Haneda Airport International Passenger Terminal
[Eco Airport Guide Book]

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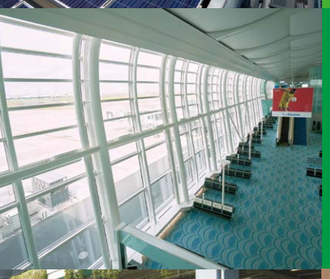
ECO AIRPORT



From Haneda Environmental Measures for the Future

Tokyo is the world-leading advanced environmental city. As the entrance to Tokyo, the International Passenger Terminal of Haneda Airport is improving energy efficiency and reducing CO_2 emissions as an environmentally friendly eco-airport. The eco-airport is aiming to realize a low-carbon society, a recycle-oriented society, and a society which coexists with nature through these efforts.

What is Eco-Airport?

Eco-airport is an airport that is implementing measures to conserve the environment and to produce a healthy environment in and around the airport.

1 Airport with Global Environmental Perspectives

2 Airport Able to Coexist with the Global Environment

3 Sustainable Airport that Contributes to the Development of Low-carbon Society, Recycle-oriented Society, and Society which Coexists with Nature

The International Passenger Terminal of Haneda Airport organized the Tokyo International Airport Eco-Airport Council with airport administrators and relevant airport businesses under the Eco-Airport Guideline established by the Ministry of Land, Infrastructure, Transport and Tourism. The Council is implementing various environmental measures, including the improvement of energy efficiency and the reduction of CO_2 emission.

*Source: March 2014 Eco-Airport Guideline, Civil Aviation Bureau

Basic Concept of the Improvement of Energy Efficiency and the Reduction of CO_2 Emissions at the International Passenger Terminal of Haneda Airport

Tokyo International Airport Passenger Terminal is improving energy efficiency and reducing CO_2 emissions through various measures, such as the use of natural energies, effective use of unused energies, and the use of the latest energy conservation technologies under the theme of efficient use of energy.

Efficient Production of Energy

Efficient Use of Energy

Reduction of the Amount of Energy Consumption & Reduction of CO_2 Emissions

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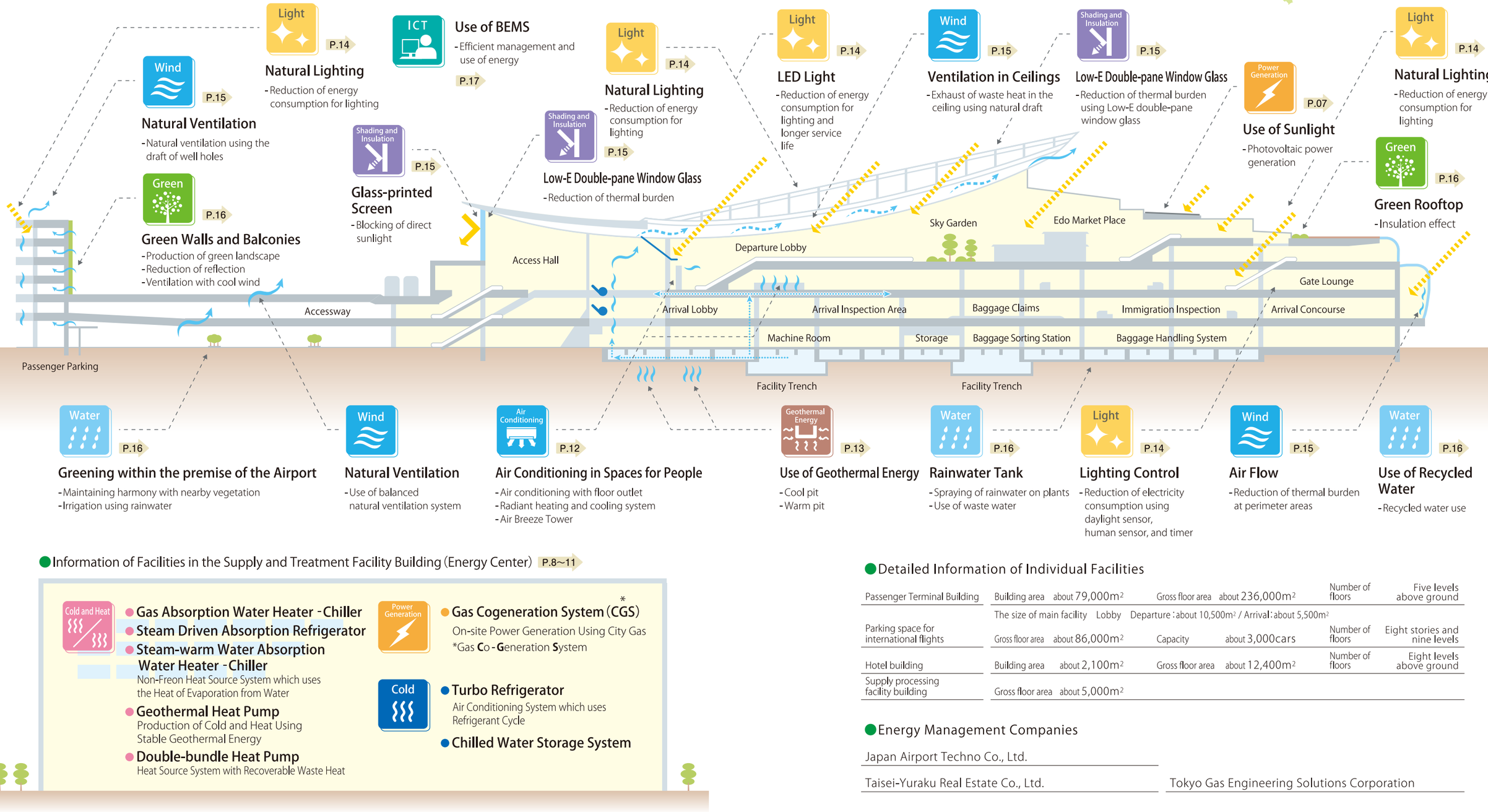
Energy Conservation and CO_2 Reduction Map of the International Passenger Terminal of Haneda Airport

The International Passenger Terminal of Haneda Airport is improving energy efficiency and reducing CO_2 emissions by combining the latest energy conservation technologies with natural energies (light, wind, heat, water, and vegetation) and reasonably and efficiently using energy supplies and energies.

Latest in Japan

Many Energy Technologies!



