GREEN Airports – Features and Perspectives
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Characteristics of airport as building type:

1. Categories depend on passenger movement and flight movement per year, generally split into 3 broad categories:
   i. International
   ii. Regional
   iii. Local

2. International airports are large structures with large gross floor area, 24 hour services, high flight movement and services, almost like mini cities

3. Airport have both static transient occupant load due to high passenger and visitor movement

4. Airport have both landside and airside activities and services
## Characteristics of Airports

### Airport Passenger Movement

<table>
<thead>
<tr>
<th>Airport</th>
<th>Annual Enplanement (taken from report year)</th>
<th>GFA (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kota Kinabalu</td>
<td>5,112,577</td>
<td>117,463</td>
</tr>
<tr>
<td>Kuching</td>
<td>3,627,671</td>
<td>45,900</td>
</tr>
<tr>
<td>Penang</td>
<td>3,103,772</td>
<td>28,596</td>
</tr>
<tr>
<td>KLIA</td>
<td>24,129,748</td>
<td>406,444</td>
</tr>
<tr>
<td>LCCT</td>
<td>15,300,300</td>
<td>150,000</td>
</tr>
</tbody>
</table>
Examples - Green Airports
Austin Bergstrom Airport

• Orientation of the building and glass façade

• Even during cloudy days, ample quantities of daylight illumination were seen adequately distributed into the internal spaces.

• Due to passengers’ movement and short duration of occupancy in the space, they could adjust well towards direct sunlight, irregularities in lighting and varying light levels, as well as comfort irregularities.

• Integration of premium building insulation, light fixtures that automatically adjust for day-lighting, efficient lights and lamps, high efficiency boilers and chillers and heating and cooling system that use primary-secondary piping.

• Its energy-efficiency features had led this airport to exceed IES energy lighting power limits by 15% and ASHRAE energy requirements by 11%.
Examples Of Airports
Boston Logan Airport

• With notable features like heat-reflecting roof and windows, low-flow faucets and waterless urinals, self-dimming lights, and storm water filtration, Boston Logan Airport's new Terminal A has become the first airport to be LEED certified.

• Terminal A features a roofing membrane and paving designed to reflect heat from the building and special stormwater filtration devices to remove suspended solids and total phosphorous.

• Water-efficient plumbing and irrigation; extensive daylighting and high-insulation glass; energy-efficient electric lighting; construction waste recycling; and the use of recycled, local materials.

• Adhesives, sealants, paints and carpets were specified to have very limited or no volatile organic compounds.
• The heart of the terminal will be a 43,000ft² circular central plaza with a 100ft diameter skylight, to make use of natural illumination and give a feeling of openness.

• Recycling and re-use opportunities; and lessen the new airport's overall environmental impact, both during construction and subsequent operation.

• The arched form of the roof structure is designed to promote natural cooling by harnessing the laminar airflow over its surfaces. The roof surface will also reflect energy, limit heat gain and channel rainwater for collection and use in building services. The building structure also incorporates light wells to channel natural sunlight from the roof to the first floor.
A variety of environmentally friendly features contribute towards LEED certification:

- A roofing membrane that is star rated for energy efficiency will be used.
- Local materials wherever possible.
- Light fixtures with shielded and directed light – which reduces light pollution – will be used.
- Infrared switches on bathroom and toilet fixtures will be used, as well as high-efficiency toilet fixtures to reduce water consumption.
- Construction waste management carefully controlled, and old asphalt and concrete reused as back-fill in other areas of the project.
- The timber used in construction will be obtained from Forest Stewardship Council environmentally managed and sustainable forests.
• Airport vehicles will be powered by electric motors wherever possible or using clean-burning fuels

• An energy-efficient underfloor heating / cooling system will be used in the plaza and adjacent spaces

• The high ceiling space of the terminal will have a conventional air volume HVAC system employing stratification principles to conserve energy

• High-performance glazing with ceramic frits will be used to reduce interior glare and solar heat build-up in the concourses

• Locations will be provided for the storage and collection of recyclable materials

• A two-tiered glycol recovery system will be used for the separate collection of high- and low-concentrated storm water run-off. Glycol and wastewater will be recycled

• Sealants, coatings, paints and carpet systems with low levels of volatile organic compound will be used to reduce allergic reactions and odors
Characteristics Of Airports
Hyderabad International Airport

• Savings (25% in energy and 30% water) has inculcated a discipline within the organization to preserve the environment. RGIA is one of the few airports in the world to achieve green status.

