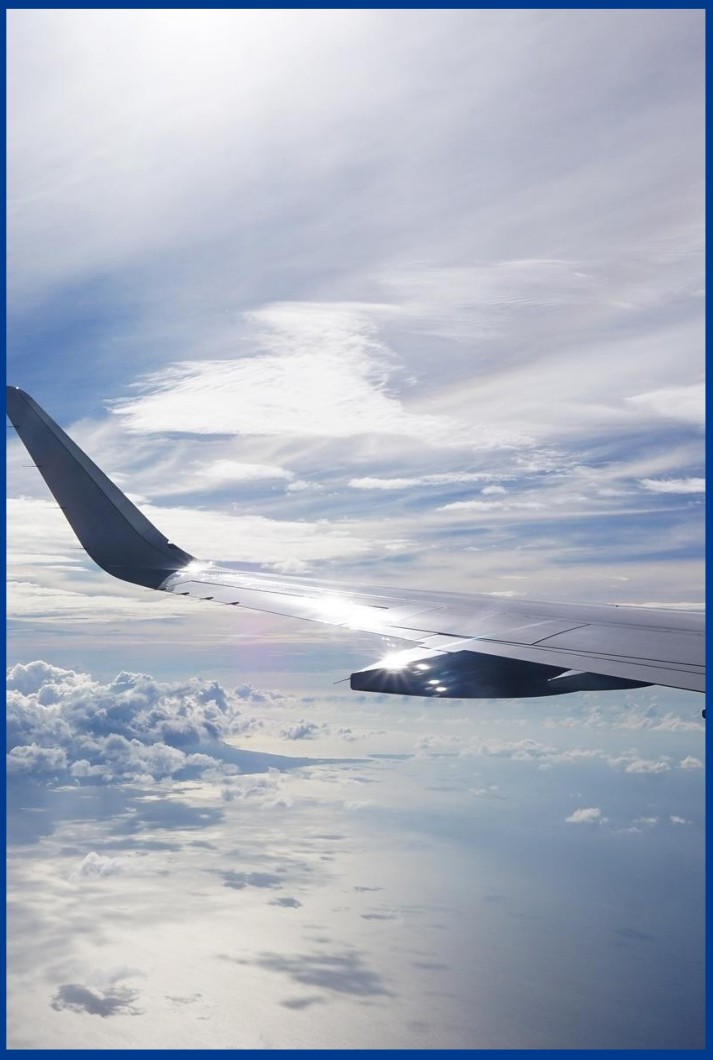
ACI ASIA-PACIFIC
AIRPORTS COUNCIL INTERNATIONAL

Green Airports Recognition 2021

Air Quality Management

ACI ASIA-PACIFIC
GREEN AIRPORTS RECOGNITION



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June 2021
ACI Asia-Pacific

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INTRODUCTION AND ACKNOWLEDGEMENTS

The Green Airports Recognition programme was established with the support of the ACI Asia-Pacific Regional Environmental Committee (REC). The objective of this recognition is to share the best practices to minimize aviation's impact on the environment and to recognize ACI Asia-Pacific airport members who have achieved outstanding performance in their environmental projects.

Understanding that different airports have many varieties of environmental priorities, a specific environmental aspect is chosen each year as the theme of Green Airports Recognition. In the Environmental Survey 2019, 34% of senior management at airports highlighted air quality as a priority. With mitigation and best practices implemented by airports in the region, air pollutants such as Nitrogen Oxides (NOx), Sulphur Dioxides (SOx), Volatile Organic Compounds (VOC), Carbon Monoxide (CO), Hydrocarbons (HC) and Particulate Matters (PM) are monitored and reduced to minimize the negative impacts to local community. Without proper air quality management, air pollution has known negative environmental and health impacts such as chemical smog, acid rain and human respiratory disease.

There are several references available to address airport air quality issues. ICAO's Airport Planning Manual Part 2 (Doc 9184) identifies the emissions issues related to airport operation and the relevant mitigation measures. The ICAO Airport Air Quality Guidance Manual (Doc 9889) provides detailed guidance on assessing air quality at airports.

There are also tools available to determine emissions at the airport such as Zurich Airport's Aircraft Local Emissions Calculator for Airports (ALECA), a standalone emission calculation tool for all aircraft-related emission sources at an airport. The ACI Aircraft Ground Energy System - Simulator (AGES-Simulator) evaluates the environmental and economic benefits of substituting the use of the Auxiliary Power Unit (APU) by AGES by calculating the reduction of fuel consumption.

Carbon Dioxide and other greenhouse gases (GHG's) affecting the climate have interdependencies with air quality and will be briefly mentioned. However, this recognition and publication will focus only on airport local air quality.

Eleven member airports, ten of which are already accredited under the *Airport Carbon Accreditation* programme, submitted eligible submissions This year's submissions showcased innovative practices in the categories of basket of measures, equipment and vehicle power replacement, green plantation and prevention of open fire.

The submissions were reviewed by a panel of judges comprising;

- Mr. Christopher Surgenor, Editor/Publisher, GreenAir Online
- Dr. Panagiotis Karamanos, Aviation Environmental Consultant
- Mr. Christopher Paling, Senior Lecturer in Environmental Management, Manchester Metropolitan University
- Ms. Juliana Scavuzzi, Senior Director, Sustainability, Environmental Protection and Legal Affairs, ACI World
- Mr. Stefano Baronci, Director General, ACI Asia-Pacific

We would like thank all judges for their expertise and valuable time.

RECOGNIZED AIRPORTS

After collective assessment with eight relevant criteria, the panel of judges recognized the following airports:

Over 25 million passengers per annum:

- Platinum – Indira Gandhi International Airport
- Gold – Hong Kong International Airport
- Silver – Taoyuan International Airport

Less than 25 million passengers per annum:

- Platinum – Brisbane International Airport
- Gold – Rajiv Gandhi International Airport
- Silver – Kaohsiung International Airport

ACKNOWLEDGEMENT OF ALL PARTICIPATING AIRPORTS

The outstanding work of the above six airports plus other submissions are summarized in this publication to ensure best practices are shared. Two additional case studies were added to this publication to facilitate best practices sharing. However, it should be emphasized that all airports in this publication deserve to be recognized for their commitment to air quality management and willingness to share their stories with the airport community, fully reflecting the objective of this recognition.

