Renovation Technology That Optimizes Renewable Energy;

Targeting a Zero-Energy Building (ZEB)

SANKEN SETSUBI KOGYO CO., LTD. JAPAN

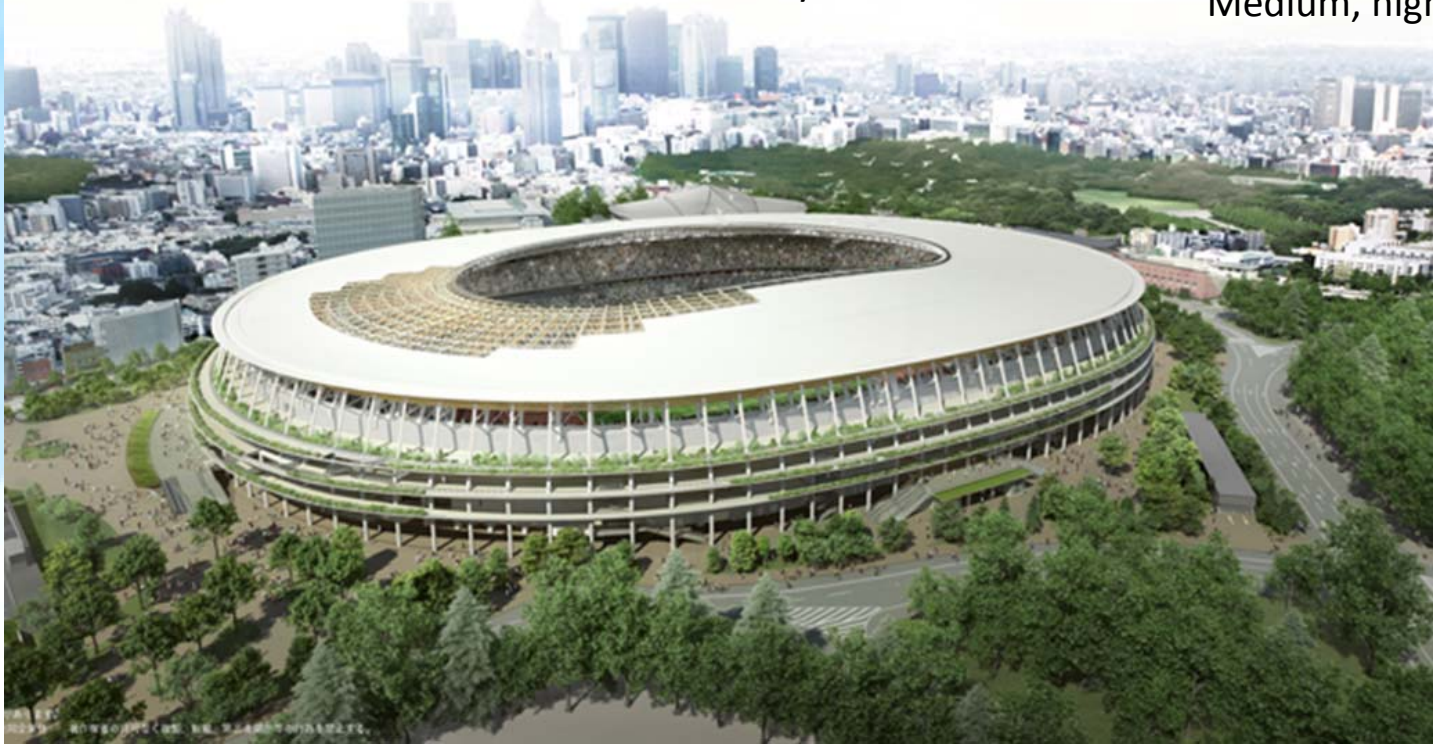
SANKEN
ENVIRONMENTAL ENGINEERING

Company Profile

Company Name	**SANKEN SETSUBI KOGYO CO., LTD.** **Established in 1946.**
Head Office	Kayabacho First Building, 17-21 Shinkawa 1-Chome, Chuo-ku, Tokyo 104-0033
Paid-in Capital	¥739,954 thousand
Number of Employees	**Technical Staff 832** Clerical Staff 328 **Total 1,160 (As of April 1, 2019)**
Net Sales	¥79,127 million (FY 2019) ≒ $750 million
Construction Business License	(Toku-24) No.1879 by Minister of Land, Infrastructure, Transport and Tourism
Business Lines	Plumbing Business, Architectural and Construction Business, Electrical Contracting Business, etc.
First-Class Architect Office Registration	No. 16996 by Governor of Kanagawa Prefecture
	https://skk.jp/en

Representative projects

New Olympic Stadium for Tokyo 2020
Total area 194,000m2 B2F-5F 68,000 seats by 11/2019



Toranomon I, 2-chome redevelopment project in Tokyo
A-1 Tower 237,000 m2 B4F-49F 265 m
Medium, high-rise office, Low rise hotel, commercial facility
By 2023

What is a ZEB (Zero Energy Building) ?

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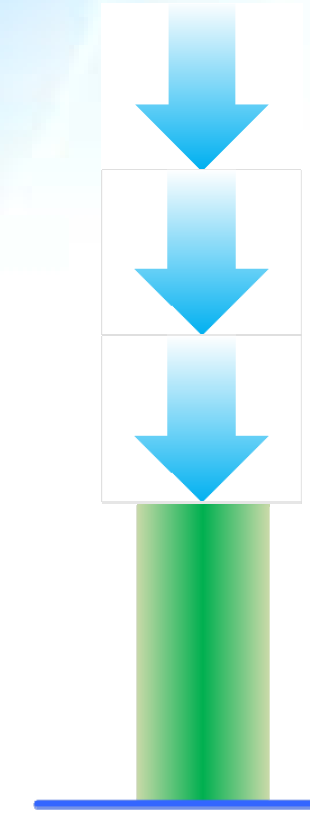
・ZEB is a building that utilizes high-efficiency air-conditioning systems, natural daylight and enhances the heat-insulation to save energy usage as much as possible while maintaining comfortable indoor environment and generating electricity by photovoltaic and wind power generation on the site.

・ZEB minimizes the supply of electricity from power plant that uses fossil fuels.

ZEB is necessary to reduce climate change and to realize a Low-Carbon Society.

Procedure for Achieving ZEB



1. Minimize the load

Enhancing the heat-insulation
Control of internal heat generation

2. Introducing high-efficiency systems

Sensible heat and Latent heat decoupled air-conditioning system

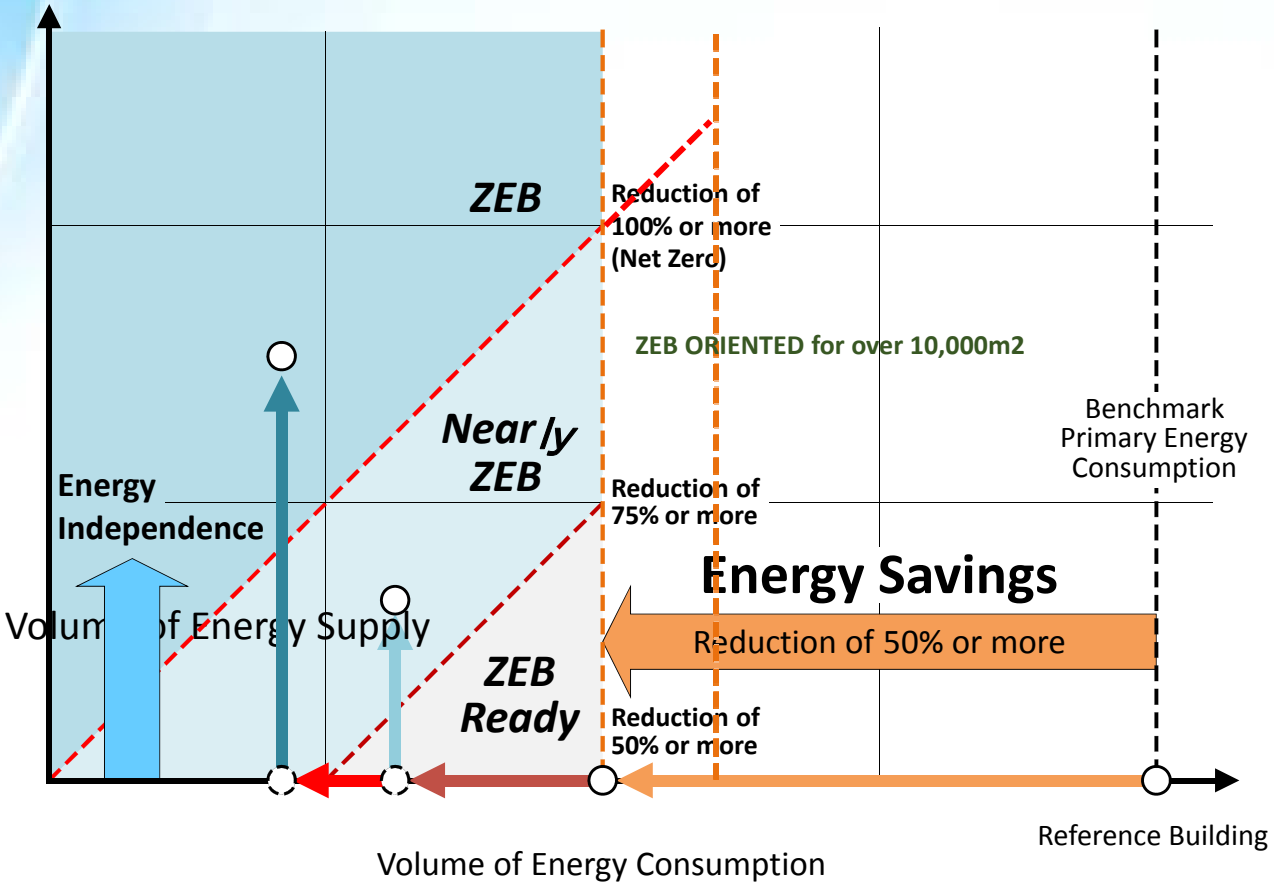
3. Utilizing renewable energy

PV, Geo-heat, Solar thermal, Natural ventilation

Achieve ZEB

Energy Consumption Photovoltaic Power Generation

Image of ZEB Definition of Japan



A prerequisite for ZEB is to reduce energy consumption by 50% or more

Outline of Innovated Technology for ZEB of SANKEN

Outline of the Building

TSUKUBA TECHNICAL CENTER (TTC)

