

**Renovation Technology That Optimizes Renewable Energy;
Targeting a Zero-Energy Building (ZEB)**

SANKEN SETSUBI KOGYO CO., LTD. JAPAN



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>

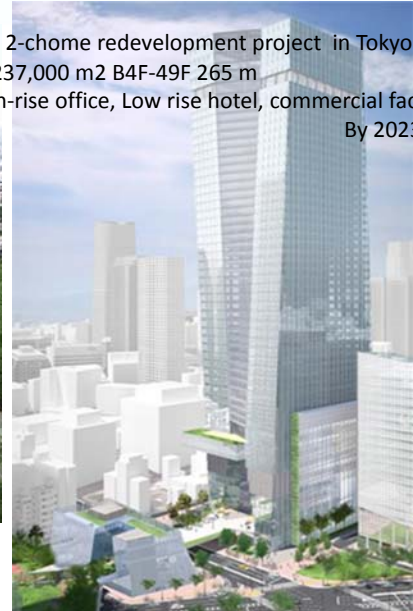
Representative projects



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



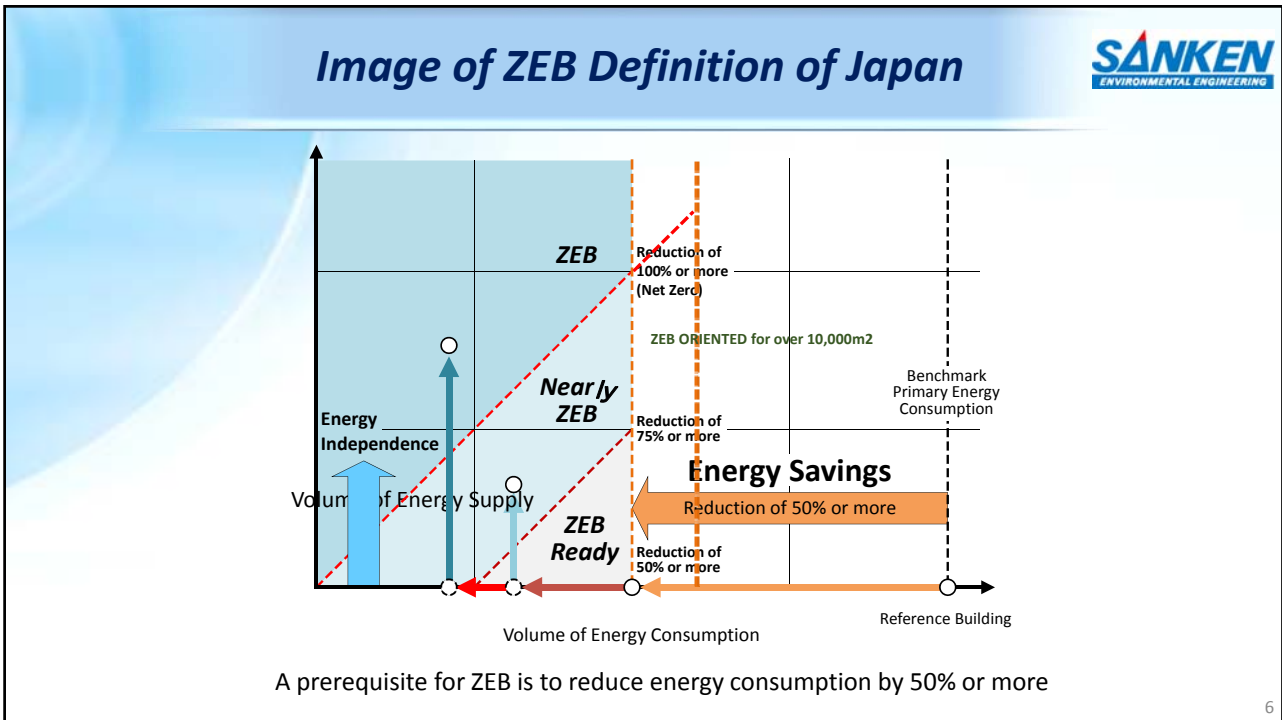
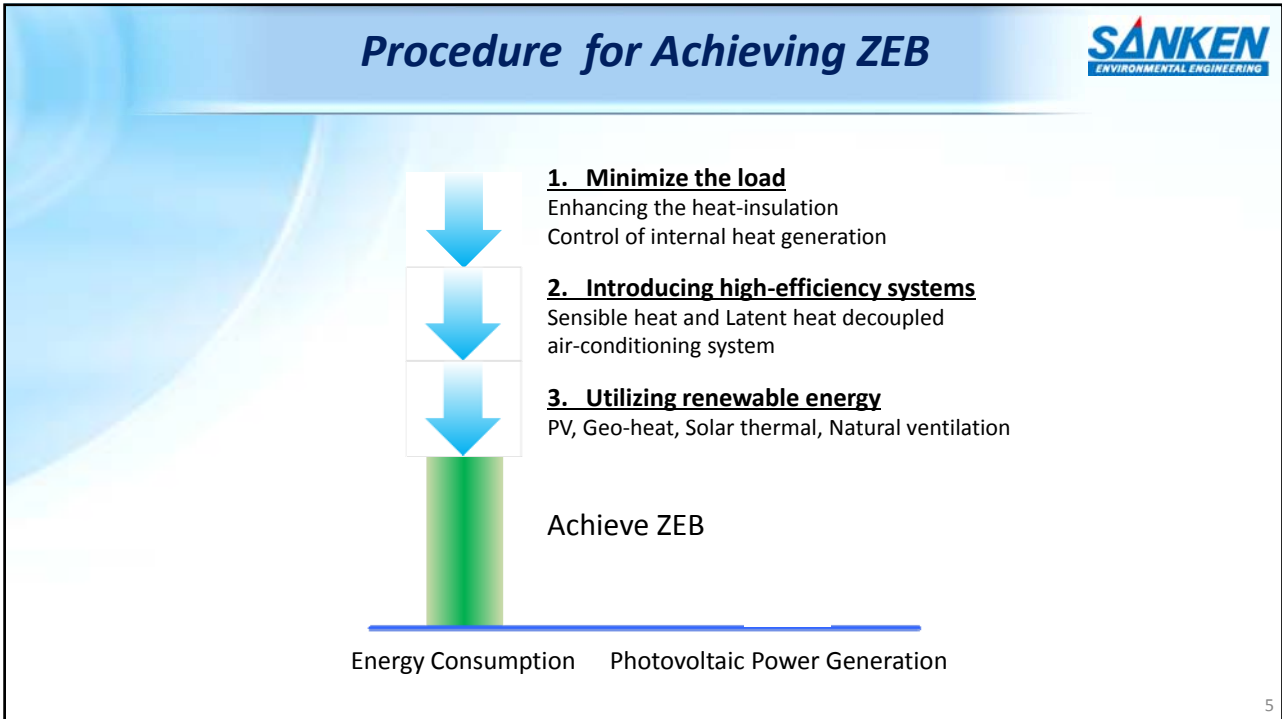
What is a ZEB (Zero Energy Building) ?