Basket of Measures

Chhatrapati Shivaji Maharaja International Airport

Enhancement in Ambient Air Quality

Chhatrapati Shivaji Maharaja International Airport (CSMIA) airport is located in the heart of India's capital city Mumbai and is the second largest airport in the country. Though CSMIA is situated at the center of the city and surrounded by a highway and an industrial belt, it has always put efforts to safeguard ambient air quality levels. The airport continuously monitors ambient air quality levels for Sulphur Dioxide (SO2), NOx, CO, Ozone (O_3), Total hydrocarbon (THC), Lead (Pb), PM2.5 and PM10, etc. It has recently conducted a project of enhancement of air quality, executed simultaneously via two initiatives: the installation of fixed electrical ground power (FEGP) and pre-conditioned air (PCA) systems at all the aerobridges of the terminal buildings, and the use of Airport Collaborative Decision Making (A-CDM). The total cost of this project was approximately 12.5 million INR (~US$160K). Both these initiatives were a retrofitting project to achieve maximum landing and take offs in an hour. Both these projects were simultaneously implemented from 2016 - 2019.

Fixed electrical ground power

To reduce fuel burn emissions while aircraft are parked, FEGP units were installed at 70 aerobridges between Terminals 1 and 2 (72 GPU and 58 PCA units). At some aerobridges in terminal 2, both GPU and PCA units were fitted. The diesel consumption of power units used before the installation of FEGP is now non-existent, as diesel-based GPUs were completely replaced with FEGP.

Airport Collaborative Decision Making (A-CDM)

To effectively utilize slots and minimize taxiing time for aircraft, the A-CDM application was developed in collaboration with the Airport Authority of India (AAI) for all aircraft landing and take-offs. A-CDM takes into consideration the Expected Time of Arrival (ETA), Target Off Block Times (TOBT) of departures, runway in use, and the handling capacity of runway to determine the arrival and departure sequence. Based on the sequence and the parking position, it calculates the Target Take Off Times (TTOT) and Target Start up Approval Times (TSAT) of departures and Target in Block Times for arrivals. The airport was able to reduce aircraft taxiing time, which resulted in drastic reduction in fuel consumption and aircraft emissions on taxiways.

The airport also installed Continuous Ambient Air Quality Monitoring Stations (CAAQMS) at two different locations, covering the landside and airside areas. The parameters monitored at these stations are per the 2009 National Ambient Air Quality Monitoring Standard (NAAQS).

These stations were installed in 2016 and 2018. The reducing trend of the Air Quality Index (AQI) for 2018, 2019 and 2020 (until March) shows a reduction in emissions including gaseous and particulate matter.

Project Graphics

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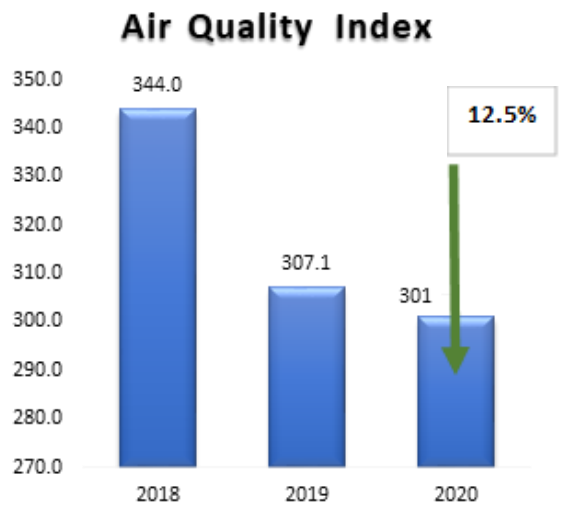
<td> 
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<td>Air Quality Index for three consecutive years.</td>
<td>Continuous Ambient Air Quality Monitoring Station installed at airside near R/W 09 end.</td>
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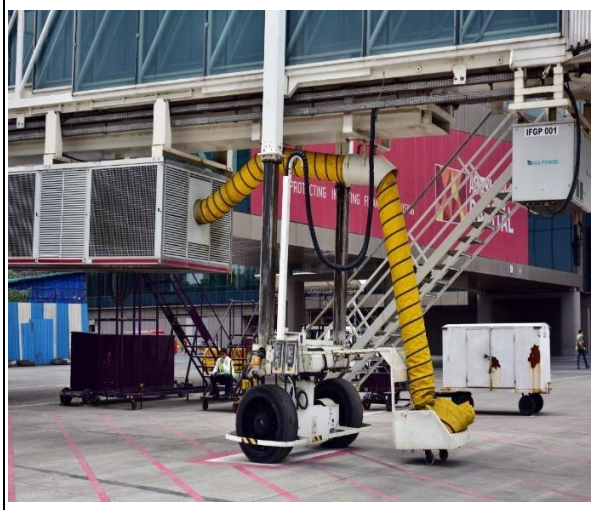
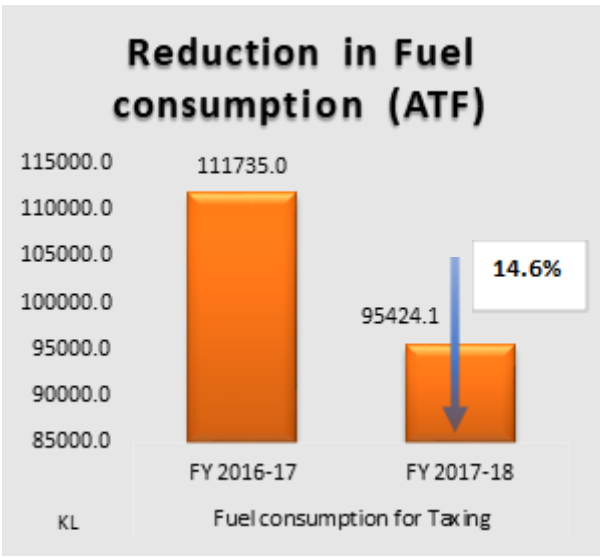
<td>  </td>
<td> 
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<td>PCA system installed at the aerobridge of Terminal 1.</td>
<td>Reduction in fuel consumption following installation of A-CDM application.</td>
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Basket of Measures

Kaohsiung International Airport

Outdoor Air Quality Management

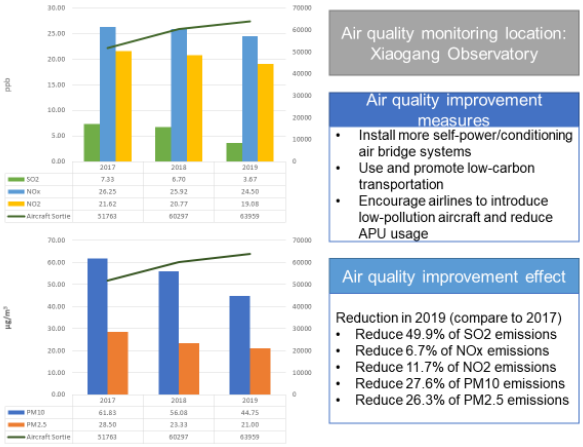
Kaohsiung International Airport (KHH) regards environmental management as one of the key sustainability topics, in which initiate the Air Quality Management project. In the past three years, air pollution, which consists of NOx, SOx, and Pms, has significantly decreased. Through the analysis of pollution inspection points, pollution concentration reductions from 2017 to 2019 are as follows: SO2 49%, NOx 6.7%, NO2 11.7%, PM10 27.6%, PM2.5 26.3%. Air quality has significantly improved.