Location: Tsukubamirai-city, Ibaraki-pref.
40km (25mils) northeast from Tokyo
Site Area: 4,123m^2 (44,380ft^2)
Floor Area: 2,258m^2 (24,305ft^2)
Reinforced-Concrete structure
Floor Number: Three stories
Completion date: Oct, 1992

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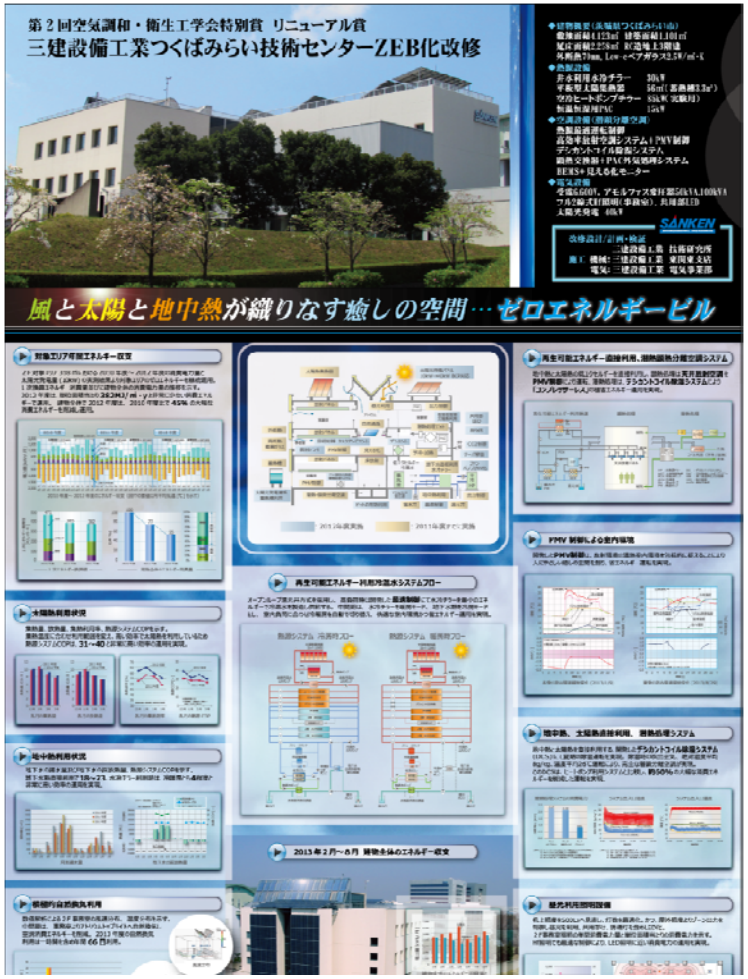
TSUKUBA TECHNICAL CENTER IN JAPAN

Title: Renewal of TTC towards Zero Energy Building



A prize of Renewal Award from SHASE in 2014

SHASE: Society of Heating, Air-Conditioning and Sanitary Engineers of Japan

Title: The ZEB is interwoven with Wind, Sun and Geothermal heat.

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Minister of the Environment Award

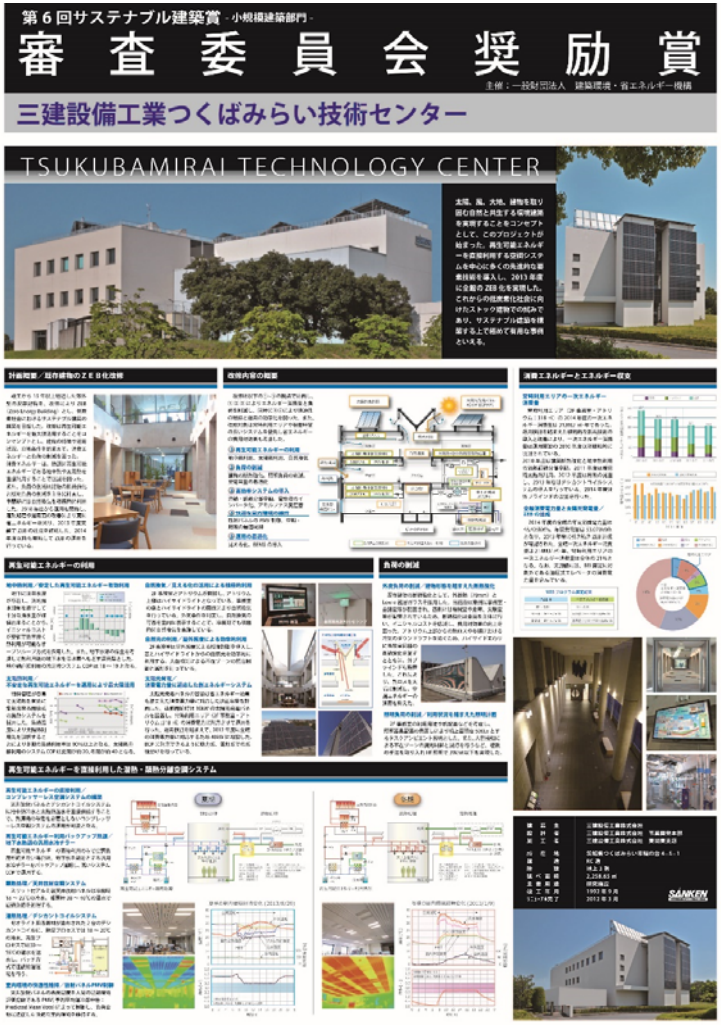
at the countermeasure technology advanced introduction department of global warming prevention activities in 2014.

Title: **Renewal towards Zero Energy Building**

Carbon Neutral Award from JABMEE in 2014 .

:Japanese Association of Building Mechanical and Electrical Engineers

Title: **The 6th Sustainable Architecture Award**



Sustainable Architecture Award from IBEC in 2016.

:Institute for Building environment and energy conservation.

TSUKUBA TECHNICAL CENTER IN JAPAN

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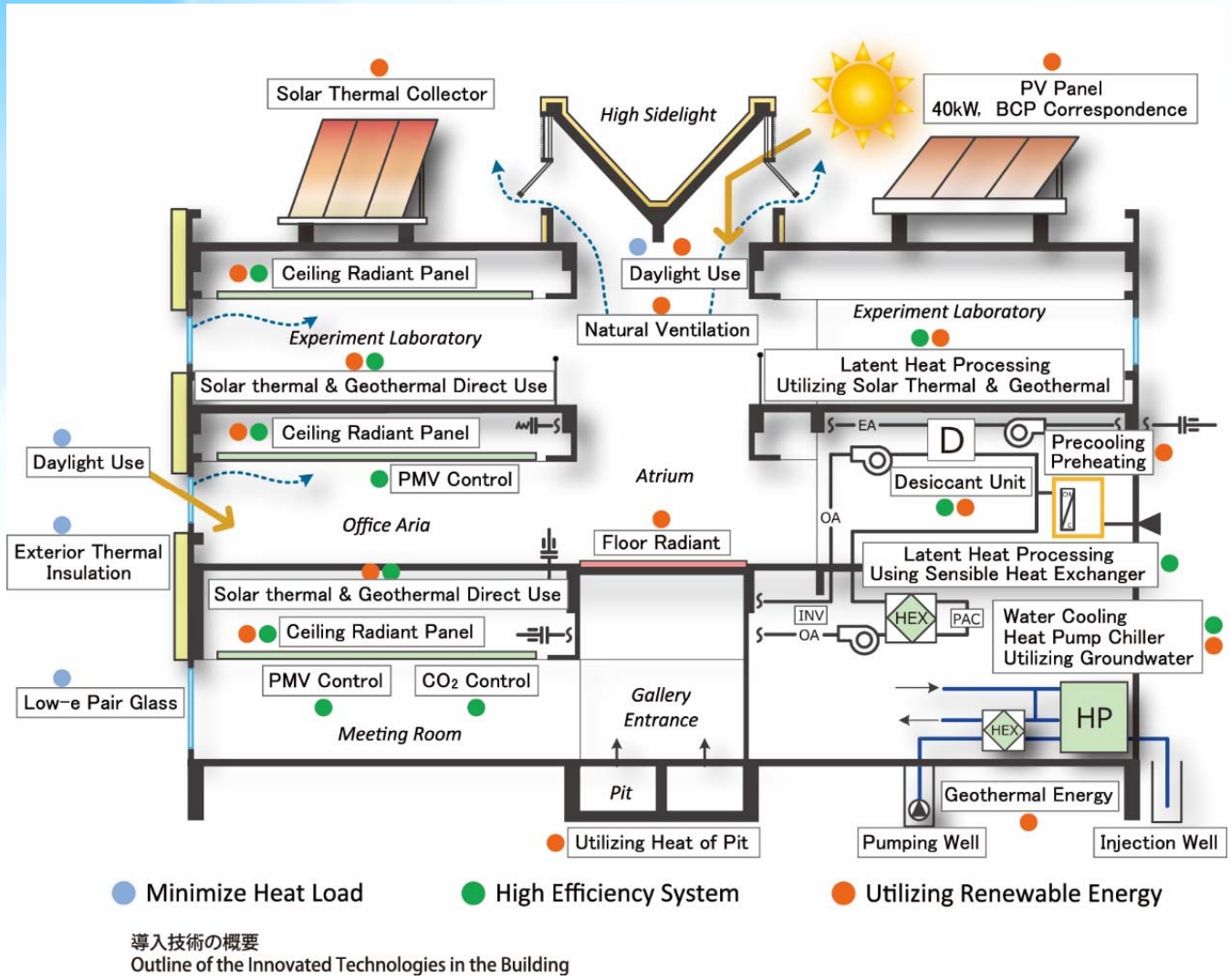

