



# The Role of Heat Pumps towards Net Zero Emissions

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**We are**



**Heat Pump & Thermal Storage Technology Center of Japan**



- ◆ Foundation
- ◆ Activities
- ◆ Membership

1986  
Public Dissemination/Promotion  
Technical Support  
International Activities  
98 companies / organizations  
(As of 2021)



# We are

conducting international activities including **Technology Collaboration Programmes (TCPs) on Heat Pumping Technologies and Energy Storage** by **IEA** and other activities.

## 1. Technology Collaboration Programme on **Heat Pumping Technologies (HPT TCP)**

- **Annex 54: Heat pump systems with low GWP refrigerants**
- **Annex 58: High-Temperature Heat Pumps**



## 2. Technology Collaboration Programme on **Energy Storage (ES TCP)**

- **Annex 36: Carnot Batteries**
- **Annex 37: Smart Design and Control of Energy Storage Systems**



## 3. Other international activities

- **Asian Heat Pump & Thermal Storage Technologies Network (AHPNW)**





# What is Heat Pump?

Heat pumps in our lives



Air Conditioner



Refrigerator

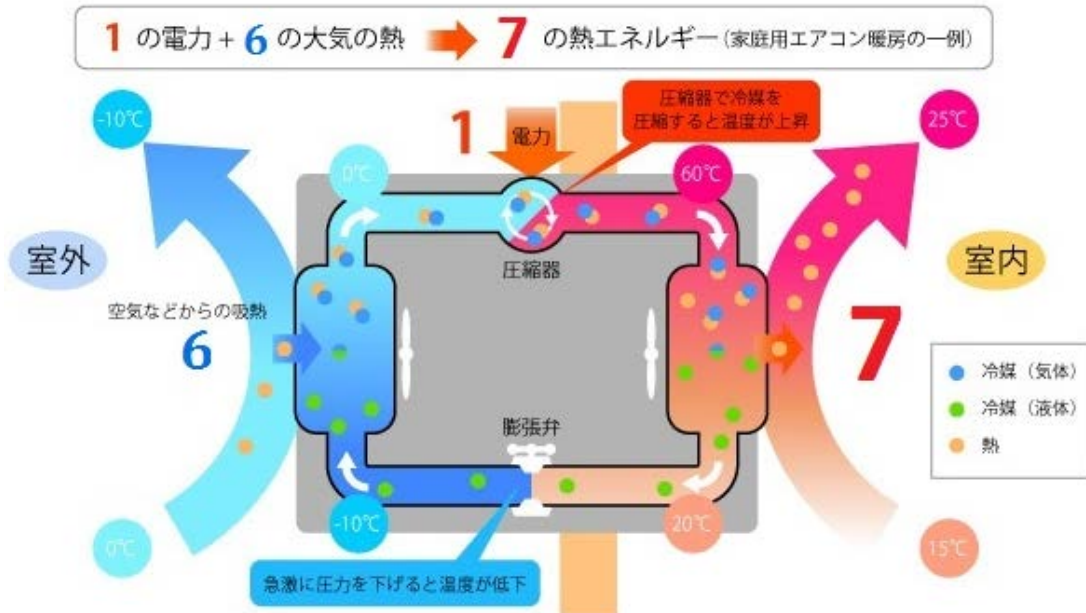


Clothes Dryer

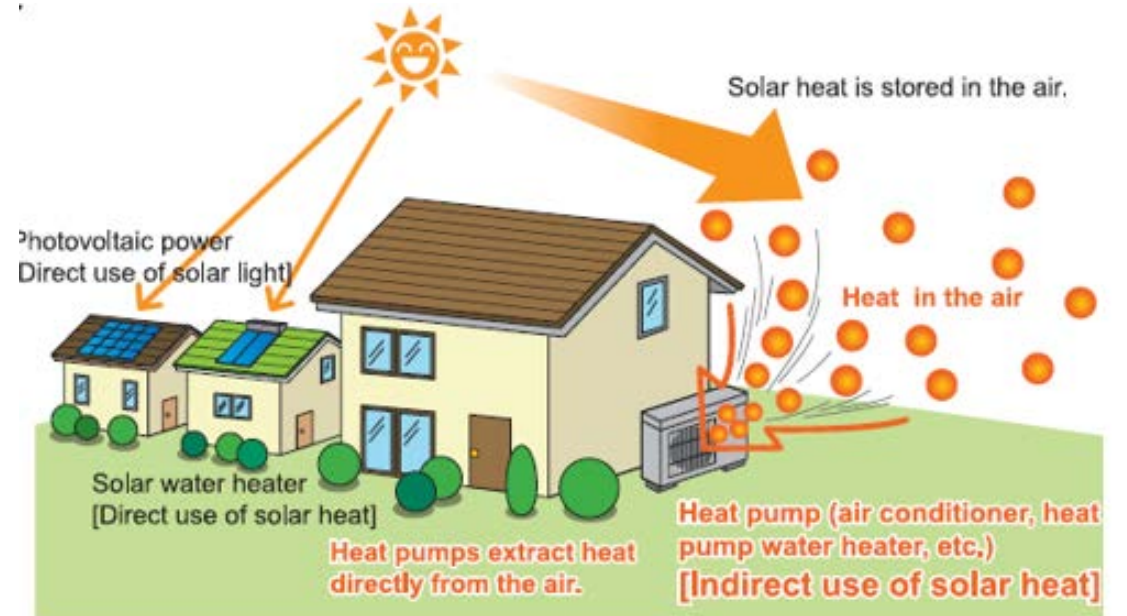


Water Heater

## Energy efficient heat supply by HPs

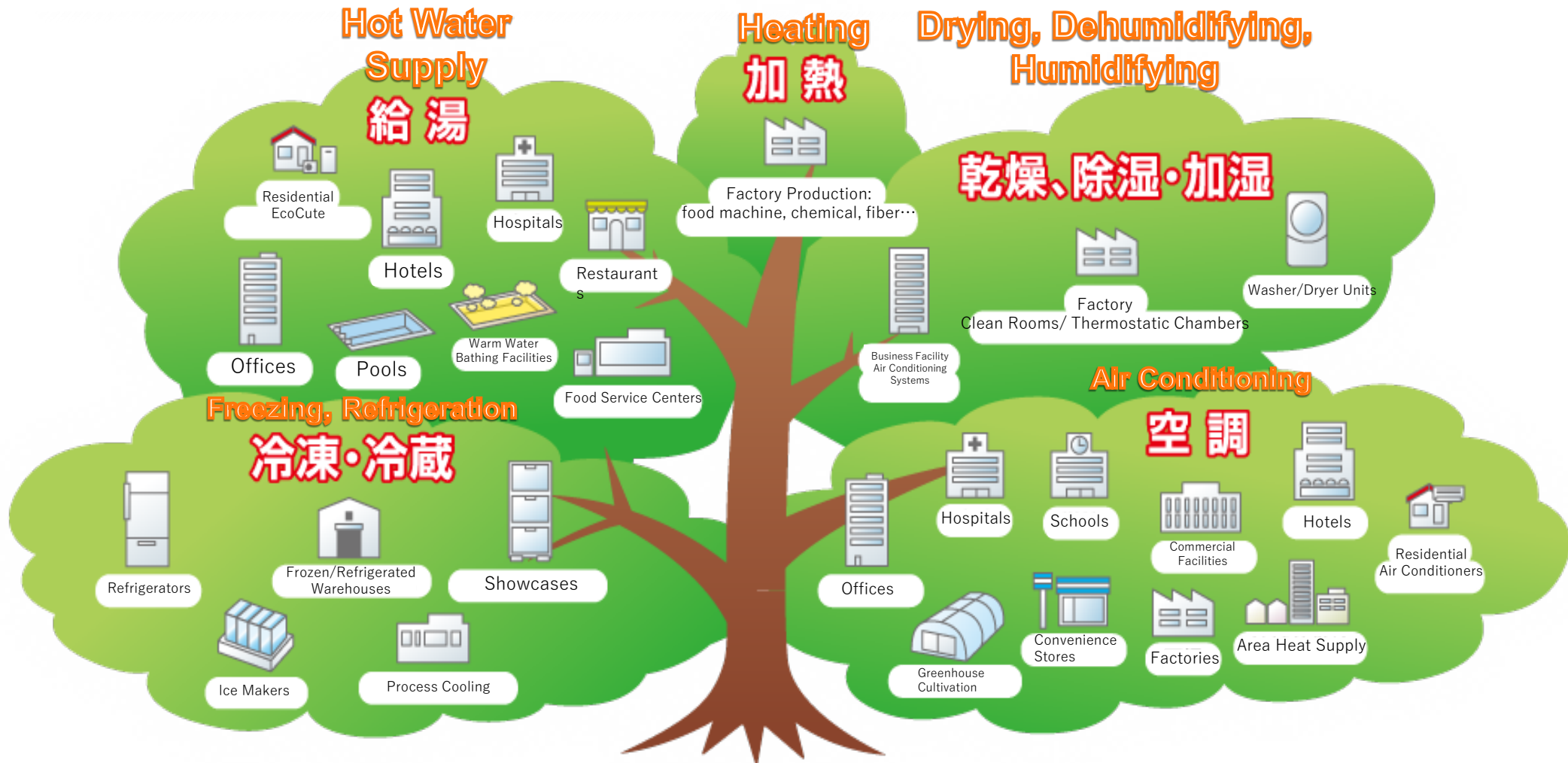


## Renewable energy utilization by HPs



# Expanding Heat Pump Utility

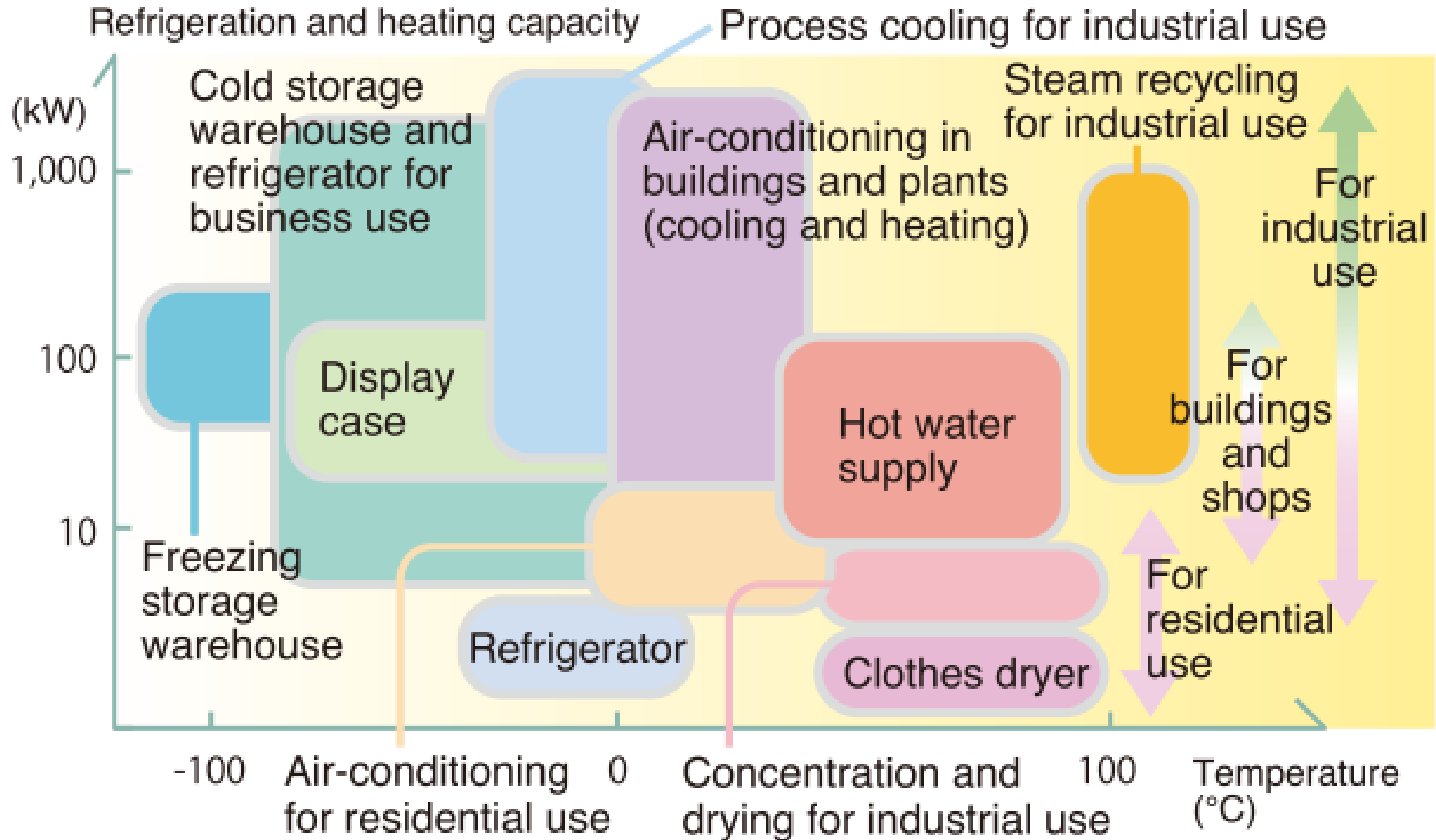
Thanks to Technological Advancement, Heat Pump Application has Diversified, and Extended into Various Fields and Applications



# Mechanism of Heat Pump

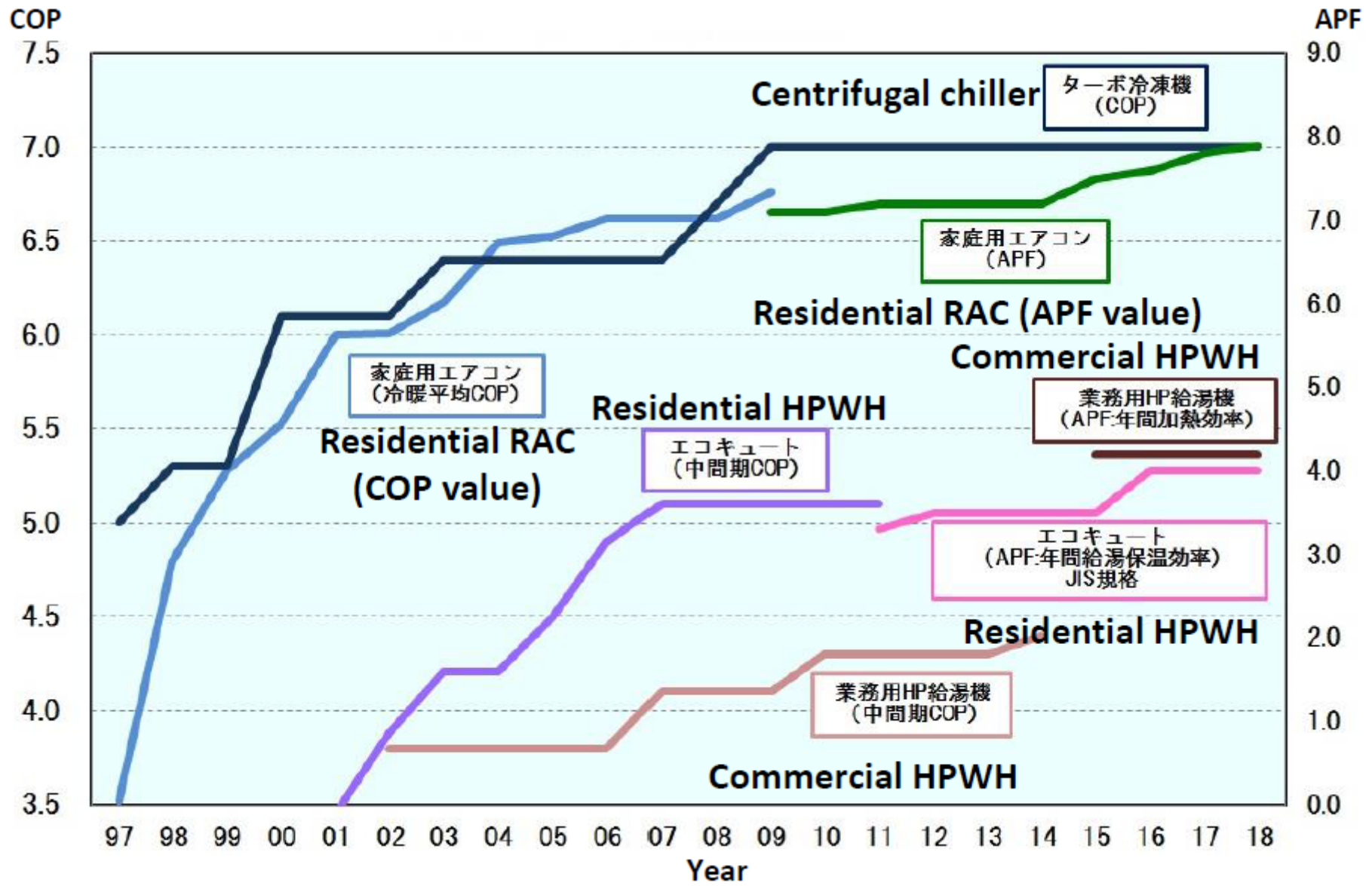
[1:Heat Pump Transfers Heat Without experimental image version \(hptcj.or.jp\)](http://hptcj.or.jp)