The project implementation included five approaches:

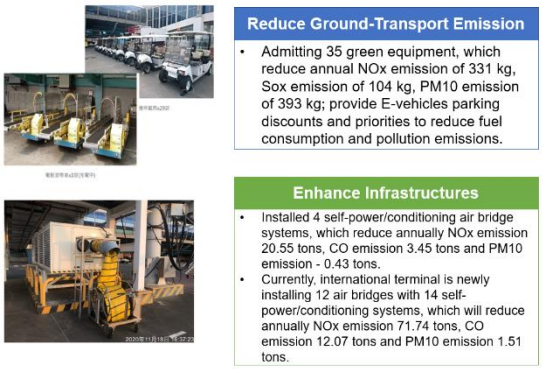
1. Airport Air Pollution Monitoring: English pollution inspection points near runway (monitoring pollutants such as SO2, NO2, PM25/PM10, NOx) to ensure emission within standards.
2. Regulating Pollutions: Implement No Open-Air Burning policy around airport to ensure flight safely and emission control, which prohibit burning of plants and solid waste.
3. Enhance Infrastructure: Installed 4 self-power/ conditioning air bridge systems in 2017, which reduced annual NOx emission by 20.55 tons, CO emission by 3.45 tons and PM10 emissions by 0.43 tons. The CO2 emissions caused by APU in 2018 were 11,288 tons, reduced to 8,602 tons in 2019. Currently, the international terminal is installing eight more by 2024. It estimated to reduce annual NOx emission by 71.74 tons, CO emission by 12.07 tons and PM10 emission by 1.51 tons.
4. Reduce Ground Transport Emission: Supporting to admit 35 green transportation equipment, which reduce annual NOx emission by 331 kg, Sox emission by 104kg, PM10 emission by 393 kg and provide parking discounts for electric-vehicles and priorities to reduce fuel consumption and pollution emissions. In 2018, the CO2 emissions caused by ground transport equipment was 1,020 tons, reduced to 1,007 tons in 2019.
5. Promotion: Periodically air pollution management promotion, encourage to introduce low emission aircrafts and close 1-2 APU when gliding etc. Establish environmental achievements section on company websites and promote emission control actions through social media.

Project Graphics

Five approaches of air quality control project



Air quality improvement effect



Reduce ground transport emission and enhance infrastructure

Promoting air quality control

Basket of Measures

Rajiv Gandhi International Airport

Sustainable Airport Operation for Effective Airport Air Quality Management

To reduce air emissions as well as operating costs, GMR Hyderabad International Airport Limited (GHIAL) has adopted a wide array of eco-friendly technology, infrastructure, and practices in collaboration with their stakeholders. These efforts have resulted in minimizing the air emissions and maintaining good air quality at the airport and its surroundings. Rajiv Gandhi International Airport's (RGIA) green initiatives are also aligned with ICAO's Environmental Goal *to limit or reduce the impact of aviation emissions on local air quality*, and the UN Sustainable Development Goal 3 to ensure healthy lives and promote well-being for all at all ages.

More concretely, these sustainable airport operations have resulted in significant reduction in fossil fuel consumption and air emissions at the airport:

- **Sustainable landing and take-off cycle of aircraft(s) and ground support operations, single engine taxiing**: Air Traffic Control and the airlines practiced Continuous Descent Approach and Continuous Climb Operations for landing and departing aircraft to reduce aircraft fuel burn. Single engine taxiing of aircraft avoided 40-50% of aviation turbine fuel (ATF) fuel burn per air traffic movement, or approximately 4,382 kl of ATF saving in a year. The airline in co-ordination with the airport operator implemented aircraft single engine taxiing and used the Fixed Electric Ground Power Unit (FEGP) in place of the APU since 2016.
- **Fixed Electric Ground Power Unit**: From 2017-2019, 1,596,190 kWh of electricity used which in turn avoided ATF of 152,749 litres from aircraft APU.
- **Solar-powered ground support equipment**: In 2019, Air India's ground handler SATS developed a prototype of solar ground support equipment - baggage flight loader, and step ladder in place of diesel equipment. Airside annually avoided 102,209 litres of diesel and emissions: NOx: 1672 kg; CO: 965 kg; PM: 190 kg.
- **Electric ground transportation**: GHIAL and ground support departments introduced five electric coaches and 12 e-tugs and cars. The airport collaborated with the State Road Transport Corporation in introducing 40 electric buses in 2019 for the passengers' commute. Electric buses and cars in the city side of the airport prevented 4,567 litres of diesel and emissions savings: NOx: 38,105 kg; CO: 22,874 kg; PM: 1,750 kg in 2019.

- **Green belt**: 693 acres of developed greenery and more than 2,000 acres of natural vegetation absorb 685 tonnes of CO2 in the premises of the airport.
- **Ambient air quality monitoring station**: GHIAL installed a real-time monitoring station that measures NOx, CO, PM 10 and PM 2.5, SO2, O3, and HCs. The airport's recorded air quality parameters are well within the stipulated norms.
- **Dust mitigation** from the airport expansion activities.

The savings from all these measures are to the tune of INR 150-195 million (~US$2.0- 2.6 million) every year.

Project Graphics

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<td>Electrical shuttle coach for passengers by the airport operator</td>
<td>Vehicle charging point provided by the airport for GSD equipment to avoid diesel equipment</td>
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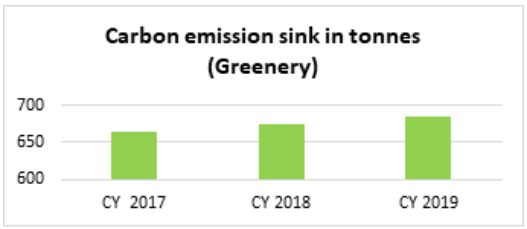
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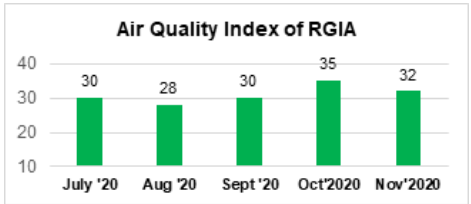


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<td>Forty electric busses introduced for city-side passengers to commute between the airport and the city of Hyderabad.</td>
<td>The Ambient Air Quality Monitoring Station (24X7) provided by the airport to continuously monitor the airport air quality.</td>
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Basket of Measures

Taoyuan International Airport

Air Pollutant Reduction Plan

To strengthen the management and operation performance of environmental protection, Taoyuan International Airport introduced an ISO 14001 environmental management system in 2019 and identified incinerators and fuel vehicles as the main contributors to air pollution. Through continuous improvement, stationary pollution sources and mobile pollution sources from airside and landside, including incinerators, baggage consignment, and taxi scheduling, as well as other fuel vehicles and others, are now monitored. With the integration of third-party resources and the provision of complete educational training and other measures, the partners have helped to promote an integrated gaseous and particulate pollutants reduction plan, containing three sub-projects, described below.