導入技術の概要
Outline of the Innovated Technologies in the Building

Innovated Technologies

Elemental Technologies

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1. Architectural

① Exterior thermal insulation

② Low-e pair glass

2. Air-conditioning system

① Decoupling Latent heat and Sensible heat

Ceiling radiant panel, Latent heat treating system

② Direct use of renewable energies

Geo-heat, Solar thermal, Natural ventilation

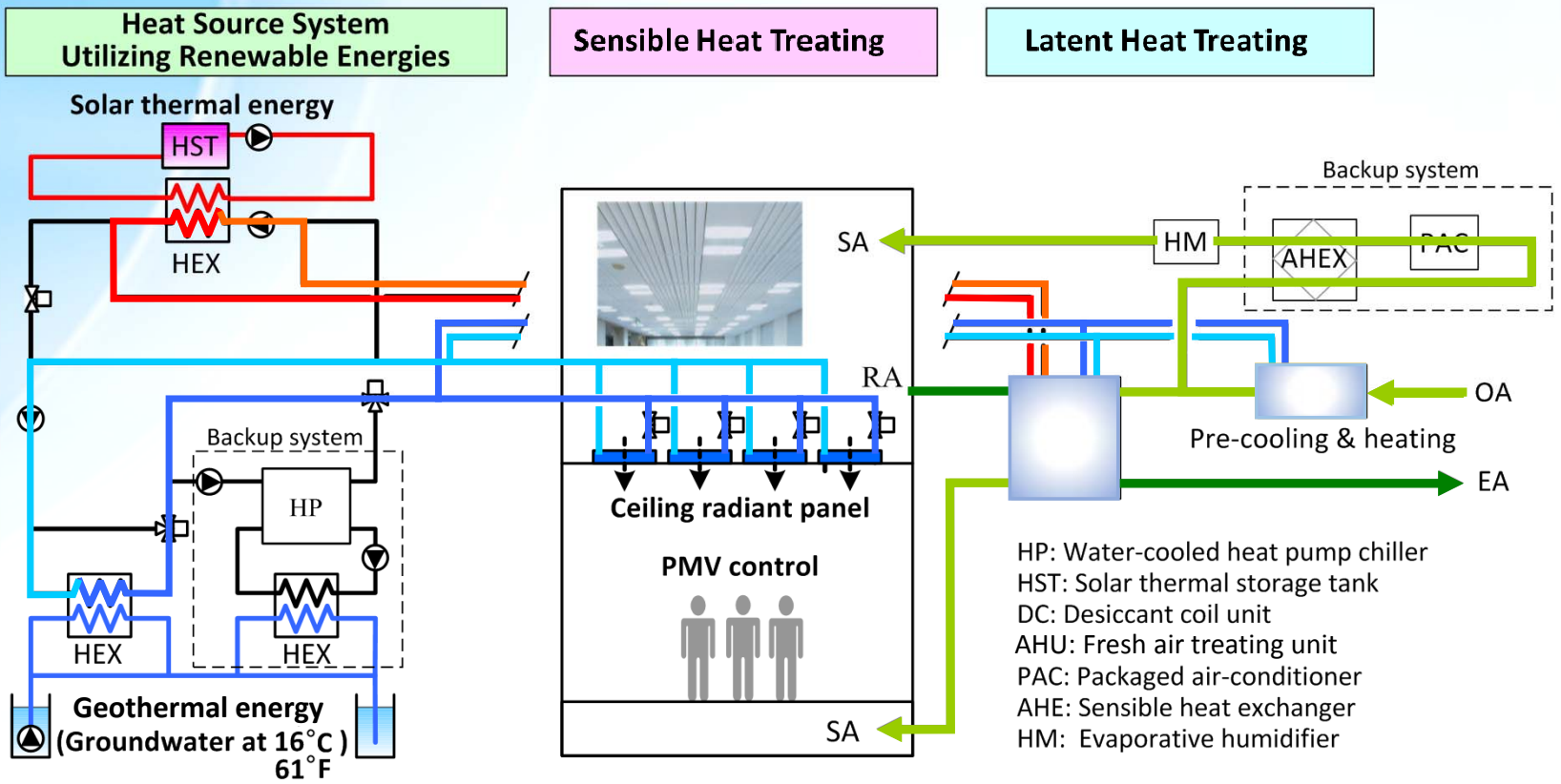
3. Electric equipment and lighting system

① High efficiency lighting (LED)

② Daylight control and zone control of lighting

③ High efficiency transformer

Decoupled Sensible Heat and Latent Heat Air-conditioning System
Utilizing Renewable Energies



Main heat source for the air-conditioning system

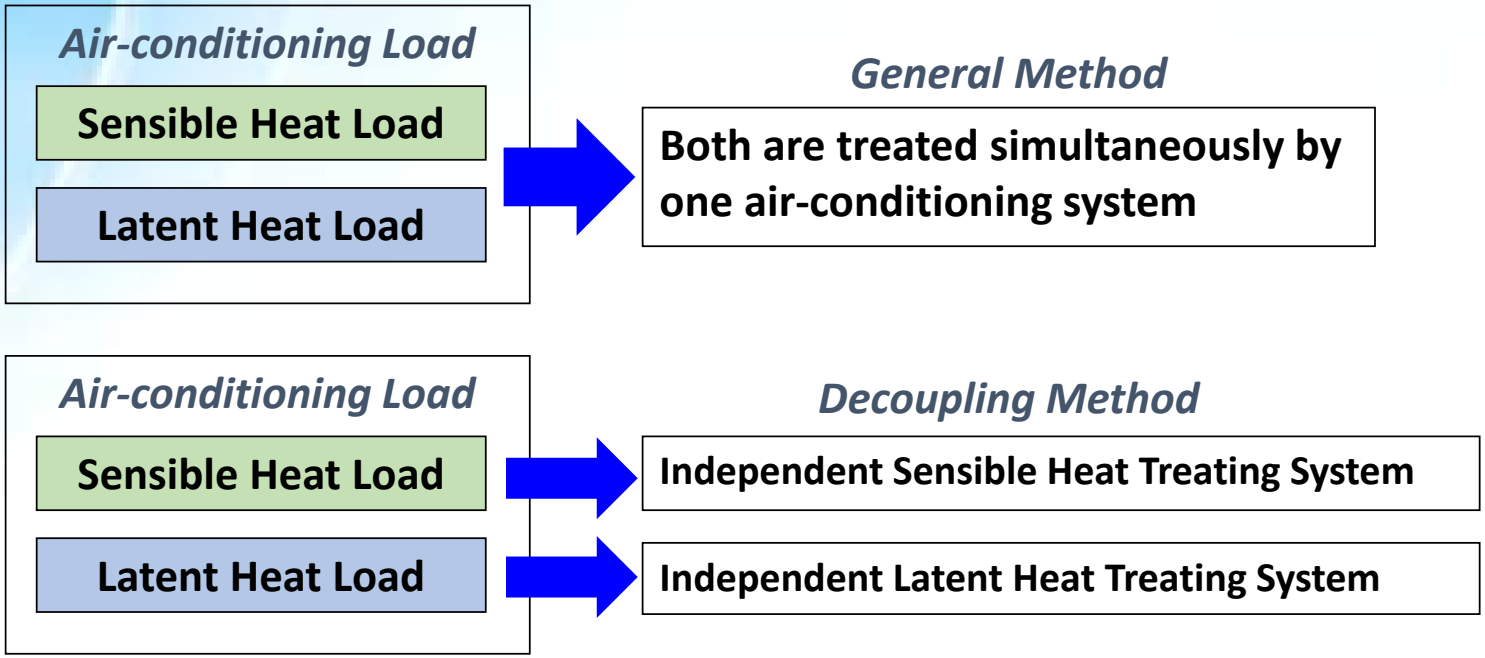
Cooling: Direct utilization of geo-thermal energy and solar thermal energy
(Solar thermal energy for regeneration process of desiccant coil unit)