# Heat Pumps are applicable to all sectors.





# Energy Efficiency improvement of HPs



# Building sector x Heat pumps



# Heat Pump used in building sector

## Chilling Unit

大規模ビル空調  
産業用途

- ・クリーンルーム
- ・プロセス冷却
- ・洗浄・殺菌・加熱



## Centrifugal Chiller

大規模ビル空調  
産業用途

- ・クリーンルーム
  - ・プロセス冷却
  - ・洗浄・殺菌・加熱
- 地域熱供給



## VRF



中小ビルの個別空調

- ・事務所
- ・店舗

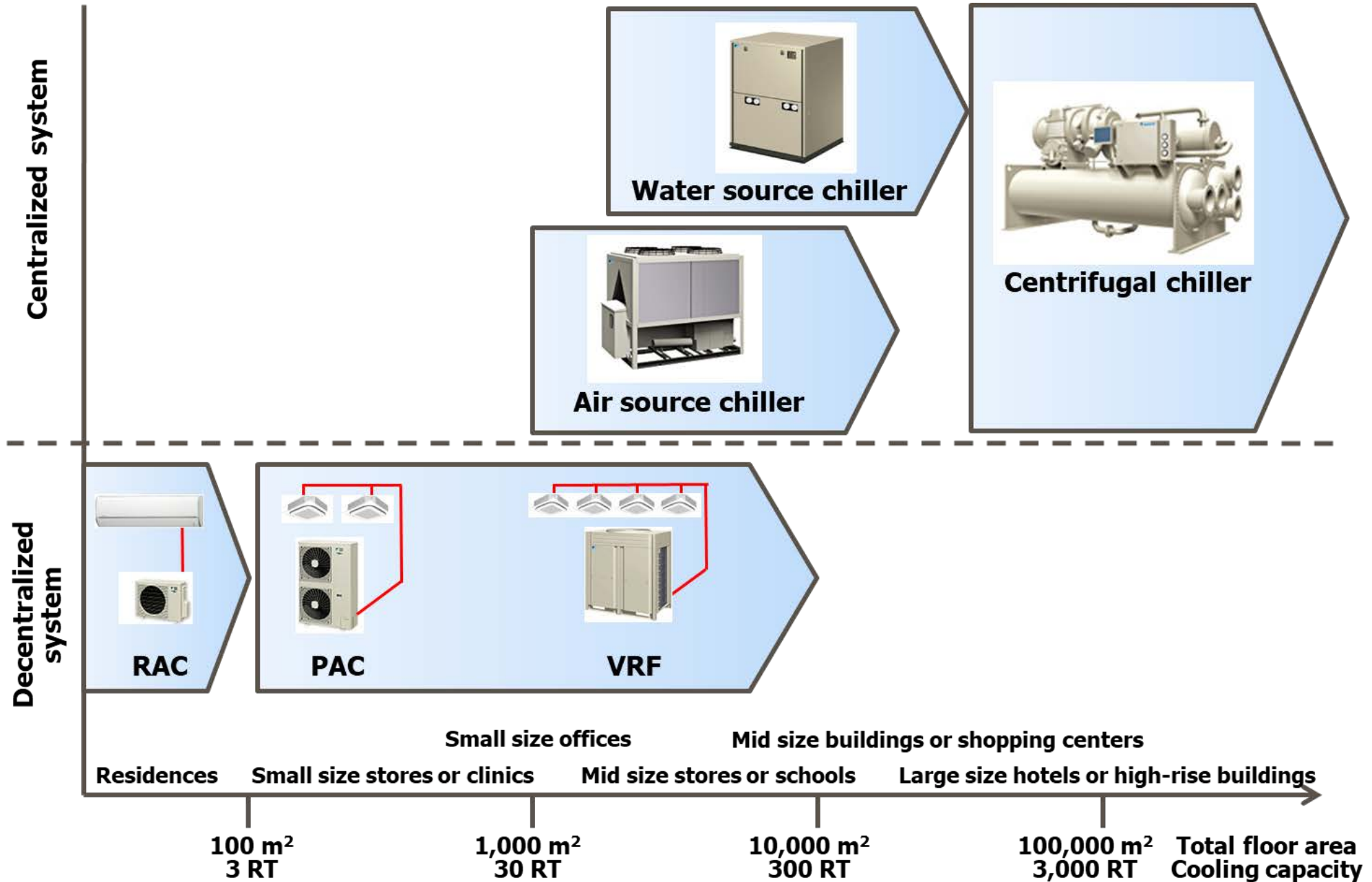


## Heat Pump Water Heater

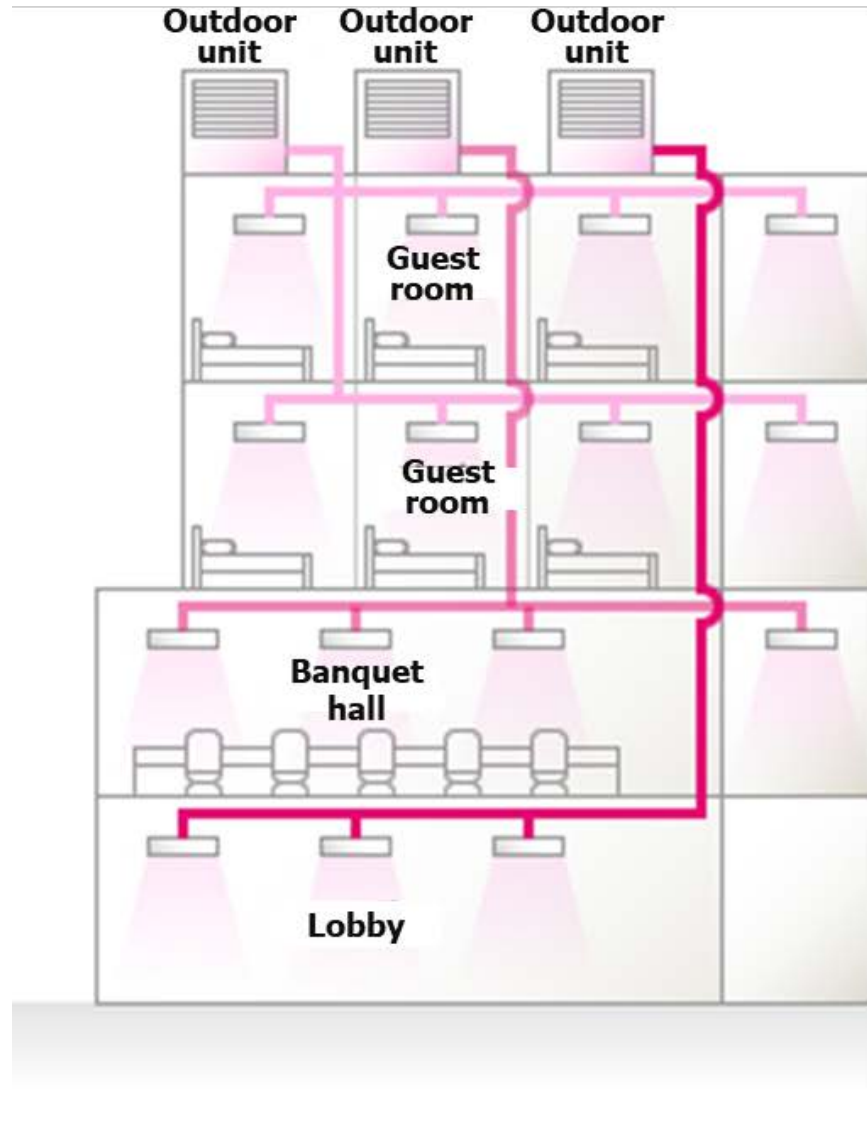
福祉施設  
ホテル  
スーパー銭湯  
保育園  
ゴルフ場



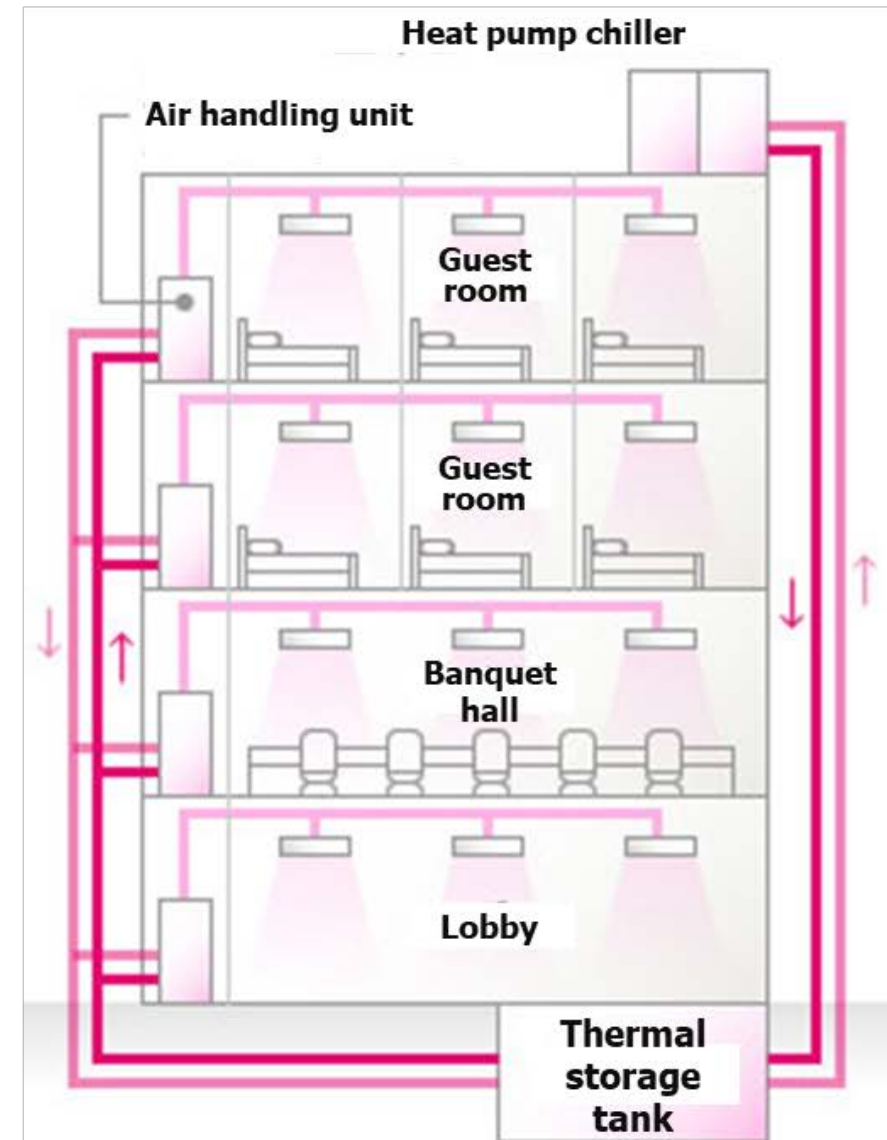