- **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.



Outline of Innovated Technology for ZEB of SANKEN

7

Outline of the Building TSUKUBA TECHNICAL CENTER (TTC)



Location: Tsukubamirai-city, Ibaraki-pref.
40km (25mils) northeast from Tokyo
Site Area: 4,123m² (44,380ft²)
Floor Area: 2,258m² (24,305ft²)
Reinforced-Concrete structure
Floor Number: Three stories
Completion date: Oct, 1992

8



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.



平成26年度 地球温暖化防止活動
環境大臣賞 受賞
対策技術先進導入部門

風と太陽と地中熱が織りなす Zero Energy Building

つばきあいの環境センターの Zero Energy Building は、自然エネルギーを最大限に活用する風と太陽と地中熱を統合した再生可能エネルギーシステムを構築し、省エネルギーと省コストを実現。また、自然エネルギーを有効活用する蓄熱システムと、コンプレックスのエネルギー消費を削減するための蓄熱システムを採用し、省エネルギーを実現。また、自然エネルギーを有効活用する蓄熱システムを採用し、省エネルギーを実現。また、自然エネルギーを有効活用する蓄熱システムを採用し、省エネルギーを実現。

CO₂ 排出量
▲2.1t-CO₂/年

三建設備工業株式会社



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



第3回 建築設備技術者協会
カーボンニュートラル賞 受賞
ZEBからCO₂マイナスビルへ

再生可能エネルギー直接利用潜熱顕熱分離空調システムの開発

2013 年度

給電電量	55,451kWh	22.2t-CO ₂ 削減量
電力消費量	49,600kWh	20.1t-CO ₂ 排出量

年間で▲2.1t-CO₂

「温室効果ガス排出量を2010年と比べ、2050年に70%削減」の要求を満たす技術でもあり、「温室効果ガス排出量を2100年にゼロもしくはマイナスとする技術」の核となるシステム

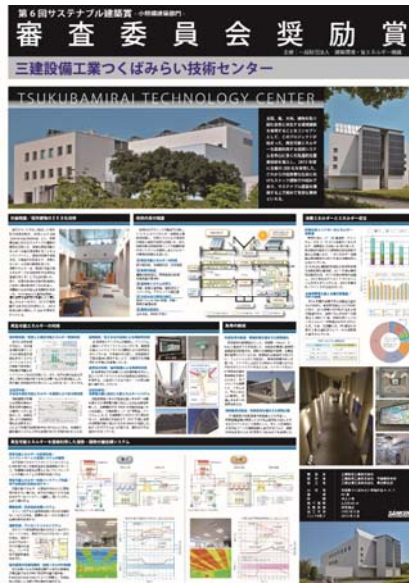
年間のCO₂排出量がマイナス、地球温暖化防止に貢献するビルへ。

風と太陽と地中熱が織りなすZEBコンセプトに、外気の新熱性能を最大限に活用し、自然エネルギーを最大限に活用する蓄熱システムと、コンプレックスのエネルギー消費を削減するための蓄熱システムを採用し、省エネルギーを実現。また、自然エネルギーを有効活用する蓄熱システムを採用し、省エネルギーを実現。また、自然エネルギーを有効活用する蓄熱システムを採用し、省エネルギーを実現。