Information of Facilities in the Supply and Treatment Facility Building (Energy Center) P.8~11

Cold and Heat

- **Gas Absorption Water Heater -Chiller**
- **Steam Driven Absorption Refrigerator**
- **Steam-warm Water Absorption Water Heater -Chiller**
  Non-Freon Heat Source System which uses the Heat of Evaporation from Water
- **Geothermal Heat Pump**
  Production of Cold and Heat Using Stable Geothermal Energy
- **Double-bundle Heat Pump**
  Heat Source System with Recoverable Waste Heat

Power Generation

- **Gas Cogeneration System (CGS*)**
  On-site Power Generation Using City Gas
  *Gas **C**o-**G**eneration **S**ystem

Cold

- **Turbo Refrigerator**
  Air Conditioning System which uses Refrigerant Cycle
- **Chilled Water Storage System**

Detailed Information of Individual Facilities

Passenger Terminal Building	Building area about 79,000m²	Gross floor area about 236,000m²		Number of floors	Five levels above ground
	The size of main facility Lobby	Departure : about 10,500m² / Arrival : about 5,500m²			
Parking space for international flights	Gross floor area about 86,000m²	Capacity about 3,000cars		Number of floors	Eight stories and nine levels
Hotel building	Building area about 2,100m²	Gross floor area about 12,400m²		Number of floors	Eight levels above ground
Supply processing facility building	Gross floor area about 5,000m²				

Energy Management Companies

Japan Airport Techno Co., Ltd.

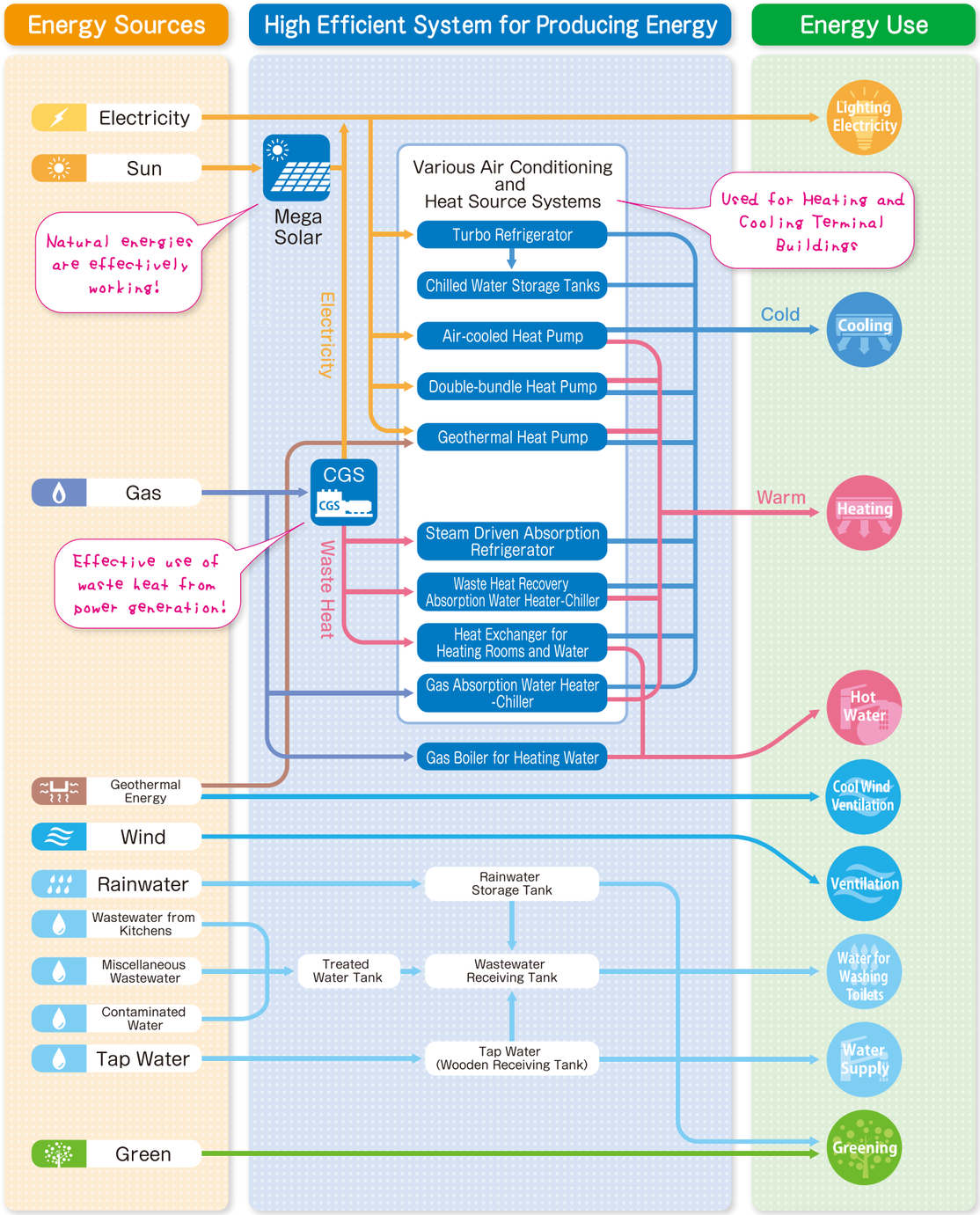
Taisei-Yuraku Real Estate Co., Ltd.

Tokyo Gas Engineering Solutions Corporation

OutLine

Diagram of the Energy System

The system is being designed to flexibly respond to various issues such as energy conservation, cost effectiveness, and disaster management by combining various and highly efficient energy systems and effectively using unused energies such as natural energy and waste heat.



