Member Country Report 2023 - Japan

Takahiro ASAHI, Heat Pump and Thermal Storage Technology Center of Japan (HPTCJ)




Japan - Overview

Population : **124.63 million** (**92%** in urban areas)

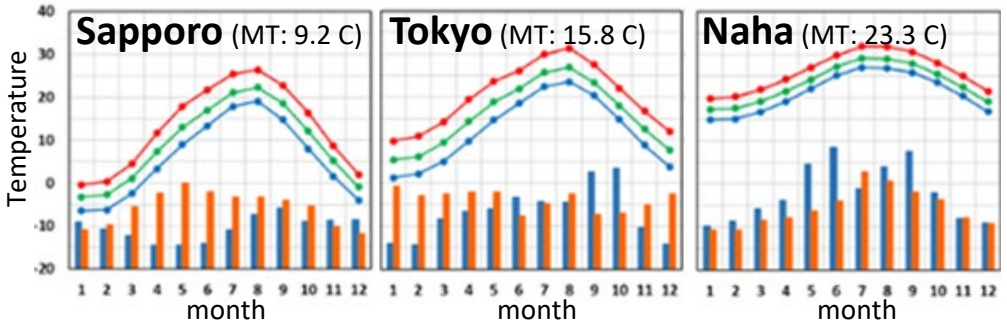
Households : **55.71 million** (1/2/3/4/>5 pers.: 38%/28%/17%/12%/5%)

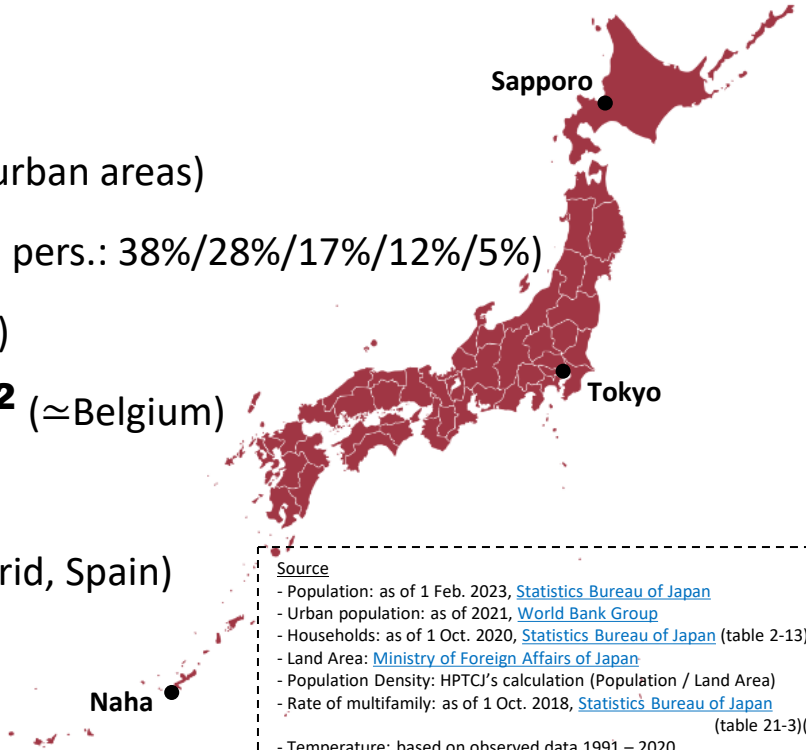
Land Area : **378,000 km²** (≃Germany)

Population Density : **330 people / km²** (≃Belgium)

Rate of multifamily : **46 %**

Mean temperature : **15.8 C** (Tokyo) (≃Madrid, Spain)





Source
- Population: as of 1 Feb. 2023, Statistics Bureau of Japan
- Urban population: as of 2021, World Bank Group
- Households: as of 1 Oct. 2020, Statistics Bureau of Japan (table 2-13)
- Land Area: Ministry of Foreign Affairs of Japan
- Population Density: HPTCJ's calculation (Population / Land Area)
- Rate of multifamily: as of 1 Oct. 2018, Statistics Bureau of Japan (table 21-3)(JP)
- Temperature: based on observed data 1991 – 2020, Japan Meteorological Agency Source1, Source2(JP)

Policy - Decarbonization

46-50% GHG reduction in FY **2030**

and **Net-Zero** by **2050**

Source
- Policy Speech: Cabinet of Japan
- Leaders Summit on climate: Ministry of Foreign Affairs of Japan
- Date of enforcement of the amended act: Ministry of the Environment (MOEJ)(JP)
- Japan's NDC, Long-term Strategy, Plan: MOEJ (EN, JP)
- The Sixth strategic Energy Plan: Ministry of Economy,Trade and Industry (METI) (EN, JP)
- Cabinet Decision on the Basic Policy for the Realization of GX (JP)

Policy Speech by the Prime Minister to the 203rd Session of the Diet

"We hereby declare that **by 2050** Japan will aim to reduce GHG emissions to **net-zero**, that is, to realize a **carbon-neutral, decarbonized society**."