# For air conditioning



# For air conditioning



**Decentralized system**



**Centralized system**



# Case study 1 Chilling Unit



**Use of building: Hospital**  
**Total floor area: 10,000m<sup>2</sup>**  
**Construction completion: 2008**  
**(replaced)**  
**Air conditioning equipment:**  
**Heat pump chiller**  
**520kW × 2 units**

## Current system

Heat pump chiller

## Conventional system

A type heavy oil fired absorption water heater-chiller

## CO<sub>2</sub> emissions reduction



## Primary energy consumption reduction



## [Specifications]

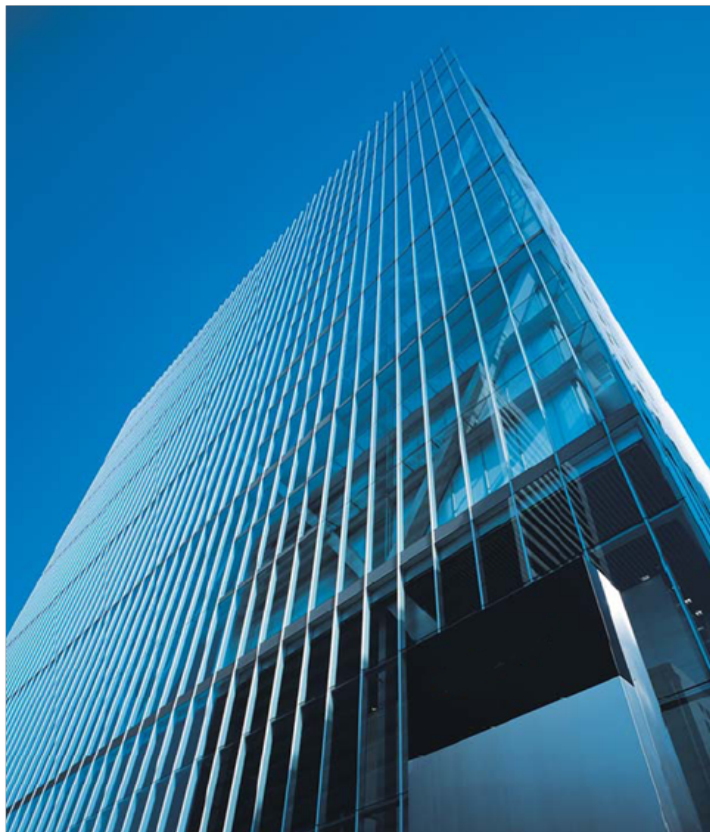
Comparison of an annual simulation under the same air conditioning load conditions.