Efficient Production of Energy

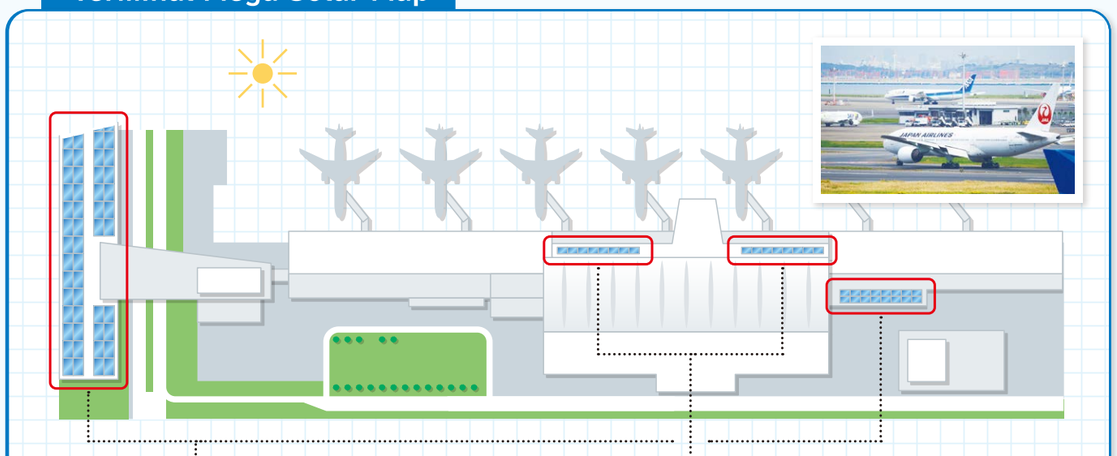
Power Generation

Clean Power Generation Using Solar Energy

Photovoltaic Power Generation, Mega Solar

Shade is rare at an airport because high-rise buildings are not located near an airport. Thus, an airport is a suitable site for installing solar power generation facilities. Using this characteristic, about 1,050 kW of solar panels are installed on the rooftops of the terminal buildings to generate power within the airport and reduce CO_2 emissions.

Terminal Mega Solar Map



Rooftop of Satellite Terminal

922kW

Photovoltaic power generation is clean, and its energy source is unlimited. It can be installed anywhere, and its maintenance is also easy.

Eaves at the Rooftop Observation Deck

10kW

The photovoltaic power generation panels are part of the eaves. The transparent panels give a bright impression.

Annual Power Generated from Photovoltaic Power Generation

(actual power generation in 2015)

about **1.10** million kWh

Point

Equivalent of the annual power consumption of about 220* households!

Scale

Rooftop panels : 1,042kW
Panels integrated with construction materials : 10kW
Total : 1,052kW

*When the average annual power consumption per household is about 5,024 kW
Source : Household Finance Survey, Statistics Bureau of Ministry of Internal Affairs and Communications (2015)

Efficient Production of Energy

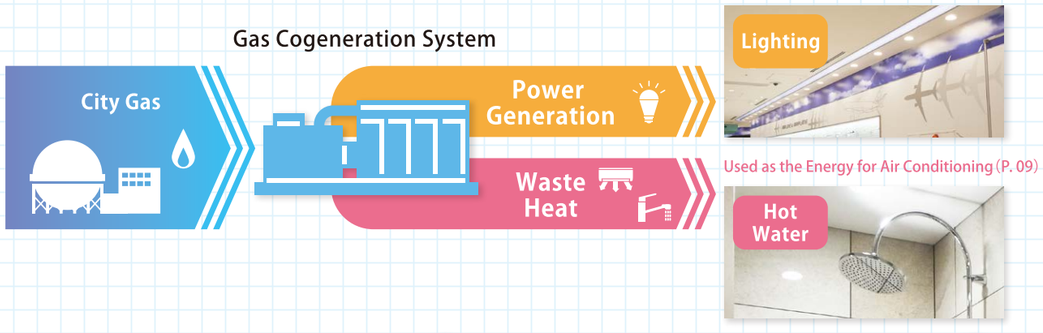
Power Generation

The Supply of Electricity and Heat Using City Gas

Gas Cogeneration System

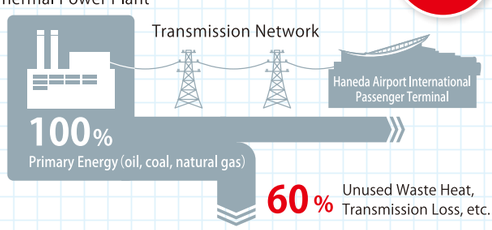
Gas cogeneration system is a distributed power generation system to generate electricity on site using environmentally friendly city gas. The heat generated during power generation can be effectively used for air conditioning and heating water. Thus, this system realizes high energy efficiency. The use of commercial power can also be reduced by connecting the generated electricity to commercial systems. By doing so, this system reduces the consumption of commercial power and lowers the peak consumption of the commercial power.

Mechanism of Gas Cogeneration System



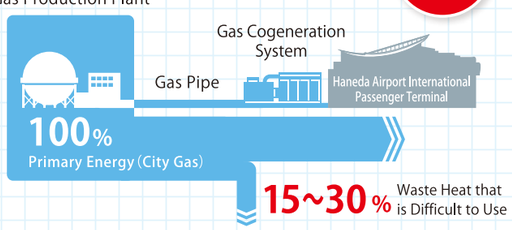
●To Send Power from a Thermal Power Plant *1

Total Energy Efficiency 40%



●When using a gas cogeneration system *2

Total Energy Efficiency 70~85%



*1: LHV standard: The thermal efficiency and total loss at a thermal power station are calculated based on the FY 2003 operational record (September 2005, Energy Conservation Standard Division) of nine power companies and power wholesalers.

*2:The efficiency of the gas cogeneration system is an example of the LHV standard.

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Annual Power Generation of Gas Cogeneration System
(actual production in 2015)

about **7** million kWh

Point
Equivalent of the annual power consumption at about **1,400*** households!

Received the Excellency Prize in the FY 2015 Cogeneration Award for the realization of carbon reduction and enhanced energy security through the use of CGS at Haneda Airport International Passenger Terminal

Scale
- Gas cogeneration system which works during power failure (one unit) Power output: 1,000 kW Gross energy efficiency: 85.9% (power generation efficiency: 30.8%, waste recovery efficiency: 55.1%)
- Gas cogeneration system (one unit) Power output: 900 kW Gross energy efficiency: 80.1% (power generation efficiency: 41.3%, waste heat recovery efficiency: 38.8%)

*When the average annual power consumption per household is about 5,024 kW Source: Household Finance Survey, Statistics Bureau of Ministry of Internal Affairs and Communications (2015)