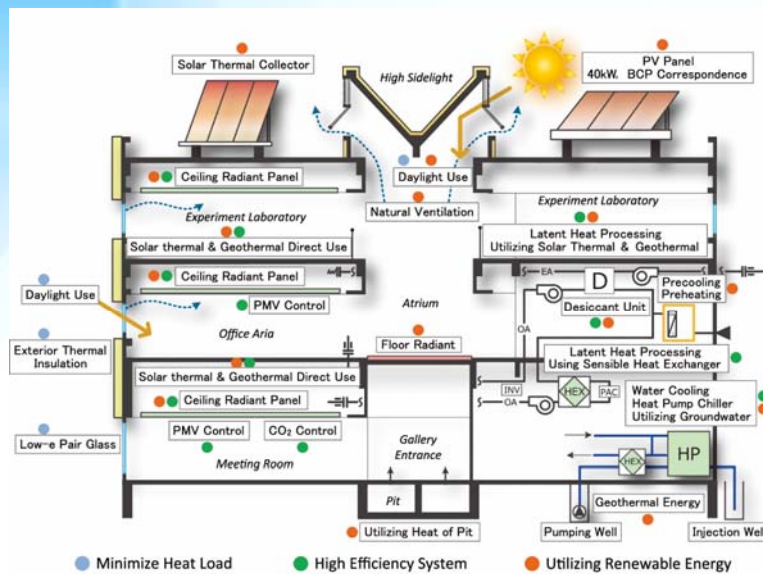
Carbon Neutral Award from JABMEE in 2014 .
:Japanese Association of Building Mechanical and Electrical Engineers

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



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

Innovated Technologies Elemental Technologies



1. Architectural

- ① Exterior thermal insulation
- ② Low-e pair glass

2. Air-conditioning system

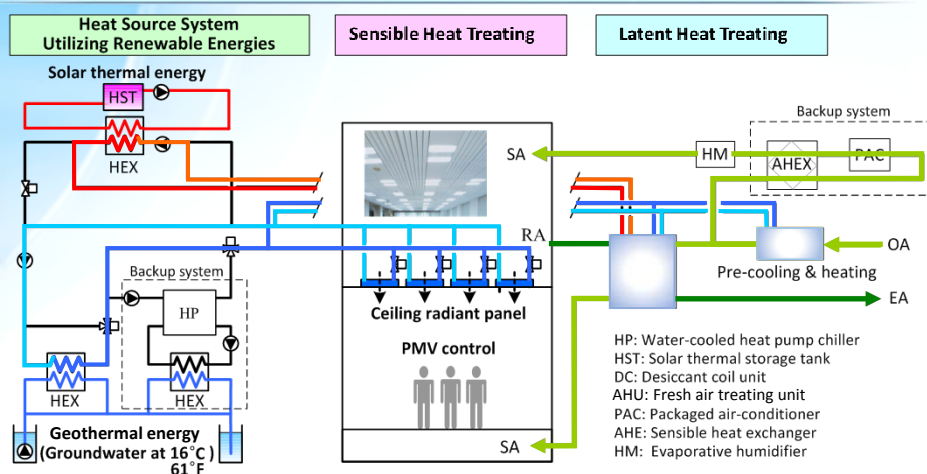
- ① Decoupling Latent heat and Sensible heat
Ceiling radiant panel, Latent heat treating system
- ② Direct use of renewable energies
Geo-heat, Solar thermal, Natural ventilation

3. Electric equipment and lighting system

- ① High efficiency lighting (LED)
- ② Daylight control and zone control of lighting
- ③ High efficiency transformer