- CO<sub>2</sub> emissions intensity:
  - Electricity: 0.555 kg-CO<sub>2</sub>/kWh (\*1)
  - A type heavy oil: 2.71 kg-CO<sub>2</sub>/L (\*2)
- Primary energy intensity:
  - Electricity: 9.76 MJ/kWh(\*3)
  - A type heavy oil : 39.1 MJ/L (\*4)

(\*1) Greenhouse Gas Emissions Calculation and Reporting Manual Ver. 2.1”(2007)

(\*2) "Act on the Rational Use of Energy "(values as amended in 2006).

# Case study 2 Centrifugal Chiller



**Use of building: Office building**

**Total floor area: 163,000m<sup>2</sup>**

**Construction completion: 2006**

**Air conditioning equipment:**

**Water thermal storage + Centrifugal chillers**

**Centrifugal chiller 3,481kW capacity × 2 units**

**Inverter centrifugal chiller 3,481kW capacity × 1 unit**

**Heat recovery Centrifugal chiller 1,723kW/ 2,109kW × 1 unit  
(using sewage heat)**

**Thermal storage tank 6,470m<sup>3</sup>**

**Current system**

**Centrifugal chiller +**

**Heat recovery Centrifugal chiller + Water thermal storage system**

**Conventional system**

**Gas fired absorption water heater-chiller + boiler**

**CO<sub>2</sub> emissions reduction**



**Primary energy consumption reduction**



[Specifications]

Comparison of an annual simulation under the same air conditioning load conditions.

■ CO<sub>2</sub> emissions intensity:

Electricity: 0.372 kg-CO<sub>2</sub>/kWh (\*1)

City gas (13A): 2.08 kg-CO<sub>2</sub>/Nm<sup>3</sup> (\*2)

■ Primary energy intensity:

Electricity: 9.76 MJ/kWh (\*3)

City gas (13A): 46 MJ/Nm<sup>3</sup> (\*4)

(\*1) Tokyo Electric Power Co. Inc. Sustainability report 2006

(\*2) Greenhouse Gas Emissions Calculation and Reporting Manual Ver. 2.1" (2007)

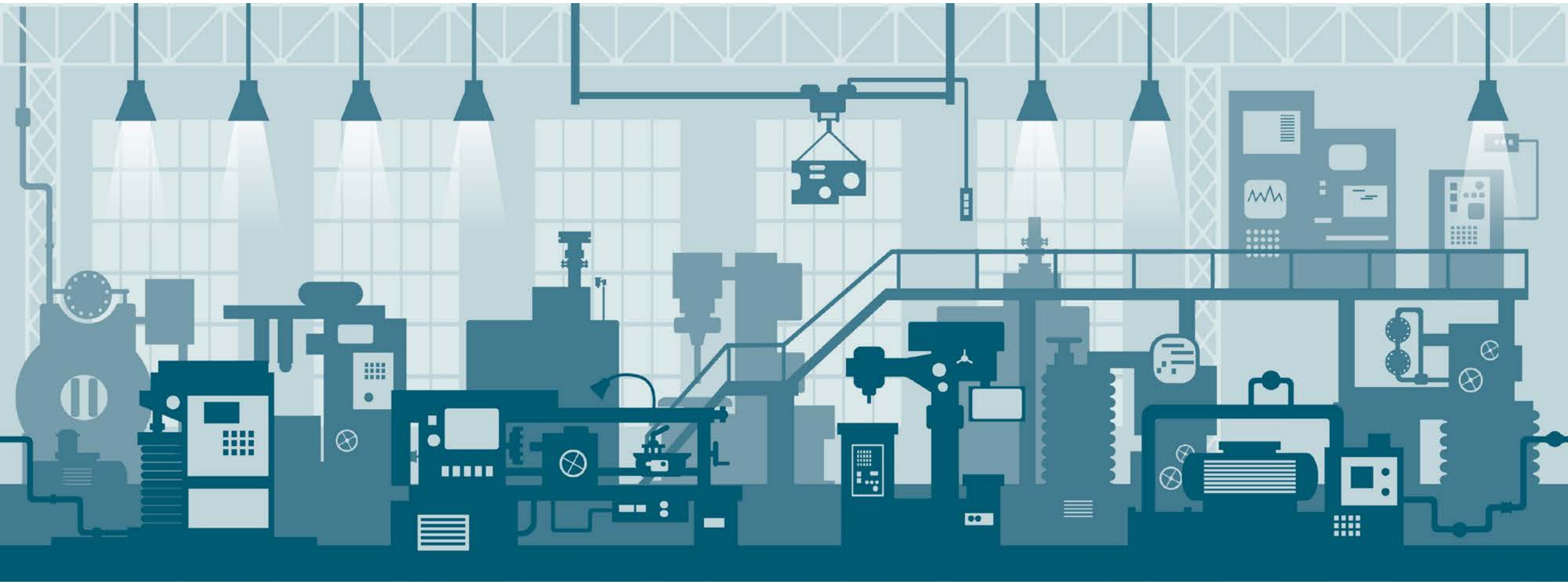
(\*3) "Act on the Rational Use of Energy" (as amended in 2006).