Efficient Production of Energy

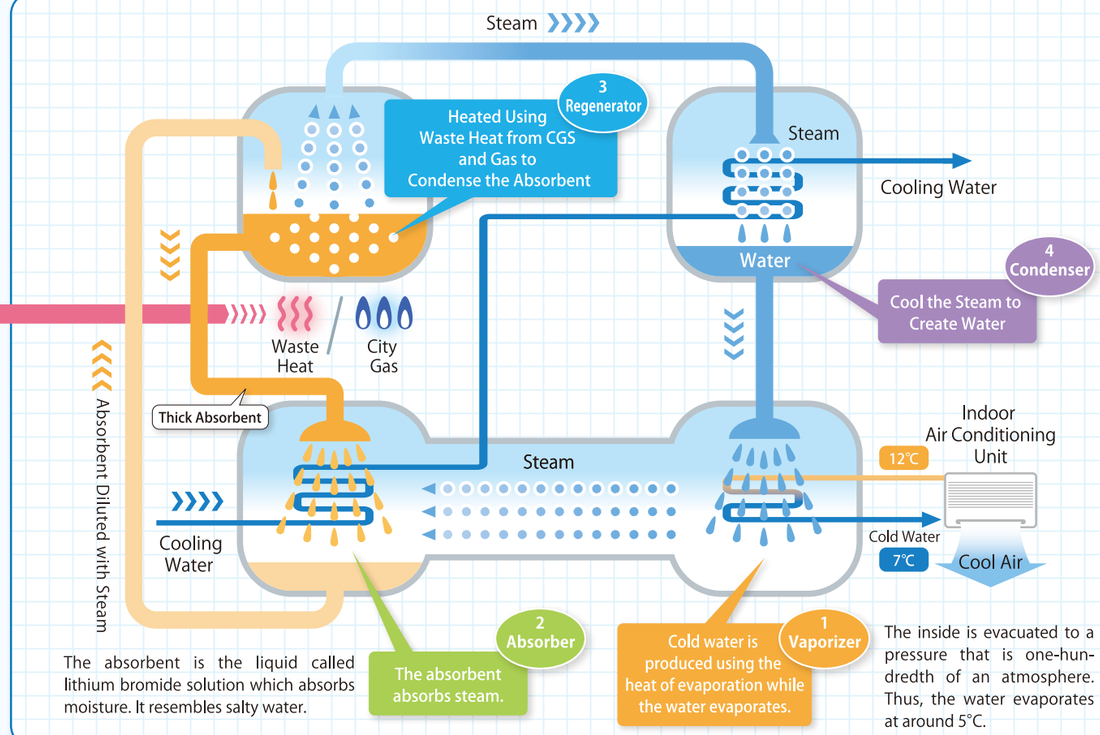
Cold and Heat

Cooling and Heating Using Zero-CFC Air Conditioning System with Water Refrigerant

Waste Heat Recovery Absorption Water Heater-Chiller

The CFCs used as the refrigerant of air conditioning accelerate global warming. Thus, the use of CFCs is now being strictly regulated. The gas absorption water heater -chiller is an environmentally friendly air conditioning system as it uses water as the refrigerant. It drastically reduces the power consumed for air conditioning because it uses the waste heat from gas cogeneration systems and city gas as the power source. This system thus improves energy efficiency and reduces power consumption.

Mechanism of Gas Absorption Water Heater-Chiller



The absorbent is the liquid called lithium bromide solution which absorbs moisture. It resembles salty water.

The inside is evacuated to a pressure that is one-hundredth of an atmosphere. Thus, the water evaporates at around 5°C.

The Freezing Capacity of the Steam Driven Absorption Refrigerator and the Waste Heat Recovery Absorption Water Heater-Chiller

about **4,200** kW *1

Point
Equivalent of the power of about **1,500** *2 units of household air conditioners!

*1: Scale
- Waste Heat Recovery Absorption Water Heater-Chiller (one unit) Refrigeration capacity: 3,516 kW (1,000RT), heating capacity: 3,256 kW
- Steam Driven Absorption Refrigerator (one unit) Refrigeration capacity: 705 kW (20RT)

*2: Based on a wall-mounted system used for both cooling and warming with the refrigeration capacity of 2.8 kW

Efficient Production of Energy

Cold

High-efficient Cooling Using Electricity Reduction of Cost by Using Nighttime Power

Turbo Refrigerator

This is a high-efficient power source system which uses Freon refrigerant. It compresses the refrigerant and creates efficient circulation to generate high refrigeration capacity. The system realizes high energy efficiency and low cost by using inverter turbo refrigerator which delivers optimal operations depending on the thermal load.

Mechanism of Turbo Refrigerator

Turbo Refrigerator

Produces Cold Water and Supplies it

Cooling

Cooling Tower

The cooling water is lowered in the cooling tower and used for circulation to maintain a high-efficient refrigerant cycle.

Point

The power of about 5,000 *2 units of household air conditioners!

*1: scale
- Inverter turbo refrigerator (one unit) Refrigeration capacity : 3,516kW
- Constant-rate turbo refrigerator (three units) Refrigeration capacity : 3,516kW

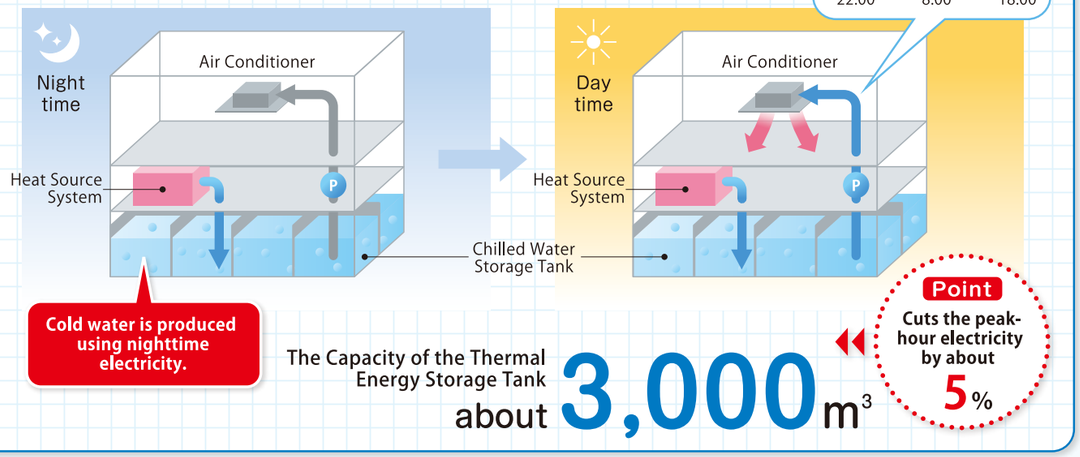
Refrigeration capacity about 14,000 kW *1

*2: Based on a wall-mounted system used for both cooling and warming with the refrigeration capacity of 2.8 kW

Chilled Water Storage System

The idea is to produce a large amount of cold water during the nighttime when the electricity cost is low and reduce the electricity consumption during peak hours in the daytime. This method enables effective operation and reduces costs.