15

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

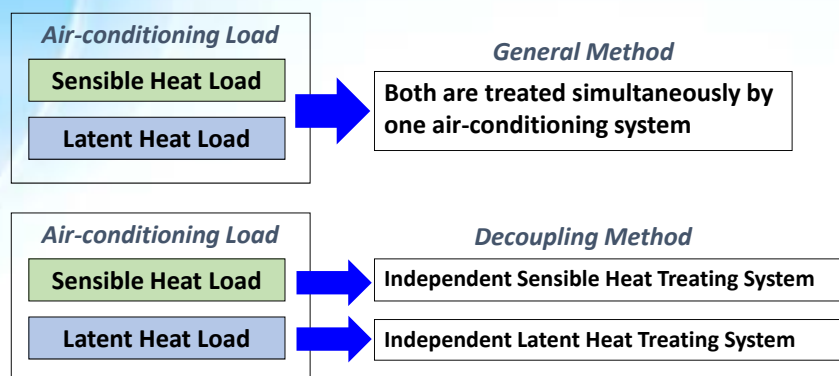
16

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

Concept of Energy-Saving Effect

17

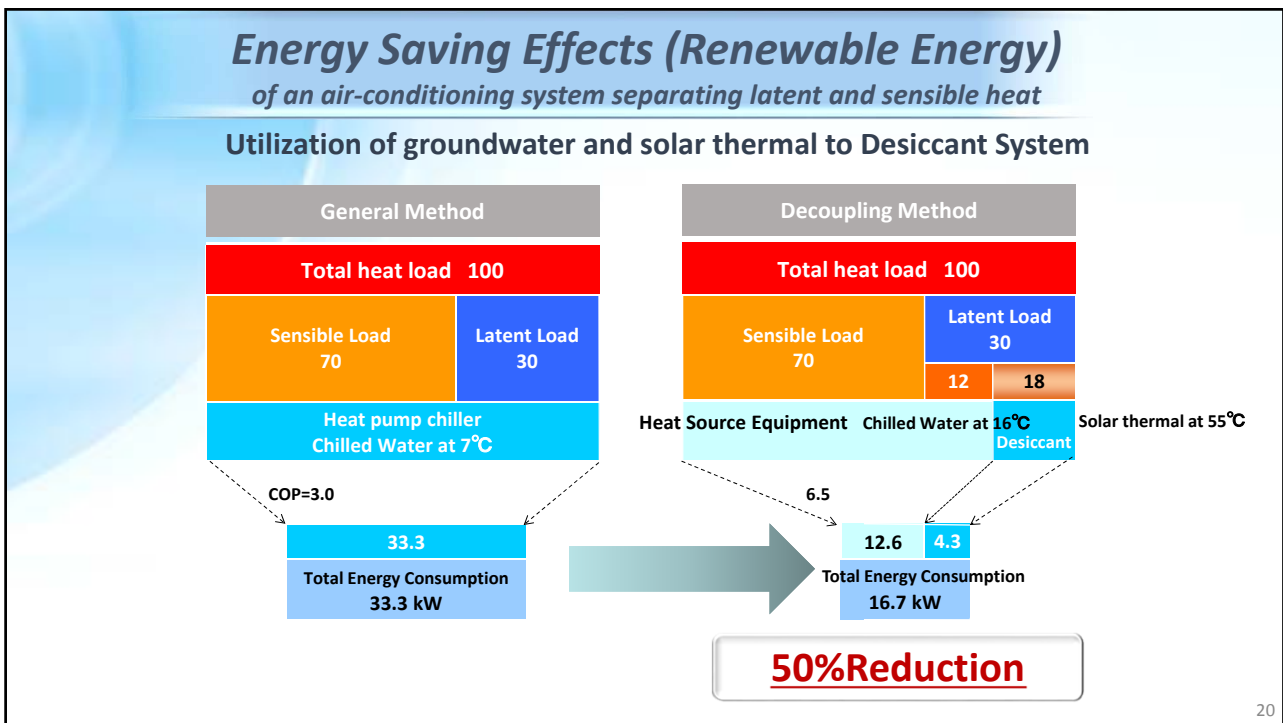
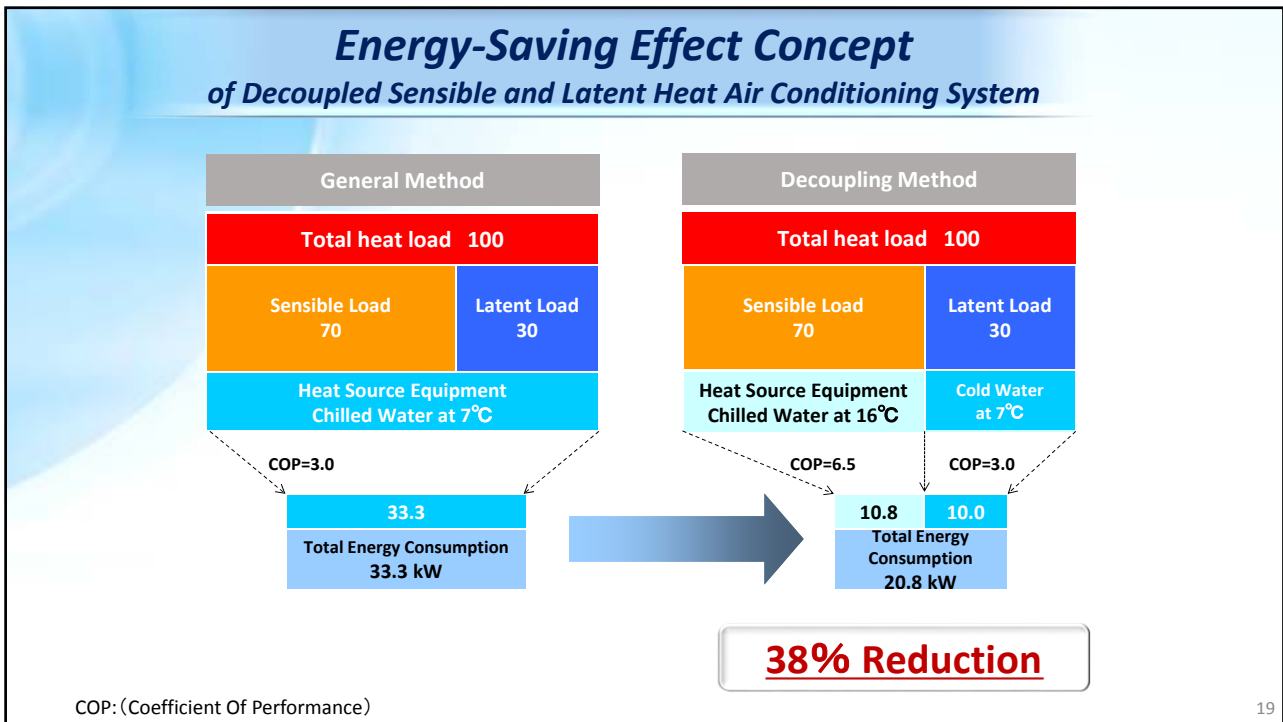
Decoupled Sensible and Latent Air-conditioning System