Heating: Direct utilization of solar thermal energy

Air-conditioning systems that decouple and treat sensible heat load and latent heat load

Concept of Energy-Saving Effect

Decoupled Sensible and Latent Air-conditioning System



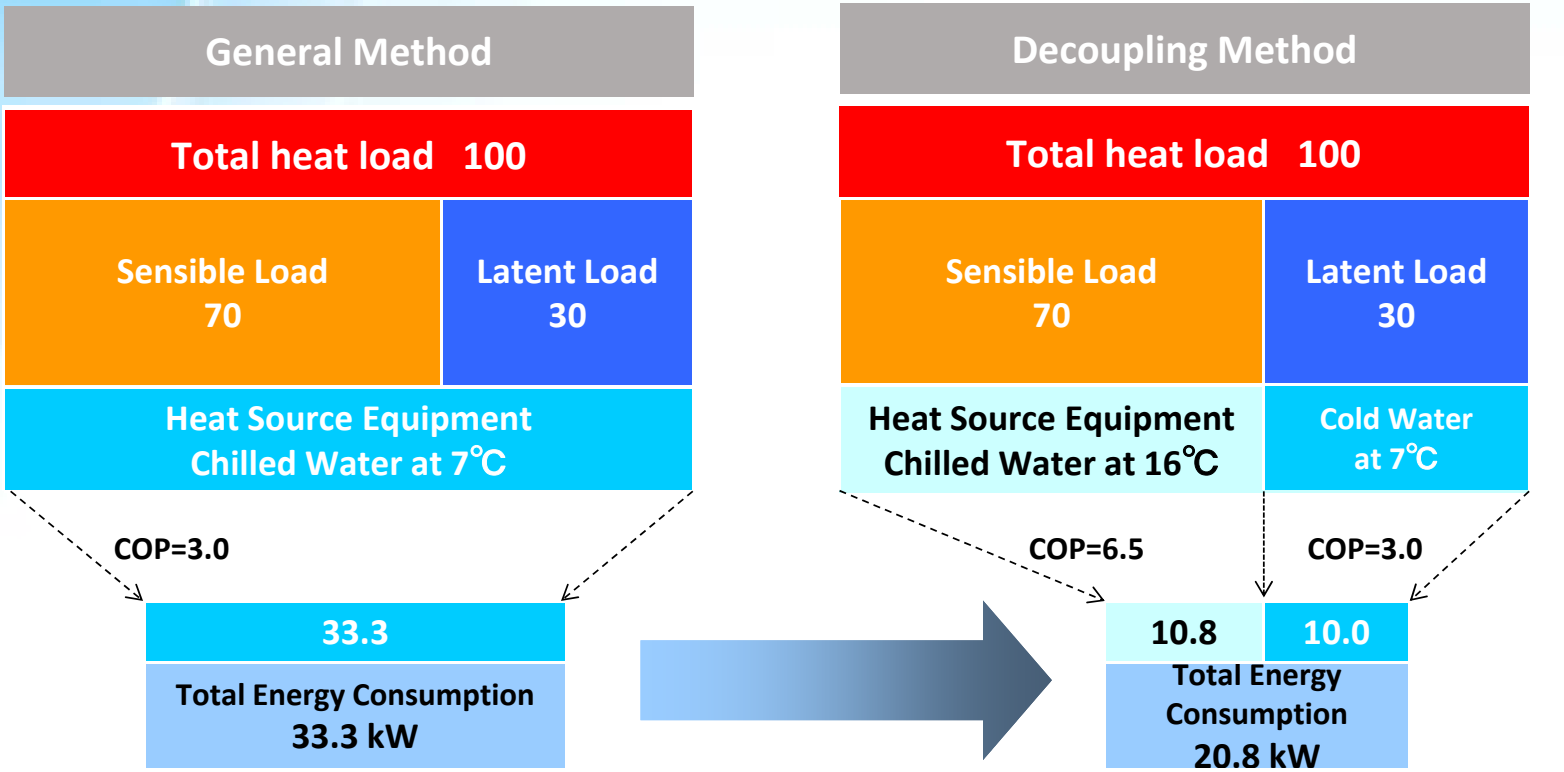
SANKEN's decoupled Sensible and Latent Air-conditioning System

Independent Sensible Heat Treating System: ***Ceiling radiant panel***

Independent Latent Heat Treating System : ***Dehumidifying unit*** and ***Desiccant coil unit for Outdoor air system***

Energy-Saving Effect Concept

of Decoupled Sensible and Latent Heat Air Conditioning System



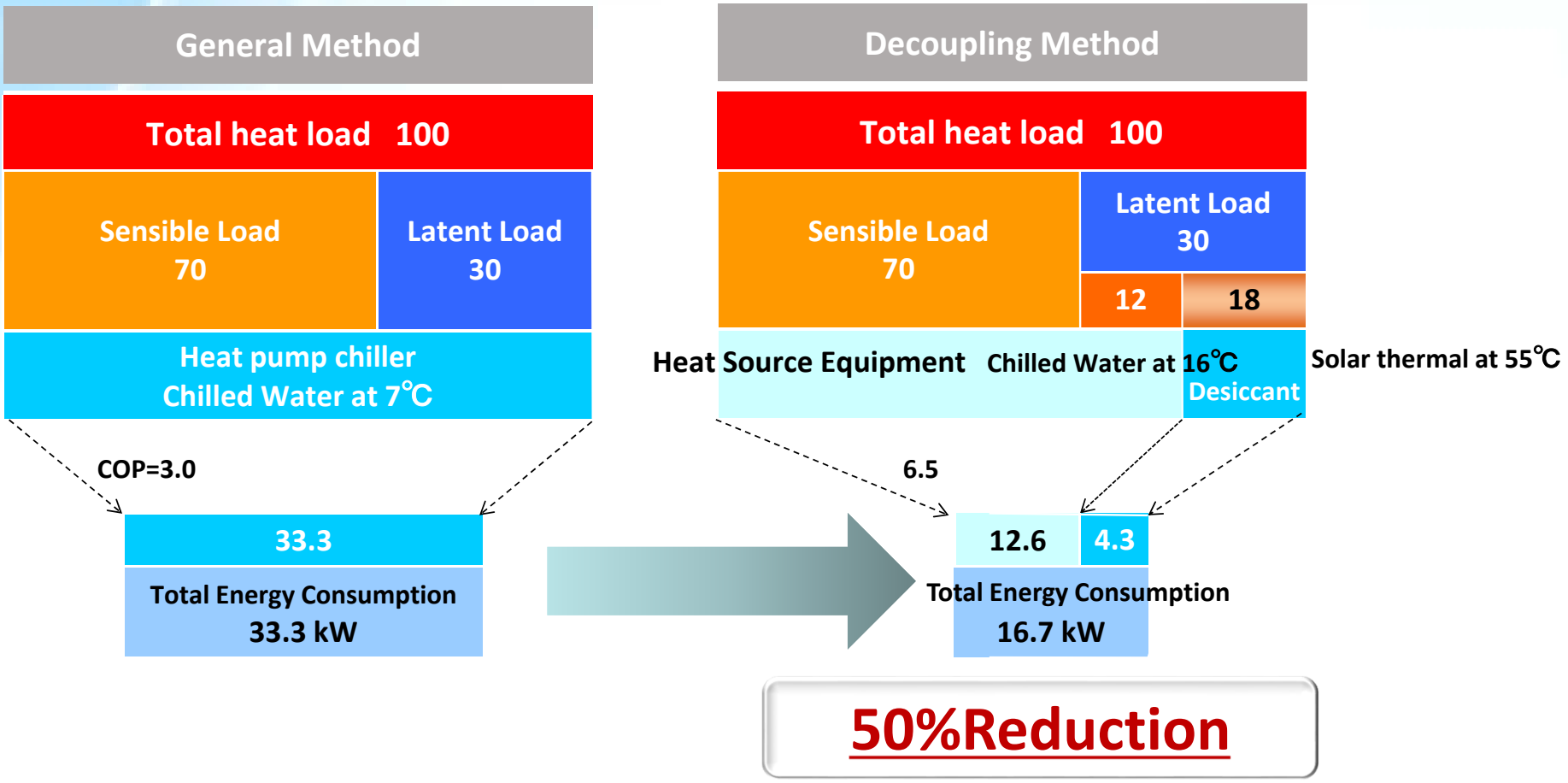
38% Reduction

COP:（Coefficient Of Performance）

Energy Saving Effects (Renewable Energy)