Mechanism of the Chilled Water Storage System



Point

Cuts the peak-hour electricity by about 5 %

The Capacity of the Thermal Energy Storage Tank about 3,000 m³

Efficient Production of Energy

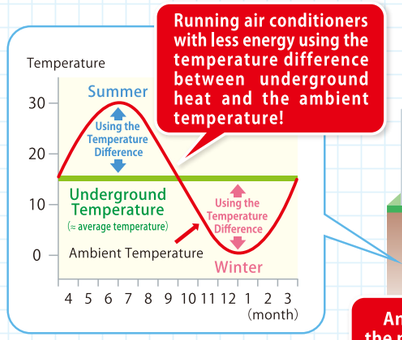
Cold and Heat

Effective Use of Geothermal Energy and Waste Heat from Air Conditioning and Heat Sources

Geothermal Heat Pump

The underground temperature remains nearly constant throughout the year unlike the air temperature. Geothermal energy recovery pipes are embedded inside the pile foundation of the supply and treatment facility buildings to recover geothermal energy using a heat pump. This is a heat source system which uses geothermal energy, one of the natural energies.

Mechanism of Geothermal Heat Pump



Running air conditioners with less energy using the temperature difference between underground heat and the ambient temperature!

Supply and Treatment Facility Building

Geothermal Heat Pump Chiller

Antifreeze is circulating inside the pile foundation to collect heat.

Point

The power of about 60 *2 units of household air conditioners!

*1 Scale
Geothermal heat pump (one unit)
Refrigeration capacity: 176kW (50RT)
Heating capacity: 176 kW

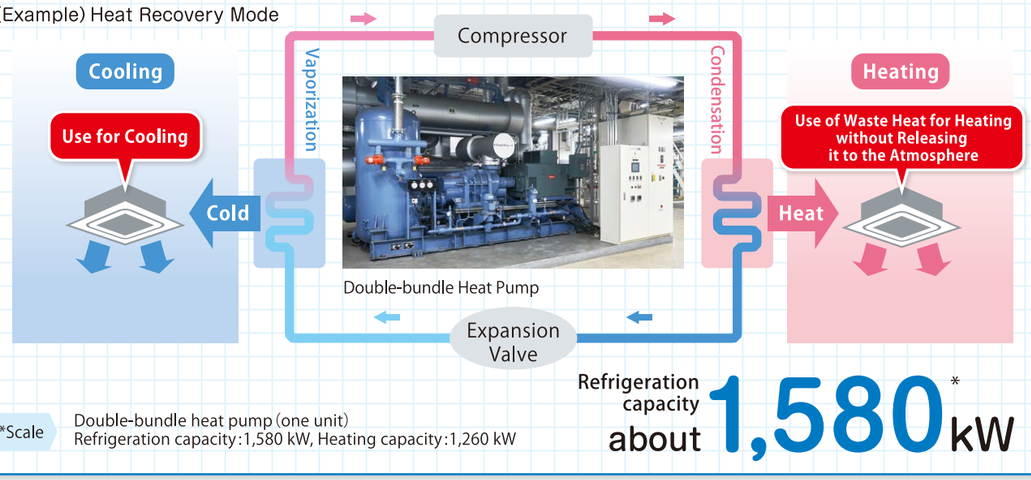
*2: Based on a wall-mounted system used for both cooling and warming with the refrigeration capacity of 2.8 kW

Refrigeration capacity about 176 kW *1

Double-bundle Heat Pump

Waste heat is usually released to the atmosphere through the radiator (outdoor unit). This system collects such waste heat and produces cold and heat at the same time. It efficiently uses energy by collecting heat during the cool season and cold during hot season.

Mechanisms of the Double-bundle Heat Pump



Double-bundle Heat Pump

*Scale
Double-bundle heat pump (one unit)
Refrigeration capacity: 1,580 kW, Heating capacity: 1,260 kW

Refrigeration capacity about 1,580 kW *

Efficient Use of Energy

Air Conditioning

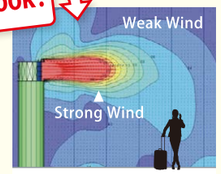
Occupied-zone Air Conditioning for Necessary Amount of Air Conditioning Only in Necessary Zones

Air Breeze Tower/Air Conditioning with Floor Outlet

The ceiling in airport terminals is high, and the height of the ceiling at the third floor departure lobby is up to about 20 meters. The air conditioning is provided only at zones occupied by people to realize efficient air conditioning rather than air conditioning the entire area of a large space.

Air Breeze Tower with a Spacious Air Conditioning Design

Look!



Thermography

Air Breeze Tower creates gentle air flows to create comfortable space.

This system provides localized air conditioning only at spaces occupied people to avoid wasteful thermal energy uses.

Look!

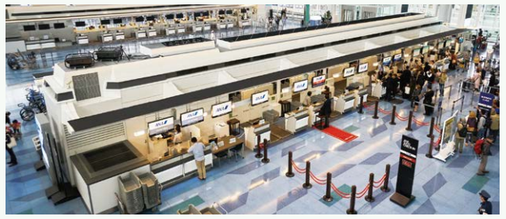
Air Conditioning with Floor Outlet

Energy Conservation with Air Conditioning from the Floor

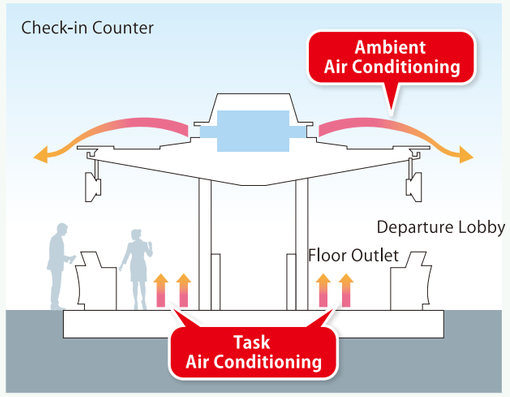
Energy efficiency is higher when air conditioning is provided near people in a large space with a high ceiling rather than heating and cooling the entire space.

Task-ambient Air Conditioning

The check-in counters are working stations located in island styles in a large departure lobby space. Thus, individual air conditioning isolated from other areas is provided at individual stations. The check-in counter on the third floor is arranged in island-form. Passengers and airport workers are wearing different types and amounts of clothes, and their activity levels are also different. Thus, individual air conditioning methods are employed to individually regulate the temperature and create comfortable spaces.



Air conditioning outlets for a large space are installed above to provide ambient air conditioning and realize energy efficient air conditioning.



The temperature inside a check-in counter is kept comfortable by providing air conditioning through a breathable carpet by installing a film duct for air conditioning below the floor of the counter.