1. **Reduction projects electrification for airside operation vehicles:** Through a pass-review mechanism, fuel vehicles were gradually prohibited from using airside areas, and 148 fuel luggage trailers have been replaced, helping to cut down air pollutant emissions: 1.4 tons of NOx and 1.8 tons of CO.
2. **Incinerator upgrade**: Introduced a remote intelligent monitoring system to improve the proper availability rate of equipment, strengthening the efficiency of waste incineration and waste gas treatment, and comprehensively improving the efficiency of incineration plants, further reducing all kinds of air pollutants such as TSP, SOx, NOx, CO, and others, to levels lower than 10% of the national emission standards.
3. **Cloud-smart scheduling application for taxis**: Developed a scheduling application and cloud software to reduce emissions from landside taxis. It helped 600 vehicles to apply passenger services through the app. The system proactively notifies the drivers about passengers' journey times, reduced fuel consumption and CO emissions, and reduced fuel costs by NT$21.6 million (~US$760K) every year.

After the implementation of the plan in 2019, the annual environmental performance includes a reduction of 10.1 metric tons of TSP, 1.7 metric tons of PM10, 1.2 metric tons of PM2.5, 59.9 metric tons of NOx, 36.1 metric tons of SOx, 49.9 metric tons of CO, 13.9 metric tons of total hydrocarbon, and 12.5 metric tons of Non-Methane Hydrocarbon.

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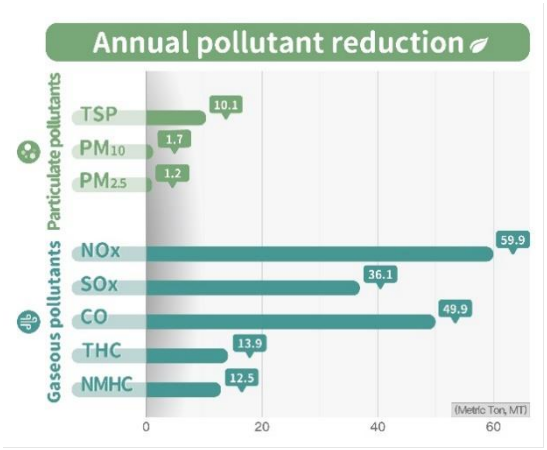
<td> 
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<td>Annual environmental performance</td>
<td>Continuous Emission Monitoring System</td>
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<td>Electrification for airside operation vehicles</td>
<td>Cloud-smart scheduling application for taxis</td>
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Brisbane Airport

Electric Bus Fleet and Changing Station

At Brisbane Airport, dedicated bus services are required to convey passengers and staff to and from remote car parks; between the domestic and international terminals, and to and from the terminals and Skygate shopping precinct. Brisbane Airport's landside bussing contract was due for renewal in 2017 which was the trigger to upgrade the older, diesel bus fleet.
The electric bus fleet operates landside servicing the whole airport precinct. The tender panel included representatives from BAC's Parking and Transport, Customer Experience, Environment and Sustainability, and Finance teams. Each of the 12 electric buses were built new and funded through operational expenditure as part of the bus services contract, whereas the construction of the dedicated facility for bus charging, parking, and maintenance was funded through capital expenditure, all of which is privately funded by BAC.

The BYD TORO is the world's most modern and technologically advanced electric bus. Developed jointly by Carbridge and electric vehicle manufacturer BYD, the TORO is helping to reduce carbon emissions, improve local air quality, lower noise levels, and reduce waste fluids. Real time data is generated for each electric bus and monitored via the ViriCiti dashboard, an all-in-one platform for electric fleet management. The dashboard provides a vast array of information to optimize the fleet's operations including temporal metrics (e.g. time charging/time driving), performance metrics (e.g. C02/pollutants, mileage driven), energy metrics (e.g. energy consumed/regenerated driving) and state of charge metrics. ViriCiti has recorded the following data for the bus fleet's operation to date (February 2018 to 18 November 2020):

- 1,049,922 km have been driven
- 1,223,000 L of diesel fuel has been saved
- 1,952,561 kwh of energy has been consumed in charging

Grid electricity emissions are offset by a 1.8MWp solar PV array located in the same precinct as the bus charging station (Brisbane International Terminal rooftop array). However, without including the emissions offset by renewable energy, ViriCiti calculates the following emission savings have occurred from using the electric bus fleet since operations commenced:

Emission type	Emission Factors	Total Savings	Per Year Savings
C02 (tonnes)	0.5925 kg/kWh and 2.642 kg/L	1,025.8	341.93
PM (particles) (kg)	0.005 g/ kWh and 0.111 g/L	15.2	5.06
N0x saved (kg)	0.2 g/kWh and 4.44 g/L	608	202.66

Other assumptions:

- Emissions produced from the grid (0% renewable energy) – not including 1.8MWp solar
- Non-electric (diesel) bus consumption = 35 L/ 100 km
- Per year savings divide 3 full years of operation by the emission types and are conservative due to a reduction in service due to COVID-19 from April – November 2020

Project Graphics

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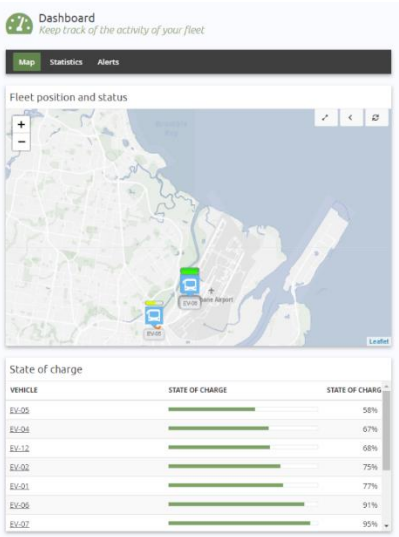
<td> 
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<td>Skygate/ terminals electric transfer bus
Credit: Brisbane Airport Corporation, Photographer Jen Dainer</td>
<td>ViriCiti dashboard showing fleet position and status, 19 November 2020</td>
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<td>Electric bus charging station and electric bus
Credit: Brisbane Airport Corporation</td>
<td>Electric bus charging station
Credit: Brisbane Airport Corporation</td>
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Equipment, Vehicle Power Replacement

Christchurch Airport

Innovation and Aquifers

At the heart of Christchurch Airport's sustainability strategy is the Maori concept of Kaitiakitanga – responsibility, care and guardianship for our natural environment and future generations.

