais, Director, Sustainability and Environmental Protection, ACI World
Dr. Panagiotis Karamanos, Aviation Environmental Consultant
Mr. Stefano Baronci, Director General, ACI Asia-Pacific & Middle East

ACKNOWLEDGEMENT OF PARTICIPATING AIRPORTS

All 39 airports that submitted their projects deserve to be recognised for their commitment to ***Sustainable Energy at Airports*** and willingness to share their stories with the airport community, fully reflecting the objective of this recognition.

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

مطار البحرين الدولي
Bahrain International Airport

Bahrain International Airport
BIA Sustainable Energy

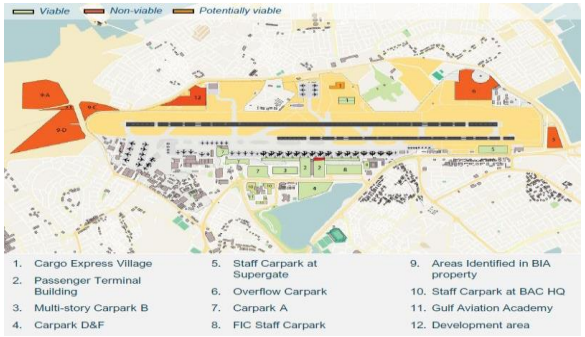
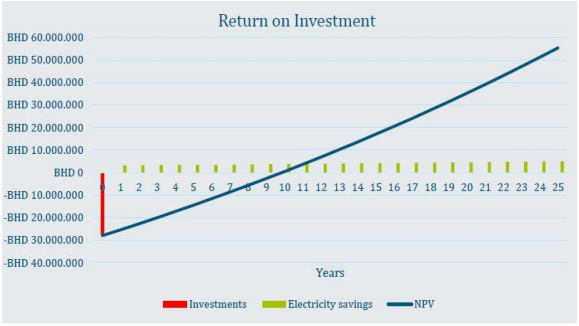
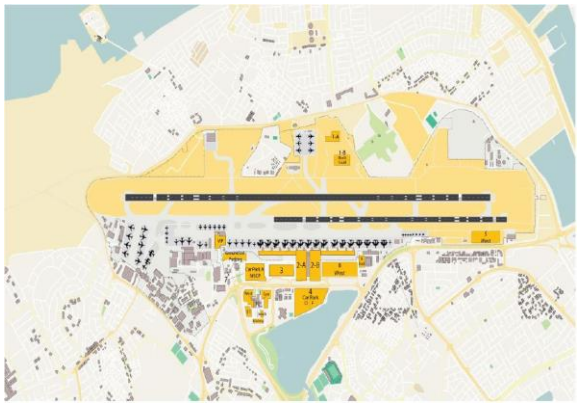
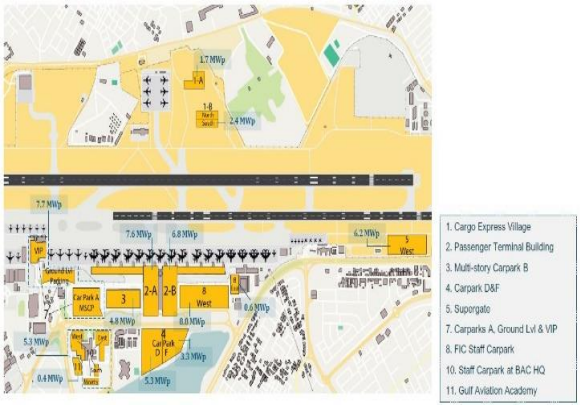
Bahrain International Airport (BIA) has embarked on a transformative journey towards renewable energy adoption, demonstrating its commitment to sustainability and operational excellence. As part of its decarbonisation strategy, BIA has identified renewable energy as a cornerstone to achieving energy independence, reducing costs, and minimizing its carbon footprint. This initiative complements the airport's broader goals of optimizing resources while aligning with global efforts to combat climate change.

Led by NACO consultants, a comprehensive feasibility study identified twelve potential sites for solar panel installations across the airport. These include passenger and employee parking facilities, terminal and cargo rooftops, and offsite areas under the approach path of Runway 12L. The Solar Impact Study ensured that all locations met stringent regulatory, environmental, and aeronautical safety standards. Following this, the Solar Yield Study determined the energy production potential of each site, culminating in the installation of a 61 MWp solar capacity across 19 sublocations.

The project is expected to generate 104,400 MWh annually, reducing BIA's reliance on grid electricity by 86% and significantly contributing to its net-zero targets. Advanced tools such as the FAA-approved ForgeSolar "Solar Glare Hazard Analysis Tool" were used to eliminate risks of glare on aeronautical operations, ensuring compliance and safety.

By integrating cutting-edge solar technologies, BIA not only reduces operational costs but also establishes itself as a leader in sustainable airport operations. This initiative underscores BIA's commitment to innovation, environmental stewardship, and long-term energy resilience, setting a benchmark for establishments within the kingdom of Bahrain and airports across the Asia-Pacific and Middle East regions.

Project Graphics

Caption 1: Energy yield by location	Caption 2: Return on investment chart showcasing cost savings over a 25-year lifecycle.
	
Caption 3: The 19 (sub)-locations that are investigated in this study	Caption 4: Installed PV capacity across the airport with corresponding energy outputs.
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

BROOME INTERNATIONAL AIRPORT

Broome International Airport
Renewable Energy and Metering Upgrade

In 2024, BIA installed 660kW of solar PV across three sites at the airport. This project included a 400kW system installed at our terminal public carpark, mounted on a structure over parking bays, providing 100 covered parking bays.

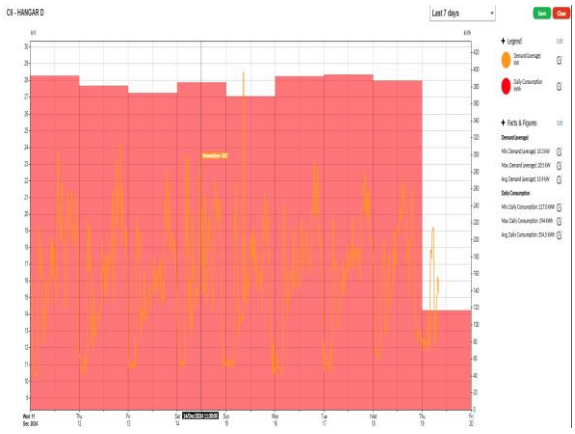
These installations are a crucial part of BIA's journey to becoming carbon neutral under the ACA program. The systems will supply more than half of BIA's electricity requirements and reduce our current carbon footprint by 50%.

In 2024, BIA also undertook a significant upgrade of its internal electrical metering infrastructure by installing 48 new smart electrical data logging devices across the network. This upgrade, essential for an airport with extensive grounds and multiple tenants, offers several key benefits:

1. **Accurate Billing:** Smart meters provide precise readings, ensuring tenants are billed accurately for their actual energy usage.
2. **Operational Efficiency**: Reduces the need for manual meter checks, saving time and labour costs.
3. **Enhanced Monitoring:** This system allows tenants to log in to their meters and monitor their energy consumption in real-time. By doing so, they can manage their usage more effectively and potentially lower their bills. Additionally, by optimising their energy use, tenants can contribute to reducing carbon emissions.
4. **Promote Energy-Efficient Habits:** Engage tenants by educating them on energy-efficient practices and how their habits impact overall energy consumption. This engagement will help facilitate a reduction in Scope 3 emissions at BIA.
5. **Environmental Benefits**: Reduced energy consumption contributes to lower carbon emissions, benefiting the environment

These upgrades reduce carbon emissions and promote energy efficiency by providing real-time usage data, supporting renewable energy, optimizing grid management, and encouraging sustainable habits, aligning with BIA's carbon-neutral goals under the ACA programme.

Project Graphics

Caption 1: Covered parking at the terminal	Caption 2: Covered parking bays and passengers
	
Caption 3: 400kW solar system	Caption 4: Graph depicting the electrical usage pattern of a high energy consumption tenant. The data reveals insights into their peak usage times, behaviour patterns, and overall usage trends.
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Christchurch International Airport

Kowhai Park – reaching FID

Kōwhai Park - A new concept in renewable energy

Christchurch Airport's Kōwhai Park is a platform for guiding CIAL's energy transition through the onsite deployment of renewable energy generation, transmission and distribution upgrades, storage, and creation of scaled clean energy capacity for our campus, and future aviation fuels.

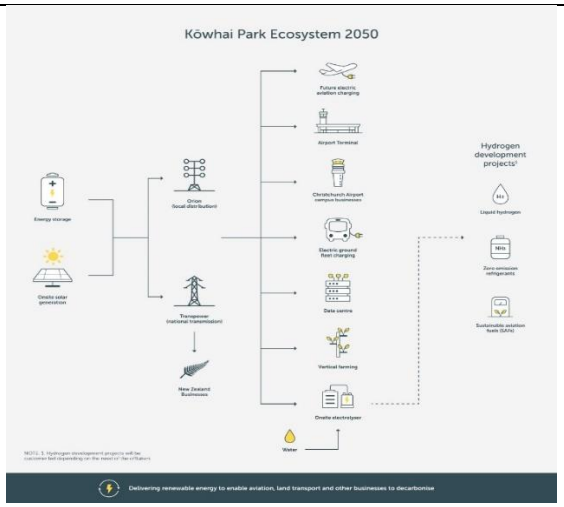
Phase One will see Contact Energy and Lightsource bp deliver a 168MWp solar array – larger than any other currently in New Zealand. 400 hectares of land have been set aside for clean energy use just beside the runways. In creating Kōwhai Park, Christchurch Airport is building opportunity for businesses and organisations looking for an ideal site for any renewable generation project or a future supply of green energy.

In April 2022, Contact and Lightsource bp entered an exclusive partnership to co-develop grid-scale solar farms. In August 2024, Contact Energy and Lightsource bp confirmed their final investment decision (FID) to build the Kōwhai Park solar farm, with construction commencing in 2024, and final completion in early 2026.

With around 300,000 solar panels, Kōwhai Park's solar farm will be among the largest in New Zealand. It is expected to generate 168MWp, which at an annual level is equivalent to the needs of around 36,000 New Zealand homes and will provide energy resilience for the people of Christchurch. Additionally, the solar farm will have the same carbon benefit as planting around 1.25 million native trees and shrubs.

A new airport-owned substation will provide expanded access to electricity, from solar in the day and the public grid overnight, to a variety of airport users. This helps prepare Christchurch for low-emissions aviation, and support the decarbonisation of land transport and other energy-intensive activities based on our 1400-hectare campus.

Project Graphics

Caption 1: Kowhai Park solar farm render	Caption 2: Kowhai Park renewable energy ecosystem
	
Caption 3: Christchurch International Airport	Caption 4: Sod turning for phase one solar farm
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Cochin International Airport
12MWp Solar Power Plant, Payyannur

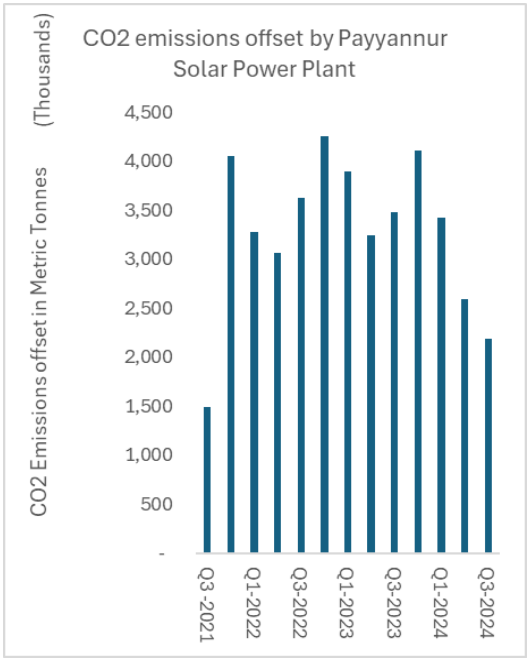
Cochin International Airport Limited (CIAL) is committed to the reduction of carbon footprint in the aviation sector by meeting its energy requirements from its own solar power plants. CIAL achieved the status of "World's first fully solar-powered airport" in 2015, when we had a solar capacity of 13.1 MWp. Today, CIAL has a total solar capacity of 50 MWp and continues its prestigious position as the "fully solar-powered airport".

To meet the future energy demands, CIAL decided to have an off-site solar power plant and bought a hilly terrain of 35 acres at Payyannur, 300 kms away from the airport. The land here is characterized by laterite soil and is unsuitable for agriculture. But this land is ideal for solar plant installation. The 12MWp solar plant was installed on the hilly terrains of Payyannur, with least disturbance to the terrain by meticulously aligning approximately 35,000 solar panels parallel to the sloping terrain, thereby ensuring maximum utilisation of land. Here solar panels are placed in all directions – South, North, East and West, instead of following the traditional South faced orientation for a country lying above equator. There is only marginal variation in power generation between different panel orientations. The Payyannur solar plant was commissioned in March 2022.

Since its commissioning, this solar power plant has generated 47.22 million units of green energy. This initiative not only supports CIAL's energy needs but also underscores CIAL's unwavering commitment to environmental stewardship. In addition to solar power, we have also developed an artificial pond at the lowest point in that land, wherein rainwater gets collected. This water is utilized for cleaning the panels and watering the landscaping within the solar plant.

CIAL's achievements in renewable energy, including the Payyannur solar plant, serve as a benchmark for sustainability in the aviation sector.

Project Graphics

Caption 1: Solar Plant in hilly terrain – day view	Caption 2: Solar Plant in hilly terrain –sunset view
	
Caption 3: Artificial pond at solar plant site	**Caption 4: CO2 emissions offset chart**
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

Hubballi Airport

8 MW Solar Power Plant at Hubballi Airport

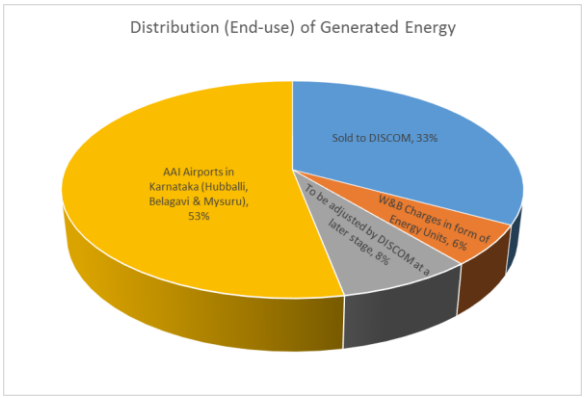
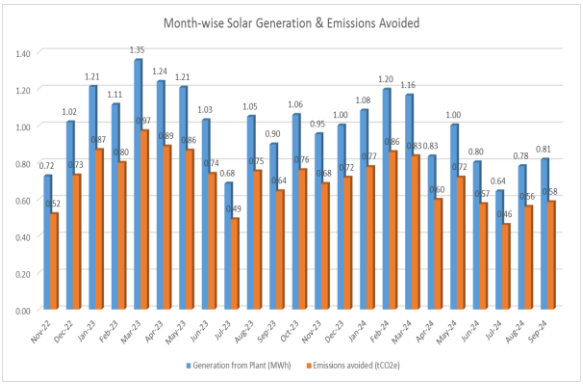
Airports Authority of India (AAI) proudly presents its pioneering 8 MW solar power plant at Hubballi Airport, Karnataka—a transformative step toward achieving carbon neutrality and energy self-sufficiency. Completed in December 2022, this state-of-the-art facility is the first in India where a solar power plant installed within one airport's premises supplies clean energy to multiple airports across a state.