• The airport reuses 100% of the treated wastewater generated in the site for landscaping, air conditioning make up water and flushing requirements.

• With good day lighting which helps in the reduction of lighting energy consumption.

• Energy efficiency is achieved by a host of measures like the use of high performance glass with excellent thermal properties, high efficiency chillers, insulated walls and roof and variable frequency drives for the pumps.

• In addition, the application of skylight and fenestration strategy with integration of high performance glass, which allows daylight and to achieve energy efficiency, together with high efficacy chillers, insulated wall minimizes internal heat gain in maintaining overall comfort condition.
Characteristics Of Airports
Hyderabad International Airport

- The RGIA is one of the few airports where the indoor air quality is monitored on a real-time basis. The differential CO2 levels at any point of time is maintained at levels below 530 ppm.

Some of the green features of airport include:

- Conservation of top soil
- Electric charging refueling stations in the parking lots
- 100% Rain water harvesting 100% Grey water treatment
- 23% reduction in energy consumption as against ASHRAE baseline
- Use of efficient chillers, lighting controls and a lighting power density of 0.9 watt/ sq. ft
- as against a norm of 1.3 watt/ sq.ft
- Use of materials with high recycled content
- Fresh air purging to maintain good indoor air quality
- Use of green house-keeping chemicals
Example – Green Airports

Indira Gandhi International Airport

Terminal 3 earned a ‘Leadership in Energy and Environmental Design New Construction’ (LEED NC) gold rating.

capacity to handle up to 34 million passengers a year. The terminal was completed in time for the 2010 Commonwealth Games held in New Delhi. Here are some of the features that earned the terminal the rating:

• Storm water drains were constructed to control erosion and sedimentation
• Parking facility has 215 electric charging stations
• Water supply for landscaping is supplied by recycled water from the sewage treatment plant
• Radar sensors that control lifts and escalators 1,200 energy-efficient LCD screens are used to display passenger information
• More than 95% of the construction waste was sold for recycling
• 100% of the departure level is lit by natural light during the day
• All housekeeping chemicals are eco-friendly and biodegradable
• 300 rainwater harvesting stations, up from 50 in 2008.
Breakdown Carbon emission – Building Life cycle
Airport masterplan – Comparative Carbon Emission
Percentage breakdown

Main Terminal Building: 65%
Seatelit Building: 20%
Track Transit System: 10%
Taxiway: 5%
Runway: 3%
Ground Service Equipment: 2%
Sewerage Trement Plan: 2%
Fire Station: 1%

GreenAirport Features
**Energy Consumption**

Main Terminal Building

- **kWh/year**
  - Baseline: 156,561,840
  - Main Terminal Building: 98,159,140

- **Others**: 37%

- **Main Terminal Building**: 63%
Energy Consumption
Satellite Building

KWh/year

Baseline
Satellite Building

156,561,840
36,134,756

Satellite Building 23%
Others 77%
Energy Consumption
Runway 1&2

kWh/year

- Baseline
- Runway 1&2

Baseline: 156,561,840
Runway 1&2: 1,402,163

Runway 1&2: 0.9%
Others: 99.1%
**Energy Consumption**

**Track Transit System**

- **Energy Consumption (kWh/year)**
  - Baseline: 156,561,840
  - Track Transit System: 2,127,268