Leaders Summit on Climate

"Japan aims to reduce its GHG emissions by **46%** in **FY 2030**" (Furthermore, the lofty goal of **50%**)

LEADERS SUMMIT ON CLIMATE

Japan's Nationally Determined Contribution (NDC)
Japan's Long-term Strategy under the Paris Agreement
Plan for Global Warming Countermeasures
The Sixth Strategic Energy Plan

Enforcement of the amended Act on Promotion of Global Warming Countermeasures

"**decarbonized society by 2050**" was stipulated

Cabinet Decision on the Basic Policy for the Realization of GX

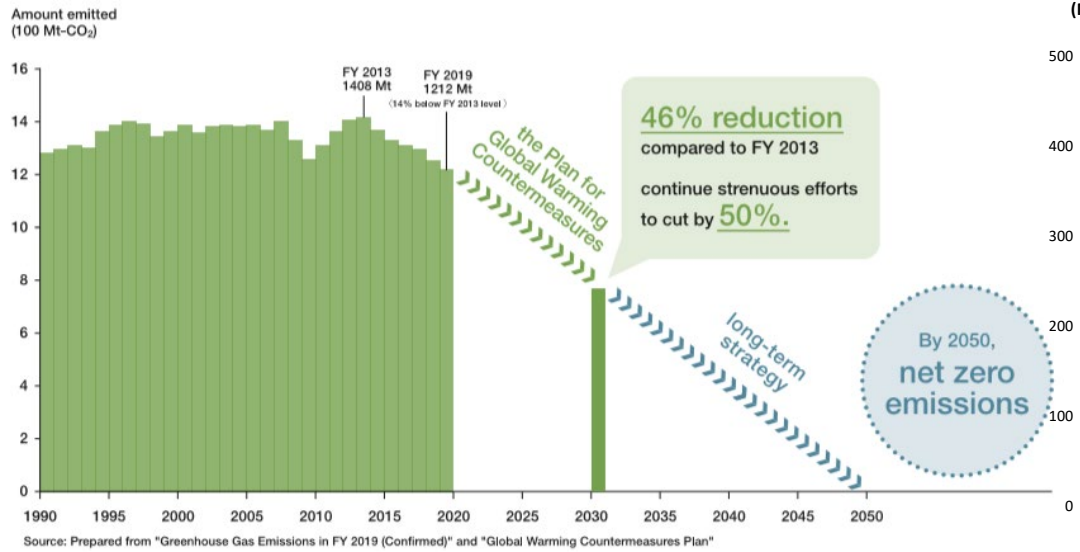
Previous WS (Nov. 2021)

26 Oct. 2020 | **22 Apr. 2021** | **22 Oct. 2021** | **1 Apr. 2022** | **10 Feb. 2023** | **Today**

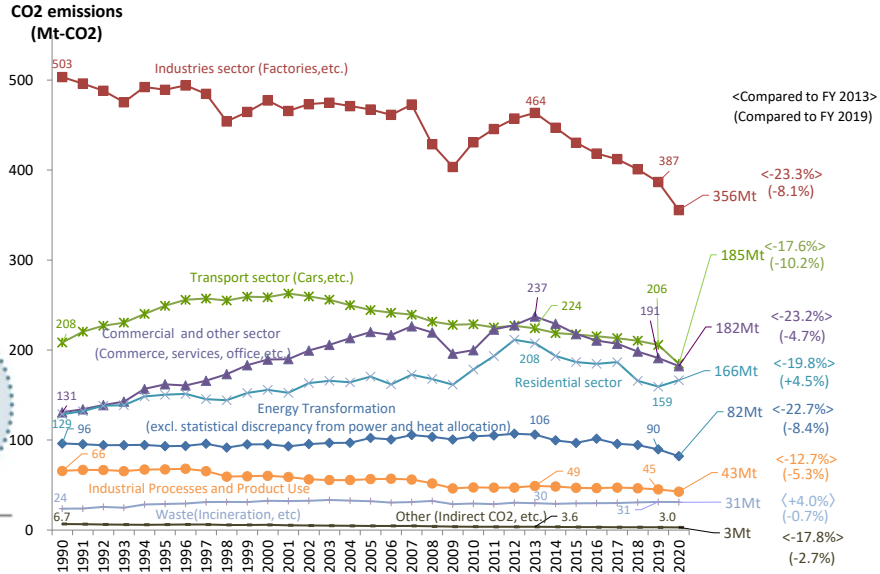
Source
- Japan's commitment: "Climate Actions towards net-zero by 2050", MOEJ
- CO2 emissions by sector: "The GHG Emissions Data of Japan", National Institute for Environmental Studies