Spanning 118,250 square meters, the plant features 22,857 photovoltaic solar modules, SCADA monitoring systems, and 8 inverters of 1.25 MW each. With a capacity utilization factor (CUF) of 19%, the plant generated 22.84 million units of electricity from November 2022 to September 2024, avoiding 16,356 tonnes of CO_2 emissions. This effort has transitioned AAI airports in Karnataka – Hubballi, Belagavi, and Mysuru – to 100% renewable energy, demonstrating a scalable model for regional energy self-sufficiency.

The plant's integration with the Karnataka Power Transmission Corporation Limited (KPTCL) grid ensures seamless energy distribution. Approximately 53% of the generated energy powers AAI's airports in the state of Karnataka, while the balance of power after deduction of wheeling & banking and other charges is sold to the local DISCOM (Distribution Company), generating revenue. This innovative approach optimizes energy utilization and significantly offsets Scope-2 emissions. Efforts are on to feed the only remaining AAI Airport in the state of Karnataka i.e. Kalaburagi Airport from this solar plant. In addition, the upcoming terminals at Hubballi & Belagavi Airports (which will be operationalized by 2026) are also planned to be fed through this solar plant.

With a total project cost of ₹31.47 crore, this initiative highlights AAI's commitment to sustainable energy and operational efficiency. By reducing dependency on fossil fuels, the Hubballi solar plant exemplifies how airports can lead climate action and support India's net-zero goals.

Project Graphics

Caption 1: Satellite view of 8 MW Solar Plant at Hubballi Airport	Caption 2: View of Ground-mounted Solar Panels
	
Caption 3: Distribution (End-use) of Generated Solar Energy	**Caption 4: Month-wise Solar Generation & Emissions Avoided (Nov' 2022 to Sep' 2024)**
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Kempegowda International Airport
Sustainable Energy for a Greener Perpetuity

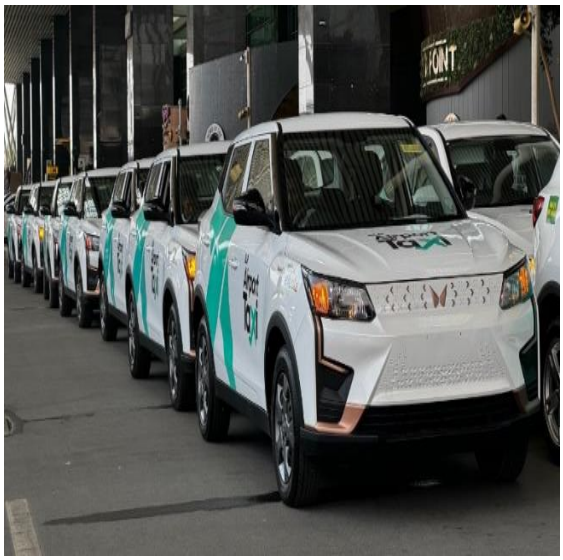
Bangalore International Airport Limited (BIAL) is the operator of Kempegowda International Airport located in Bengaluru. **Our Sustainability Vision:** Touch lives by nurturing a sustainable future through initiatives that drive economic, social, and environmental transformation.

BIAL outlines a triple bottom line through multiple interventions. It is guided by the mission, vision, and values as a part of Sustainability 2030. BIAL leadership and commitment outlined 6 key strategic pillars: water stewardship, Net Zero carbon emissions, community-aligned noise management, circular economy, sustainable procurement, and sustainable mobility, and three core foundational values (Corporate Social Responsibility (CSR), Behavioural Change, Compliance) driving multiple initiatives across the organization and community. Our strategic framework directly contributes to 11 of the United Nations' Sustainable Development Goals (UNSDGs) and indirectly contributes to six UNSDGs.

BIAL strives to create a meaningful impact not just for our customers and partners but also for the community and environment in which we operate. Considering our expansion plans, we have implemented a 100% renewable electricity consumption project and also undertaken proactive expansion through a group captive model, ensuring energy resilience and Net Zero emissions (scope 1& 2). Highest elimination of 95.6% from the base line by an Indian airport. The sustainable energy for a greener future project covers equipping onsite renewable energy generation, offsite renewable power procurement (PPA) and a group captive model to sustain our 100% renewable electricity, consumption till 2030 requirements. These initiatives help us towards substantial cost savings, further bolstering our commitment to sustainability, collaborative stakeholder engagement, and responsible growth. Currently BIAL generates around 160+ million kWh accomplishing 100 percent renewable electricity, and has the capacity of up to 220 million kWh for future.

"Our purpose is to create a better world for people transforming towards green and responsible communities, collaborating and driving change towards a healthier planet."

Project Graphics

Caption 1: Solar	Caption 2: Wind
	
Caption 3: Solar	**Caption 4: Renewable electricity Mobility**
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

MANOHAR INTERNATIONAL AIRPORT, GOA

Manohar International Airport

Sustainable Airports Operations based on Onsite Renewable Energy at GOX

Manohar International Airport (GOX) is operated and managed by GMR Goa International Airport Limited (GGIAL). GOX Airport is a greenfield international airport, and scheduled commercial flight operations started on 5 January 2023.

Sustainability is the core value at GOX. Sustainable practices were embedded at the design and construction at project stage itself. GOX has received a Platinum Certificate for Green Building from the Indian Green Building Council (IGBC)

The need for Solar PV generation became more pronounced to tackle climate change, fossil fuel dependence, and energy security. Technological advancements, alongside falling costs, further accelerated the adoption of solar in the recent times.

At the inception of the Airport, Renewable Energy of 5 MWp Solar PV generation unit was installed and commissioned at the Airside of the Airport. Plant is spread across an area of about 10.6 acres land. There are a total 9184 High efficiency Mono Crystalline Modules of capacity 545 Wp each.

Solar PV plant can generate an annual power of 7.0 MU at PLF of 16%. However, for Calendar Year 2023, 7.5 MU were generated at PLF of 17%.

Solar PV power generation at Manohar International Airport by GMR Goa International Airport Limited has saved 10056 tCO2e going into the atmosphere, contributed on average 30% to the total electricity consumed, and saved INR 50.77 million till date.

Solar PV generation offered a way to meet the evolving energy demands while addressing environmental and economic goals.

Project Graphics

Caption 1: Solar PV Panels	Caption 2: Name Plate Capacity
	
Caption 3: Transformer	Caption 4: HT/LT Panels
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Melbourne Airport

Melbourne Airport Integrated Decarbonisation Program

Melbourne Airport undertook a comprehensive program of sustainable energy initiatives to decarbonise its operations in line with its ESG and Carbon Management Strategies. Between 2021 and 2024, Melbourne Airport developed and executed an integrated set of energy solutions involving key stakeholders such as airport staff, tenants, contractors, and suppliers. The comprehensive precinct-wide approach was essential for effective emissions reduction, integrating solar power installations, renewable energy procurement, and the offer of the GreenPower electricity plan to tenants.

The project scope covered the entire airport precinct, engaging with stakeholders at all levels. Key initiatives included the establishment of a 12 MW solar farm at Oaklands Junction—the largest installation of its kind at any airport in Australia—funded through internal investments. In July 2023, Melbourne Airport signed a Power Purchase Agreement (PPA) securing renewable energy supply from Stockyard Hill, a large-scale wind farm, with a fixed rate for Large-Scale Generation Certificates. The Airport also joined the GreenPower Program, leveraging its accredited renewable energy capacity and PPA to offer competitively priced GreenPower electricity plans to tenants.

The results of the program have been significant. From the emissions perspective, Melbourne Airport reduced its Scope 2 GHG emissions by 78% in FY24 as compared to FY23. From the innovation perspective, Melbourne Airport is the first Australian airport to offer a GreenPower Accredited Product under the GreenPower Program, underscoring the organisation's vision and leadership in sustainability. From the stakeholder engagement perspective, the continued growth in tenant participation - up to 149 tenants using GreenPower by Q3 CY24 from 10 tenants a year earlier—demonstrates the program's effectiveness and the airport's commitment to sustainable operations. The comprehensive approach has not only significantly cut emissions but also fostered a sustainable ecosystem, positioning Melbourne Airport as a leader in sustainability within the Australian aviation sector.

Project Graphics

Caption 1: Melbourne Airport Solar Farm at Oaklands Junction (photo from Melbourne Airport's GreenPower Network | Melbourne Airport)	Caption 2: Melbourne Airport Solar Farm at Oaklands Junction (photo from the Melbourne Airport Final Master Plan 2022.pdf)
	
Caption 3: Melbourne Airport GreenPower Network visual (photo from Melbourne Airport's GreenPower Network | Melbourne Airport)	Caption 4: Stockyard Hill Wind Farm where Melbourne Airport procures energy under the PPA (photo from Stockyard Hill Wind Farm)
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

مطار الشارقة
Sharjah Airport

Sharjah Airport

Solar lighting in car parking and service road

In line with Sharjah Airport carbon management plan and by inspiring from the UAE clean energy strategy 2050 and its target to introduce 44% clean energy to the total energy mix, Sharjah Airport Management decided to introduce clean energy sources at the Airport. The "Solar lighting in car parking and service road" Project was implemented near the cargo terminal 4 as two projects PNP 840 and PNP 776.

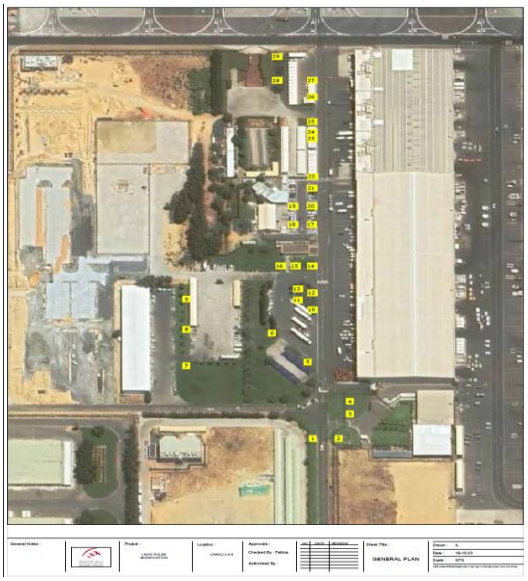
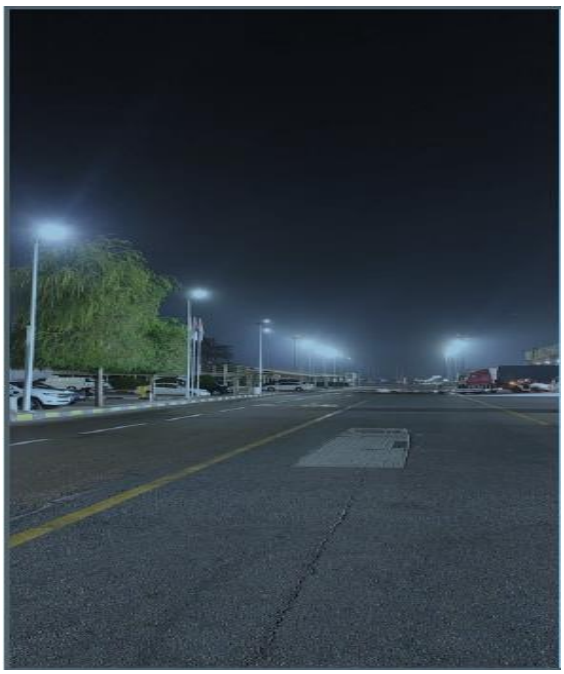
The project includes the installation of Solar lighting system at shaded car parking slots and a service road near the car parking. By introducing solar lighting in this area, Sharjah Airport manages to avoid a marginal amount of energy consumption from conventional sources and replace it with clean energy sources. PNP 776, a project at shaded carparking is in front of cargo terminal 4 and the service road is adjacent, executed with a total project value of AED: 969128.76.

This car park, planned and built to provide permanent parking facility to the cars belongs to Sharjah airport and its stakeholders staff working in cargo terminal. The PNP 840, planned to replace the old light poles near the parking and service road with a total project cost of AED: 574101.9.

The energy consumption was high for the old conventional lighting system, and the management decided to replace it with energy-efficient lighting with a high luminesce level connected to solar panels. 12 light poles with a capacity of 100 watts in the parking area and 39 lights with a 20 watts capacity in the sheds are part of Project Number 840 parking area lighting.

The service road light pole project includes a total of 29 light poles with a capacity of 80 watts. All lights are energy-efficient LED lights with a high luminance level, which ensure maximum lighting in the area with minimum energy consumption.

Project Graphics

Caption 1: Location Plan for service road light poles	Caption 2: Solar Panel for cargo shed
	
Caption 3: Solar Lighting in service road	Caption 4: Solar Lighting in car parking shed
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Singapore Changi Airport

Singapore's largest single-site rooftop solar at Changi Airport

Solar is the most viable form of renewable energy in resource-constrained Singapore. Changi Airport Group (CAG) has been actively addressing the airport's energy demands at its core, including upgrading airport systems with best-in-class energy-efficient models and supporting the airport community in transitioning towards cleaner energy vehicles. Against a backdrop of limited access to renewables, maximising onsite solar potential plays a critical role in CAG's decarbonisation strategy.

Since early 2024, CAG has embarked on a major project to expand solar deployment across its terminal and cargo buildings. With a combined generation capacity of approximately 38 MWp, the installation is Singapore's largest single-site rooftop solar project. Annually, the system is expected to generate sufficient energy to power over 10,000 residential flats* in Singapore and reduce 19,000 tonnes of carbon emissions, equivalent to around 10% of CAG's Scope 1 & 2 emissions. This is a critical lever towards meeting CAG's 2030 target of 20% Scope 1 & 2 emissions reduction, as well as the longer-term Net Zero 2050 target.

Part of this installation also enabled a newly refurbished air logistics facility (Changi Nexus One) to be Changi's first positive energy building, achieving the highest accolade under Singapore's Building and Construction Authority – Green Mark Platinum Positive Energy Building certification.

The success of this solar project paved the way for further innovation. Together with the Civil Aviation Authority of Singapore, CAG is examining the technical and commercial feasibility of installing solar systems beyond the newly-installed areas. The new solar installation will enable CAG to apply new insights to the future solar generation potential of new developmental sites within the airport land, such as the upcoming Terminal 5, enabling our engineers to optimise both the design, placement, and materials used for future solar installations.

*Refers to a 4-room flat constructed by Singapore's Housing Development Board.

Project Graphics

Caption 1: Installation process of rooftop solar panels at Changi Airport's terminal building	Caption 2: Completed rooftop solar installation with Jewel Changi Airport in the background
	
Caption 3: Changi Nexus One – the first building in Changi Airport to achieve Singapore's Green Mark Platinum Positive Energy Building certification	
	

SOLAR POWER GENERATION AND POWER PURCHASE AGREEMENTS (PPA) PROCUREMENT

Suvarnabhumi International Airport

The solar power generation system on the rooftops of Suvarnabhumi Airport's Main Terminal Building

Airports of Thailand (AOT) has taken a significant step towards sustainability with the installation of a 4.408-megawatt solar power generation system on the rooftops of Suvarnabhumi Airport's Main Terminal Building. Completed and commissioned in August 2023, this initiative aligns with AOT's vision of "Moving toward International Leading Eco-Airport."