The "Innovation and Aquifers" project involved the replacement of our diesel and LPG boiler system with a clean ground source heating and cooling system, resulting in improved air quality and carbon reductions.

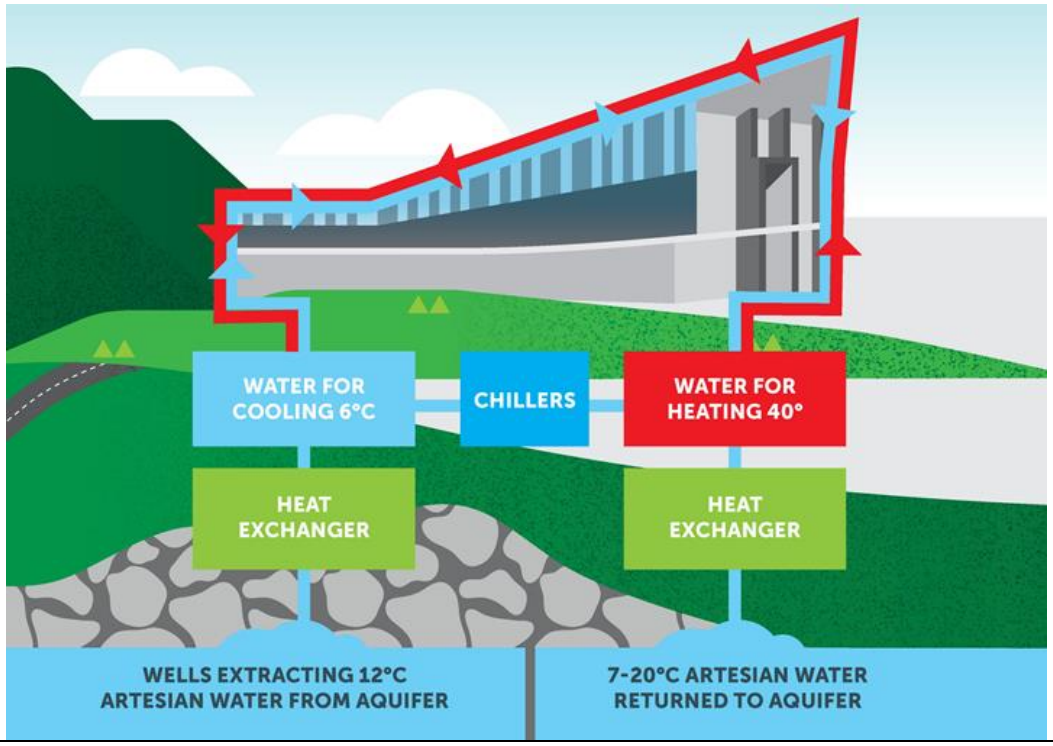
Christchurch Airport pioneered the use of ground source heat systems (GSHP) in New Zealand. GSHP works by harnessing the artesian water flowing underneath Christchurch and the Canterbury Plains to both heat and cool Christchurch's entire terminal building.

The artesian water, which has a fairly consistent year-round temperature of 12°C, lent itself well to a heat pump-type system. Once extracted, the artesian water passes through heat exchangers that increase or decrease the water's temperature to extract or reject heat energy. Cooling the water provides heating to the building (by extracting heat energy), while heating the water provides cooling to the building (by rejecting heat energy). When conditions suit, this equipment can be bypassed to further enhance performance. The heat exchangers create a physical separation between the artesian water and the building's water supply to eliminate the risk of contamination of the artesian water. Afterwards, the water is returned in the same condition it was taken (with only the temperature altered).

The installation of our GSHP system has allowed us to decommission our terminal diesel boilers. During the 12 months since its installation in November 2019, the airport has seen a reduction of 982 tCO2e, this equates to an 83% reduction in our Scope 1 emissions.

In terms of air quality measures, Christchurch Airport takes hourly air quality readings, and achieves an average of 17 AQI (US), which puts us within the top eight cities worldwide.

Project Graphics



Ground source heat systems schematic

Ground source heat systems plant room

Equipment, Vehicle Power Replacement

Hong Kong International Airport

Ground Services Equipment Pooling Scheme – Phase 1

With a view to improving operating efficiency and reducing air emissions, Airport Authority Hong Kong (AAHK) rolled out a new Ground Services Equipment (GSE) Pooling Scheme at Hong Kong International Airport (HKIA) in July 2018. Initially implemented as Phase 1 at Midfield Apron, the scheme enables ramp handling operators (RHOs) serving client airlines to rent critical GSE, of which 95% are electric-powered, from AAHK. Phases 2 and 3 of the scheme are planned and when fully implemented in 2024, AAHK will own 1,000 units of GSE.

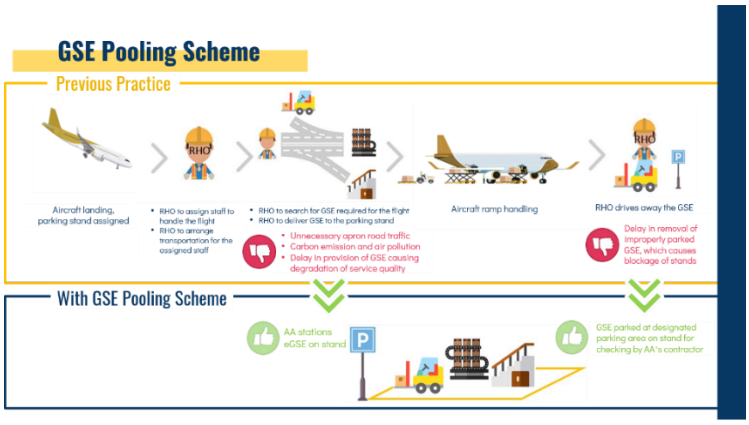
The scheme was first conceived when AAHK initiated a review of aircraft ramp handling processes, which included an in-depth analysis of arrival baggage delivery performance in 2016. The findings revealed timely provision of GSE is one of the most important factors affecting HKIA's service standards. Likewise, the deployment of GSE from flight to flight across the apron increasingly led to traffic congestion peak periods throughout the day. This not only affected the on-time performance of arriving baggage and departing flights, but also led to increased air emissions, especially when the RHOs have been using many aged diesel-powered GSE.

Under the new AAHK's ownership model, all critical GSE are standing by at every parking stand and the need for mobilizing GSE is minimized. This not only brings benefits in terms of reduced emissions and energy use, but also reduced unnecessary traffic on apron road and traffic congestion. Moreover, with 95% of GSE being electric-powered, exposures of workers and other receptors to NOx, particulates and other pollutants are significantly reduced. In addition to spending over HK$300 million (~US$38.6 million) to procure the GSE, AAHK also funded installation of chargers, established two GSE maintenance workshops, provided training, and developed detailed operations process to include in its handbook.