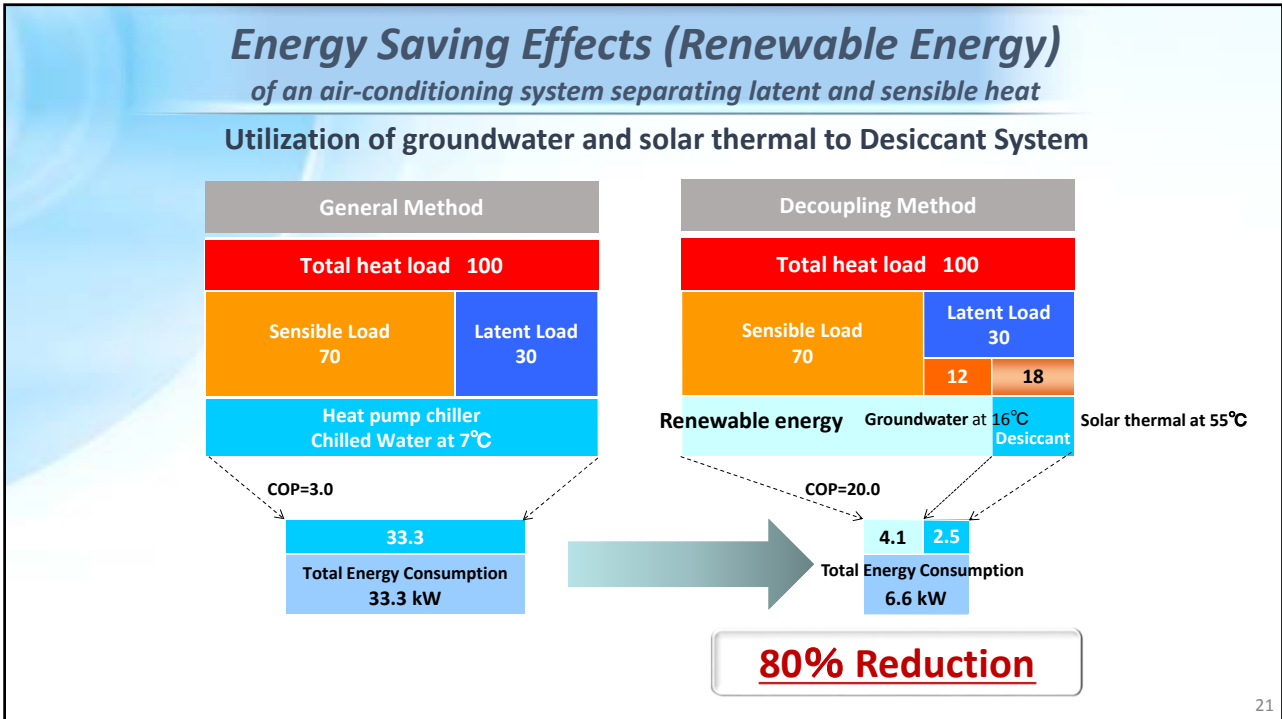


SANKEN's decoupled Sensible and Latent Air-conditioning System

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

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

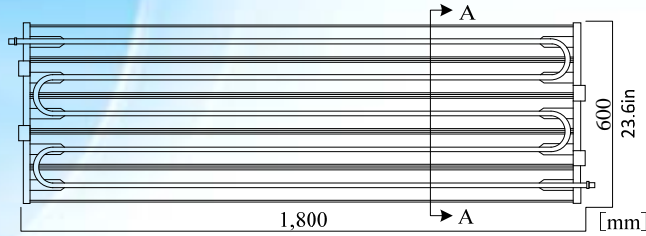




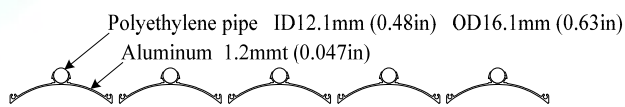
Decoupled Sensible Heat and Latent Heat Air-conditioning System

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

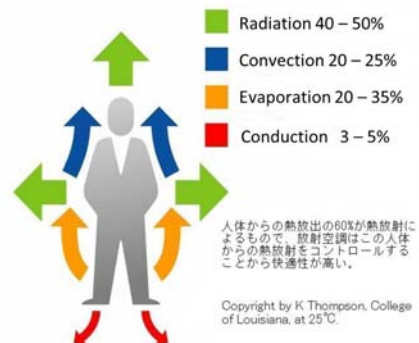
23

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.