- **Others**: 98.6%
  - Track Transit System: 1.4%
Energy Consumption
Taxiway and ASU Building

kWh/year

- Baseline
- Taxiway and ASU Building

156,561,840
1,618,994

Baseline
Taxiway and ASU Building

98.97%
1.03%

Taxiway & ASU Building

1.03%

Others

98.97%

GreenAirport Features
Energy Consumption
Ground Service Equipment

- Baseline: 156,561,840 kWh/year
- Ground Service Equipment: 4,724,561 kWh/year

Others: 97%
Ground Service Equipment: 3%

Energy Consumption
Main Fire Station

Baseline: 156,561,840 kWh/year
Main Fire Station: 647,938 kWh/year

Others: 99.6%
Main Fire Station: 0.4%
GreenAirport Features

Energy Consumption
Sewerage Treatment Plant

- Baseline kWh/year: 156,561,840
- Sewerage Treatment Plant kWh/year: 1,191,000

- Others: 99.2%
- Sewerage Treatment Plant: 0.8%
**Energy Consumption**

Track Transit System

- **kWh/year**
  - Baseline: 156,561,840
  - Track Transit System: 2,127,268

- **Others**: 98.6%
  - Track Transit System: 1.4%

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**GreenAirport Features**
Energy Consumption

Airport Main Terminal Building
Airport Satellite Building

kWh
- Baseline

156,561,840
Energy Saving Strategies
Architectural Passive Elements

High performance glazing
Roof
Daylight harvesting for terminal and piers
Energy Saving Strategies
Mechanical & Electrical Elements

CO₂ Sensor Ventilation Strategies
Baggage handling system
VSD Fans and VAV boxes
Energy Saving Strategies
Mechanical & Electrical Elements

- Lighting Power Density (LPD)
- High Fan Efficiency and Electrostatic Precipitation Air Filters
- Jet Diffuser Ventilation Strategies
- Daylight Sensors
Energy Consumption
Energy Consumption

<table>
<thead>
<tr>
<th>Building</th>
<th>Baseline kWh</th>
<th>Green kWh</th>
<th>Saving kWh</th>
<th>Saving (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport Main Terminal</td>
<td>156,561,840</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite Building</td>
<td>112,724,524</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airport Satellite</td>
<td>43,837,316</td>
<td></td>
<td></td>
<td>28%</td>
</tr>
</tbody>
</table>

28% Energy Saving
Energy Consumption

- Baggage Handling System: 13%
- Interior Lighting: 14%
- Exterior Lighting: 1%
- Retails/F&B: 5%
- Exhaust Fans: 3%
- Miscellaneous Load: 19%
- Space Cooling: 39%
- Elevators & Escalators: 3%
- Receptible Equipments: 3%
Estimated Energy Saving

37,602,290 kWh saved

28% Energy Saving

Baseline

Green

Graph showing energy savings comparison between Baseline and Green scenarios. The Baseline case is represented by a blue bar, indicating a large energy consumption. The Green Airport case shows a significantly reduced energy consumption, with the blue bar representing energy savings at 28%.

Base case: Actual data on site

Green Airport Features
Estimated Energy Saving

37,602,290 kWh/year x RM0.365 = RM13,724,835/year

28% Energy Saving
Water Consumption
Water Saving Strategies

- Rainwater Harvesting
- Air Conditioner Condensates
- Water Efficient Fittings
318,054 m³ saved

Estimated Water Saving

Baseline: 424,072
Design: 106,018

75% Water Saving
## Estimated Water Saving

Airport Potable Water Consumption

<table>
<thead>
<tr>
<th></th>
<th>Baseline (m³)</th>
<th>Green (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>5,992</td>
<td>2,130</td>
</tr>
<tr>
<td>Flush Fixtures</td>
<td>195,000</td>
<td>98,139</td>
</tr>
<tr>
<td>Flow Fixtures</td>
<td>223,080</td>
<td>93,403</td>
</tr>
<tr>
<td><strong>Subtotal (A)</strong></td>
<td><strong>424,072</strong></td>
<td></td>
</tr>
<tr>
<td>Less</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AHU Condensate Water</td>
<td>25,617</td>
<td></td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td>62,037</td>
<td></td>
</tr>
<tr>
<td><strong>Total Potable water used (B)</strong></td>
<td><strong>106,018</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Potable Water Saving (A-B)</strong></td>
<td><strong>318,054</strong></td>
<td></td>
</tr>
</tbody>
</table>
Estimated Water Saving