(\*4) Tokyo Gas Co., Ltd. CSR report 2006

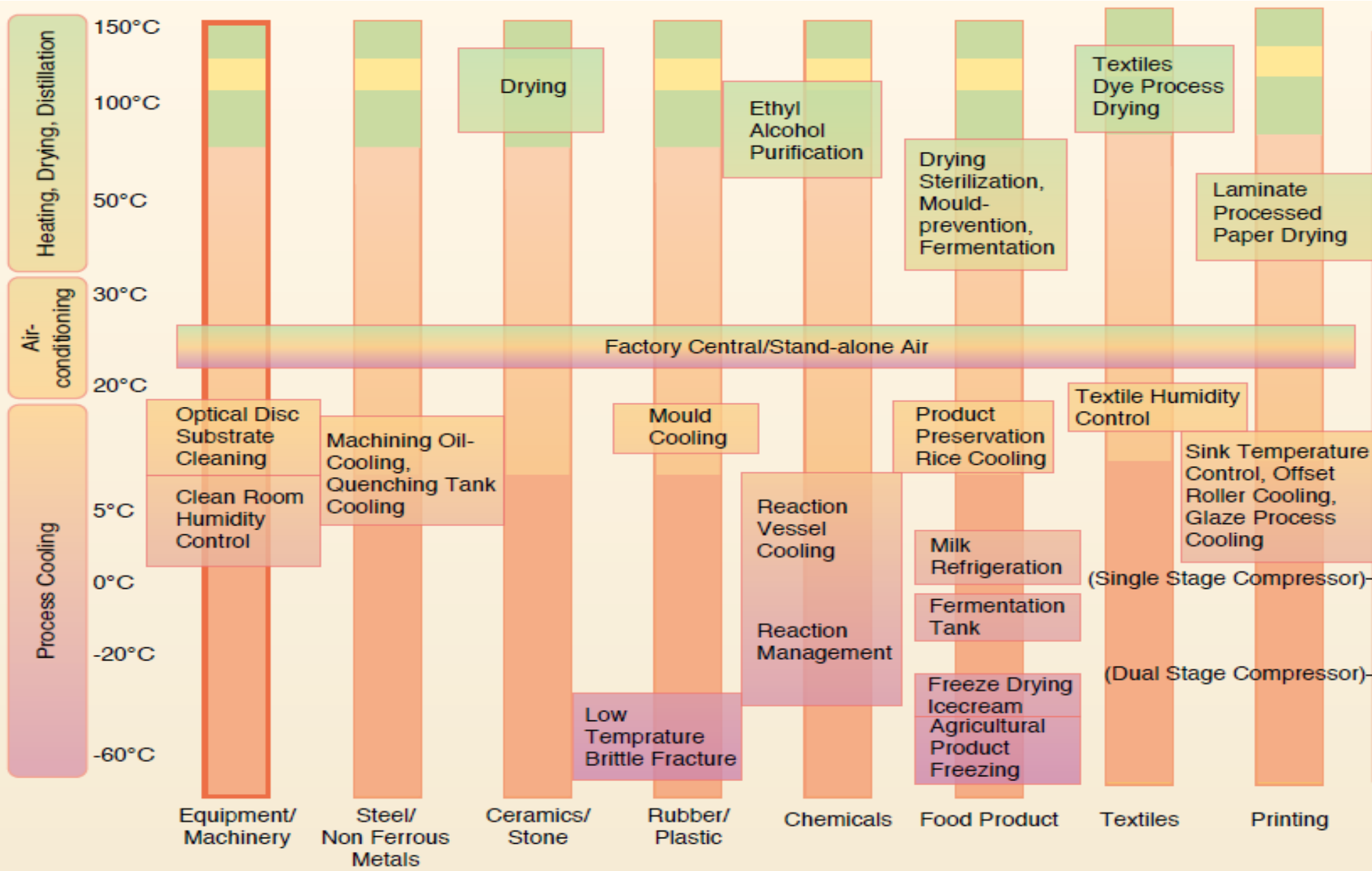




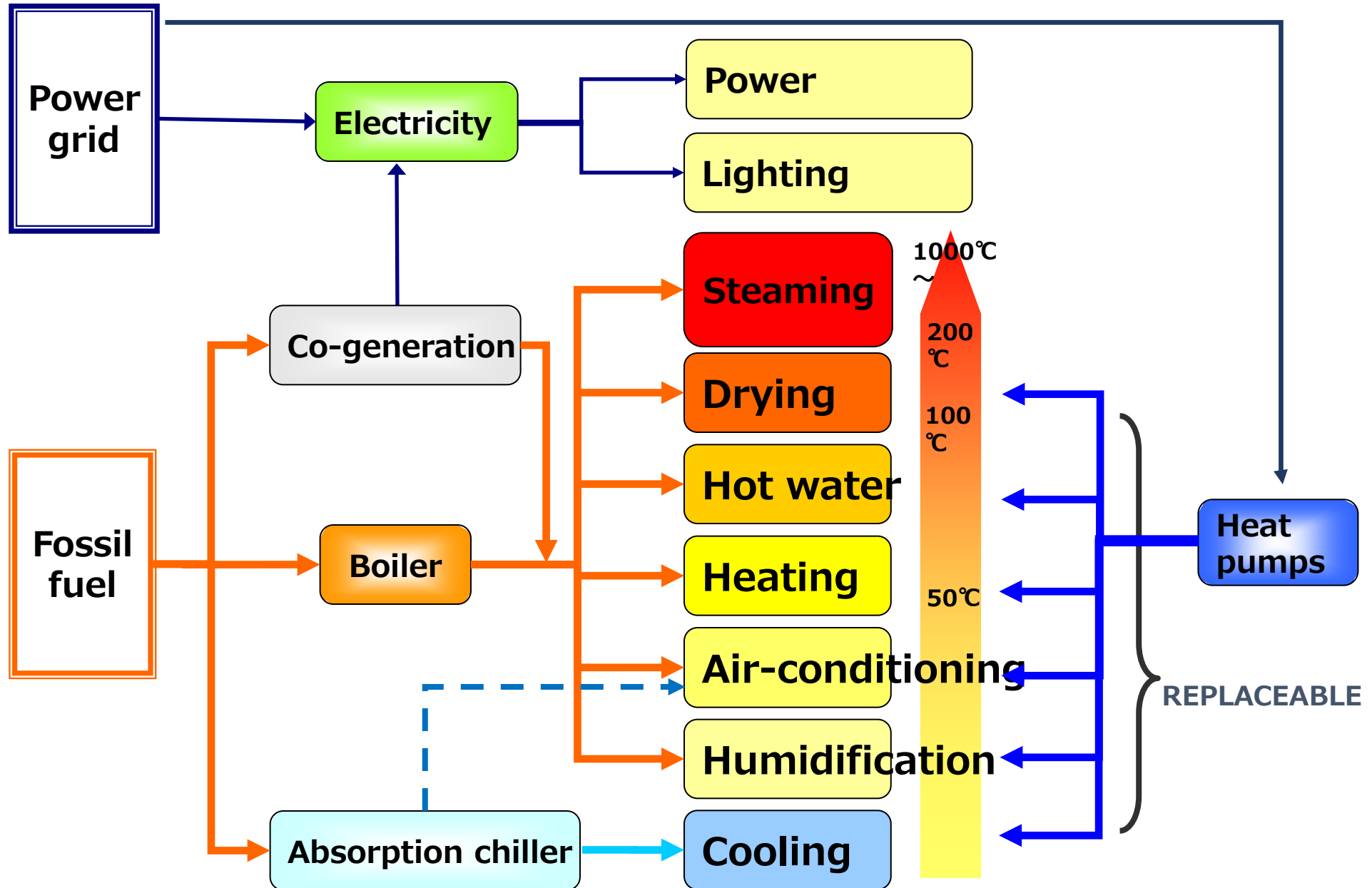