of an air-conditioning system separating latent and sensible heat

Utilization of groundwater and solar thermal to Desiccant System

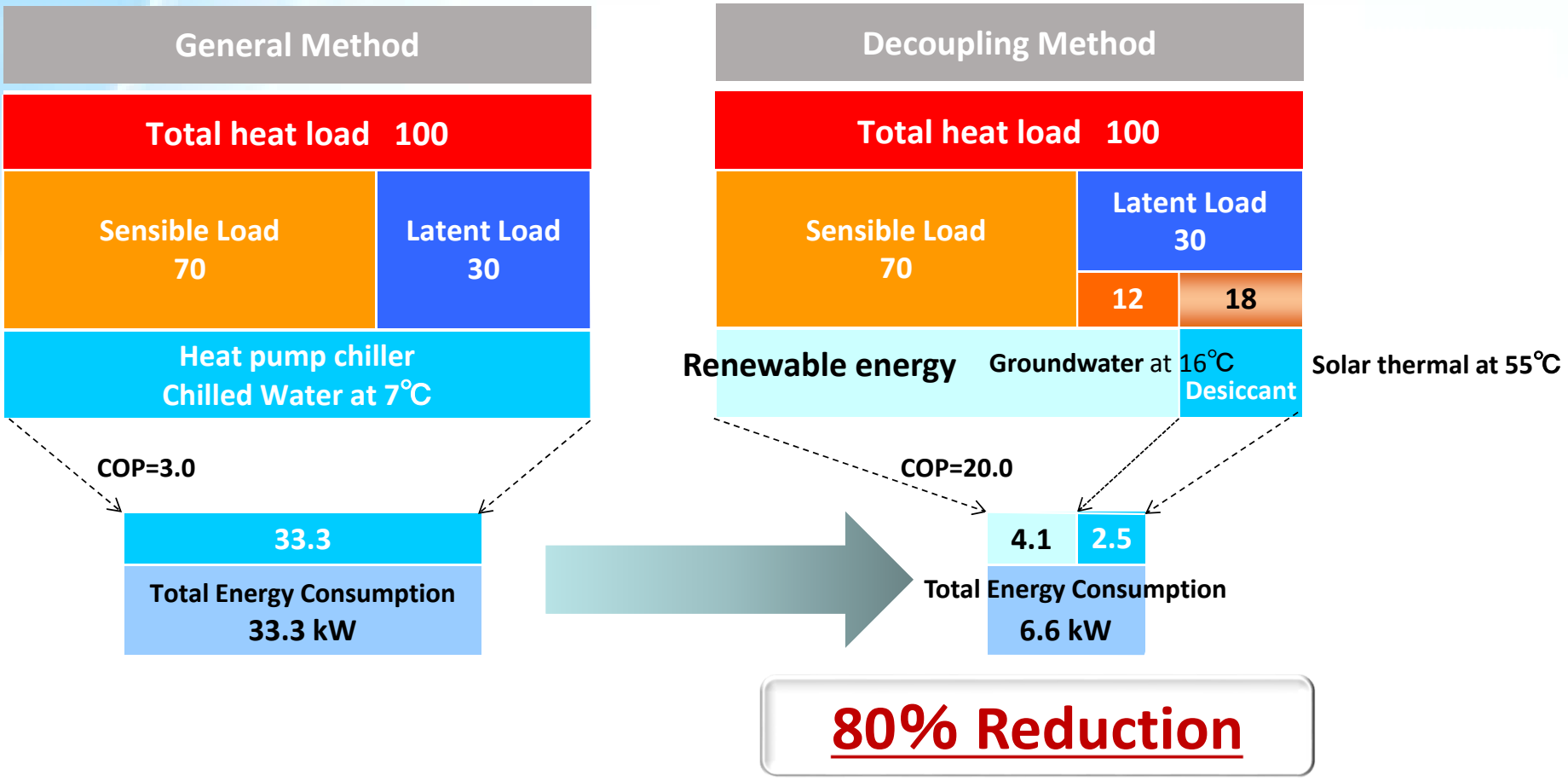


50%Reduction

Energy Saving Effects (Renewable Energy)

of an air-conditioning system separating latent and sensible heat

Utilization of groundwater and solar thermal to Desiccant System

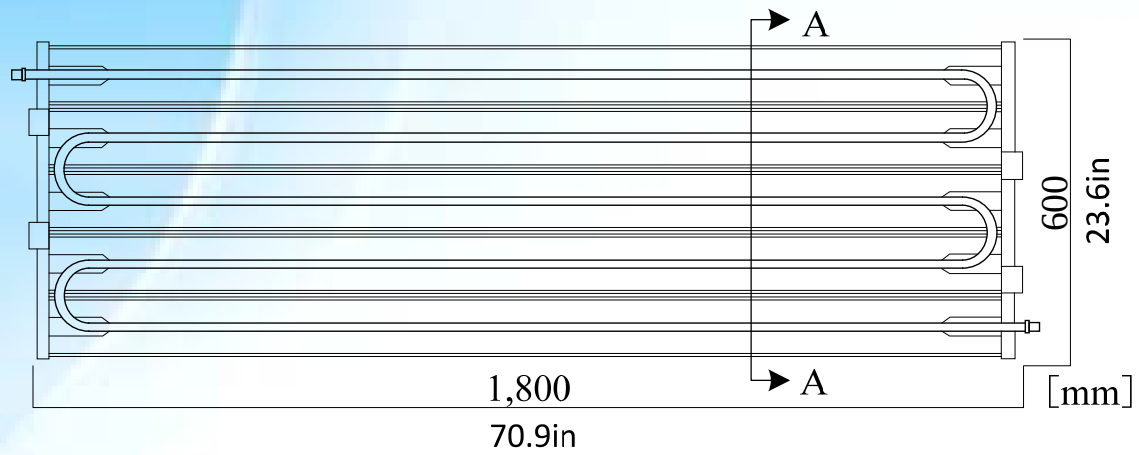


80% Reduction

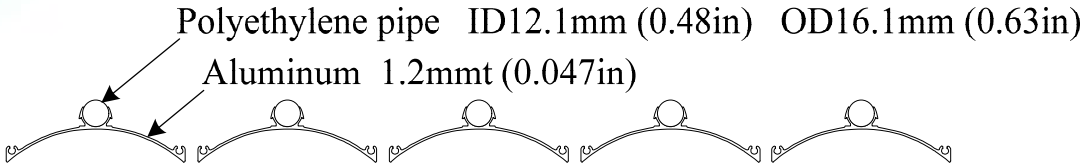
Decoupled Sensible Heat and Latent Heat Air-conditioning System

Sensible Heat Load Treating System (Radiant Ceiling Panel)

Appearance of Radiant Ceiling Panel



Plan View



A-A Cross-section

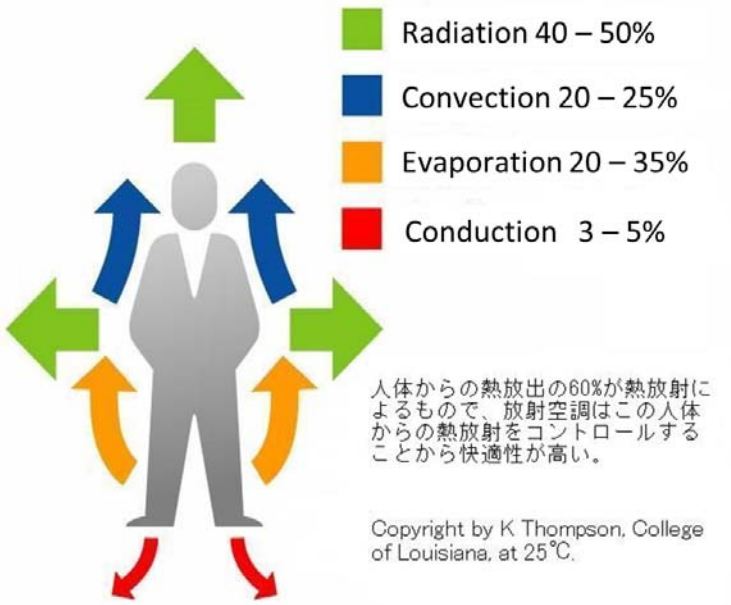
A panel made of aluminum → Good heat conductance, Lightweight

Slit between the panel → Natural convection effect

Positive Points of Radiant Air-Conditioning

Comfort of Radiant Air-Conditioning

- Heat radiation is the biggest heat quantity of the heat released by a human body.
- The temperature distribution of the room is even because there are only a few drafts.



Positive Points of Radiant Air-Conditioning

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Energy Saving of Radiant Air-Conditioning

・The Cooling is possible by sending cold water to the ceiling metal panel at 18℃, and the efficiency of the heat source COP is improved by a factor of 1.5 or more.

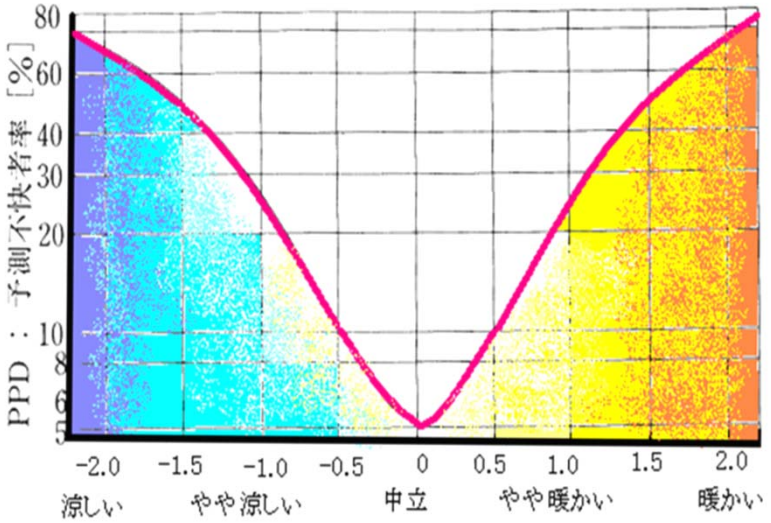
・Further, since water having a specific heat of 1 Cal/g・K and it is used as the cooling refrigerant, the conveying electrical power is about 30% of that of air.