The project, jointly implemented with the District Cooling System and Power Plant Company Limited (DCAP), generates 5.78 million kWh of electricity annually, reducing greenhouse gas emissions by 2,891.62 tCO_2eq. The system also enhances energy efficiency by reducing heat transfer into the terminal. The 8,816 solar panels, covering 35,000 square meters, act as an additional roofing layer, minimizing air conditioning energy consumption by 4.12 million RTH annually and cutting emissions by an additional 2,309.79 tCO_2eq.

This innovative project not only contributes to clean energy production but also considers aviation safety. A comprehensive Glare Analysis was conducted by the National Science and Technology Development Agency (NSTDA) to ensure no adverse impact on airport operations or personnel.

By replacing a portion of electricity traditionally sourced from natural gas, the project underscores AOT's commitment to reducing pollution and enhancing resource efficiency. It exemplifies how modern airports can integrate renewable energy solutions to achieve environmental responsibility while maintaining operational excellence. This achievement marks a major milestone in driving Suvarnabhumi Airport toward a sustainable future.

Project Graphics

Caption 1: Solar Rooftop at Suvarnabhumi Airport's Main Terminal	Caption 2: Solar Rooftop at Suvarnabhumi Airport's Main Terminal
	
Caption 3: Solar Rooftop at Suvarnabhumi Airport's Main Terminal	**Caption 4: Solar Rooftop at Suvarnabhumi Airport's Main Terminal**
	

SUSTAINABLE GROUND OPERATIONS & ALTERNATIVE FUELS INFRASTRUCTURE

Brisbane Airport
Electric Airside Vehicles

Brisbane Airport Corporation (BAC) has taken a pioneering step in sustainability by introducing electric vehicles (EVs) into its airside safety fleet, replacing Internal Combustion Engine vehicles. This initiative includes two Ford F-150 Lightnings, Kia EV9, Ford E-Transit and BYD Atto 3, chosen for their fit-for-purpose outcomes, reduced operational costs, and improved driver ergonomics.

The project aimed to electrify a significant portion of BAC's airside vehicles, focusing on zero tailpipe emissions, operational value, reduced total cost of ownership, functionality, and driver comfort. The detailed review of available EV options ensured the best fit for airside operations. The vehicles were fully modified for tool and safety device storage, with hundreds of collaboration hours invested to meet the unique needs of the airside operations team and the challenging airside environment.

This initiative aligns with BAC's sustainability and innovation goals, aiming to reduce emissions, improve energy efficiency, foster technological advancement, enhance regulatory compliance, and cut long-term operational costs. The transition is expected to reduce scope one emissions and fleet maintenance costs, with the fleet requiring only routine maintenance and safety inspections. The EVs are also expected to provide a longer service period and require less frequent renewal, offering cost savings and speeding up the transition.

Reduction in vibration and noise from EVs addresses issues faced by operators in internal combustion engine vehicles, reducing driver fatigue and allowing operators to focus on airside safety. The seamless introduction of these vehicles is crucial as they serve as the 24/7 office for the airside operations team.

BAC aims to achieve a fully zero tailpipe emissions airside fleet within three years. The airport's fleet manager's efforts have been recognized by peers, with other airports seeking advice on their sustainability journey. Additionally, from January 2025, 100% of BAC's energy will come from renewable sources, further supporting the EV fleet.

Project Graphics

Caption 1: Kia EV9 Electric Airside Vehicle	Caption 2: BYD Atto 3, Kia EV9, Ford F150 Lightning Airside
	
Caption 3: BYD Atto 3, Kia EV9, Ford F150 Lightning Airside	Caption 4: Fleet and Mechanical Manager with Electric Airside Fleet
	

SUSTAINABLE GROUND OPERATIONS & ALTERNATIVE FUELS INFRASTRUCTURE

Hong Kong International Airport
Renewable Diesel Adoption at HKIA

Airport Authority (AAHK), in collaboration with Hong Kong Air Cargo Terminals Limited (Hactl) and Shell Hong Kong Limited, launched a Renewable Diesel (RD) pilot at Hong Kong International Airport (HKIA) in April 2024. This innovation marked HKIA as the first airport in Asia to use RD in Ground Services Equipment (GSE) and is a key initiative under the HKIA Decarbonisation Roadmap, developed to support the 2050 HKIA Net Zero Carbon Pledge and 2035 midpoint target.

RD, also known as Hydrotreated Vegetable Oil, is a "second-generation biofuel" produced entirely from renewable resources such as waste animal fat and used cooking oil. This cleaner and more efficient burning fuel can reduce up to 95% of GHG emissions compared with conventional fossil diesel. It is a drop-in fuel that does not require modification to existing fleets, or changes to fuel distribution infrastructure. By adopting RD as a transition fuel, AAHK and its airport business partners (BPs) can immediately decarbonize “hard-to-electrify” equipment until electric/new energy vehicle options become available and economical, contributing to the 2035 midpoint target.

Since the commencement of the pilot, seven additional BPs have initiated their own RD pilots this year, demonstrating the scalability of the initiative. Types of GSE that have adopted 100% RD include apron sweepers, rubber removal machines, tractors, forklifts, plane fuelling trucks, emergency/mobile generators, with more to come. AAHK supports BPs by subsidising RD trials through the $20Million HKIA Greenovation Fund, covering 80% of the green premium for the fuel.

The adoption of RD at HKIA represents a significant milestone for AAHK, which has purposefully adopted an ambitious airport-wide approach to accelerate decarbonisation efforts with airport business partners over the years. The project successfully demonstrates the effectiveness of collaboration between supportive partners under the HKIA 2050 Net Zero Carbon Pledge to pilot and collectively scale up low-carbon initiatives.

Project Graphics

Caption 1: The first HKIA Renewable Diesel Pilot was launched in April 2024 with the support of AAHK, Hactl and Shell senior management.	Caption 2: HKIA is the first airport in Asia to use renewable diesel in ground service equipment and extend its implementation to other airport business partners.
	
Caption 3: AAHK senior management has actively promoted this programme in Hong Kong via symposium and seminars, such as ReThink HK 2024 and The ESG Corsortium.	Caption 4: AAHK has pledged to achieve Net Zero Carbon at HKIA by 2050 and to support pledged business partners in reducing their emissions through technology pilots, such as the HKIA Renewable Diesel Pilot.
	

SUSTAINABLE GROUND OPERATIONS & ALTERNATIVE FUELS INFRASTRUCTURE

Mangaluru International Airport
Conversion of fossil fuel-based vehicle to Ev (Electrical vehicle)

Mangaluru International Airport Limited (MIAL) signed a concession agreement with the Airports Authority of India (AAI) to operate, maintain, manage, and develop Mangaluru International Airport (MIA), commencing operations on October 31, 2020.

As an environmentally responsible organization, MIAL established an environmental management system and promoted sustainability. MIA aims to achieve "Net Zero by 2029."

Under its sustainable energy project, MIA has launched the "Conversion of Fossil Fuel-Based Vehicles to Electric Vehicles (EV)" initiative. This project aims to reduce the use of diesel, petrol, and CNG for airport operations, employee, and stakeholder commutes. MIAL has already converted 66% of its internal combustion engine (ICE) fleet to EVs, with plans to convert the remaining fleet as technology becomes available from original equipment manufacturers (OEMs). This transition has significantly reduced diesel, petrol, and CNG consumption under Scope 1 emissions.

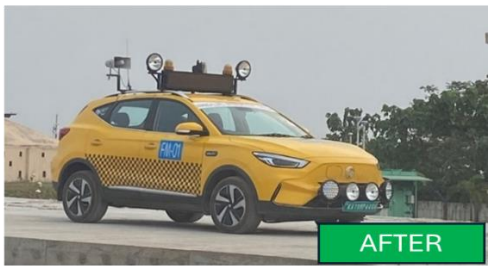
MIA is promoting the use of EV taxi services for passengers instead of fossil fuel-based vehicles (prepaid taxi services) and has installed an EV charging station in the car parking area. Additionally, MIA has collaborated with stakeholders to encourage the use of EVs for their commutes and operations. MIA has provided 6 EVs to customs, immigration, and CISF officials & installed an EV charging station at the airside for ground handlers and stakeholder vehicles.

The following actions have been implemented:

- Identified vehicles related to the airport operator and stakeholders and provided EVs for all operational activities.
- Introduced an EV bus for airport employee commutes.
- Installed two EV charging stations: one in the airport parking area for public use and another at the airside for operations.

MIAL has initiated a project under Scope 2 emissions, introducing renewable energy (RE) – specifically solar energy – for MIA operations and all stakeholders' energy requirements, with the goal of achieving 100% RE usage by 2026.

Project Graphics

Caption 1: ICE based vehicle to EV Vehicles	Caption 2: Employee commute
 	 
Caption 3: Introduced the EV taxi Services	**Caption 4: EV Charging stations at airside/**
 	 

SUSTAINABLE GROUND OPERATIONS & ALTERNATIVE FUELS INFRASTRUCTURE

Wellington International Airport
Hydrogen Fuel Cell Trial

This project was a collaboration between Wellington Airport, Air New Zealand, Hiringa Energy, and Toyota New Zealand and is the first time hydrogen has been used at a New Zealand airport.

The trial setup consisted of hydrogen storage tanks feeding a hydrogen fuel cell, which in turn supplied electricity to a charger for electric ground service equipment (including tugs and service vehicles).

This work provided insights into potential challenges of wider use cases, including as a viable green alternative for standby power generation in airport operations.

Planning for the trial commenced in mid-2023 and the trial ran from 29 February to 15 March 2024. In this time, 30.5kg of hydrogen was used to deliver 508kwh of power across 34 individual charges.

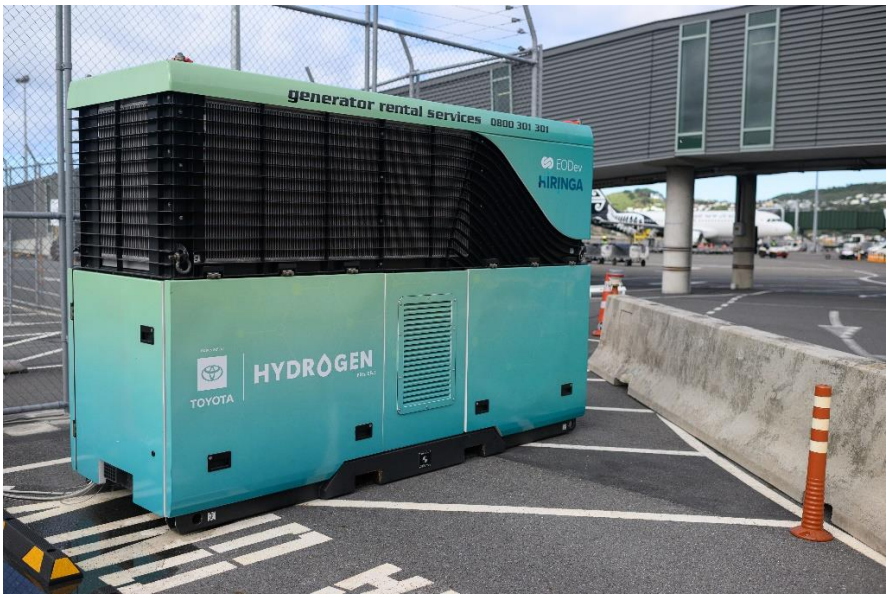
From an end user perspective, operation of the fuel cell was extremely straight forward and highlighted some of the key benefits of hydrogen as an alternative energy source with green emissions (water and steam) and negligible operating noise.

Through the trial, there were no issues with the electrical supply from the fuel cell, and all GSE charges were able to be successfully completed as they would via mains-powered charging.

This project presented challenges in where hydrogen could be sourced, safely stored, and accessed, with standards for implementation in the aviation environment not yet developed. It also required new operational and emergency response procedures to be developed.

Overall, it provided valuable insights into the implementation of hydrogen in an aviation setting, which will help the long-term decarbonisation of aviation.

Project Graphics

Caption 1: The Hydrogen Cell Generator in position airside at WLG airport.

Caption 2: The Hydrogen Cell Generator in position airside at WLG airport.


SUSTAINABLE AVIATION FUEL (SAF) INITIATIVE

Chubu Centrair International Airport

Engagement with local municipalities to encourage the collection of waste cooking oil for use as SAF

In the surrounding area of Chubu Centrair International Airport (NGO), much of the waste cooking oil discharged from households is either absorbed by paper or solidified using waste oil treatment agents, and then discarded as regular combustible waste.

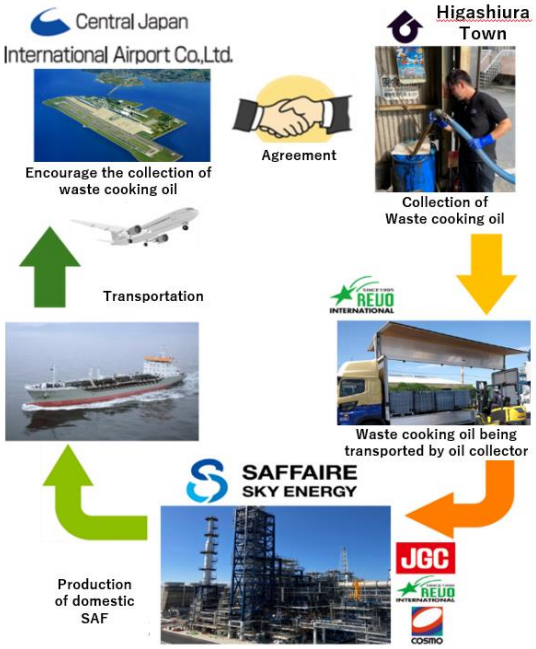
NGO actively engaged with local municipalities to encourage the collection of waste cooking oil for use as SAF (from waste cooking oil to SAF flying over NGO). After being approached by NGO, Higashiura Town in Aichi Prefecture (with a population of 50,132 as of the end of September 2024), located about 20 kilometres from NGO, agreed with this initiative, and signed an agreement with NGO to promote the collection of waste cooking oil as a raw material for SAF In April 2024.

Waste cooking oil collected in Higashiura Town is being transported every 2 months by Revo International Co., Ltd. to the manufacturing plant of domestic SAF in Osaka operated by SAFFAIRE SKY ENERGY (jointly established by JGC Holdings Corporation, Revo International Co., Ltd., and Cosmo Oil Co., Ltd.). The public-private collaboration of this project between the airport company, local municipalities, and SAF producers to establish a domestic SAF supply chain is the first initiative in Japan, and it is drawing attention as a model case for the whole country.

Besides, this initiative provides an opportunity for local residents to directly contribute to decarbonization and resource recycling, which aim to drive changes in the awareness and behaviour of the entire community.

As a result, there was a significant change in the residents' behaviour, with the first collection and transportation at the end of May recording 682 liters from a total of 11 locations in Higashiura Town. The collections are still ongoing bi-monthly, and the amount collected has significantly increased, with a 40% increase compared to the same period last year.

Project Graphics

Caption 1: New supply chain leading to domestic SAF production	Caption 2: The agreement ceremony attracted a lot of media attention.
	 