Policy - Decarbonization

Japan's commitment to Net-Zero by 2050



CO2 emissions by sector (FY1990 - 2020)



Source
- Japan's Nationally Determined Contribution (NDC): UNFCCC
- Japan's Long-term Strategy under the Paris Agreement: UNFCCC (EN), MOEJ (JP)

Policy - Decarbonization

Japan's Nationally Determined Contribution (NDC)

- **2030, 2050 targets** and implementation of policies (e.g. amending the law)

Japan's Long-term Strategy under the Paris Agreement

- **Industry**: "For the heat demand in low-temperature such as steam and hot water, utilizing electrification technologies including **heat pumps** and electric heating wires would be a relevant option for decarbonization."
- **Building**: "…, the Government aims to achieve the sector coupling of electricity, heat, and mobility in general, using electrified vehicles, **heat pump-type water heaters**, fuel cells and cogeneration, …", "… improvement of heat energy efficiency such as **heat pump**.", "The Government will also look into the potential flexibility of heat storage type air-conditioning equipment, **heat pump water heaters** in facilities with large demand for hot water supply, "

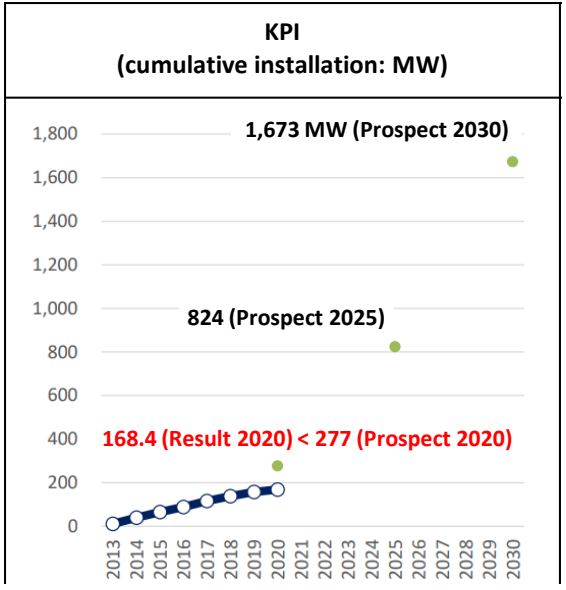
Source
- Plan for Global Warming Countermeasures: MOEJ (JP)
- The Sixth Strategic Energy Plan: METI (EN, JP)
- Track record: The document of the Central Environment Council, METI (JP)

Policy - Decarbonization

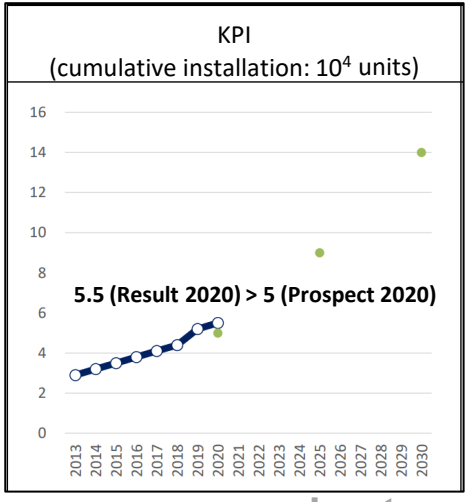
Plan for Global Warming Countermeasures and The Sixth Strategic Energy Plan

- Quantitative targets are set for industrial HPs and commercial and residential HPWHs

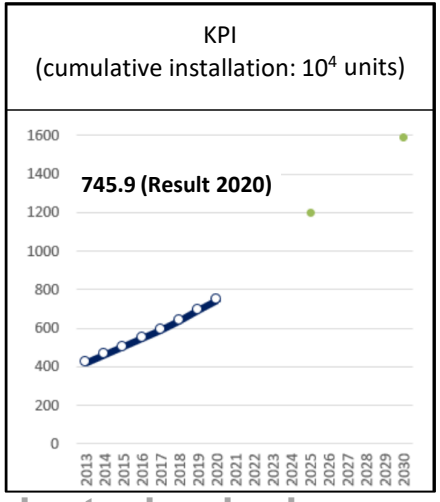
Industrial HPs



Commercial HPWHs



Domestic HPWHs



Source
- Cabinet Decision on the Basic Policy for the Realization of GX (JP)