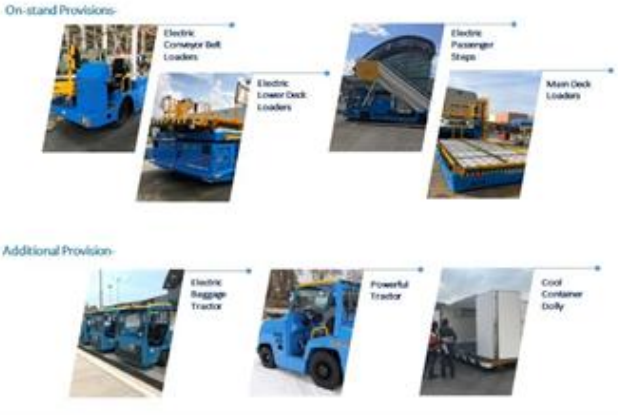
Through early engagement of RHOs and other relevant stakeholders in planning of the scheme, AAHK demonstrated the power of proactive, collaborative stakeholder engagement. The scheme is well received by all stakeholders including the RHOs, as it promotes resources sharing with guaranteed GSE availability at a lowered operating cost. The scheme allowed optimized use of GSE and at the same time reduced the total GSE fleet size needed at HKIA.

Through centralized provision, management and maintenance of all critical GSE, the overall investment and operational cost are reduced while safe operation of GSE are also enhanced via relevant training provided to RHOs. The provision of on-stand GSE also helped RHOs to meet prescribed performance level and avoided aircraft ground delays caused by lateness or insufficient provision of GSE. From available statistics for Q4 2019, the key performance indicators for baggage delivery performance have consistently surpassed 97% with a daily throughput exceeding 127K bags on average, which demonstrated overall enhancement of the RHOs' operation efficiency.

Project Graphics



Enhanced ramp handling process enabled via new HKIA's GSE Pooling Scheme



AAHK's GSE provided for rental use of RHOs

New GSE Maintenance Workshop established by AAHK

eGSE Chargers installed by AAHK at parking stands

Equipment, Vehicle Power Replacement

Indira Gandhi International Airport

Green Taxi

Local air quality management at Indira Gandhi International Airport (IGIA)is one of the important environmental and key materiality aspects of Delhi International Airport Limited (DIAL)'s business sustainability. DIAL and its stakeholders always believe that the air quality at the airport has a major influence on its business, since the region of Delhi experiences bad air quality during winter seasons. To exemplify the air quality improvement in the region, DIAL and its stakeholders have taken numerous initiatives. One of the most recent and promising projects implemented at Delhi Airport is the use of TaxiBot for aircraft taxiing.

TaxiBot is a semi-autonomous vehicle that enables airplane taxiing without engines running, controlled by the pilot and without shortening the nose landing gear lifetime. In a conventional aircraft taxi process, an aircraft is tugged by a ground vehicle to the Tug Detach Point. Following this, the aircraft switches on its engines and taxies to the runway. Starting the engines early means the aircraft is using more aviation turbine fuel (ATF), and it also leads to air pollution in the form of NOx, CO, HC, SO2, PM and CO_2 emissions.

The use of TaxiBots helps in delaying the operation of aircraft engines and avoids the burning of AFT. This benefits DIAL and its stakeholders both environmentally and economically, as well as the region's local air quality.

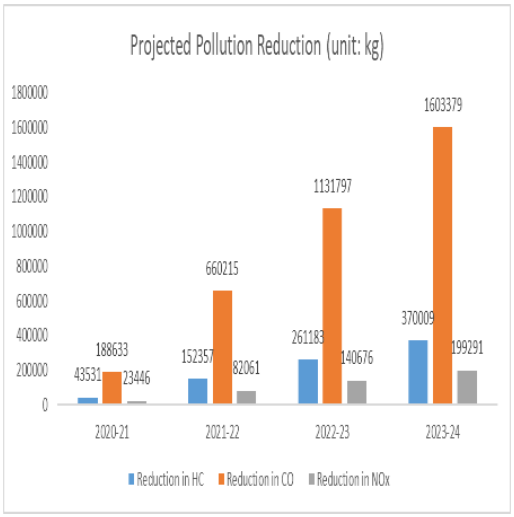
Airlines in Delhi Airport have achieved the following benefits (calculated using ICAO Aircraft Engine Emissions Databank), from more than 450 TaxiBot missions completed till now:

- Saved more than 52,463 liters of ATF (the actual benefits are much higher than the presented values).
- Local air quality benefits:
    - Total NOx saving 723 kg, total CO saving 5,814 kg and total HC saving 1,342 kg.

Currently, two TaxiBots are deployed at Delhi Airport, which can handle 30-40 aircraft/day. In addition, DIAL is planning to add 15 more TaxiBots in the next three years, which will further multiply the local air quality benefits in the region. Following the success of Delhi Airport, a number of Indian airports as well as few global airports are planning to adopt TaxiBot to support the business sustainability.

Project Graphics

First time in the world an Airbus aircraft of a passenger airline performed TaxiBot operations at Delhi Airport

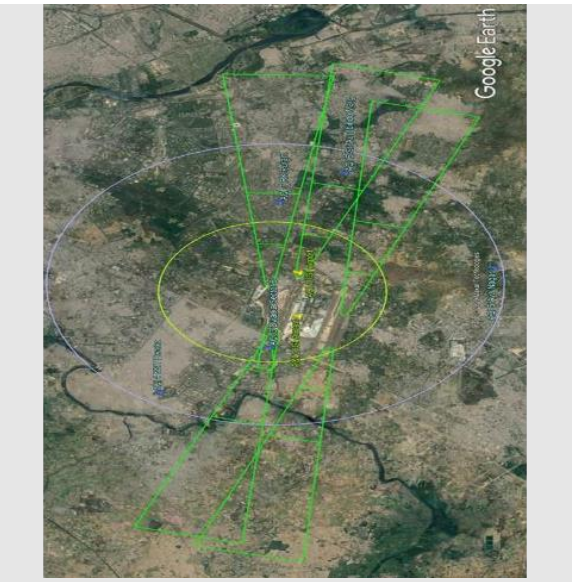


Projected pollution reduction with planned implementation of 17 TaxiBots at Delhi Airport

By the year 2023-24, TaxiBot will cover more than 47% of all departure movements at IGIA. Keeping 47% as a base, the calculated total pollution load reduction in local air quality is shown below

Year	ATM as per Master Plan 2016	No of Departures	Reduction in (tonnes)			Total Pollution Load reduced (tonnes)
			HC	CO	NOx	
2024/25	579520	289760	409	1772	220	**2401**
2025/26	603400	301700	426	1845	229	**2500**
2026/27	625610	312805	441	1913	238	**2592**
2027/28	645820	322910	456	1974	245	**2675**
2028/29	664140	332070	469	2030	252	**2751**
2029/30	680860	340430	480	2082	259	**2821**
2030/31	698790	349395	493	2136	266	**2895**

The projected total pollution load reduction in local air quality by using TaxiBot



Air Quality Monitoring Stations in IGI Airport and neighboring area, within a radius of 5 km (yellow mark) and 10 km (blue mark). The yellow points are monitoring stations within IGIA, blue points are monitoring stations in neighboring area

Equipment, Vehicle Power Replacement

Kansai International Airport

Air Pollutants Reduction by Introducing Zero Emission Vehicles

Kansai Airports Group is actively promoting the reduction of air pollutant emissions, by introducing ZEVs (Zero Emission Vehicle), equipment and vehicles that reduce environmental impact specially in confined spaces.