Caption 3: Waste cooking oil being collected in the community	Caption 4: SAF environmental education classes at elementary schools
	 

SUSTAINABLE AVIATION FUEL (SAF) INITIATIVE

Indira Gandhi International Airport

Transforming Airport for Sustainable Aviation Fuel (SAF) usage - An initiative for Delhi Airport Readiness

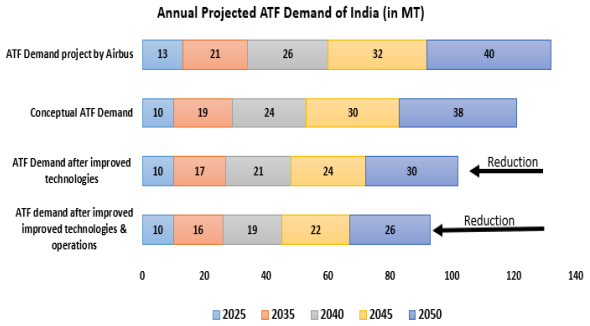
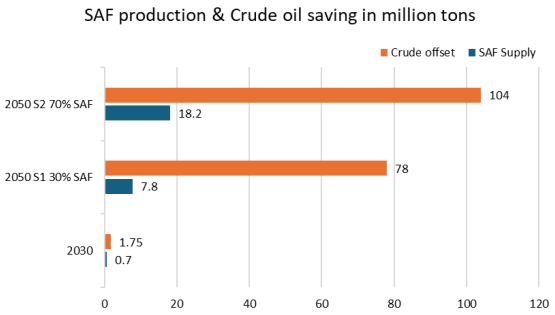
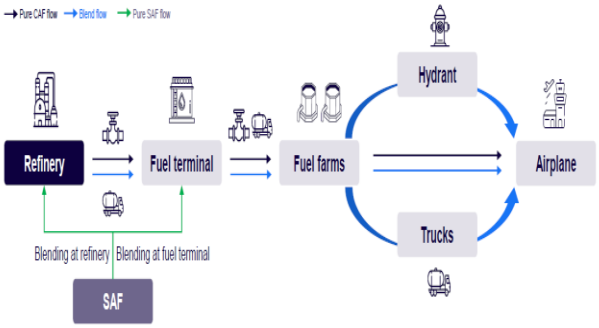
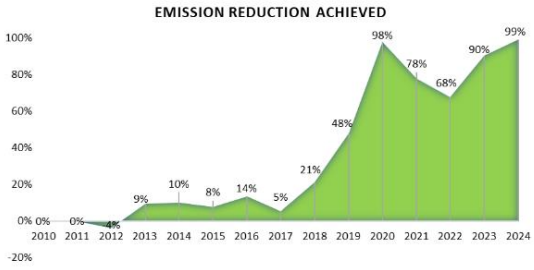
DIAL is the leading sustainable aviation hub in the Asia Pacific region and has achieved Level 5 of the ACI Airport Carbon Accreditation Programme. DIAL has implemented various sustainable energy initiatives for emission reduction, such as the usage of 100% renewable electricity, 100% electric cars, and has also adopted energy efficiency & conservation measures. Recognizing the importance of addressing scope 3 emissions, particularly resulting from Aviation Turbine Fuel (ATF), DIAL in collaboration with various knowledge partners, initiated a comprehensive project to have a wider understanding of the different aspects of SAF including demand analysis, feedstock availability, environmental externalities, fuel production technologies, logistics systems, and integration of airport infrastructures to make it future ready for SAF.

The outcome of the study highlights that India's SAF demand by 2050 will be driven by blending mandates ranging from 30-70% of total ATF usage. With aviation turbine fuel (ATF) demand projected to grow from ~13 million tons in 2030 to ~26 million tons by 2050, meeting this demand will require scalable SAF production technologies like initially with HEFA and later with AtJ as well as BtL.

Further, the infrastructure and logistic requirements for the SAF value chain has been assessed from production to blending, to storage and distribution at the airports. SAF blending can occur at refineries or fuel terminals, with the latter offering flexibility. Criteria for selecting blending locations include proximity to fuel sources, available space, infrastructure, environmental impact, and regulatory compliance. Airports may limit SAF blends to reduce complexity, using single blends compatible with all aircraft until full SAF compatibility is achieved.

This initiative supports Delhi Airport's sustainability goals and offers a blueprint for other airports to adopt SAF. In collaboration with stakeholders and securing funding, airports can contribute to global carbon emission reductions and fosters a more sustainable aviation industry.

Project Graphics

Caption 1: SAF penetration mandate scenarios	Caption 2: Amount of savings in crude oil imports in India
 Source: Study Findings	 Source: Study Findings
Caption 3: Ideal integration of SAF at airport infrastructure	Caption 4: Emission reduction achieved due to usage of sustainable energy (Scope 1 & 2) (solar & hydro based electricity and electric vehicle)
 Source: Study Findings	 Source: DIAL Data

SUSTAINABLE AVIATION FUEL (SAF) INITIATIVE

Kansai International Airport

Creating supply chain aimed at local production and consumption of SAF

In its Basic Environmental Policy, KAP Group has set a goal of "contributing to reducing the environmental burden of overall airports, including the aviation sector," and is working with stakeholders to promote the use of SAF in various ways. The management's commitment is published on the website.

It is important for airport operators to actively work to reduce emissions from aircraft in order to reduce CO_2 emissions not only under our own responsibility but also from the entire airport.

KAP has actively contributed to the collection of used cooking oil (UCO), which is the raw material for SAF, by working with Sapphire Sky Energy, a company jointly established with a UCO collection company, an SAF plant manufacturer, and an oil wholesaler, and has built a model for local production and consumption of SAF in the Kansai region.

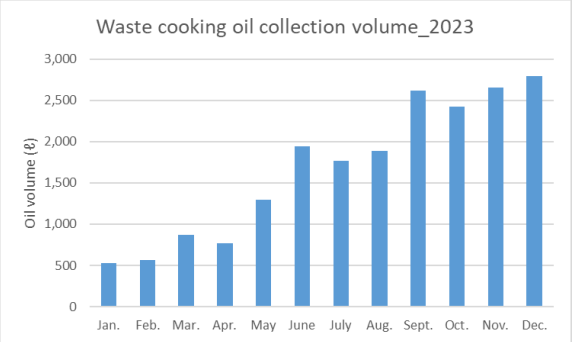
KAP has taken the lead in approaching tenants in the terminal building and surrounding municipalities to gain understanding on the importance of SAF and the significance of local production and consumption. In addition, we have contributed to the spread of SAF by raising awareness among citizens through events and on-site classes.

A groundbreaking move was the start of the collection of discarded household UCO. In addition to securing a new collection source, we were able to convey the importance of SAF to citizens who use airplanes.

By sharing the importance of SAF, airport users will have a greater understanding of the burden of SAF costs. As a result, this initiative will accelerate the spread of SAF use.

Changing people's awareness is the most important factor in achieving decarbonization. KAPs' efforts to raise awareness of the importance of SAF are effective and feasible in any region and will greatly contribute to decarbonization.

Project Graphics

Caption 1: Amount of UCO collected	Caption 2: Sharing tenants who cooperated in collecting UCO
	
Caption 3: UCO collection event	Caption 4: Information dissemination materials
	 日揮ホールディングス株式会社提供

NET ZERO STRATEGIES

Adelaide Airport
Decarbonisation

AAL developed its Decarbonisation Strategy (the Strategy) that outlines its pathway to net zero Scope 1 and 2 emissions by 2030. This involved in-depth stakeholder engagement across sustainability, finance, facilities, planning, property, and project delivery.

More than half of the initiatives outlined in the Strategy have since been completed or are in progress, reducing AAL's Scope 1 and 2 emissions by ~90% from the baseline year (2018). Key energy initiatives that contributed to this include:

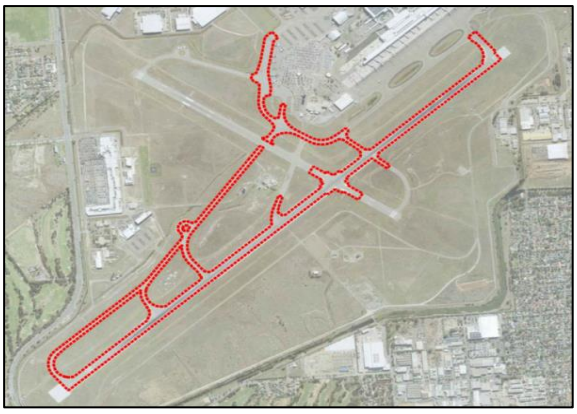
- 100% reduction in Scope 2 emissions through the commencement of a long-term renewable Power Purchase Agreement (PPA) on 1 January 2024. Our renewable energy comes from a local South Australian wind farm, 'Lake Bonney Wind Farms' located 427kms from Adelaide Airport.
- Indoor and outdoor lighting upgrades to significantly more efficient LED lights to street, apron, terminal, and carpark lighting. Our airside lighting upgrade has resulted in a ~22% (6-month avg.) reduction in monthly electricity consumption since installation.

Additionally, we are close to completing installation of a 2.3MW solar system across our terminal roof. This complements our existing solar installation, which will produce more than 15% of the electricity used across our airport (aero and non-aero).

Sustainability was a key consideration in our major runway and taxiway overlay project (MRTOP). In a first for an Australian airport of our size, 25% of all asphalt used contained Reclaimed Asphalt Pavement (RAP). This reduced the amount of energy required to develop the product, cutting down embodied carbon in our supply chain by 63 tonnes (equivalent to 450,000kms by car). The project has produced an article to share the innovation and lessons learned across the industry to support the increase of RAP for other projects.

The Strategy also addresses Scope 3 carbon emissions through value chain engagement and developing new ways of executing construction projects.

Project Graphics

Caption 1: LED light installation on airside runway and taxiway (MRTOP)	Caption 2: Terminal 1 and Car Park LED Lighting Upgrade
	
Caption 3: MRTOP Scope and scale of project	Caption 4: Lake Bonney wind farm providing AAL renewable electricity
	

NET ZERO STRATEGIES

Auckland Airport
Decarbonisation Pathway

As New Zealand's largest international airport, Auckland Airport is strongly aware of the contribution of the aviation industry to climate change and the importance of playing our part in aviation decarbonisation.

In 2020, ahead of commencing the once-in-a-generation upgrade of major assets, the Decarbonisation Pathway project was developed to ensure operational carbon reduction was factored into the design and construction of the upgrades.

The Decarbonisation Pathway project centered around a challenging target of 90% reduction in Scope 1 and 2 carbon emissions from a 2019 baseline by 2030. The Decarbonisation Pathway project established a 10-year timeline of initiatives that were aligned with the Airport's capital plan. The target and pathway were publicly disclosed in 2022 (see: 2022 Annual report page 40).

Key initiatives identified in the pathway included:

- Phasing out of natural gas within the terminals for more energy-efficient electric alternatives.
- Transitioning our fleet to electric vehicles (or hybrid where required).
- Transitioning to refrigerants with the lowest global warming potential.
- Using renewable energy generated from a mix of on- and off-site sources.

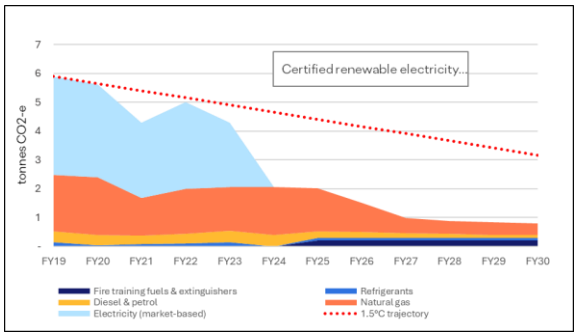
The Decarbonisation Pathway has already led to significant carbon reductions from our direct operations with, a 25% reduction in scope 1 and 2 emissions achieved in 2024. Emission reduction initiatives are underway with the first electric heat pump installed in Pier B to replace the historic natural gas boiler, two large rooftop solar arrays have been installed, generating 3.5 megawatts of renewable power, and New Zealand's first electric food court is a feature of Auckland Airport's Mānawa Bay Premium Outlet Centre.

The Decarbonisation Pathway is driving substantial investment into emission reduction at Auckland Airport while ensuring that we report progress and are transparent to our stakeholders.

Project Graphics

Caption 1: Auckland Airport's scope 1 & 2 decarbonisation pathway updated for the FY24 year.

This pathway was first disclosed in the 2022 Annual Report and has guided decision making as Auckland Airport undertakes a once-in-a-generation upgrade.

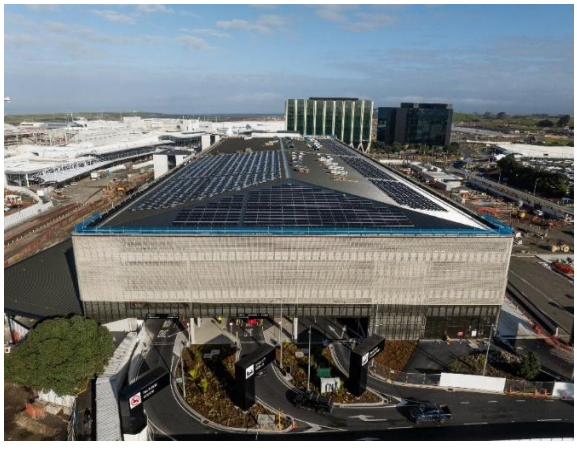


Caption 2: NZ's largest rooftop solar array has been installed on Auckland Airport's new development – Mānawa Bay Premium Outlet Shopping Centre.

Renewable energy generation (on- and off-site) is a key part of the Decarbonisation Pathway to achieve a 90% reduction in scope 1 and 2 emissions.

Caption 3: Another rooftop solar array has been installed on the newTransport Hub at Auckland Airport.

Generating 1.2 megawatts of electricity, it is enough to power the Transport Hub, attached offices and EV charging (for personal and rental cars). Having the Decarbonisation Pathway in place with a clear target on scope 1 and 2 emissions has influenced decision-making and ensured that new developments are designed with sustainability as a key metric



Caption 4: Replacing the natural gas boilers with energy efficient electric heatpumps was identified as a priority in the Decarbonisation Pathway.

Auckland Airport has NZ's largest commercial heating and cooling system, so replacing the historic gas boilers while the airport remains operational is no easy feat. The first of these replacements has occurred in Pier B, with an innovative HVAC technology that heats and cools airs within the same unit. This was installed and trialled for over a year to ensure that it runs efficiently while creating a comfortable environment for our passengers.

NET ZERO STRATEGIES

Kaohsiung International Airport

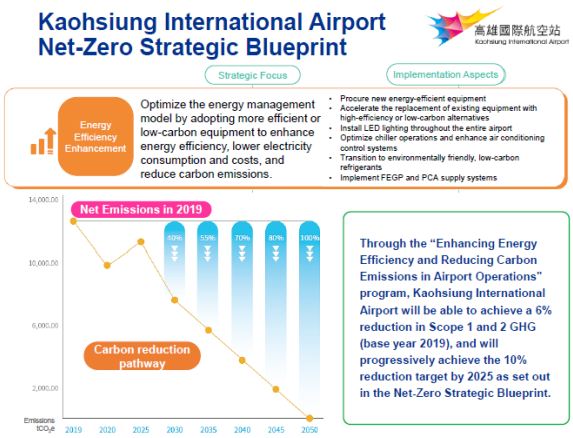
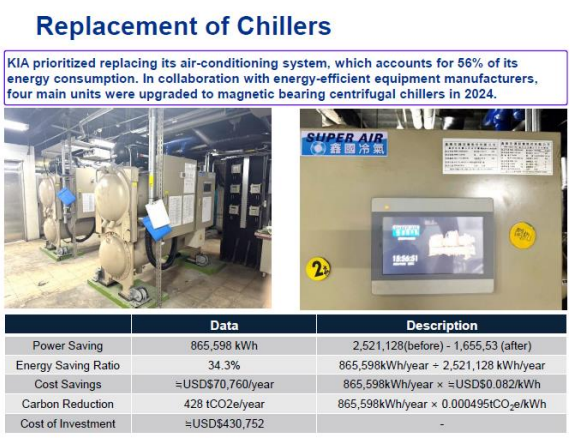
Enhancing Energy Efficiency and Reducing Carbon Emissions in Airport Operations

To achieve its 2050 net-zero goal, Kaohsiung International Airport (KIA) prioritizes energy efficiency as a key environmental focus. In 2023, the KIA launched the "Enhancing Energy Efficiency and Reducing Carbon Emissions in Airport Operations" program, reinforcing energy efficiency goals in its Net-Zero Strategic Blueprint. The energy management committee was established, led by the airport director, and collaborates with authorities, 35 stationed units that joined KIA's Joint Carbon Reduction Plan, and equipment manufacturers. The committee meets quarterly to review energy-saving progress and the effectiveness of energy-saving measures.