24

Positive Points of Radiant Air-Conditioning



Energy Saving of Radiant Air-Conditioning

- The Cooling is possible by sending cold water to the ceiling metal panel at 18°C, 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.

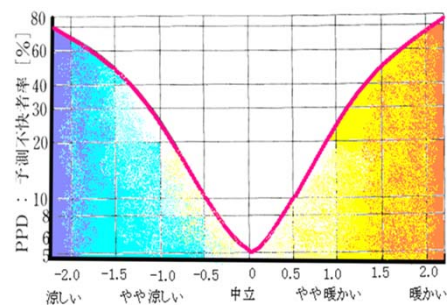
PMV Controller



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	Warm
Amount of clothing	0 ~ 2clo	+1	Slightly warm
Air temperature	10 ~ 30°C	0	Neutral
Mean Radiant Temp	10 ~ 40°C	-1	Slightly cool
Mean air velocity	0 ~ 1m/s	-2	Cool
Relative humidity	30 ~ 70%	-3	Cold

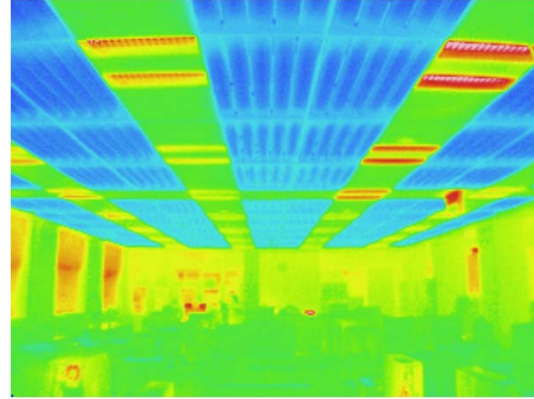


PMV: 予測平均温冷感申告
PMV と PPD の関係

Thermal Image of the Ceiling Panel



During Cooling



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

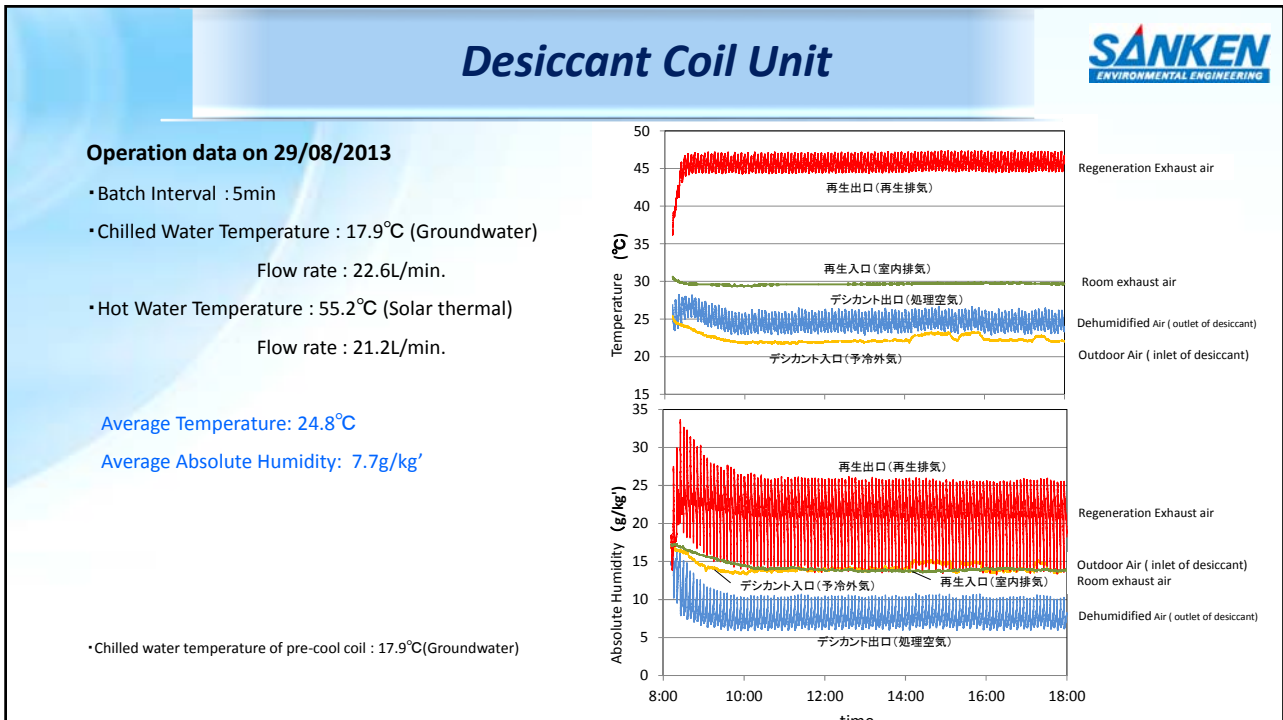
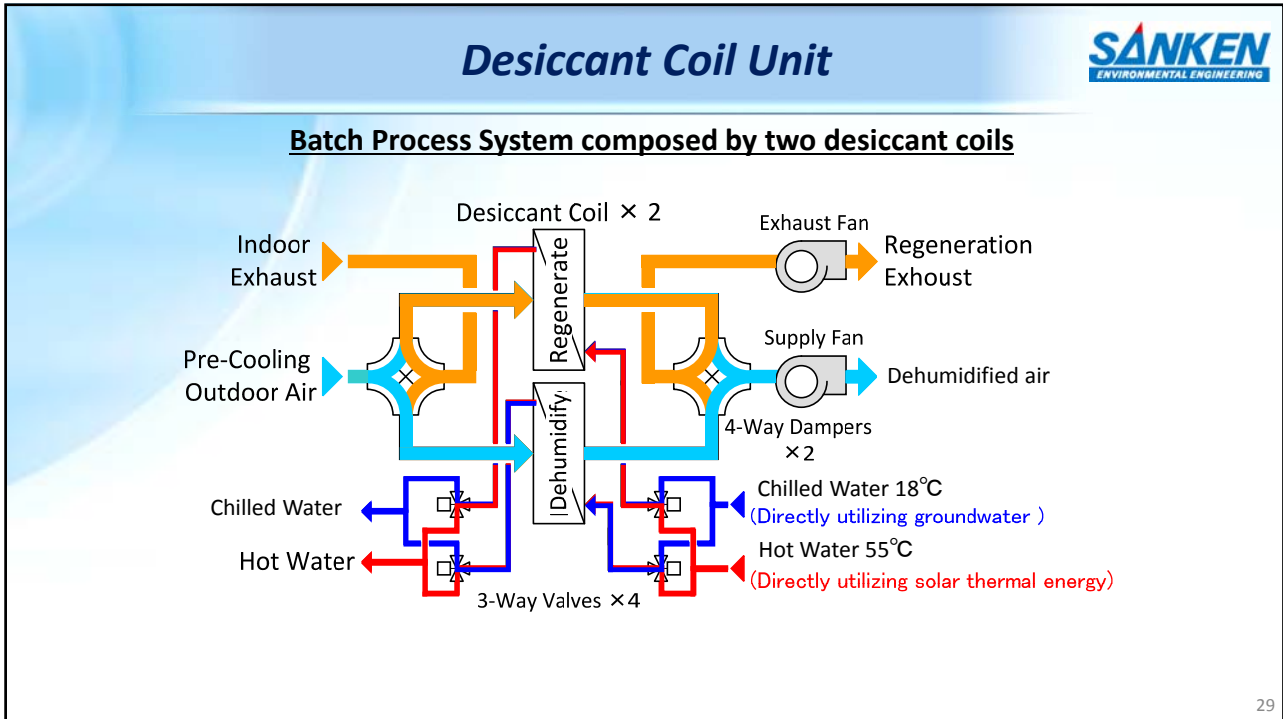
27

Decoupled Sensible Heat and Latent Heat Air-conditioning System

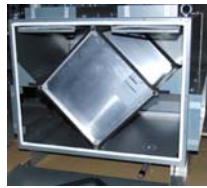
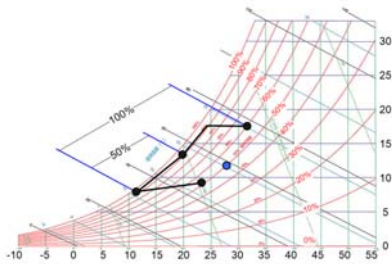
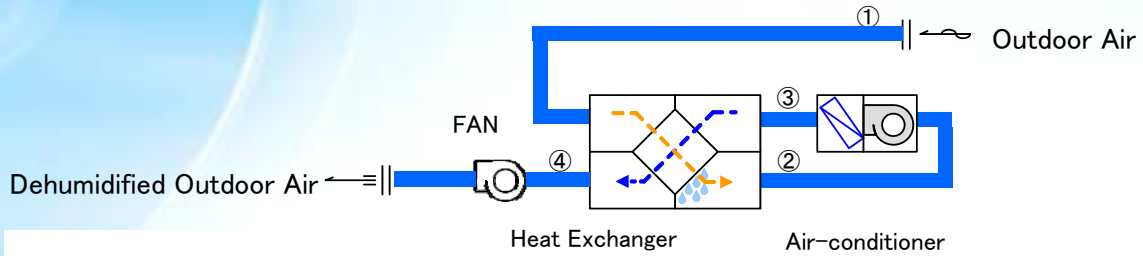