PMV Controller

SANKEN developed a PMV controller for the Radiant A/C system. It controls the PMV, which is the theoretical comfort index in the room.

:PMV（Predicted Mean Vote）and PPD（Predicted Percentage of Dissatisfied) ISO7730（1994））

Scope of application of PMV		7 stage evaluation of PMV	
PMV	-2＜PMV＜+2	**+3**	Hot
Metabolic equivalent	0.8～4met	**+2**	Worm
Amount of clothing	0～2clo	**+1**	Slightly warm
Air temperature	10～30℃	**0**	Neutral
Mean Radiant Temp	10～40℃	**-1**	Slightly cool
Mean air velocity	0～1m/s	**-2**	Cool
Relative humidity	30～70%	**-3**	Cold



PMV とPPDの関係

Thermal Image of the Ceiling Panel

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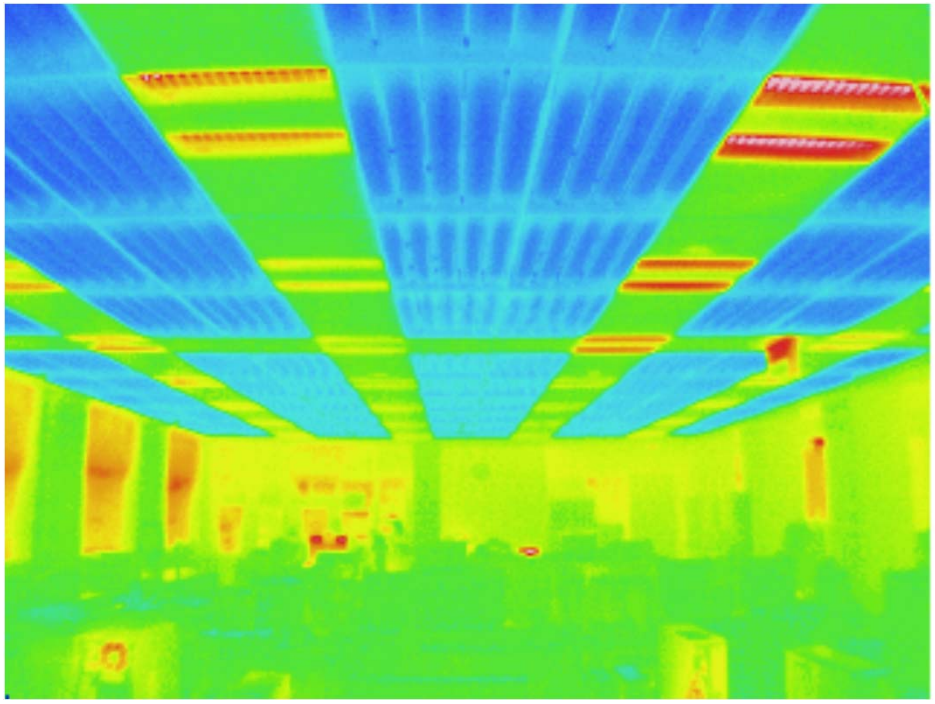
During Cooling



※Blue（Low temperature）⇔Red（High temperature）

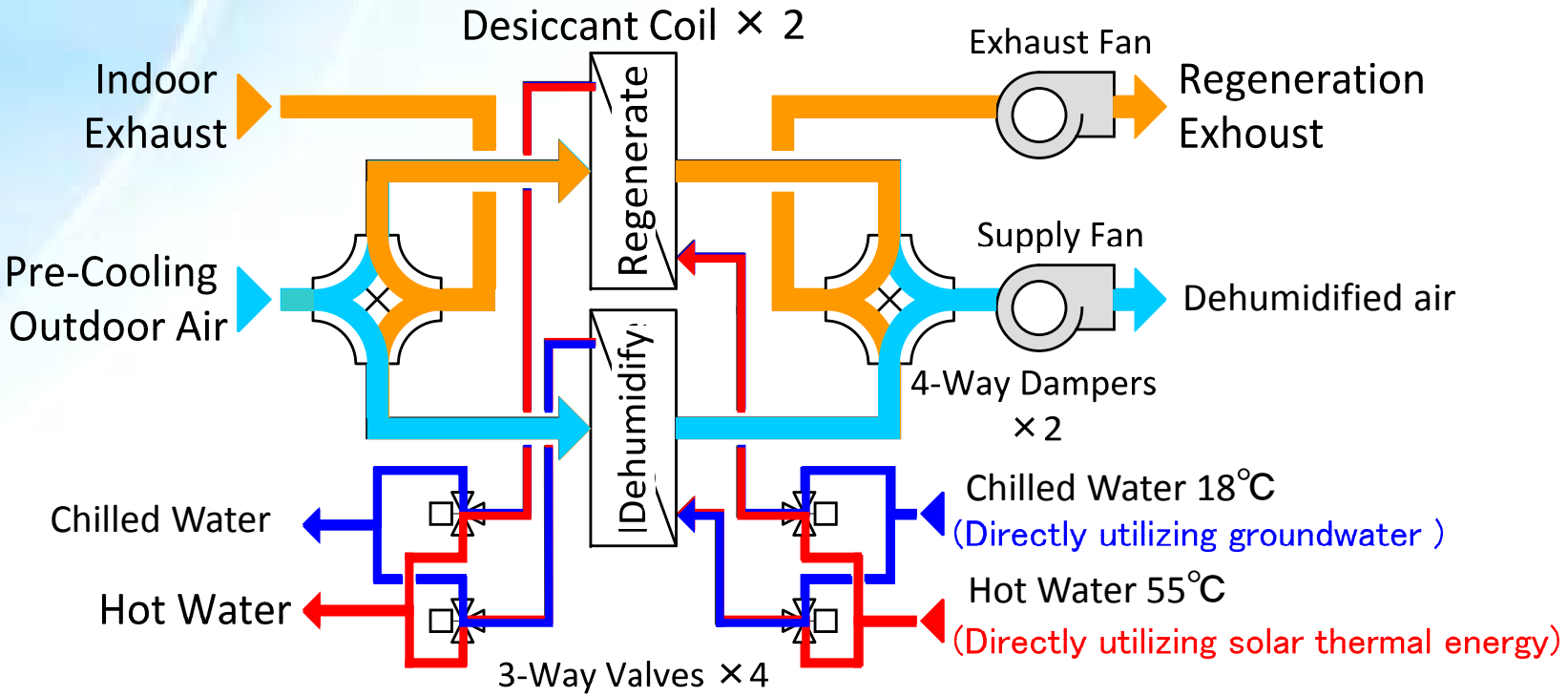
Decoupled Sensible Heat and Latent Heat Air-conditioning System

Latent Heat Treating System

(Desiccant Coil Unit and Dehumidifying unit)