The programme saves 1.82 million kWh electricity consumption annually, reducing electricity costs by approximately USD $143,000 and carbon emissions by 6,538tCO_2e, equivalent to USD $836,864 in reduced social costs through a series of energy-saving measures as followed:

1. Introduced the ISO 50001 energy management system in 2023, focusing on replacing the terminal's air-conditioning system, which consumes for 56% of its energy. In collaboration with energy equipment manufacturers, four main units were upgraded to magnetic bearing centrifugal chillers, saving 860,000 kWh annually with a 34% energy-saving rate.
2. Replaced all 16 jet bridges in 2024 with energy-saving air conditioners and LED lighting in the airport, saving 270,000 kWh annually and reducing, with a carbon reduction benefit of about 133tCO_2e. Installed 9 FEGP and PCA systems to reduce the use of ground-handling equipment, cutting diesel consumption by 1,061 kiloliters and carbon emissions by 1,235tCO_2e. Replacing APUs with FEGP and PCA systems reduced emissions by 4,400 tCO_2e annually.
3. Began replacing 208 outdoor lights with LED fixtures in 2024, reducing electricity consumption by 690,000 kWh annually with a 65% energy-saving rate.
4. Through the Joint Carbon Reduction Plan (launched in 2022) to collaborate with stationed units on energy efficiency enhancement, alternative energy, and regular education while promoting energy-saving practices to travelers.

Project Graphics

Caption 1: Net-Zero Strategic Blueprint	Caption 2: Replacement of chillers
	
Caption 3: Replacement of All Jet Bridges and Installation of FEGP and PCA Supply Systems	**Caption 4: Promote Energy Saving and Carbon Reduction with Multi-stakeholders**
	

	Data	Description
Power Saving	865,598 kWh	2,521,128(before) - 1,655,53 (after)
Energy Saving Ratio	34.3%	865,598kWh/year ÷ 2,521,128 kWh/year
Cost Savings	≈USD$70,760/year	865,598kWh/year × ≈USD$0.082/kWh
Carbon Reduction	428 tCO2e/year	865,598kWh/year × 0.000495tCO$_2$e/kWh
Cost of Investment	≈USD$430,752	-

	Reduced energy usage	Carbon Reduction
Replacement of diesel-powered gas vehicles	1,061 kilolitres	1,235tCO2e
Replacement of APU usage	-	4,400tCO2e

NET ZERO STRATEGIES

FIJI AIRPORTS

Nadi Airport

Green Airport Action Plan 2024-2025

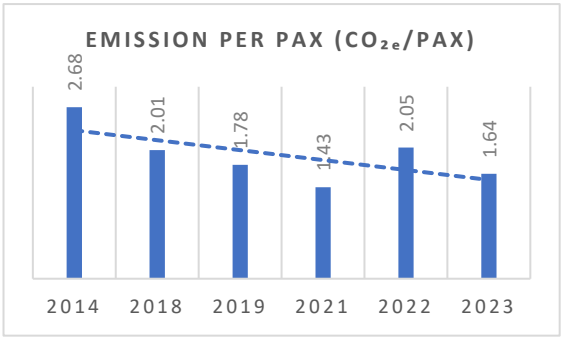
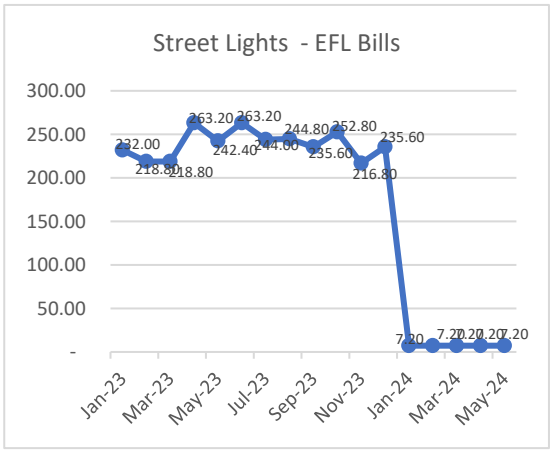
Fiji Airports is taking action to reduce its energy emissions in line with national targets aimed at a 30% reduction of business-as-usual (BAU) CO2 emissions from the energy sector by 2030. The carbon footprint analysis for Nadi International Airport in 2023 revealed that energy emissions account for 93% of total Scope 1 and Scope 2 emissions. To address this issue and enhance the sustainability of our operations—especially in the face of daily challenges posed by climate change—we plan to transition to renewable energy and implement energy-efficient practices. Nadi International Airport has already achieved a 32% reduction in carbon emissions compared to the 2014 baseline. One major step in our plan is to switch from traditional lighting to solar-powered and LED lights throughout our airport facilities. Here are some of our key initiatives:

- Replaced all 160 halogen streetlights around the Nadi Airport Compound with solar lights.
- All taxiway lights have been converted to LED.
- International and domestic terminals have been converted to LED lights.
- We have completed the procurement of 13 electric vehicles (EVs) aimed for 2024.
- Completed the solar power supply system, capable of generating 11 kW of electrical power, including the mounting of 16 panels.

These changes will help us utilize Fiji's abundant sunlight, reduce energy consumption, and lower carbon emissions.

Fiji Airports operates the largest fleet of electric vehicles in the Pacific, with 13 fully electric cars, representing over a million dollars invested to decrease our reliance on fossil fuel-powered vehicles. By following the annual themes from Airports Council International (ACI), we not only aim to improve our operational efficiency but also demonstrate our commitment to sustainable practices in tackling climate change. Through these efforts, Fiji Airports is setting a standard for sustainable aviation in the Pacific region.

Project Graphics

Caption 1: Fiji broadcasting cooperation reports that Fiji Airports has become the owner of the largest electric vehicle in the Pacific Islands region.	Caption 2: Staff performing a traditional ceremony "cere" in the welcome of the first 3 Electric Vehicles in June 2024
	
Caption 3: Changing of 160 halogen streetlights to solar powered lights and (below)-solar panels for EV charging station	Caption 4: Graph shows a reduction in emission per pax in 2023 carbon footprint. Graph below shows a cost savings reduction for streetlights around the Fiji Airports Compound.
 	 

NET ZERO STRATEGIES

Rajiv Gandhi International Airport

100% renewable energy powered airport – a sustainable journey towards net zero carbon target

Aviation is a major energy consumer. To meet increasing airport energy needs, it is essential to switch to renewable energy (RE) sources. GMR Hyderabad International Airport Limited (GHIAL) has achieved this task by transforming Rajiv Gandhi International Airport (RGIA) into a 100% RE powered airport.

GHIAL's Sustainability Policy is also aligned with:

- UNSDG 07: Affordable and clean energy
- UNSDG 13: Climate action

RE Initiatives of the Airport:

- Onsite 10MWp solar power plant for captive use.
- Green power purchase from the State grid.

Energy Efficient Operations:

- Replacing conventional lights with LED lights in the Terminal and Airfield Ground Lighting (AGL).
- Air conditioning equipment use optimization based on flight schedules.
- Efficient operation of cooling towers and chiller plants.
- Replacement of 23 petroleum vehicles with electric vehicles
- Minimising diesel generator (DG) load test duration through a fast bus transfer system.

GHIAL has collaborated with the airport stakeholders for Scope 3 emission reduction:

- All the offices and workshops
- Fixed Electric Ground Power unit (FEGPU) and pre-conditioned air (PCA) units to prevent APU use during aircraft turn around
- 120 electric ground support equipment (GSE)
- Provision of 5MW- EV charging stations for GSE.
- GSE with solar panels

These practices reduced carbon emissions during 2020-2024:

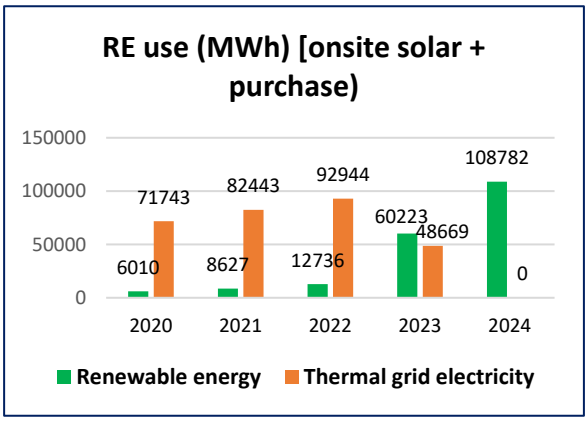
- Total 196378 MWh of renewable energy was used in place of thermal energy.

- Scope 2 and 3 (aviation) electricity emissions are zero.
- Prevented 149812 tCO_2 emissions.
- Air pollutants of 1413 tonnes of SO_2 and 860 tonnes of NO were avoided.
- INR 149.86 million cost saving from onsite solar power generation.

In 2024, GHIAL achieved 92% of carbon emission (Scope 1+2) reduction over its baseline year of 2010 with a target of net zero carbon by 2035. RGIA has a long-term aspiration goal towards net zero carbon of Scope 3 emissions by 2050 using sustainable aviation fuels, complete electric GSE, and energy-efficient operations.

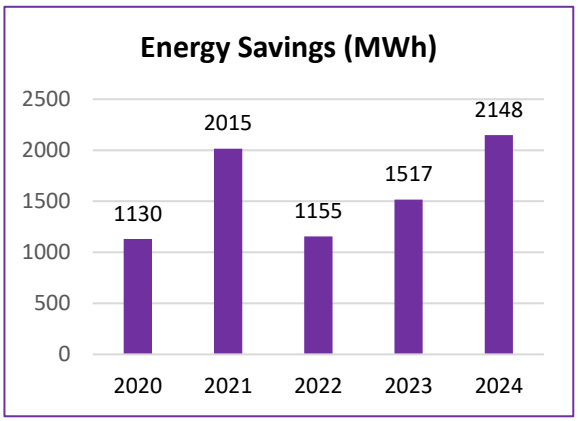
Project Graphics

Caption 1: Renewable energy (RE) use at the Airport

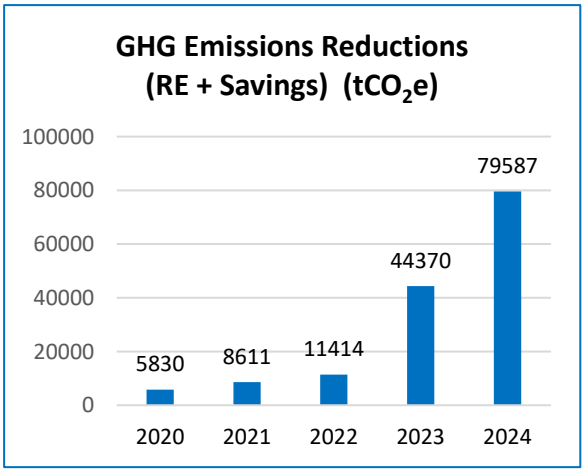


Note: in 2023, GHIAL started to purchase RE power from grid in addition to the onsite solar power generation (till Nov'24)

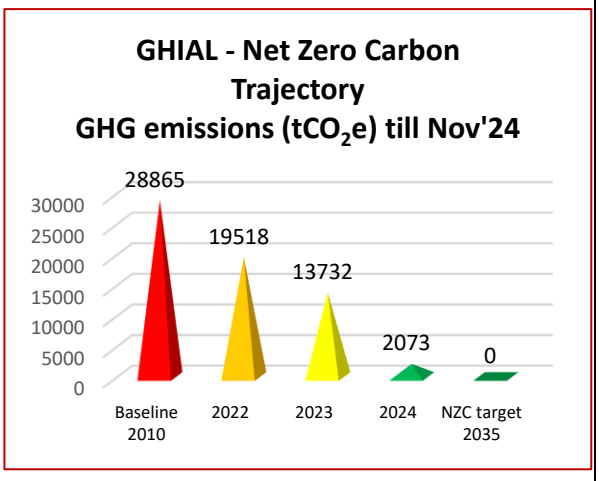
Caption 2: Energy efficient airport operations



Caption 3: Saving of GHG emissions



Caption 4: Net zero carbon (NZC) emission trajectory



NET ZERO STRATEGIES

Sydney Airport

Progress to Net Zero 2030 (Scope 1 & 2)

In May 2021, Sydney Airport announced its commitment to achieve Net Zero for emissions under its operational control (Scope 1 and Scope 2 emissions) by 2030. Sydney Airport has developed a detailed Net Zero 2030 Roadmap (the Roadmap) to support this commitment, which the Sydney Aviation Alliance Holdings Pty Ltd (SAAHPL) Board approved in 2023.

The Roadmap details the key initiatives that Sydney Airport plans to implement to reduce and eventually eliminate its emissions (where practicable), and the estimated timing and potential emissions savings from these initiatives. During 2024, Sydney Airport made significant progress on several of the initiatives identified in the Roadmap.

Scope 2 emissions reduction progress

Purchase renewable electricity under power purchase agreements – Sydney Airport has secured the equivalent of 100% renewable electricity for 2025 onwards through large-scale generation certificates from Crudine Ridge Wind Farm (New South Wales, Australia), which will match Sydney Airport's electricity consumption (Sydney Airport's own operations excluding tenants and aircraft).

Reduce energy use through energy efficiency measures - Energy efficiency measures include LED lighting upgrades and chilled water plant optimisation.

Replace grid electricity with onsite solar generation – Progress has commenced through Sydney Airport's internal project gating system to install at least 4.05MWp solar PV system on the roofs of the international terminal and freight buildings.

Scope 1 emissions reduction progress

Decarbonise fleet – Transition to electrify Sydney Airport's own car fleet (66 vehicles) has commenced through Sydney Airport's internal project gating system. Decarbonising the vehicle fleet airside and landside improves the air quality surrounding airport staff.

Remove residual emissions through carbon credit procurement – Sydney Airport initiated exploring opportunities for developing an innovative blue carbon removal (seagrass-based carbon sequestration) program in partnership with industry experts. This program will aim to supplement a portion of our carbon removal offset requirements as part of our Net Zero 2030.

Project Graphics

Caption 1: Sydney Airport contracts its renewable electricity from Crudine Ridge Wind Farm, New South Wales, Australia.	Caption 2: Sydney Airport is investigating innovative projects to enhance local biodiversity and capture carbon through native seagrass restoration.
	