Latent Heat Treating System
(Desiccant Coil Unit and Dehumidifying unit)

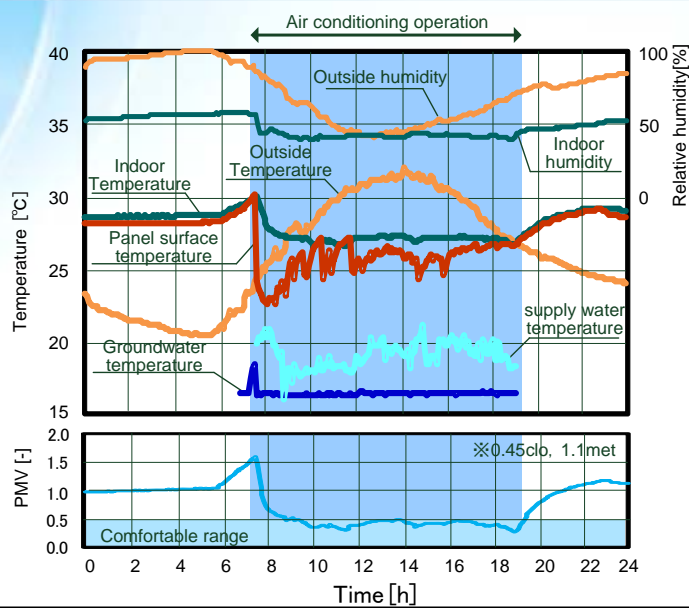
28



Outdoor Air Dehumidifying Unit



Operating Condition by PMV control

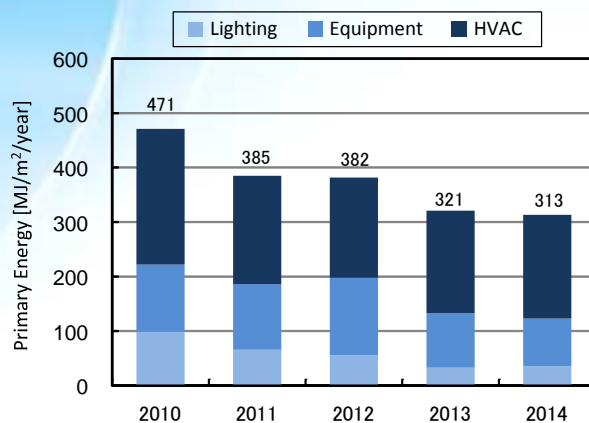


Energy Consumption and Energy Balance

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

33

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.

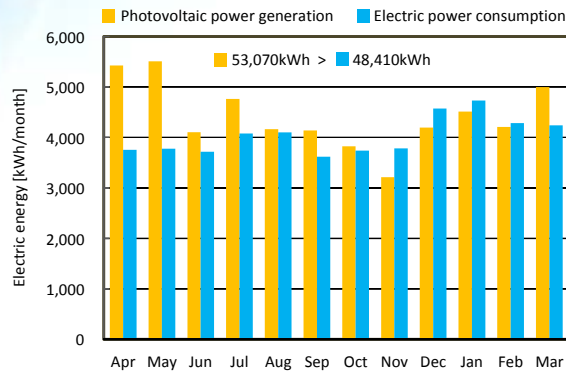
- Primary energy consumption of the office area in 2014 was **313 MJ/m²/year**.
- Primary energy consumption of the reference office building is approximately **1600 MJ/m²/year**.

34

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.

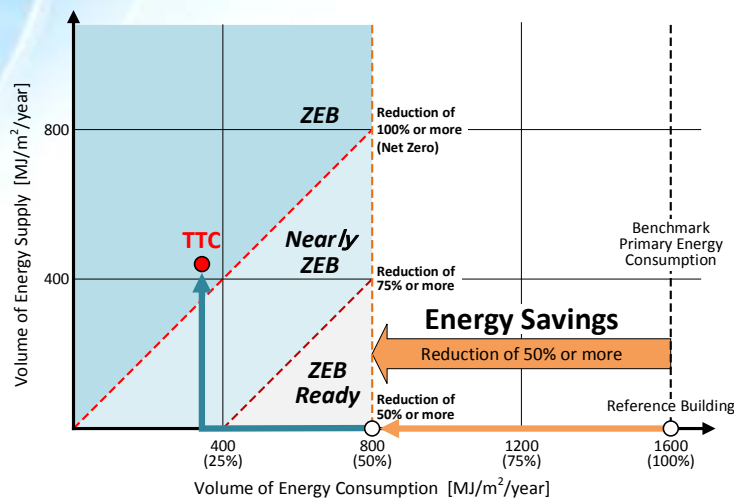


We achieved net ZEB

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.

37

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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