Desiccant Coil Unit

Batch Process System composed by two desiccant coils



Desiccant Coil Unit

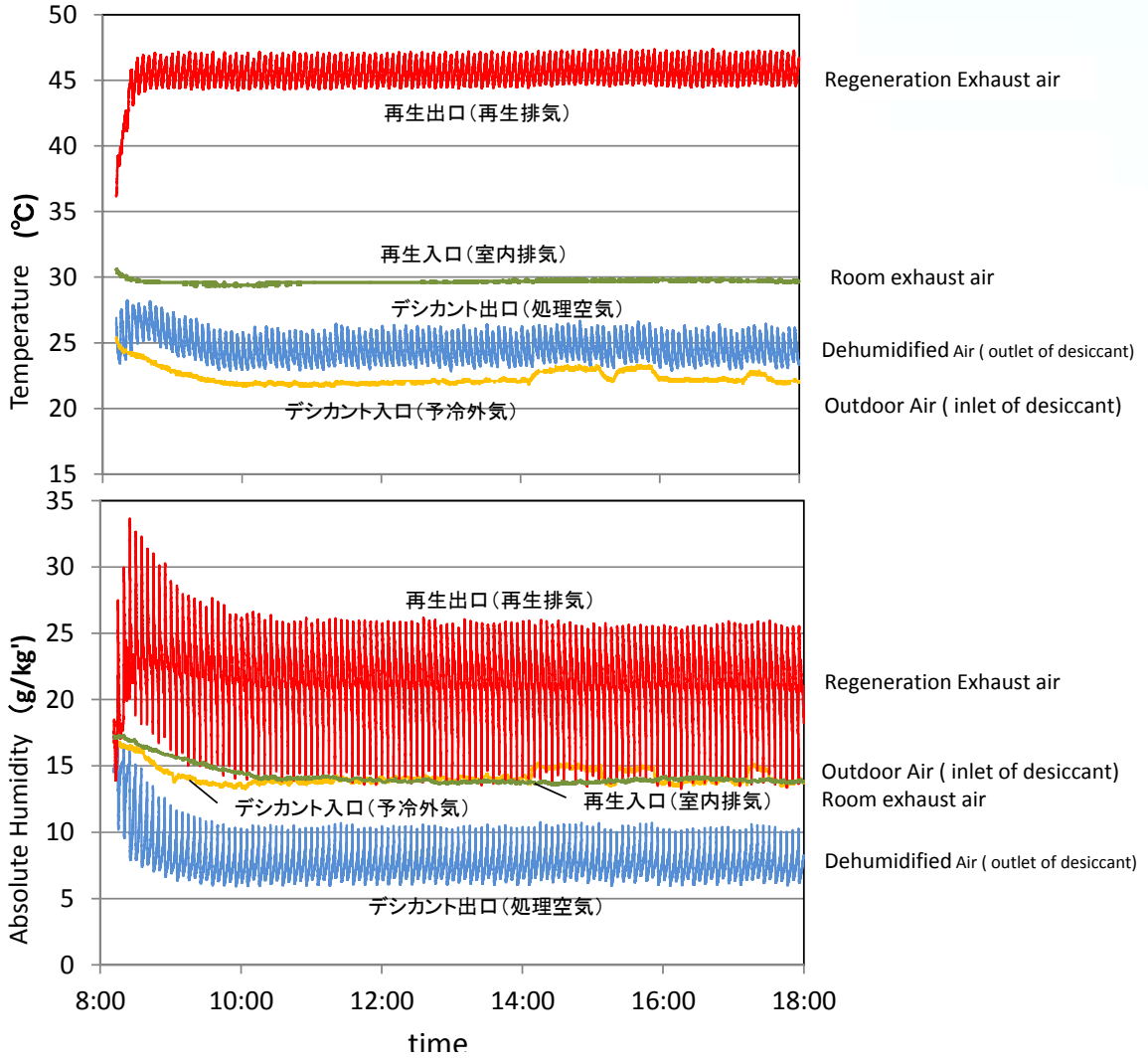
Operation data on 29/08/2013

- Batch Interval : 5min
- Chilled Water Temperature : 17.9℃ (Groundwater)
  Flow rate : 22.6L/min.
- Hot Water Temperature : 55.2℃ (Solar thermal)
  Flow rate : 21.2L/min.

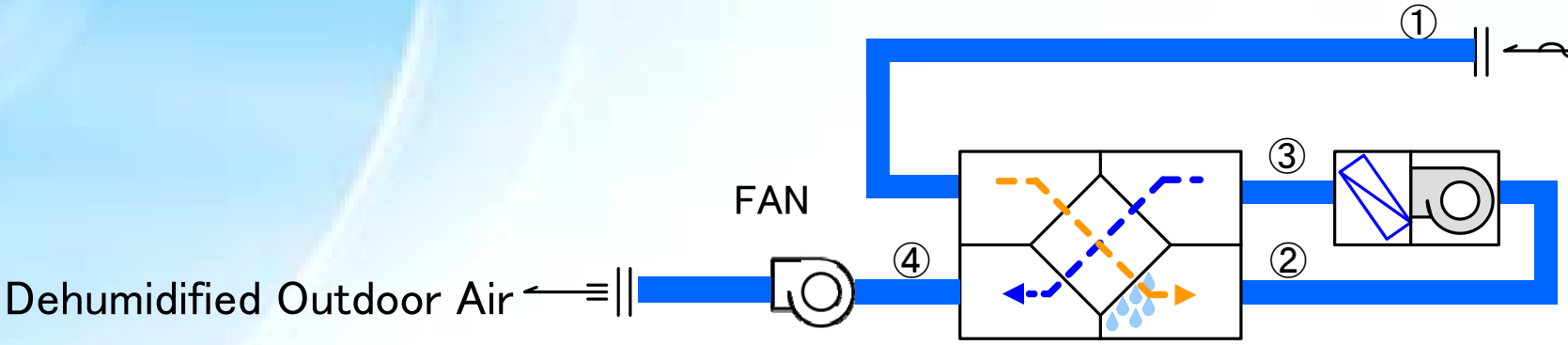
Average Temperature: 24.8℃

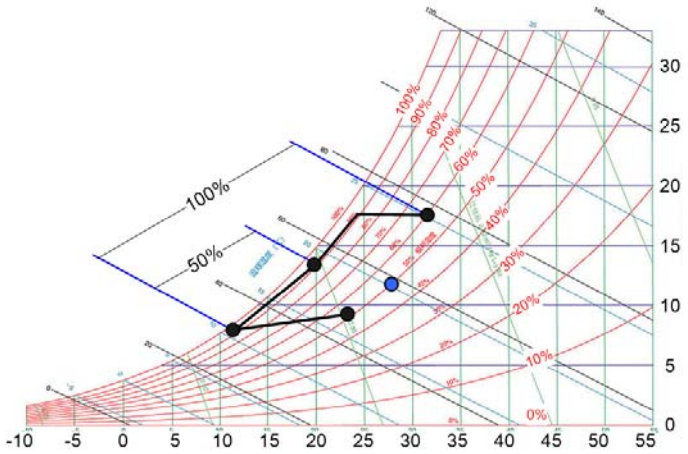
Average Absolute Humidity: 7.7g/kg'

- Chilled water temperature of pre-cool coil : 17.9℃(Groundwater)