Caption 3: Chilled water plant optimisation project has improved Sydney Airport's energy efficiency.

GREEN & ZERO-ENERGY BUILDING TO ENHANCE ENERGY EFFICENCY

Cluster 2
تجمع مطارات الثاني

Arar International Airport
Energy-efficient Terminal

The Arar Airport Development Project aligns with GACA's vision to build a modern airport system and support the Kingdom's Vision 2030 by enhancing the national economy. The new airport accommodates over 1,039,000 passengers annually, with a capacity of more than 10,000 flights per year. It represents a significant leap in air transport for the northern border region, offering advanced technologies and services to elevate the passenger experience.

The airport's design incorporates an environmental dimension, featuring an exterior inspired by the Arabic letter "Ain," symbolizing the city's name, and an eye-shaped structure. The terminal includes 10 check-in counters, 6 travel gates, and 2 passenger bridges capable of handling 4 planes simultaneously. Additionally, 4 gates serve aircraft parked airside. The main terminal is equipped with an advanced luggage handling system, 2 conveyor belts, 12 passport control counters in arrivals, 8 in departures, and 900 passenger seats.

GACA prioritised accessibility in the airport's design, ensuring services and facilities cater to people with disabilities. The main terminal includes mobile pathways, dedicated service counters, and accessible security and check-in areas. This initiative reflects GACA's commitment to creating inclusive, disability-friendly airports across the Kingdom.

By integrating modern infrastructure, advanced systems, and inclusive services, the Arar Airport serves as a benchmark for airport development, enhancing regional connectivity and supporting Saudi Arabia's broader economic and social goals.

Project Graphics

Caption 1: New Terminal Building	Caption 2: old Terminal Building
	
Caption 3: EV charger	**Caption 4: Terminal LED light**
	

GREEN & ZERO-ENERGY BUILDING TO ENHANCE ENERGY EFFICENCY

Jenderal Ahmad Yani Airport

Green Building Implementation (New Building) Airport Development

Jenderal Ahmad Yani Airport Semarang (referred to as SRG Airport) is one of the airports managed by PT Angkasa Pura Indonesia (Injouney Airports), located in West Semarang District, Semarang City, Central Java.
The number of passengers up to November 2024 is 2 million passengers, an increase compared to November 2023 of 1.9 million passengers.
SRG Airport is famous as the first floating airport in Indonesia and has carried out the concept of green buildings and environmentally friendly airports (Eco-Airport). The implementation of Eco Airport at Jenderal Ahmad Yani Airport is as follows:

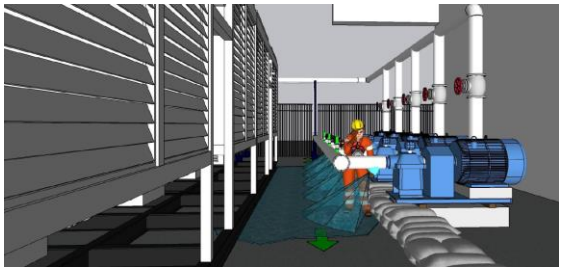
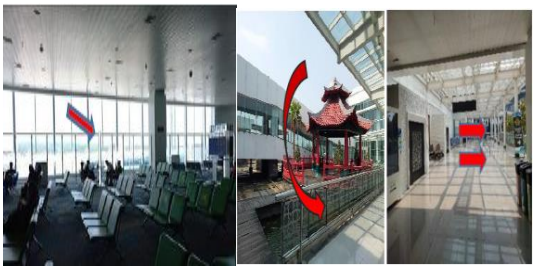
1. Water conservation, through wastewater management at the Sewage Treatment Plant with a closed circle system using recycled wastewater for landscape watering and terminal toilet flushing.
2. Energy conservation through new renewable energy programs through the operation of rooftop solar PV, implementation of green building through energy efficiency, traffic operation management, operation of Building Automatic System (BAS) and implementation of chiller zoning system.
3. Integrated waste management 3R (reduce, reuse, recycle) and hazardous waste management.
4. Air Quality and Noise Management through environmental monitoring.
5. Greening, monitoring biodiversity of flora and fauna at the airport

Tree planting day, product waste management (compost, dried maggot, eco enzyme)

Efforts made to support Energy Conservation at Jenderal Ahmad Yani Airport through the implementation of green building via active and passive design energy efficiency in the terminal building, and in 2022, Jenderal Ahmad Yani Airport received the Green Building (new Building) certification from the Green Building Council Indonesia. (GBCI).


Active design and passive design of airports

Project Graphics

Caption 1: Active Design Chiller (environmentally friendly using refrigerant R-407A (non-ODP), GWP value = 1.774.)	Caption 2: Passive Design of Lighting
	
Caption 3: Active design of Chiller Zoning System	**Caption 4: Green Building Implementation (Active Design and Passive Design)**
 	 

GREEN & ZERO-ENERGY BUILDING TO ENHANCE ENERGY EFFICENCY

Narita International Airport

New Construction Project for Cargo Building No.8: Enhancing Operational Efficiency and Reducing

Narita International Airport Corporation (NAA) has constructed Cargo Building No. 8 in the cargo terminal area, which began operations in October 2024 with All Nippon Airways (ANA) using it as its largest cargo terminal. Cargo Building No. 8 addresses the issues of facility decentralization and congestion at Narita Airport, while also serving as a pioneering initiative for future terminal development and a new cargo area. It incorporates renewable energy procurement and environmentally friendly energy solutions, featuring the following key elements:

"ZEB Oriented" Certification

As part of its decarbonization efforts, NAA aimed for ZEB (Zero Energy Building) standards during the construction of Cargo Building No. 8, based on BELS certification. The building includes high-efficiency air conditioning, advanced insulation materials, and energy-saving air circulation systems, such as large ceiling fans. These efforts earned the "ZEB Oriented" certification.

Solar Power Generation System

NAA plans to introduce a large-scale solar power system generating up to 180 MW. Cargo Building No. 8 houses Narita Airport's largest solar power system, providing approximately 16% of the building's electricity. Future plans include adding battery storage systems to further optimize energy use.

Operational Efficiency

The introduction of automated guided vehicles (AGVs), automated guided forklifts (AGFs), and automated cargo handling systems (CHS) has streamlined operations, reducing environmental impact through electrification.

This large-scale project was developed in close collaboration with ANA, strengthening a long-term partnership for future growth. NAA issued a Green Bond in September 2023, raising approximately 16.1 billion yen (approximately 102.9 million dollars) for this project.

Narita Airport handles about 70% of Japan's trading value and is consistently ranked among the top 10 global airports in cargo throughput. This project reinforces Narita's role as a key international air logistics hub, supporting both domestic and global economies and contributing to NAA's "Sustainable NRT 2050" long-term decarbonization goals.

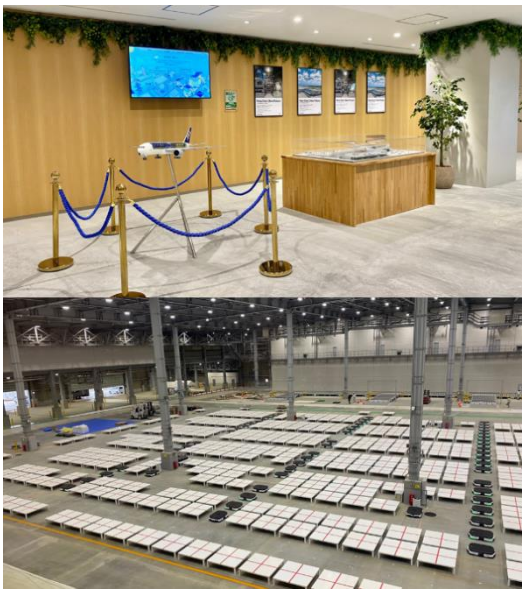
Project Graphics

Caption 1: Cargo Building No. 8 (Exterior) with ZEB Oriented* Certification

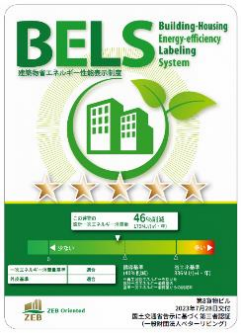
*A Net Zero Energy Building (ZEB) is designed to reduce annual primary energy consumption to zero while ensuring comfort. ZEB Oriented buildings, with a floor area of 10,000 m^2 or more, achieve energy savings of at least 40% or reduce primary energy use by 30% compared to standard levels.

Caption 2: Cargo Building No. 8 (Interior)

Entrance Interior with Focus on Work Environment (Displaying Solar Power Generation Status on a Monitor)
Export Warehouse Interior: Rows of Automated Guided Vehicles (AGVs)

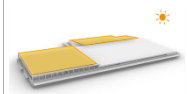
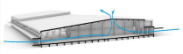
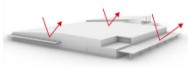


Caption 3: BELS, Energy Conservation and Energy Creation Initiatives



Building-Housing Energy-efficiency Labelling System (**BELS**) is a certification system led by the Ministry of Land, Infrastructure, Transport and Tourism Japan, which is a third-party evaluation organization specializing in energy-saving performance of buildings.

Energy Conservation and Energy Creation Initiatives

Creation of renewable energy through solar power generation	Air circulation through ceiling fans and forced-air fans	Reduction of heat load by improving insulation performance
		

Caption 4: Operational Efficiency through the Introduction of AGVs and AGFs

Contributing to Automation and Environmental Impact Reduction

ENERGY OPTIMIZATION INITIATIVES

adani | Ahmedabad Sardar Vallabhbhai Patel International Airport

Ahmedabad International Airport

Energy efficiency initiatives at SVPI Airport, Ahmedabad

The energy efficiency initiatives undertaken by Sardar Vallabhbhai Patel International Airport over the past four years for ACI's future publications:

- Comprehensive energy efficiency initiatives aimed at reducing carbon footprint and enhancing operational sustainability.
- **Cooling Towers**: Replacement of old cooling towers with low-approach (2.8°C) CTI-approved cooling towers.
- **Chillers**: Upgrading of three 425 TR chillers to more efficient centrifugal chillers with COP more than 6.5@AHRI conditions.
- **BHS Area**: Conversion of split units to FCUs with centralized chillers.
- **VRV AC Systems**: Installation of eight 12 HP VRV AC systems to replace old R-22 reciprocating compressors, saving around 25% of electricity.
- **Terminal 02 HVAC**: Replacement of 50 AHUs with plug fans against old belt-driven, saving around 30% energy in the low side of HVAC.
- **Vehicle Fleet**: Conversion of 65% of the vehicle fleet to EVs, saving approximately 10,000 liters of diesel per annum.
- **Solar Panels**: Implementation of a 1400 KW solar panel initiative, contributing 7% of the airport's total energy demand.
- **Occupancy Sensors**: Installation of around 50 occupancy sensors in various offices for lighting control, leading to significant energy savings.
- **EV Charging Stations**: Installation of EV charging stations to support the EV replacement initiative.
- **LED Lighting**: Installation of new LED high mast lighting at the airside to reduce electricity consumption.
- **Recognition**: Merit of appreciation from the Energy Bureau of the Power Ministry for these efforts.

These initiatives have resulted in substantial **energy savings of 2.2 million units per annum**, **cost savings of 23.76 million INR per annum**, and more than 1540 tons of reductions in greenhouse gas emissions per annum, contributing to the airport's sustainability goals. The project is part of SVPI's plan to achieve 100% green electricity by 2026 and ACA level 4+ accreditation by CY25.

Project Graphics

Caption 1: Low approach (2.8°C) cooling tower with more than 25% energy saving and low condenser water temperature helps in low power consumption in chillers	Caption 2: Fleet from conventional fuel to electric vehicles (EVs)
	
Caption 3: 425 TR centrifugal chiller installation with COP more than 6.4@AHRI condition.	Caption 4: 50 nos of AHUs replaced with plug fans and auto-control which saves around 30% of low side of HVAC.
	

ENERGY OPTIMIZATION INITIATIVES

Darwin International Airport

Darwin International Airport Sustainable Energy Transformation

Darwin International Airport (DRW) embarked on the Sustainable Energy Transformation project to significantly reduce carbon emissions and enhance energy efficiency. This initiative aligns with global sustainability goals, the Airports Council International's (ACI) target of net zero carbon emissions by 2050, and DRW's own target of net zero emissions (scope 1 & 2) by 2030.

Key components of the project include the installation of 7.6 MW of solar power systems, generating 81% of our energy use in FY24. We overhauled our electrical infrastructure with new High-Voltage (HV) intake stations and a new HV ring main, replacing over 10km of HV paper lead cable. Additionally, we synchronised backup generators, installed advanced SCADA monitoring hardware, and automated four substations to improve safety.

Further improvements include converting all precinct streetlights, Air Transport Apron floodlighting, and terminal lighting to LED. We also installed electric ground power units and pre-conditioned air units for the Air Transport Apron to support scope 3 emission reductions and reduce airlines' reliance on fossil fuels during aircraft turnaround.

In 2024, we invested over $7.5m AUD in a new chiller system for our terminal, which is expected to improve terminal cooling efficiency by over 40% and reduce our annual carbon emissions by approximately 950 tonnes. The new infrastructure, designed and rated to Importance Level 3 (IL-3), has a 25-year lifespan and can be expanded to meet future demand.

These initiatives have resulted in substantial energy savings, a significant reduction in carbon emissions, and enhanced the safety and reliability of our electrical infrastructure, supporting the future installation of energy storage solutions. The Sustainable Energy Transformation project underscores DRW's commitment to leading the aviation industry in sustainable energy management and contributing to a more environmentally responsible future. The project was successfully completed in 2024 with the installation of the new chiller system.

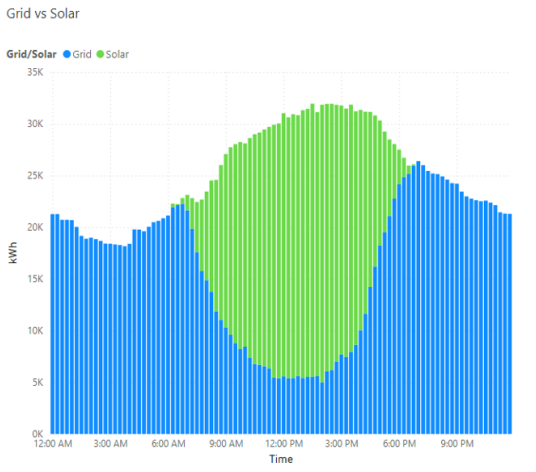
Project Graphics

Caption 1: Harnessing solar power across the precinct and monitoring energy efficiency in real-time. (Bottom right: Solar 1, Top left: Solar 2, Top right: Solar on terminal, Bottom left: monitoring dashboard)

Drone footage of installations:
https://show.pics.io/preview/6751451315de333dd33c1570
https://show.pics.io/preview/6751434715de333dd33c152b
https://show.pics.io/preview/6751439e15de333dd33c1541

Caption 2: Construction of the new chiller system to enhance terminal cooling efficiency by over 40%

Caption 3: Digital monitoring dashboard for senior management, displaying daily energy consumption and solar generation in real-time in an easily digestible format.



Open in Power BI
Power Monitoring Dashboard
Data as of 09/12/24, 07:11
Filtered by Solar or Grid (is Grid or Solar), **Date** (is on or after Tuesday, 1 October 2024 and is before Friday, 1 November 2024), **Measurement Name** (is Real Energy into the Load)

Terminal

Caption 4: Key events and milestones in our journey to net zero, highlighting major project deliverables, achievements, and future direction.