Main objectives carried out from 2018 to 2020:

1. Electric power to aircraft using electric Ground Power Unit (eGPU)
2. Replacement of GSE vehicles (forklifts)

The following activities were implemented:

- Using the eGPU effectively, we found that we can supply power to aircraft parked in areas where there are no GPUs with zero emissions of air pollutants. CO2 emissions are lower than those from in-house power generation using aircraft auxiliary engines and diesel GPUs, and have been reduced to about 1/30 of those from in-house power generation using aircraft auxiliary engines and to about 1/10 of diesel GPUs.
  This strategy has allowed us to demonstrate to Peach Airline and our partner for GPU that eGPU is a reliable alternative to APUs in locations without GPU.

- The introduction of electrical charging points was the missing infrastructure to our cargo area to promote that forklifts with no emissions can be used in a confined space.
  The results are:
  - The reduction of air pollutant emissions due to the absence of exhaust gasses and odours,
  - Improvement of the working environment by making the shed quiet and clean. Demonstrations of the commitment of Kansai Airports Group towards ZEV even during a crisis time.
  - This strategy has allowed the introduction by the ground handlers of about 22 hydrogen forklifts since 2018 and 18 electric forklifts since 2018.

As a result, we have succeeded in reducing emissions of air pollutants and CO_2.

Project Graphics

	
eGPU	Scene of use
	
Electrical charging point	H_2 station for industrial vehicles

Green Plantation

Sharjah Airport

Green Oasis project

The green oasis project at Sharjah Airport is an initiative by the Sharjah Airport Authority to improve the local air quality at the landside of Sharjah Airport. The project was planned and executed by the gardening unit of Facilities department at Sharjah Airport Authority. The project consists of development of green grass areas and plantation of trees and shrubs at the land side area of the airport which in turn improves the local air quality.

The geographical location of Sharjah Airport is in a deserted area. Barren land area near gate: 13 and near alpha catering building is mainly filled with sand and a slight wind always creates a dusty environment. Sand storms have a critical role in local air quality. Specifically, PM (Particular Matters) 10 and PM (Particular Matters) 5 level are at a high range during sandstorms. Which will have a major impact on the local air quality in that area and health of those working in that area.

To control the sandstorms in the project area, Sharjah Airport Authority decided to plant green grass, trees and shrubs at the sand-filled barren land at the landside area which is close to gate number 13, alpha catering building and Engineering complex. A total of 5038m^2 of green grass area and 5110m^2 area covering trees and shrubs which include 128 date palms, 25 washingtonia trees, 22 neem trees, 8 jamon trees, 24 other trees, 434 jatropha plants, 650 Pentium grass has been developed. The conversion of the sand-filled barren land to a green grass oasis helped to control the sandstorm in that area and improved the local air quality. The plantation of trees and plants also helped to reduce the atmospheric carbon dioxide level as a single tree is capable of 23 kg of CO2 each year.

Project Graphics

	
Project area after completion	Project area after completion
	
Project area after completion	Project area during the work

Prevention of Open Fire

Darwin International Airport

Bushfire Mitigation Project

The Rapid Creek Bushfire Mitigation Project was developed from air quality and biodiversity impacts experienced as a result of three wildfires that occurred in late 2019 at the Rapid Creek Reserve at Darwin International Airport (DIA). The fires lit by arsonists in late 2019 coincided with extremely hot and dry conditions causing wildfires to develop. Wildfires at this time have an impact on the biodiversity of natural areas and generate thick smoke that negatively impacts airside operations and the health and safety of airport users. The project focused on Rapid Creek Reserve, which is a landside reserve area on airport land.

The project was primarily a series of meetings with various project stakeholders followed up by additional land management activities, new bushfire response procedures and providing resources to Northern Territory Fire service to best undertake bushfire response.

Main achievements

1. Improved response by emergency services and DIA staff in the event of a wildfire: Updated DIA bushfire management procedures and stakeholder workshops to trouble shoot issues related to efficient bushfire response.
2. Increased fire management tasks: More detailed DIA fire management plans that include areas and timing for where cool season burns will occur.
3. A more educated and connected community: Resources and information sessions provided to the Northern Territory Fire Service including detailed maps of airport land within each fire truck and training sessions with firefighters about the biodiversity value of Rapid Creek.
4. A closer relationship with the Australian Federal Police for bushfire response and understanding the arson risk along Rapid Creek Reserve.
5. Greater engagement activities with the Larrakia Rangers.
6. Greater understanding of wildfire risks and effective wildfire response across department managers within DIA.
7. Liaising with other landowners and managers along Rapid Creek about fire response issues.

In 2020 there were two fires that were lit by arsonists, but neither event developed into wildfires, with improved coordination and response in fire management by emergency services and DIA.

Rapid Creek Reserve continues to regenerate after the 2019 fires and an updated land management plan for the reserve now includes cool season burns that will be undertaken with the Larrakia Rangers.

Project Graphics

	
Thick smoke from wildfire threatening airside operations at Darwin International Airport, October 2019.	Poor visibility and air quality across the airport, October 2019
	
Stakeholder engagement event with the Northern Territory Fire Service	Land management planning after the fire.

King Khaled International Airport

Emissions and Noise Management

King Khaled International Airport (KKIA) started the project with phase 01 in 2017 with 2 environmental stations from AQMesh - a small-sensor air quality monitoring system for measuring outdoor and indoor air quality, aiming to have actual readings of air quality for NO2, NO, CO, O3, SO2, PM2.5 and PM10 from the airside only that will help to build a full deployment plan on solid bases as well as knowledge transfer to airport staff on the measurements instruments and how to develop the analysis reports. During this phase, best practices from the Authority for Airport Nuisance Control (ACNUSA) and London Heathrow Airport were implemented.

In year 2019, phase 02 of the project was implemented. We enhanced the airport's experience achieved in phase 01 by partnering with Envisa, the international world leader in environmental consulting specialized in sustainable aviation. We arranged for effective installation of 8 air quality and noise measurement stations around the airside using high density devices from Oizom (an environmental solutions company), CO2 and noise sensors were added in all stations to understand air quality in relation to international standards and to evaluate the potential decisions to improve air quality at KKIA. A major objective was also to allocate sources of emission and noise (aircrafts or other local sources) within KKIA airside as well as to recommend charging schemes for aircrafts violating the airport standards based on best practices from international airports.