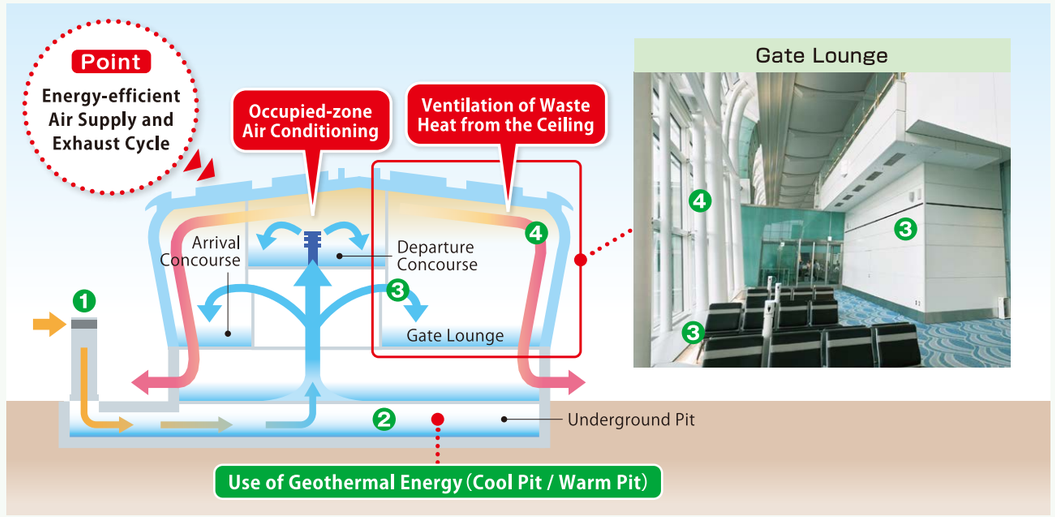
Efficient Use of Energy

Geothermal Energy

Use of Stable Underground Heat for Air Conditioning

Cool Pit / Warm Pit

The ambient air taken in for air conditioning is pre-cooled in summer and pre-heated in winter by letting the air go through the underground pit. The use of geothermal energy results in the reduction of energy used for cooling and heating.



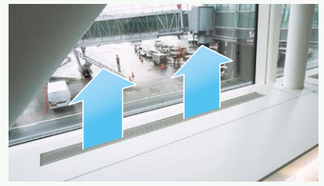
① Aeration Tower

Intake of Ambient Air

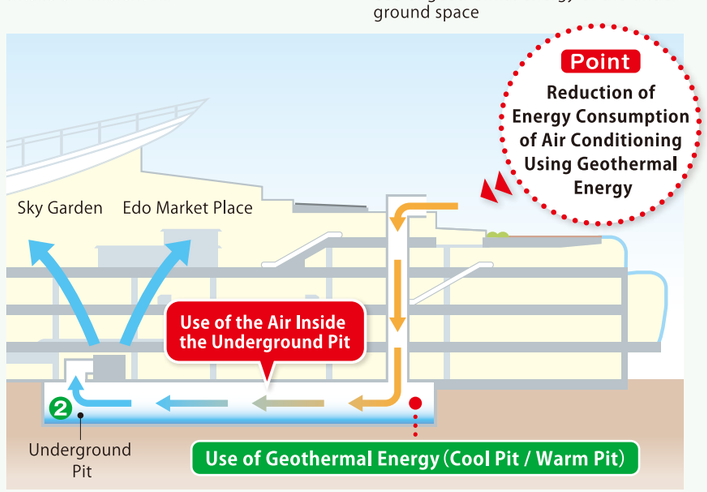
② Underground Pit

Use of geothermal energy of the underground space

③ Outlet



Air is three-dimensionally circulated from the ceiling and from the floor.



④ Waste Heat Pipe

The heat is circulated through the waste heat pipe

Efficient Use of Energy

Light

Reduction of Lighting Load by Using Natural Lighting and the Latest Technologies

Illumination Control using Natural Lighting and Light Sensors

Natural light is used as often as possible through top lights and high-side lights. The illumination control provides two-level operation including at 500 lx and 800 lx to turn the light on only when necessary to reduce wasteful use of energy.

Top Light

High-side Light

Morning	Daytime	Nighttime
Natural lighting 500 lx	Natural lighting 800 lx	Natural lighting 0 lx
Light Partially turned off	Light Mostly turned off	Light 200 to 300 lx

The light is partially turned off in order to use the outdoor light in the early morning and late afternoon when the sunlight is low. Almost all the lights are turned off during daytime when the sunlight is strong.

The lights are turned on during nighttime when no sunlight is available.

Drastic Reduction of Power Consumption through the Use of LED

Fluorescent lamps are being replaced with LED lamps to reduce power consumption and CO_2 emissions. Conventional lamps are being replaced with LED not only in lighting but also in other places such as information panels and guide signs.

TIAT Sky Road connecting to the observation deck

Look!

Many LED Signs in the Airport

Information Panel

Information Counter

Lights in Parking Structures

Airport Sign at the Observation Deck

Efficient Use of Energy

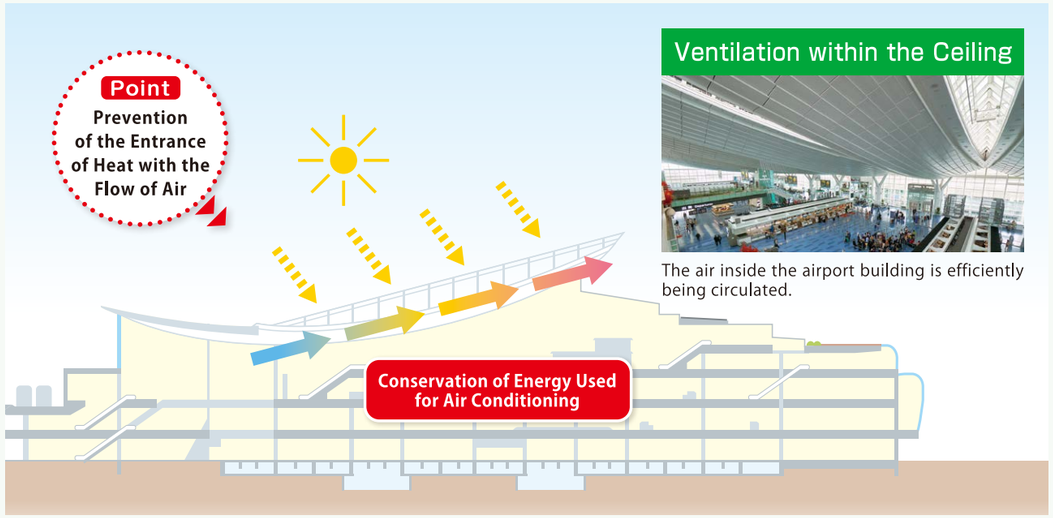
Shading and Insulation

Wind

Block the Entry of Solar Radiation Heat and Outdoor Air to Reduce the Load of Air Conditioning