ENERGY OPTIMIZATION INITIATIVES

Hamad International Airport
Demand Flow Optimisation for Centralised Utility Plants

Hamad International Airport was constructed as a greenfield project between 2005 and 2014. The airport campus covers more than 29 km^2 and comprises over 100 buildings, including the main passenger terminal at 600,000 m^2. Airport development included all critical infrastructure to operate the entire airport campus, including road networks, water networks (potable, storm, foul, treated water for irrigation, and chilled water for HVAC), HV and LV electrical systems, centralised cooling plants, as well as waste water and solid waste treatment facilities. All these vital infrastructure systems for the Airport, and tenants are now under the operational management of the Airport.

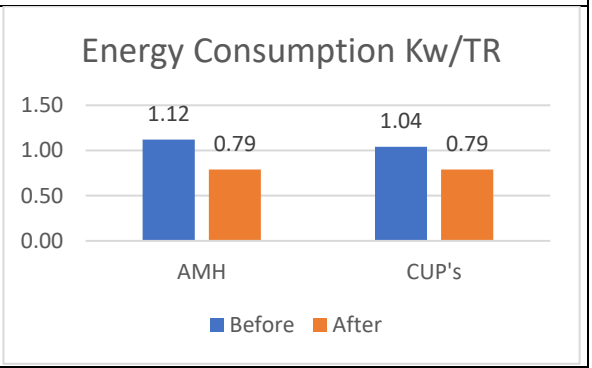
After operating for several years, in 2020, Hamad International Airport (DOH) sought to optimize its five centralised district cooling plants (cooling capacity of 62,000 tonnes of refrigeration), which supply the HVAC systems across the campus. The aim of the project was to substantially improve energy efficiency and HVAC system performance to release HVAC system capacity. Terminal expansion plans at the time required delivery of HVAC systems that could not be met by the existing centralised cooling plants. The airport had a choice to build a new plant (at significant cost, disruption, and future energy cost), or seek significantly improved efficiency from the existing plants, thereby releasing capacity to support the expansion and avoid constructing an entirely new plant.

To solve this challenge, the airport partnered with Siemens to leverage their patented Demand Flow technology to successfully improve the collective district cooling plant performance by a huge 29.5 %, measured on an energy in/cooling out basis. The project was delivered in November 2023 and met the initial project objective.

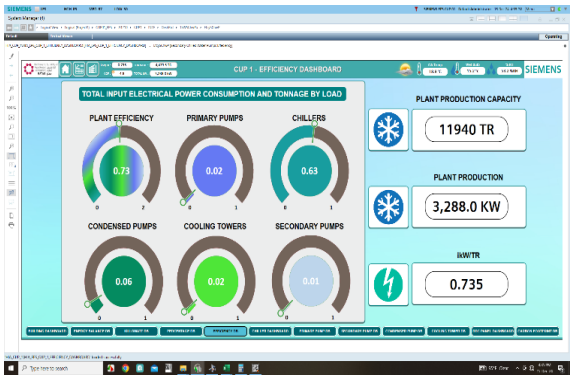
Project Graphics

Caption 1: Central Utility Plant, showing the chiller units within one of the plants.

Caption 2: Energy Savings Kw/TR



Caption 3: Overall Plant Performance dashboard showing real time energy usage, cooling load, and system performance.



Caption 4: Central Utility Plant and chilled water network layout dashboard showing operational status of network.

ENERGY OPTIMIZATION INITIATIVES

adani | Jaipur
Jaipur International Airport

Jaipur International Airport
Energy Saving Initiatives Project

Jaipur International Airport is committed to achieving operational net zero carbon emission in line with the national benchmarks and objectives. Airport, in its capacity, has gone the extra mile to ensure its commitment, which is evident from the ESG measures taken in the short span of 3 years. The work done by us so far is the reflection of our intentions, vision, and commitment for ESG.

Initially, in Terminal 2, when the lighting setup was first established, it consisted of advanced 100 W LED lights. These lights emitted a dazzling brightness at a temperature of 6500 Kelvin. Each light had a wattage rating of around 100W, ensuring a consistent and bright illumination throughout the terminal.

However, as part of a sustainable initiative to enhance energy efficiency and improve the overall ambience, these initial lights have been replaced with energy-efficient 24W LED warm white lights produced by Surya, with a color temperature of 4000 Kelvin. This switch not only reduces the power consumption significantly but also creates a warmer and more welcoming atmosphere within Terminal 2.

The transformation from the higher-powered, cooler-toned LED lights to the lower-wattage, warmer white lights provides a softer and more comfortable illumination, making the terminal more aesthetically pleasing for passengers and staff alike. This thoughtful upgrade reflects a commitment to sustainability and user experience by optimizing both energy usage and visual comfort in Terminal 2.

Under this energy-saving initiative, JIAL has replaced 6347LED lights & old chillers, with energy-efficient New 11KV HT CHILLER-800TR, 10-year-old ACs with invertor technology-based A.C (150Nos), and reduced energy consumption 1485556 which resulted in saving of INR 1.36Cr and reduced GHG emission 1064 TCO2.

In FY 2023-24, 2219700 KWH of renewable energy was generated through 1.80MW Solar panel at the airport, and overall emission reduction of 1589 tCO2.

Project Graphics

Caption 1: New 11KV HT CHILLER-800TR	Caption 2: LED lights replaced
	
Caption 3: Fuel vehicles with EVs & Installed Charging Station	**Caption 4: invertor technology-based A.C**
	

ENERGY OPTIMIZATION INITIATIVES

مـطـار الملـك عـبـد الـعـزيـز الـدولـي
King Abdulaziz International Airport

King Abdulaziz International Airport

Sustainable Energy

KAIA Terminal is a prime example of environmental sustainability in airport design, focusing on energy, water management, and sustainable transportation.

1. **Sustainable Architecture**:

- Natural Ventilation: The design incorporates passive cooling and natural ventilation, reducing reliance on mechanical air conditioning and saving energy.
- Maximized Natural Light: Large windows and strategic openings make effective use of daylight, reducing the need for artificial lighting and contributing to energy conservation.

2. **Water Management:**

- Smart irrigation systems maintain the landscaping efficiently, while water recycling and rainwater harvesting systems conserve water. Infrared sensors control water flow in faucets and toilets, ensuring water is used only when necessary, and an automated system further reduces wastage.

3. **Energy-efficient Cooling**:

- Water-Cooled Cooling System: The terminal utilizes a water-based cooling system, which is more efficient than traditional air-cooled systems. By using water to cool the air, the system requires less energy to operate, resulting in a 35% reduction in energy consumption compared to conventional methods.
- Improved Efficiency: The system is designed to optimize temperature regulation across the terminal while minimizing the environmental impact. This helps lower the airport's carbon footprint and contributes to its overall sustainability goals.

4. **Energy-efficient Moving Walkways and Escalators**:

- These systems operate only when passengers are detected, reducing energy waste. They are also equipped with automatic shutdown features to save energy when not in use.

5. **Solar Panels**:

- Solar panels generate approximately 250,000 kWh annually, meeting the building's energy needs while reducing reliance on traditional energy sources. The system's low-reflective panels minimise glare, ensuring no disruption to aviation operations. This initiative helped the terminal earn LEED Gold certification, recognizing its commitment to sustainable design and energy efficiency while also generating cost savings.

Through these measures, Terminal sets a high standard for sustainable airport design, demonstrating that modern infrastructure can align with environmental responsibility.

Project Graphics

ENERGY OPTIMIZATION INITIATIVES

King Fahd International Airport
Upgrade and Replacement of Airfield Ground Lighting (AGL) and signage project

The Western Runway and Taxiway Bravo AGL & Signage Rehabilitation Project was a complete rehabilitation of the Western Runway (60m wide and 4000m long) and Taxiways (23m wide full length of Twy B and the associated link Taxiways) flexible pavement resurfacing, AGL, signage, PAPI's and pavement markings.

Significant retrofitting of airfield lighting to LED systems, which has resulted in substantial energy savings. the rehabilitation of the West Runway and Taxiway B and the associated link Taxiways B – B7 upgrade of all airfield ground lighting (AGL) systems from halogen to LED. This transition reflects KFIA's commitment to sustainable energy management and aligns with Airports Council International's goal of achieving net zero carbon emissions by 2050. LED lighting is 57% more energy-efficient and has a longer lifespan than halogen, leading to an estimated annual savings of 172,462 kW and a reduction of approximately 86 tons of CO_2 emissions. This upgrade not only reduces energy demand and carbon footprint but also enhances operational efficiency and safety through improved visibility and reduced maintenance needs. The upgrade of the airfield signage with more efficient power-saving luminaires from halogen to the new power saving LED has been completed providing an increased contrast for better visibility of the signage to pilots. The Apron high mast lights have been upgraded with more efficient power-saving luminaires from halogen to the new energy-efficient LEDs.

Project Graphics

Caption 1: Removed old AGL runway halogen insert lights being prepared for recycling	Caption 2: New AGL Runway LED lights
	
Caption 3: Project team at the completion of the project with New AGL Runway LED lights	Caption 4: New Taxiway LED sign boards installed undertaking final testing before commissioning
	

ENERGY OPTIMIZATION INITIATIVES

King Khalid International Airport

Sustainable Energy Transformation at King Khalid International Airport (KKIA)

Objective: To implement innovative sustainable energy solutions and achieve ACA Level 4 accreditation by reducing GHG emissions and enhancing energy efficiency across airport operations.

Summary: Between 2020 and 2024, King Khalid International Airport (KKIA) launched a series of transformative projects focused on energy efficiency and carbon reduction. These initiatives were central to KKIA's commitment to sustainability, reducing GHG emissions, and setting a benchmark for sustainable airport operations.

The overall project consists of the following:

1. **Lighting System Retrofitting:**

KKIA replaced traditional lighting with energy-efficient LED systems, reducing energy consumption and enhancing overall sustainability.

2. **HVAC System Upgrades:**

Advanced HVAC systems were installed to optimize air conditioning, heating, and ventilation, improving energy efficiency and air quality across the airport.

3. **Infrastructure Optimization:**

The airport optimized its overall infrastructure to minimize unnecessary energy consumption and streamline operations for greater efficiency.

4. **Building Management System:**

The BMS was installed/integrated within the terminal to reduce our scope 2 emissions and ensure a safe environment for pax.

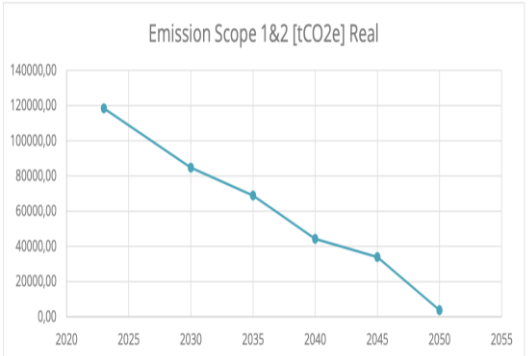
5. **BHS/Elevators/ travellators systems:**

State-of-the-art systems were installed with energy-savings measures to assist the airport in reducing the environmental impact.

These efforts resulted in significant reductions in energy usage and GHG emissions, contributing directly to Saudi Arabia's Vision 2030, which emphasizes sustainable economic growth. KKIA also actively engaged stakeholders, including airlines, regulators, and environmental groups, to ensure collaboration and alignment with global sustainability standards.

By 2024, KKIA achieved major milestones in sustainable airport operations and was on track to receive ACA Level 4 accreditation. This achievement underscores KKIA's leadership in advancing airport sustainability, providing a model for other airports worldwide.

Project Graphics

Caption 1: Before-and-After LED Installation: Workshop lighting retrofit replacing 220W fluorescent tubes with 32W LEDs.	Caption 2: Earth Hour Impact – Energy Savings
	Electric Energy Saving Calculations Proposed Location: Green, Gray & White Zone Energy Conservation statement: Electricity energy saving for the Earth Hours by 8.30PM to 9.00PM Total Energy Saving at Gray Zone for Earth Hour (KWH): 13.2 Total Energy Saving at Green Zone for Earth Hour (KWH): 41.7 Total Energy Saving at White Zone for Earth Hour (KWH): 6.9 Total Energy Saving for earth Hour: 61.8 Annual CO emission reduction (kg CO_2 E): 0.0131 KSA Co emission conversion reference : 61.8kWh x 0.21233kgCO_2e ÷ 1,000 = 0.0131 kgCO_2e.
Caption 3: Scope 1 & 2 Trajectory	Caption 4: Water Conservation Results – Treated Wastewater Use – Tertiary STP
	 

ENERGY OPTIMIZATION INITIATIVES

Kuala Lumpur International Airport

Eco-Cool Transformation at KLIA Airport

Kuala Lumpur International Airport (KLIA) has a certified Level 3 Airport Carbon Accreditation. Malaysia Airports, as the operator of Kuala Lumpur International Airport (KLIA) has a target to achieve 45% carbon emission reduction by 2030 and Net Zero Carbon Emissions by 2050. One key strategy is energy conservation as outlined in Malaysia Airports Environmental Masterplan.

Based on the energy consumption profile of KLIA Terminal 1, 45% is used by the Aircond Cooling Mechanical Ventilation (ACMV) system, which is the most significant energy user. The existing Air Conditioning and Mechanical Ventilation System (ACMV) at KLIA has been in operation since it was commissioned in 1997.

In 2019, an energy management study and acceptable thermal environment study were conducted using ASHRAE Standard 55-2017 Thermal Environmental Conditions for Human Occupancy. An energy conservation and operational reliability decision was made to replace the existing Air Handling Units (AHU) with new AHUs that have energy efficiency features. The features are electronically commutated (EC) fans, optimise demand-controlled operation and high-efficiency heat recovery. The Phase 1 works were completed on 10th October 2023 with the last Phase to be completed in 2027.

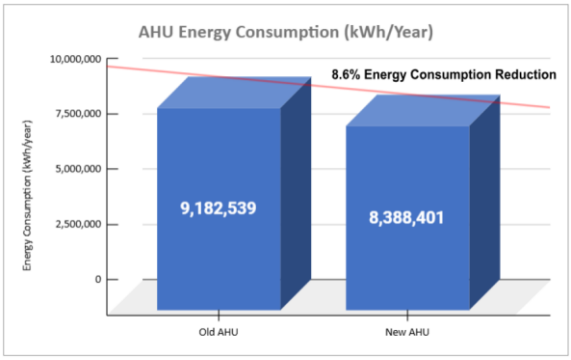
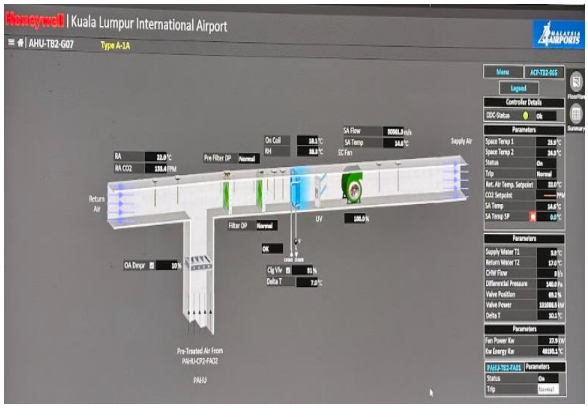
Decisions made upfront regarding the designed AHU works had significantly influenced the overall energy use of the AHU and contributed towards the KLIA Net Zero Carbon Emission journey.