# Industrial sector x Heat pumps



# Applicable area of heat pumps by biz categories

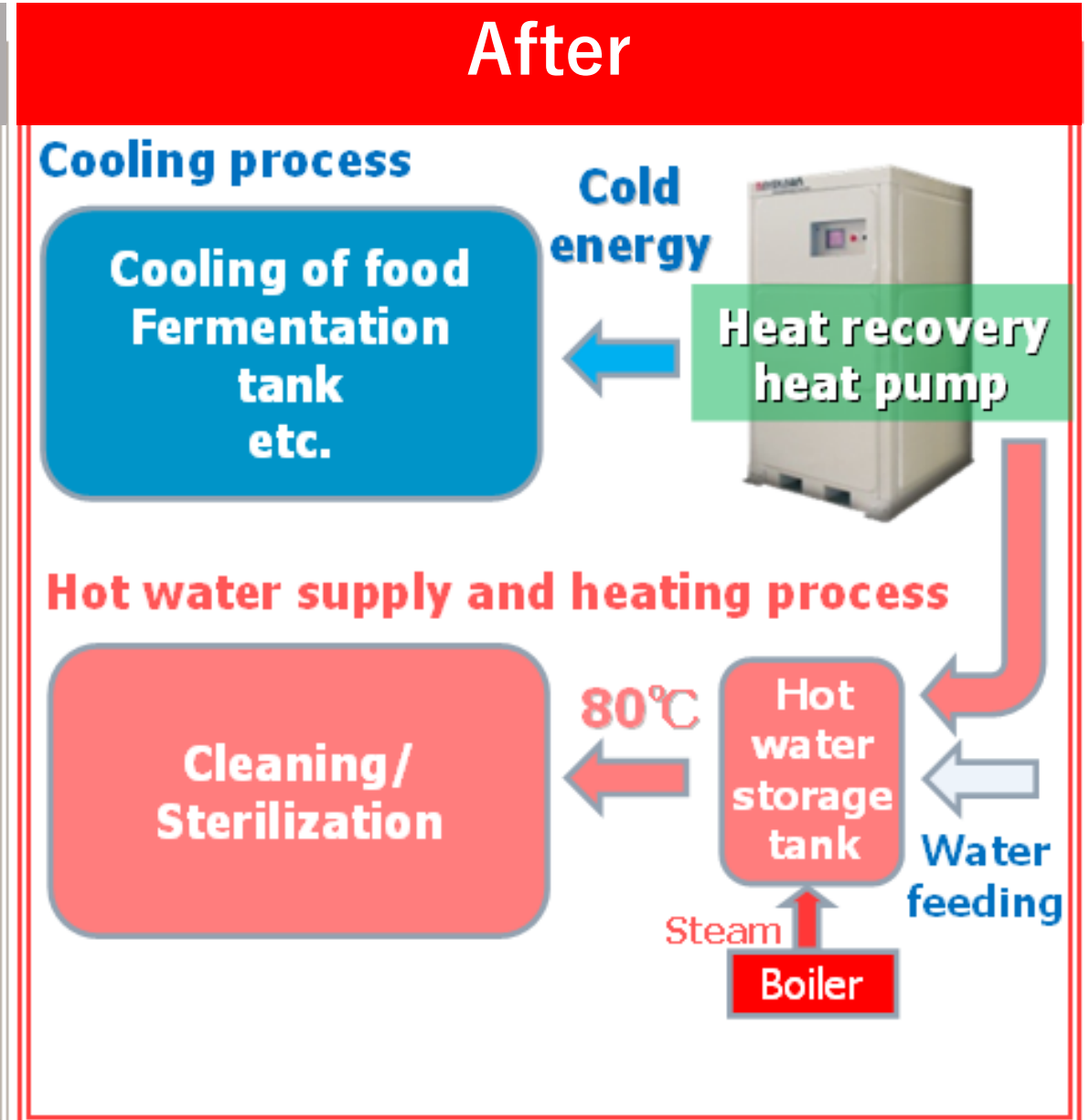
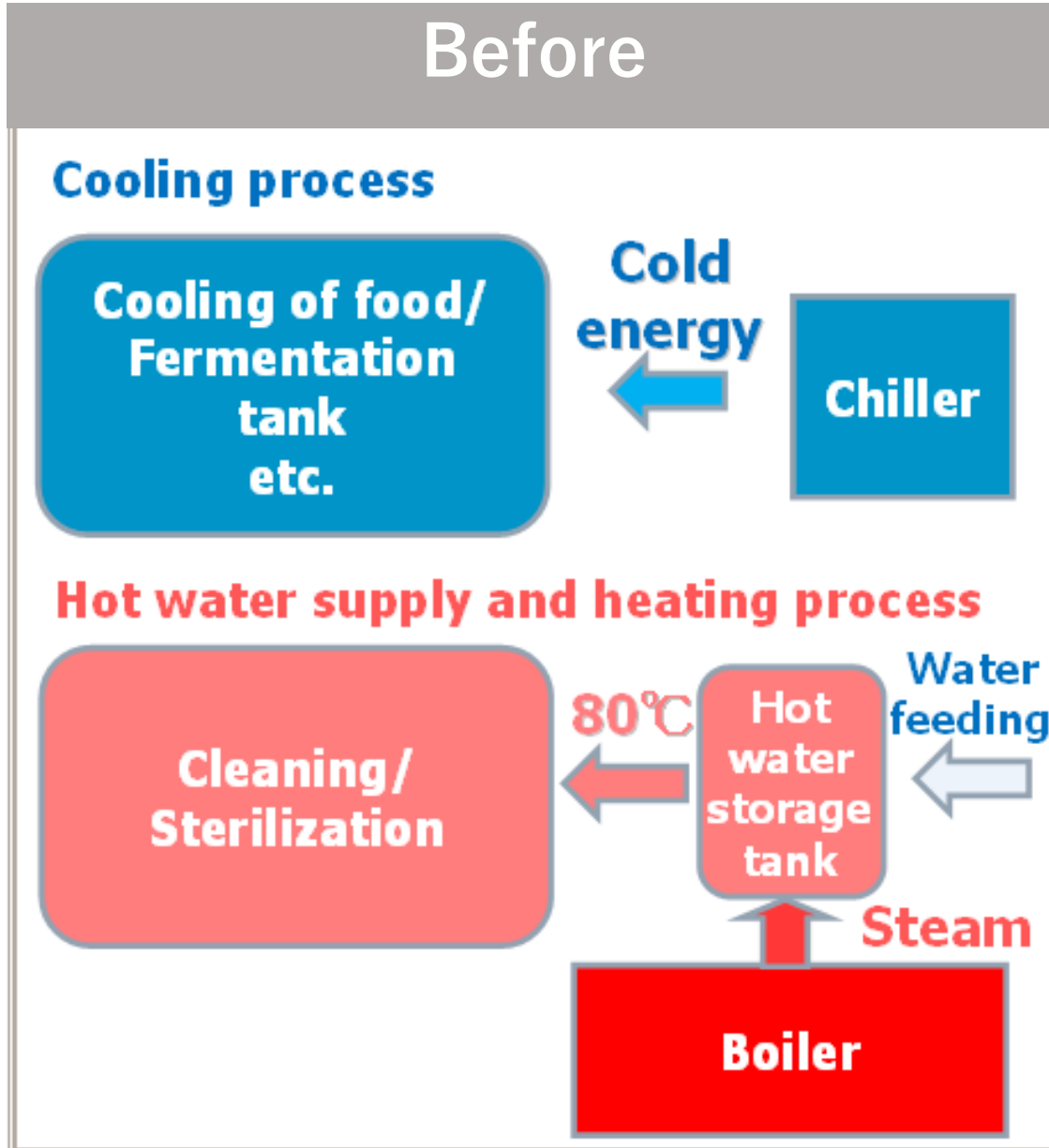