Airport Water Consumption

318,054 m³ potable water is saved
Water Saving
Airport Water Consumption

318,054 m$^3$ x RM 2.28
RM725,163/year
Return On Investments

Water Saving + Energy Saving
RM725,163 + RM13,724,835
RM14,449,998

ROI = GreenPremiumCost/Saving
5.52 years
Green targets – example airports

Source: Heathrow Airport Data
Waste generated through infrastructure projects involving demolishing, constructing and refurbishing old buildings, aircraft stands, taxiways, roads and tunnels.
Overall Strategies – lowering Carbon Emission
Levels of ‘green’ action – Airports

“Influence”
They need to influence industry partners to reduce emissions from aircraft during take-off and landing and support Government policy.

“Guide”
They need to guide emissions resulting from aircraft moving on the ground and from the activities of companies and staff based at the airport:
• managing ground aircraft movement
• staff travel
• operational vehicles
• water and waste

“Control”
They need to control emissions through a combination of energy efficiency initiatives and investment in less carbon intensive energy sources and buildings.
The green ‘big’ picture - Carbon Emission According to Scope

<table>
<thead>
<tr>
<th>Scope</th>
<th>Category</th>
<th>Baseline (m³)</th>
<th>Green (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope 1</strong></td>
<td>Company Owned Vehicles</td>
<td>985</td>
<td>825</td>
</tr>
<tr>
<td></td>
<td>Direct Combustion</td>
<td>129</td>
<td>129</td>
</tr>
<tr>
<td><strong>Scope 2</strong></td>
<td>Electricity Usage</td>
<td>44,353</td>
<td>92,417</td>
</tr>
<tr>
<td><strong>Scope 3</strong></td>
<td>Electricity Consumption by Tenants</td>
<td>2,971</td>
<td>92,417</td>
</tr>
<tr>
<td></td>
<td>Business Travel</td>
<td>726</td>
<td>725</td>
</tr>
<tr>
<td></td>
<td>Employee Commute to Work</td>
<td>11,726</td>
<td>6,976</td>
</tr>
<tr>
<td></td>
<td>Passenger Land Transportation</td>
<td>27,310</td>
<td>28,728</td>
</tr>
<tr>
<td></td>
<td>Ground Services Operations</td>
<td>5,189</td>
<td>4,539</td>
</tr>
<tr>
<td></td>
<td>Aircraft Movement</td>
<td>688,531</td>
<td>626,845</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL ANNUAL CO₂ EMISSION (MT CO₂-eq)</strong></td>
<td>832,889</td>
<td>761,186</td>
</tr>
</tbody>
</table>

Percentage of Reduction 9 %
KLIA2 works to influence, guide and control CO2 emissions from aircraft in flight, landing, taking off and on the ground, from passengers and staff travelling to the airport, and from activities on the airfield and in and around the terminals.
Thanks to...The

Malaysia Airports Berhad
MASepang
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Air Asia Bhd
WCT Construction Bhd
LKMD Architects Sdn Bhd
KTA Tenaga Sdn Bhd
UEM – Binapuri JV
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EEC Sdn Bhd
IEN Consultants Sdn Bhd
Skala Sdn Bhd
Pureaire Sdn Bhd
Cofreth Sdn Bhd
Enmac Sdn Bhd
Skala Design Sdn Bhd
HLA Architects Sdn Bhd
RPM Engineers Sdn Bhd
Scott Wilson Sdn Bhd
Li Zainal Sdn Bhd
Prolight Sdn Bhd
Hi Tech Waste Sdn Bhd
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Thank You