Now the airport is starting phase 03 of the project where 5 more environmental stations at airport community will be installed. Positions were decided according to current and future residential projects around the airport based on analysis conducted in phase 2 and additional modelling to be conducted in phase 3. Phase 03 objectives include also periodic modelling of noise and emissions from aircraft operations, as well as development of a bespoke environmental indicators' dashboard with automated custom report generation and interactive web-based dashboard. A workshop-like training will be also part of this phase for involved KKIA staff.

Project Graphics

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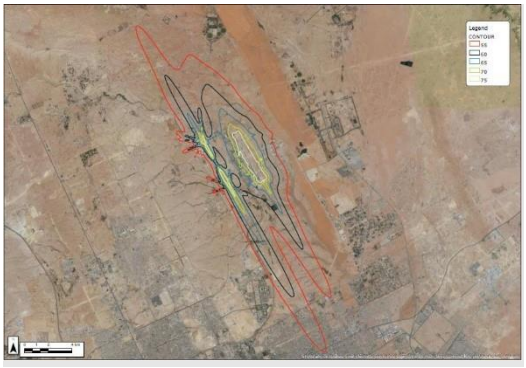
<tr><td>  </td><td> 
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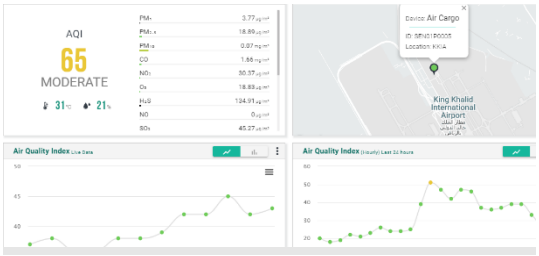
<tr><td>KKIA noise contours (phase 02)</td><td>Oizom terminal: KKIA overview</td></tr>
<tr><td> 
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<tr><td>Oizom terminal: KKIA dashboard</td><td>New installation positions in KKIA community (phase 03)</td></tr>
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Queen Alia International Airport

Continuous Air Quality Monitoring Stations

Upon being awarded the concession to operate Queen Alia International Airport (QAIA) in 2007, Airport International Group (AIG) management was focused and committed towards implementing a robust environment management system (EMS).

As part of the environment, health and safety (EHS) system, the establishment of an air quality monitoring program was essential to assess the quality of air and the impact of the aircraft's movements on the quality of air at the airport.

Initially in 2007 and for the period of four years, the air quality sampling was done through a lab operator, where the lab was conducting visits and sample analysis on yearly basis for the following perimeters: CO, NO_2, O_3, PM_{10}, $PM_{2.5}$.

In 2020, AIG launched a tender for installing two fixed Air Quality Monitoring Stations (AQMS) on the airport premises. The selection and implementation process were concluded in 2011 with an estimated cost of US$250K.

In 2012, staff training was concluded as well through an extensive testing period to make sure that the reporting and the operations of the AQMS are up to the national standards and in full compliance with the requirement of the Jordan Ministry of Environment.

Once the project was completed, it was communicated with airport stakeholders, and the air quality monitoring results were shared with the relevant authorities such as the Ministry of Transport, the Ministry of Environment and the Jordan Civil Aviation Regulatory Commission.

The two AQMS monitor the following parameters NO_2, CO, PM_{10}, $PM_{2.5}$, O_3 in addition to the weather data (wind speed/direction, temperature/ pressure), the stations were connected with a server that receives the data every 15 minutes.

On monthly basis, the data received from stations is carefully reviewed in order to generate monthly report that would be shared with Ministry of Environment.

Project Graphics

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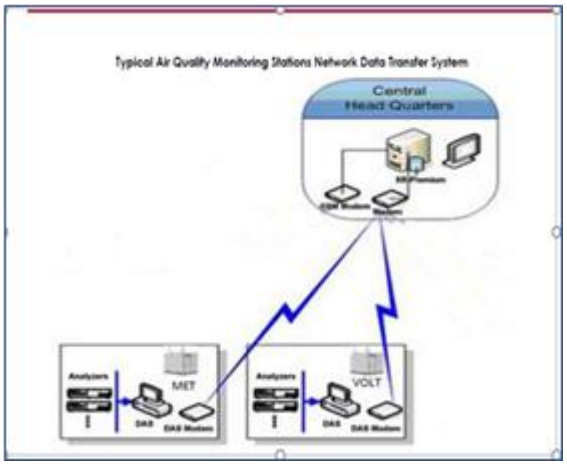
<td> 
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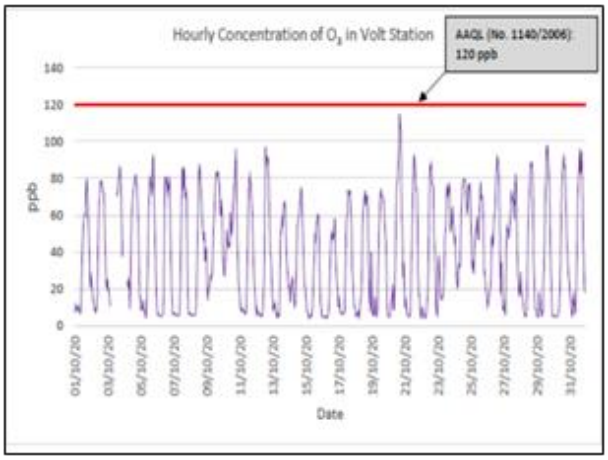
<td> 
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<td>AQMS-data transfer diagram</td>
<td>Sample of hourly monitoring O3 from one of the stations</td>
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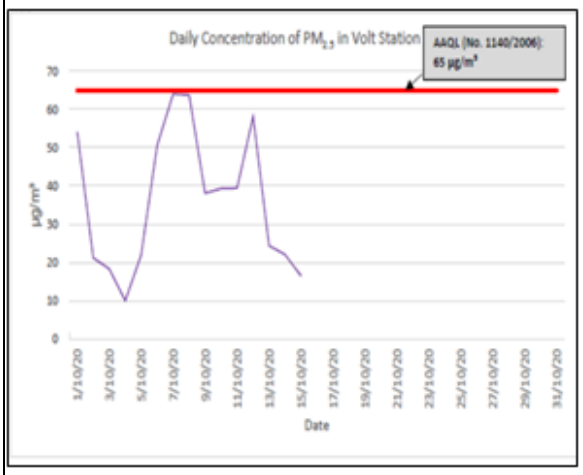
<td> 
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<td>Sample of report received on PM2.5 monitoring results</td>
<td>Image of PM10 analyzer</td>
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