Reduction of Thermal Load Using the Ceiling Ventilation System

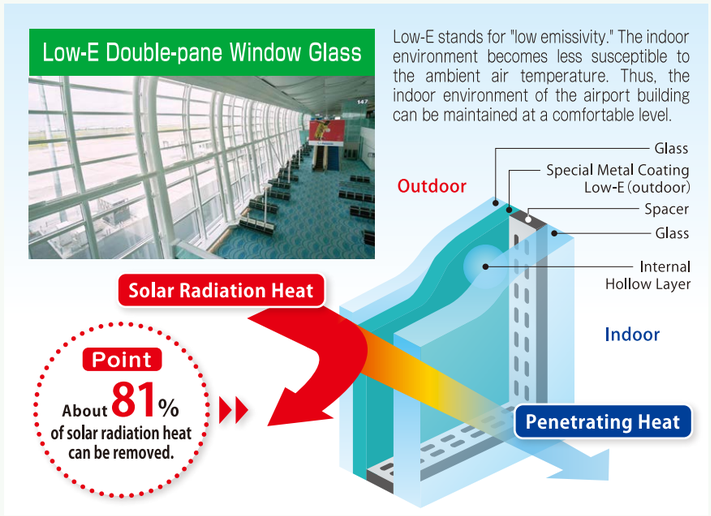
The airport has a system of releasing air near the ceiling that is heated by direct sunlight through a hollow section in the large ceiling. The insulation effect reduces the radiation heat from the ceiling and drastically cuts the cooling load.



The air inside the airport building is efficiently being circulated.

Reduction of Thermal Load and the Load of Solar Radiation with the Insulation and Shading System

Low-E double-pane window glass is installed to reduce solar radiation heat from the sun and the heat input and heat radiation through window glass. The double-pane window glass provides higher insulation performance and thus can reduce the energy loss of cooling and heating.



Stripe patterns are printed on the layer of window glasses to reduce sunlight and prevent the temperature around the window glasses from rising.

Efficient Use of Energy

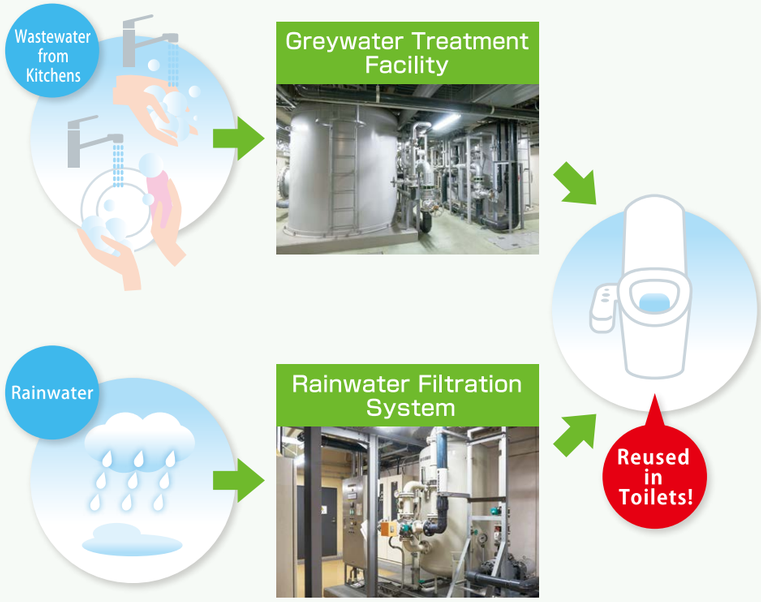
Water

Green

The Circulation and Recycling of Miscellaneous Wastewater for Reducing Water Consumption Reduction of Heat Island by Increasing Green Spaces

Water Conservation by Recycling Wastewater

Water discharged from kitchens, untreated water, and miscellaneous wastewater generated from terminals as well as rainwater are treated and used as greywater to effectively use water resources. The produced greywater is used for flushing toilets.



Look!

The Use of Durable and Recyclable Wooden Water Receiving Tanks

Wooden tanks have been used for storing sake and soy sauce for a long time in Japan. This terminal building uses wooden tanks to store water. Wooden tanks are durable and can be reused after being dismantled for purposes such as for creating recycled papers and wood chips.

Prevention of Heat Island Effect while Insulating

Plants are being planted in various areas of the airport such as the rooftop and on the walls to realize an eco-airport and to reduce the heat island effect. The plants are an effective environmental measure, such as an energy conservation measure, and also effectively create spaces surrounded with greens.

Green Rooftop

When a rooftop is covered with plants, the plants soften the solar heat in summer and keep heat in the building in winter. They increase air conditioning efficiency in both seasons.

Green Walls

Like the green rooftop, green walls also have the effect of alleviating temperature changes. They are effective as a measure to reduce the heat island effect.

Look!

The greening improves landscapes and also reduces heat island effects.

Efficient Use of Energy

ICT

BEMS* for the Total Control of Energy within a Facility

*Building Energy Management System

24-hour, 365-day Airport Security and Central Monitoring of Energy Operations

Building Energy Management System (BEMS) is constantly monitoring the operations of facilities related to electricity, heat source, air conditioning, sanitation, and transportation. The operation data obtained through the BEMS are used as a reference to explore energy conservation measures in energy meetings. The order of operation and energy balance are reevaluated based on the data to improve daily energy conservation activities and plan facility maintenance and equipment update.

Inside the Central Monitoring Center

The center is monitoring the operations of facilities in the airport around the clock every day to immediately respond to any abnormalities and troubles.

Maintenance and Management Center

Disaster Management Center

Supply and Treatment Facility Building

Look!