# Use of Energy in Factory





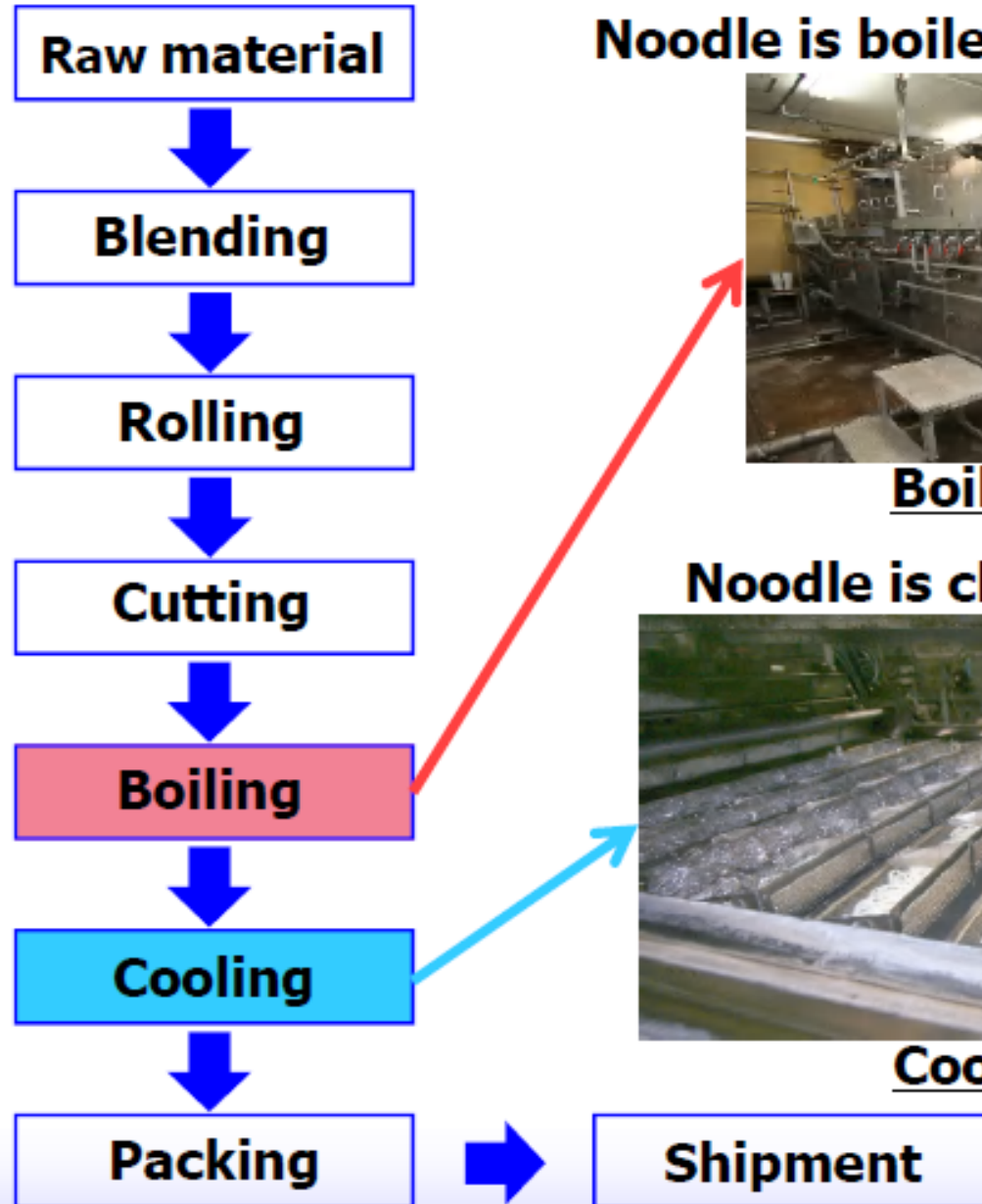
# Typical application



# Case study

## Food Manufacturing factory (Noodle)

Noodle manufacturing flow



**Noodle is boiled for 8 to 10 minutes.**



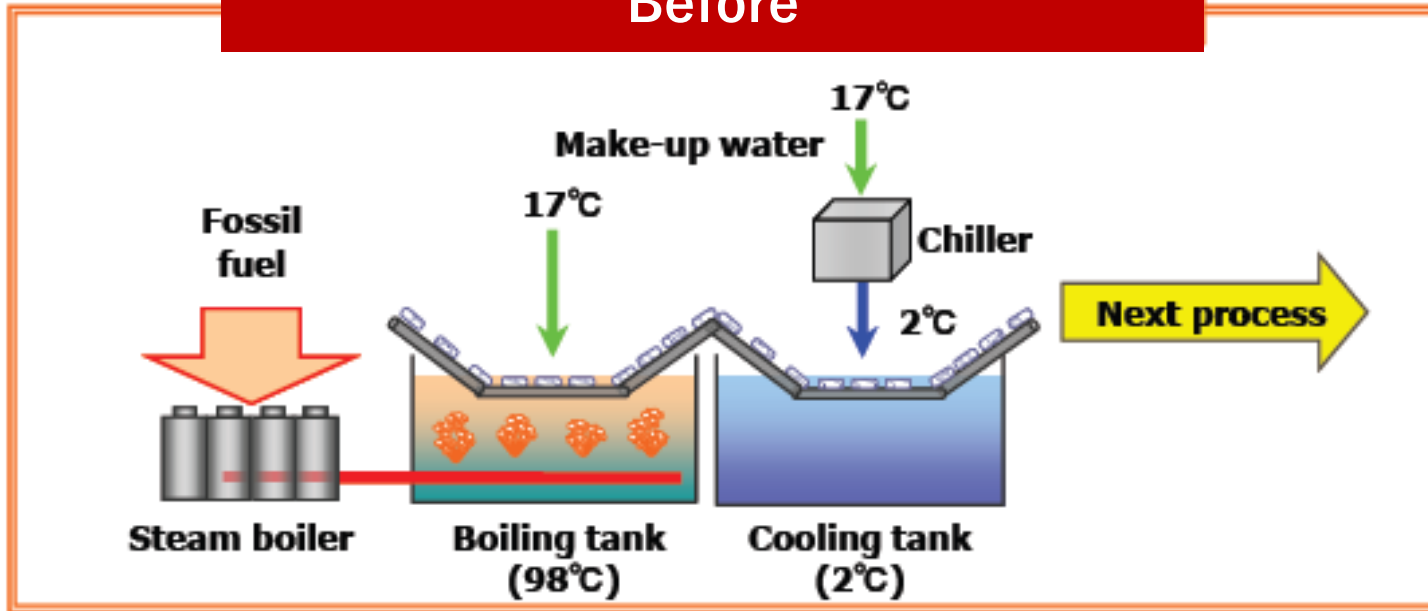
**Boiling tank**

**Noodle is chilled to 5 to 7 °C.**



**Cooling tank**

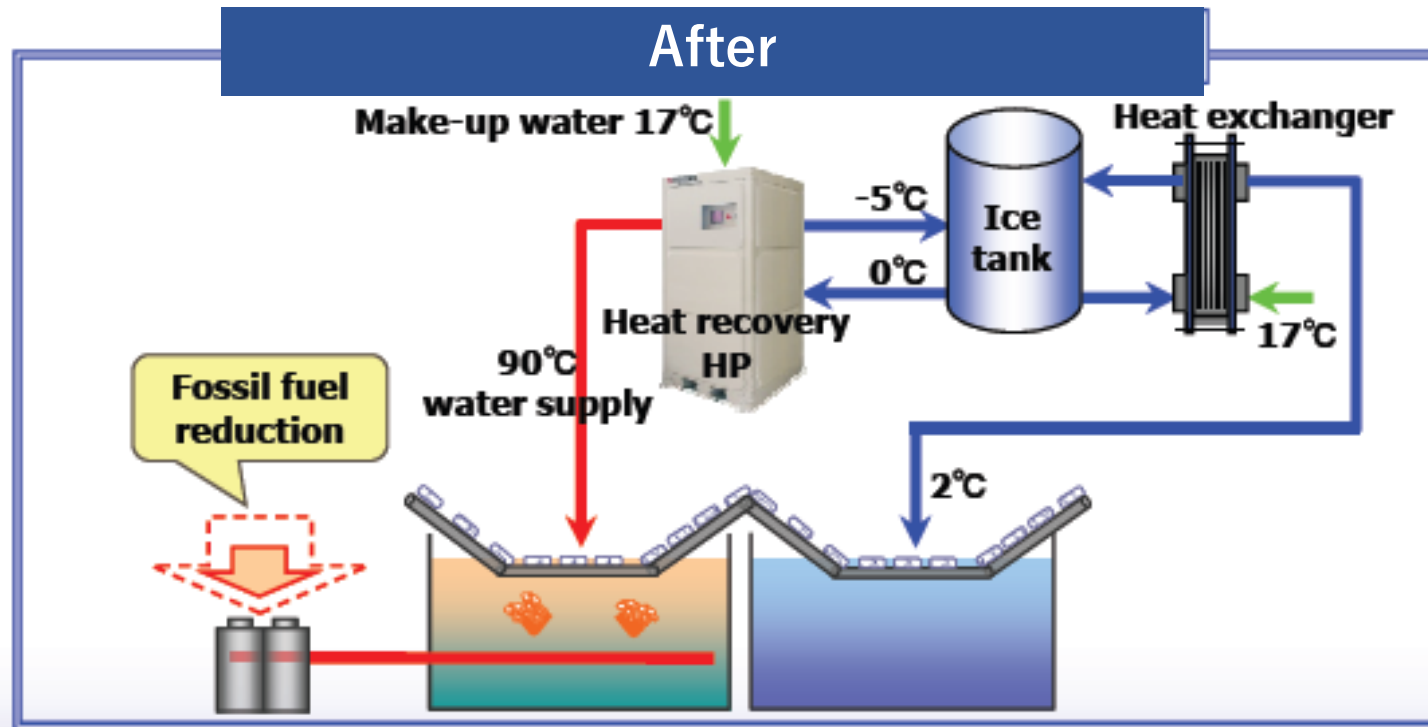
## Before



CO2 emissions

▲ 39%

## After



Energy consumption

▲ 28%

# Japanese Manufacturers of Industrial HPs

## Hot water HPs



TOSHIBA  
CARRIER



MAYEKAWA



KOBELCO



MHI



MITSUBISHI



DAIKIN



HITACHI



MHI



SCIENCE



MDI



MDI



ZENERAL

## Hot air HPs



MAYEKAWA



MHI

## Steam HPs



KOBELCO



FUJI  
ELECTRIC

## Vapor compression HPs



KOBELCO



MAYEKAWA



SASAKURA



KIMURA



# Case Studies



<https://www.hptcj.or.jp/e/publication/tabid/790/Default.aspx>



**Thank you!**