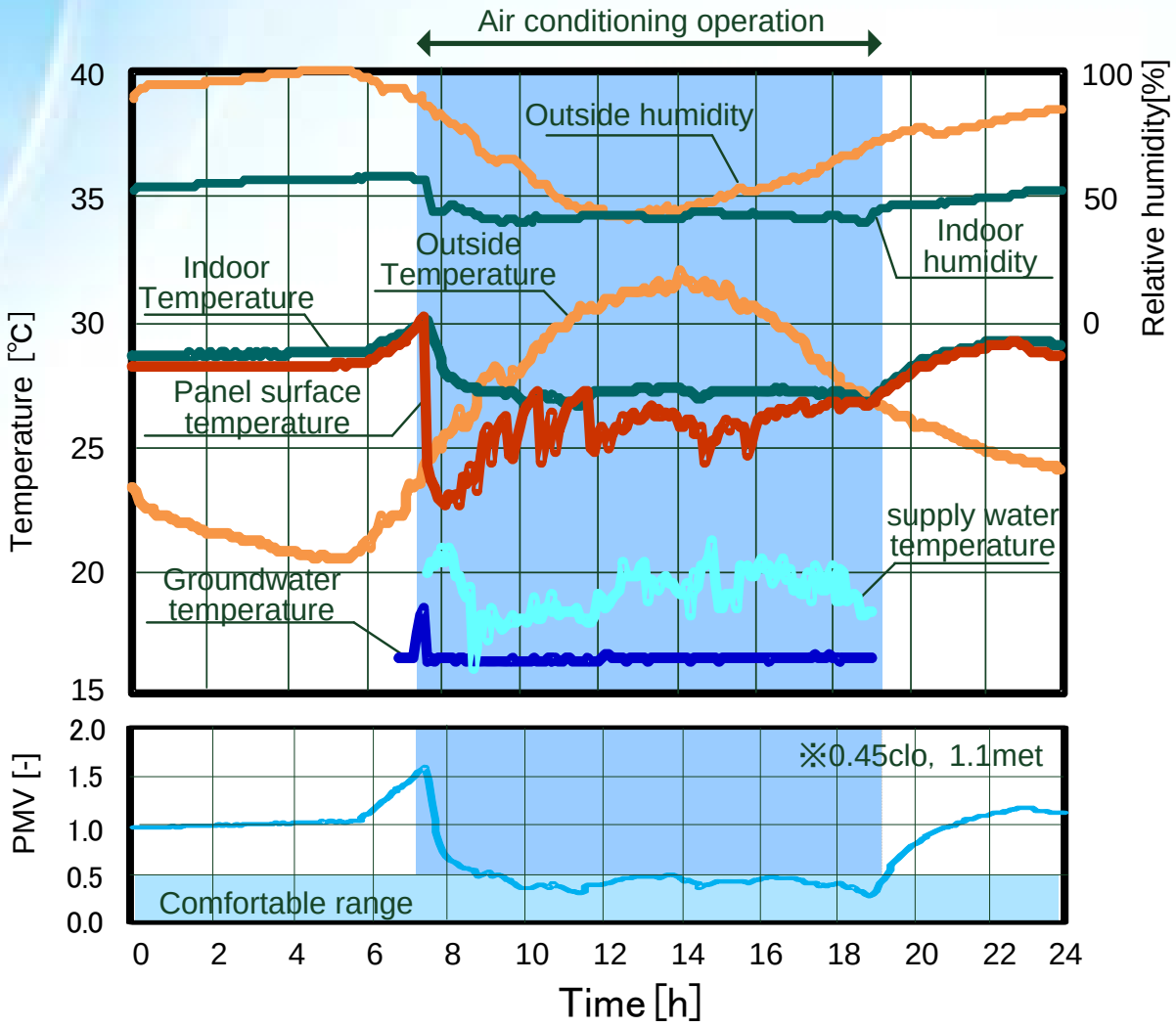


Outdoor Air Dehumidifying Unit





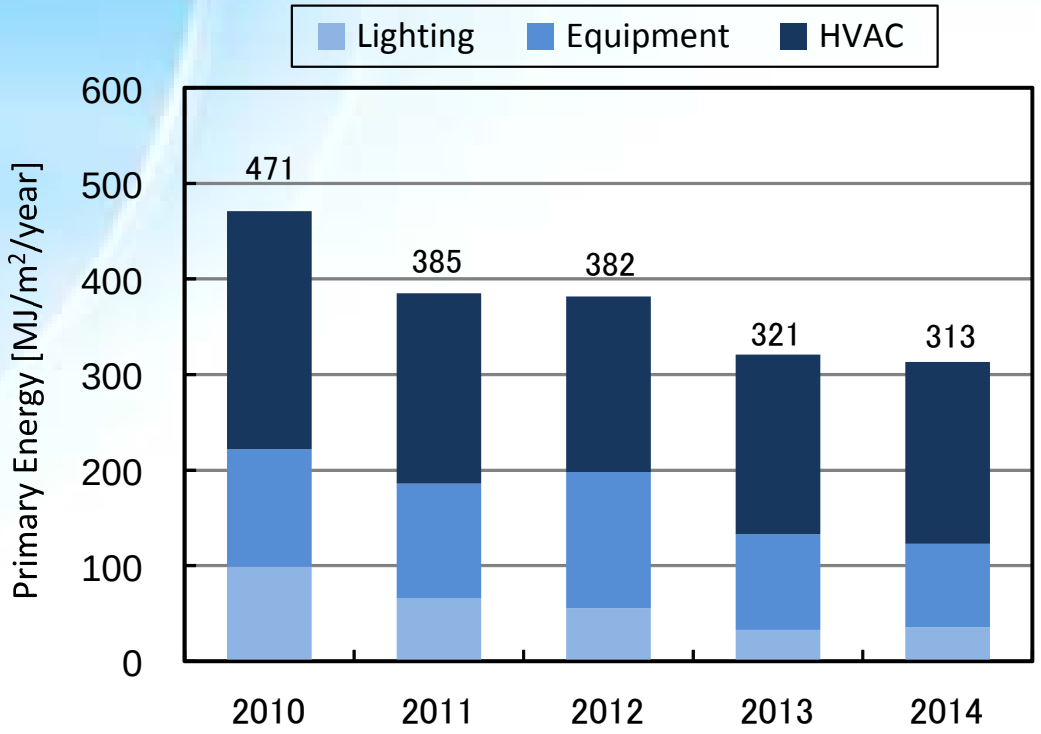
Operating Condition by PMV control



Energy Consumption and Energy Balance

https://skk.jp/en/zeb/

Primary Energy Consumption
in the Office Area

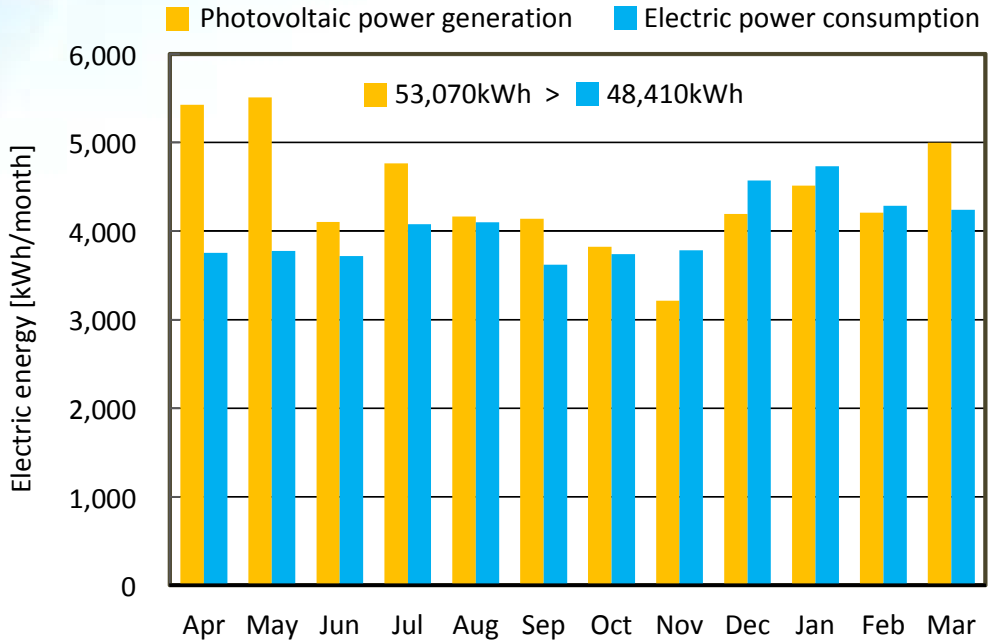


- We have been operating the renovated system since 2010.
- We have continued in introducing new technologies and improving energy conservation.
- We have achieved the ZEB since 2013.

- Primary energy consumption of the office area in 2014 was **313 MJ/m²/year**.
- Primary energy consumption of the reference office building is approximately **1600 MJ/m²/year**.

Electric Energy Balance

The Photovoltaic Power Generation and the Electric Power Consumption of the Whole Building in 2014

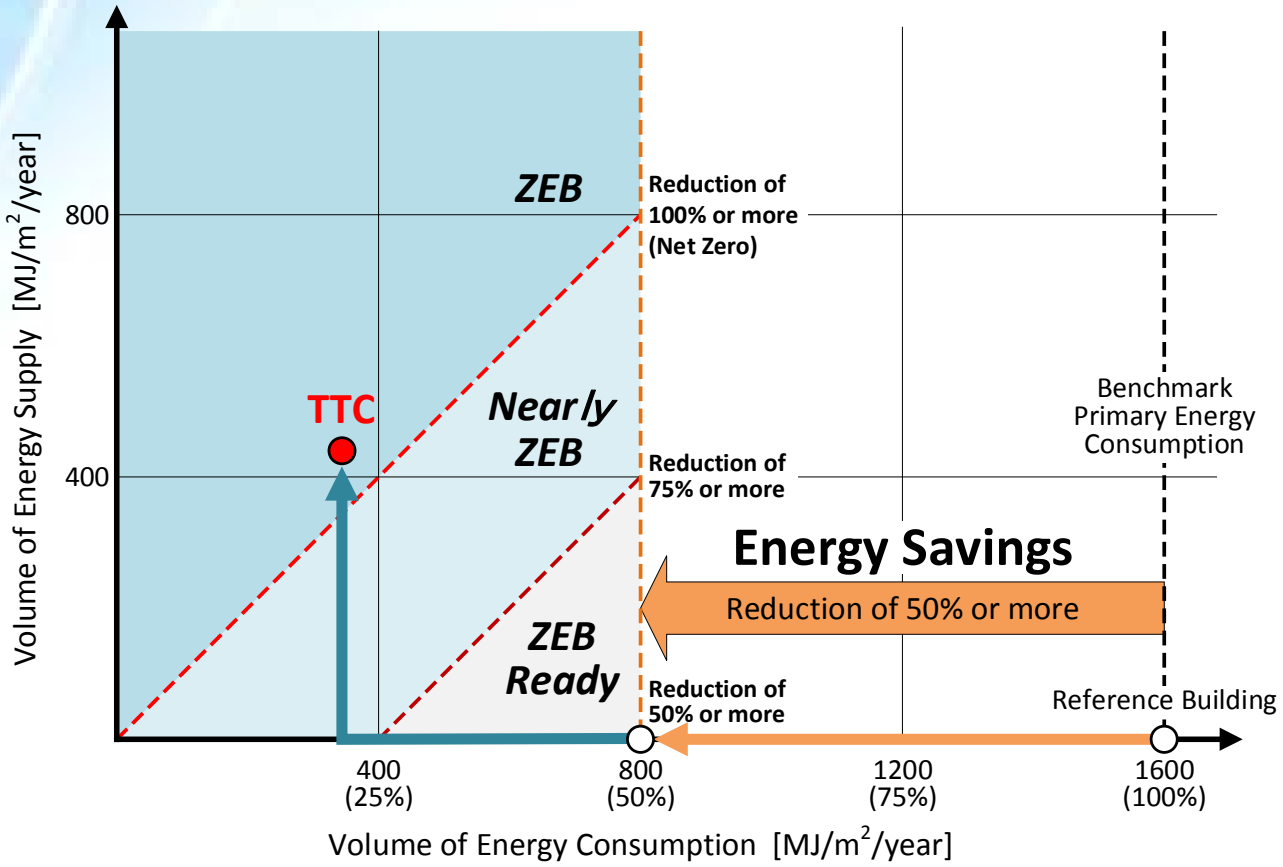


Annual electric power consumption was less than annual photovoltaic power generation.

We achieved net ZEB

Rating of TTC in ZEB Evaluation Chart

TTC is rated on ZEB as net Zero Energy Building



Conclusions

- We have achieved a ***ZEB*** of the ***existing building by the renovation work.***
- The ZEB has been accomplished mainly by ***high-efficiency system*** and ***load minimization***, and it does not rely on a large amount of photovoltaic generation.
- ***Sensible heat and latent heat decoupled air-conditioning system*** is the most important element of the ZEB technology in ASEAN.
- Utilizing renewable energy directly is also an important element of the technology in ZEB, and it is able to operate without heat source machine.

SANKEN's Actions in ASEAN

- ***SANKEN*** would like to emphasize that ***ZEB*** is necessary to stop the climate change and to realize a Low-Carbon Society for our children and their future.

- ***SANKEN*** will continue to cooperate in the dissemination of **ZEB,** which will improve **health** and **productivity** of the people in ASEAN with **minimized energy consumption**.

Thank you all for your attention !!

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