The Visible System Distributes the Information of Energy Conservation Activities to the Users of the Airport

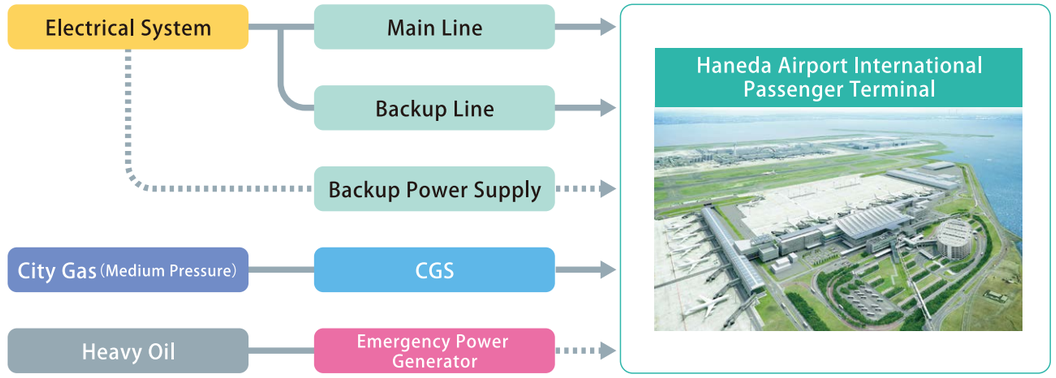
The digital signage systems in the airport buildings are displaying the information of the energy systems and the status of energy use as an eco-airport to increase the energy conservation awareness among passengers and airport workers.

Easily understandable animations and images are used to introduce energy conservation measures.

Energy Safety and Security Measures

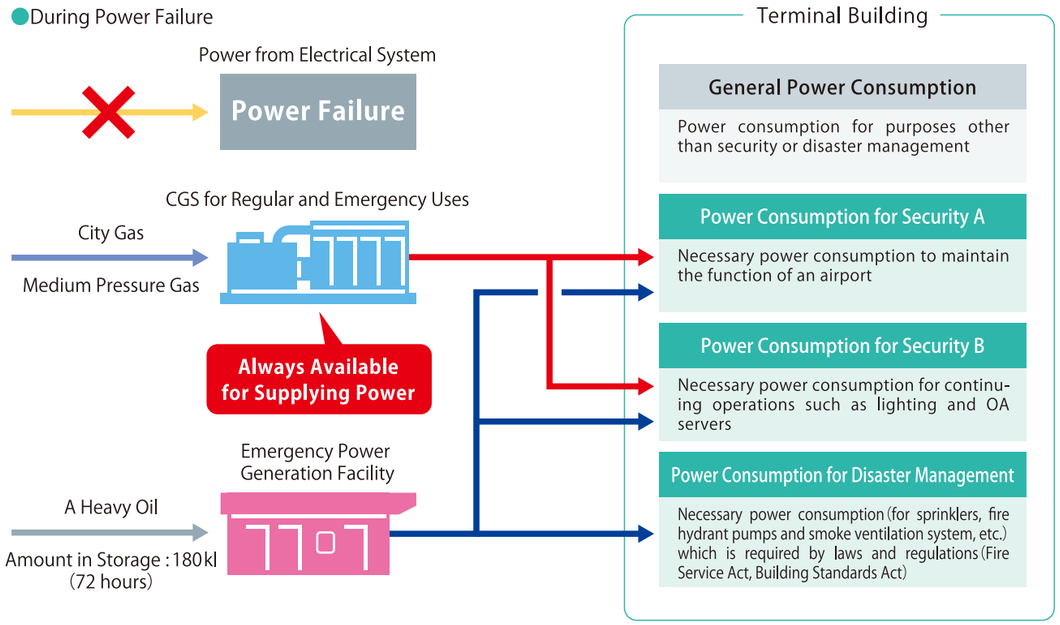
Combination of Power Sources Using Various Energies

The energy security is enhanced by combining energy supply facilities of various energy sources such as the power from the electrical system, city gas, and oil fuels. The reliability of the power from the electrical system is secured by constantly receiving power from two circuits and also having three circuits as backup power sources. Emergency power generators and CGS are connected in case of power failure in order to supply power for important facilities and for security uses



The Combination of Emergency Power Generator and Gas Cogeneration System

About 50% of the peak power consumption is secured by combining the gas cogeneration system and emergency power generators as backup power sources. The power source is diversified by having two types of power supplies including the cogeneration system that uses city gas and the emergency power generators that use oil fuel. In case of a power failure in the electrical system, the disaster management ability of the terminal is reinforced by supplying power from the emergency gas turbines, which use a heavy oil, to disaster management facilities and from gas cogeneration system to security facilities.



System Overview

●Actual data from FY 2015

	Unit	Power received	Power generated by CGS	Photovoltaic power generation
Amount of electricity	kWh	59,917,770	7,446,640	1,132,244

	Unit	Cold water	Warm water	Hot water
Produced amount of heat	GJ	147,411	50,409	13,481
Supply temperature	℃	7→12	45→37	60
Annual COP	—	0.95		

●Capacity of power generation facilities

	Unit	Power	Steam	Warm water	Number of unit installed
Photovoltaic power generation	kW	1,052	—	—	—
CGS (gas cogeneration system)	kW	1,000	618	1,174	1
CGS (gas cogeneration system)	kW	900	420	445	1
Emergency power generator	kVA	1,250	—	—	2
Emergency power generator	kVA	3,000	—	—	1

●Electric heat source

	Unit	Cold water	Warm water	Number of unit installed
Inverter turbo refrigerator	kW	3,516	—	1
Constant-rate turbo refrigerator	kW	3,516	—	3
Heat exchanger for radiating heat stored in water	kW	3,516	—	1
Double-bundle heat pump	kW	1,580	1,260	1
Air-cooled heat pump	kW	1,580	1,260	1

●City gas as heat source (including recovered waste heat of CGS)

	Unit	Cold water	Warm water	Number of unit installed
Direct-fired absorption water heater-chiller	kW	3,516	2,200	3
Waste heat recovery absorption water heater-chiller	kW	3,516	3,256	1
Steam driven absorption refrigerator	kW	705	—	1
Heat exchanger for heating	kW	—	1,174	1
Heat exchanger for heating water	kW	—	1,174	1
Boiler for heating water	kW	1,453	—	2

Awards Received

August 2014 Certified for S-rank, the highest performance in the Comprehensive Assessment System for Built Environment Efficiency (CASBEE)

September 2015 Received the Japan Toilet Award (Minister of Infrastructure, Land, Transport and Tourism Award) from the Headquarters for the Society for All Women, Cabinet Secretariat

February 2016 Received the Excellency Award in the FY 2015 Cogeneration Award from the Advanced Cogeneration and Energy Utilization Center, Japan

September 2016 Received the Five-Star Airport status in the Global Airport Ranking of SKYTRAX of U.K. for three years in a row (2014, 2015, 2016)
The top in the world for the World's Cleanest Airport (2013, 2014, 2016)
The top in the world for the World's Best Airport Security Processing (2015)

November 2016 Received the Red Dot Award Communication Design 2016, an international design award in Germany