The Phase 1 project benefits are:

- Improvement in Airport Service Quality (ASQ) for ambience thermal rating of 2023 vs 2021 by 0.2%.
- Energy Savings of 794,138 kWh per year.
- Financial savings of RM 324,802 per year.
- Carbon Emission Reduction of 602 tCO2 per year.

KLIA will continue to further reduce energy consumption and contribute significantly to the terminal's sustainability goals by continuing its energy reduction plans and by completing all phases of AHU replacement.

Project Graphics

Caption 1: Electronically Commutated (EC) Fan	Caption 2: Comparison energy consumption before vs after 18 Unit of AHU replacement
	
Caption 3: Building Management System (BMS) Honeywell Control Center	Caption 4: New Set of AHU and Installation
	 

ENERGY OPTIMIZATION INITIATIVES

Mactan-Cebu International Airport
ECO-Watt

Sustainability is at the heart of operations at Mactan-Cebu International Airport (MCIA), shaping every aspect of our airport from its construction to daily operations. Our commitment to sustainable practices begins with the building design and materials. High ceilings enhance thermal management, reducing the need for excessive air-conditioning. Skylights allow diffused natural sunlight to flow into the terminal, reducing reliance on artificial lighting, while low eaves on the east and west façades help mitigate solar heat gain, leading to further energy savings. These design elements not only boost energy efficiency but also contribute to the resort-like ambiance, creating a welcoming environment for passengers.

Our energy efficiency journey goes beyond the infrastructure, extending deeply into the core of our operations. Through our energy conservation program, **ECO-Watt**, MCIA is continuously driving initiatives to make the airport the most sustainable in the Philippines. The program focuses on optimizing energy use, adopting energy-efficient technologies, and promoting sustainable practices across all operations.

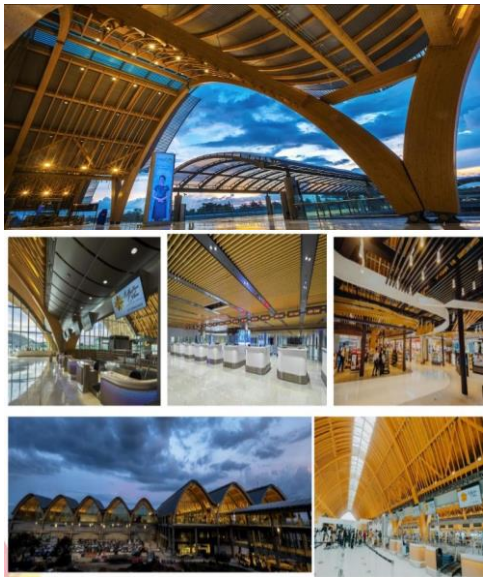
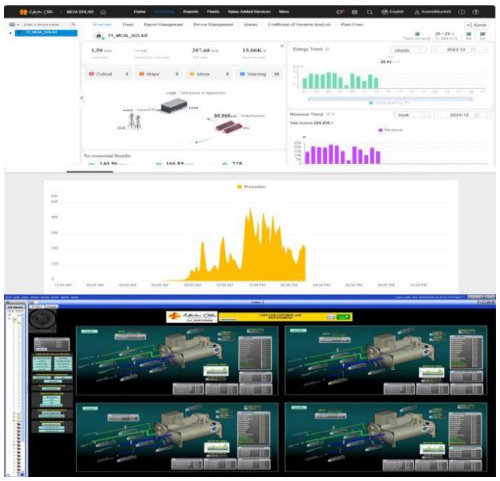
Integrating renewable energy sources, such as solar power, further supports our commitment to reducing our environmental footprint.

Key initiatives include:

- **Building Management System (BMS):** BMS monitors and regulates crucial airport functions such as lighting, power systems, and ventilation, ensuring optimal energy efficiency across the terminals.
- **Roof-Top Solar Powered Plant:** The abundance of sunlight in Mactan provides the airport with a reliable source of clean energy.
- **LED Lighting and Solar LED Street Lights:** Replacing traditional lighting with energy-efficient LED fixtures has led to a 75% reduction in energy consumption.
- **Variable Frequency Drives (VFDs):** VFDs regulate motor speeds based on demand.
- **Chiller Sequence of Operations:** Optimizing the sequence for chiller operation minimizes energy consumption.

These integrated efforts not only reduce operational costs but also enhance MCIA's sustainability and energy efficiency, positioning the airport as a leader in environmentally conscious infrastructure.

Project Graphics

Caption 1: Terminal 2 design Showcases the warmth of Cebuano hospitality and aspirations of Filipinos to the world but at the same time, it integrates state of the art technology to enhance passenger experience, optimize operations, and support sustainability efforts.	Caption 2: High ceiling, low eave, high performance glass, and skylights for optimal energy efficiency.
	
Caption 3: Interface for Solar Monitoring System and Building Management System.	Caption 4: Closer Look of our Roof-Top Solar Powered Plant at Terminal 1 of MCIA and its specification.
	

ENERGY OPTIMIZATION INITIATIVES

adani | Chhatrapati Shivaji Maharaj INTERNATIONAL AIRPORT MUMBAI

Mumbai International Airport
HVAC Optimization

Project Considered: HVAC Optimization at Mumbai International Airport Ltd. (MIAL)

MIAL is spearheading its HVAC Optimisation Project, which pivotally includes the replacement of traditional belt-driven Air Handling Unit (AHU) fans with advanced Electronically Commutated (EC) fans from Rossenburg. This critical upgrade is designed to enhance energy efficiency, operational performance, and reliability within the terminal's HVAC systems.

The replacement of the existing belt-driven fan assembly with direct-driven EC fans is **giving substantial** energy savings of approximately 25%, resulting in an annual reduction of 1.8 million units from Phase 1 **(FY2022-23),** where 50 AHUs have been retrofitted in FY 2023-24. Phase 2, covers another 68 AHUs with a total investment of INR 12 Crores (1.4 million USD) allocated for both phases.

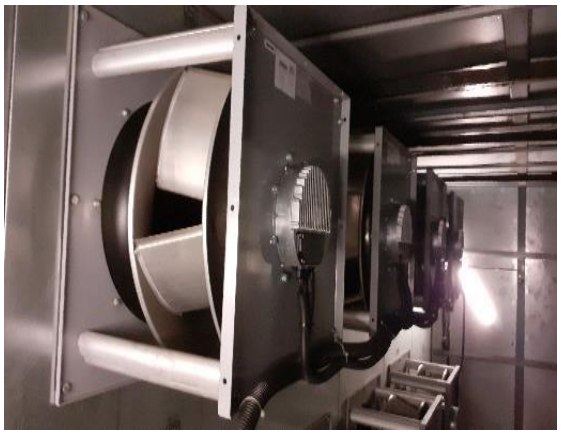
The EC fans provide multiple benefits, including improved airflow efficiency, reduced mechanical wear and tear, and lower maintenance costs. With their quieter operation and integrated redundancy systems, the EC fans promote sustainability by facilitating the removal of Variable Frequency Drives (VFDs), thereby simplifying the overall system design and increasing reliability.

Complementing the EC fan upgrade, MIAL has also implemented several additional energy-efficient technologies to optimize overall energy requirement in HVAC application within airport boundary. This includes the installation of WiFi-based temperature sensors that enable real-time monitoring of terminal conditions, leading to an estimated energy saving of 70,000 kWh. Other projects involve replacing old cooling tower nozzles and fills with more energy-efficient alternatives, collectively saving an additional 200,000 units of energy. Daily operations are further optimized through a Building Management System (BMS), which schedules AHUs, adjusts chiller operations, and manages air distribution based on real-time demand. **Also, the old non-inverter wall-mounted AC's replaced with inverter-based AC's with ISEER 5.2 or above.**

Through these initiatives, MIAL reaffirms its commitment to sustainability and energy efficiency while positioning itself as a leader in modern airport management practices.

Project Graphics

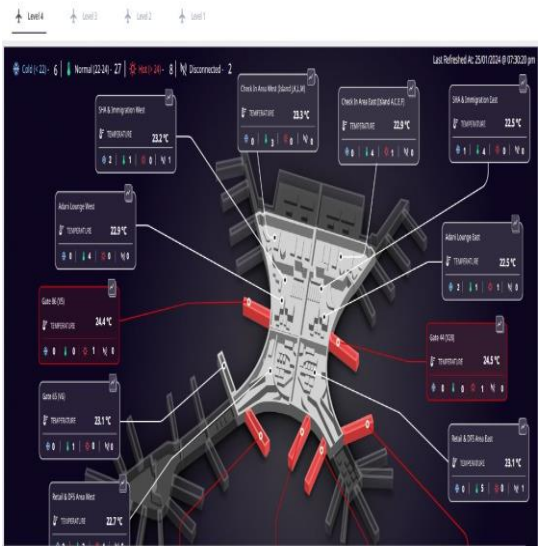
Caption 1: Sample picture of EC fan installed at Site
[Multiple fans in one unit improves reliability of system]



Caption 2: Before-After reading of few AHUs where EC fan has been installed.
[Average Energy Saving ~25%]

			KWH Reading			
Sr. No.	LOCATION	AHU NO	Before	After	Saving	% Saving
1	MEP-10	AHU 7-4 C	29.26	17.92	11.34	39%
2	MEP-10	AHU 7-4 D	30.12	20.64	9.48	31%
3	MEP-10	AHU 7-4 E	27.94	20.96	6.98	25%
4	MEP-09	AHU 11-4 C	40.21	24.8	15.41	38%
5	MEP-09	AHU 11-4 B	16.16	12.45	3.71	23%
6	MEP-11	AHU 12-4 C	36.24	17.55	18.69	52%
7	MEP-11	AHU 12-4 E	31.33	16.31	15.02	48%
8	MEP-09	AHU 11-4 D	18.47	17.89	0.58	3%

Caption 3: Real-time temperature monitoring using Wi-fi based temp sensors
[Digital replica of terminal created for better understanding and control]



Caption 4: Sample Wi-fi based temperature sensor

ENERGY OPTIMIZATION INITIATIVES

Queen Alia International Airport
Energy-Efficient Terminal Lighting Initiative

Due to the fact that 95% of Airport International Group(AIG) direct emissions are related to energy consumptions comparing with other sources which required from AIG management to focus on this emission source and take the necessary measures to reduce emission, taking in consideration AIG committed to be NetZero carbon by 2050 and reduce emissions from scope 1& 2 by 59% in 2035, that direct AIG to invest to enhance the lighting efficiency in terminal building.

Enhancing the lighting efficiency project, demonstrating AIG's commitment to energy efficiency & customer satisfaction. Taking into consideration that in 2023 more than 60% of AIG's electricity consumption is coming from terminal operations, and lighting systems.

Accordingly, retrofitting the existing lighting with higher efficiency lighting to reduce the overall emissions from the terminal facility is one of AIG's strategic directions.

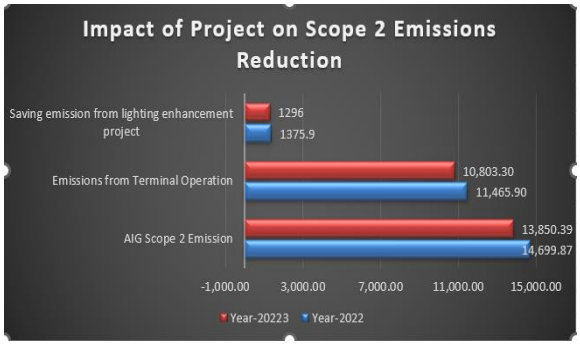
The lighting replacements across various locations inside the terminal are required by AIG to have CAPEX plan for five years due to the huge numbers (more than 16,000 units) at different locations. Most of the works were completed in-house by maintenance staff, by replacing the lighting unit and installing motion sensors in employees at offices / corridors/etc.

By replacing traditional lighting systems with state-of-the-art LED technology, AIG has achieved significant energy savings and reduced its carbon footprint. Key achievements include:

- Annual energy savings of approximately 2,872,920 kWh
- Yearly cost reduction of 360,863 JD (Jordanian Dinars)
- Improved the lighting efficiency and performance
- Enhanced the safety and visibility in critical areas
- Reduced the maintenance requirements and extended fixture lifespan

This comprehensive LED upgrade initiative aligns with global airport sustainability goals and positions QAIA as a leader in environmental stewardship within the aviation industry. The project's success serves as a model for other airports seeking to implement similar energy-saving measures, demonstrating the tangible benefits of investing in sustainable infrastructure.

Project Graphics

Caption 1: Modern LED lighting enhances terminal brightness, sustainability, and passenger comfort.	Caption 2: Image of lighting at Curb side-Public area
	
Caption 3: Image from Building Management System (BMS)	Caption 4: Chart showing project emission saving impact
	

ENERGY OPTIMIZATION INITIATIVES

Taoyuan International Airport

Sustainable Energy

Taiwan Taoyuan International Airport (TTIA) established the "Sustainability Committee" in 2019 to declare its determination to actively deepen and implement sustainable operations. As Taiwan's leader in moving toward green airports, TTIA takes concrete actions to achieve net-zero emissions by 2050. Building and purchasing more sustainable energy is an important factor in achieving net-zero emissions. Therefore, TTIA continues to promote:

1. Since 2021, photovoltaic systems have been installed in the T1 and T2 terminals; the new T3 will also be installed and obtain the green building label.
2. Research the possibility of widely installing low-carbon sustainable energy, such as biomass, photovoltaic, hydrogen, wind power, and other green energy sources, and also consider building energy storage systems to enhance power resilience. By 2030, the goal of using 20% green energy will be achieved through self-construction and outsourcing.
3. On Aug. 2024, the SOP for adding SAF had been completed on a trial basis, and airlines will be required to use more SAF; and TTIA is planning to provide at least 5% SAF by 2030.

TTIA deeply understands that "saving energy and resources" is as pragmatic as "using sustainable energy" and is a more innovative strategy and approach. Therefore, from 2020 to 2024, TTIA focused on improving the energy efficiency of equipment. At the same time, introduce electric vehicles and use renewable energy to reduce direct and indirect carbon emissions, such as: optimising dispatch for improving aircraft fuel efficiency; purchasing EV; adding charging stations/piles; using PGA and FGP; switching to environmentally friendly refrigerant; saving water; reusing wastes and waste water; using energy-saving lamps; encourage passengers to take public transportation, etc.

TTIA has implemented various measures to introduce sustainable energy, and has achieved specific quantitative and qualitative benefits in saving energy, reducing carbon emissions, increasing resilience, promoting public recognition, promoting efficiency, and moving towards sustainability.

Project Graphics

Caption 1: Photovoltaic systems on T2 of TTIA	Caption 2: Electric shuttle bus of TTIA
	
Caption 3: Charging stations/piles in TTIA	Caption 4: Electric luggage trailers of TTIA
	

Airports Council International

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ACI Asia-Pacific & Middle East (ACI APAC & MID) serves as the voice of airports. It represents 131 airport members, operating over 608 airports from 44 countries across Asia-Pacific and Middle East. ACI APAC & MID is head-quartered in Hong Kong and has a Middle East office in Riyadh (Kingdom of Saudi Arabia). ACI APAC & MID represents the collective interests of airports to promote professional excellence in airport management and operations. ACI APAC & MID's mission is to advocate for policies and provide services that strengthen its members' ability to serve their passengers, employees and stakeholders. According to the latest Economic Impact assessment, Air transport supported 46 million