Policy - Decarbonization

The Basic Policy for the Realization of GX* (February 10, 2023)

*GX = Green Transformation

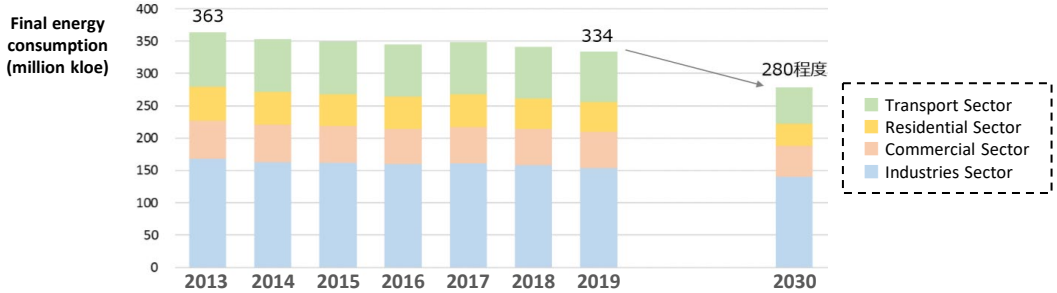
- " For the decarbonization of the heat demand and the efficient use of heat, (the government) will promote the introduction of efficient appliances such as **heat pump water heaters** and residential fuel cells for the residential sector, and efficient equipment including **industrial heat pumps** and CHPs for the industrial sector"

= Heat pumps are already well-recognized in the high-level policies in Japan

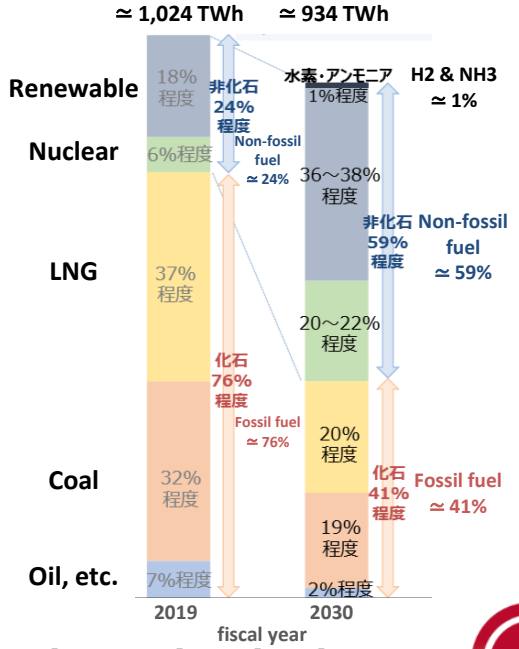
Source
- Energy demand by sector: The document by the METI (P.71) (JP)
- Electricity mix towards 2030: The document by the METI (P.70) (JP)
- Carbon intensity of electricity generation: FY2021 Energy Supply and Demand Report, METI (P.8) (JP)

Policy - Energy

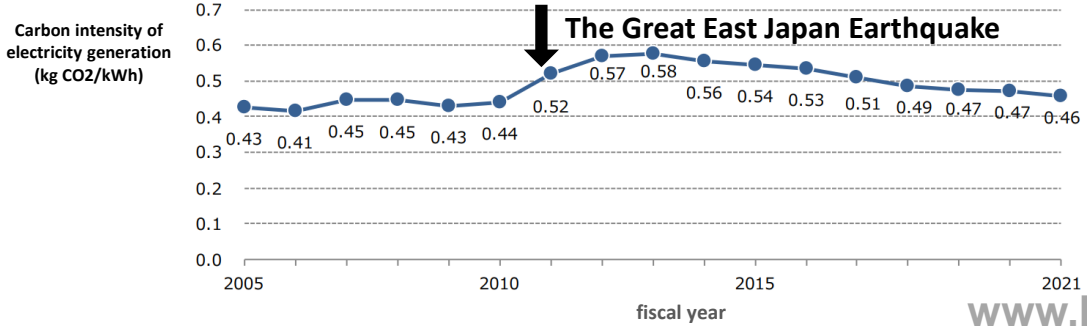
Energy demand by sector



Electricity mix towards 2030



Carbon intensity of electricity generation



Source
- Top Runner Program: Ministry of Economy, Trade and Industry (JP)
- The uniform energy efficiency labels: "Japan's ENERGY 2020", METI

Policy - Energy

"Top Runner Program"

(Efficiency standards for machinery, equipment and materials)

- 32 items are in scope (as of March 2023).

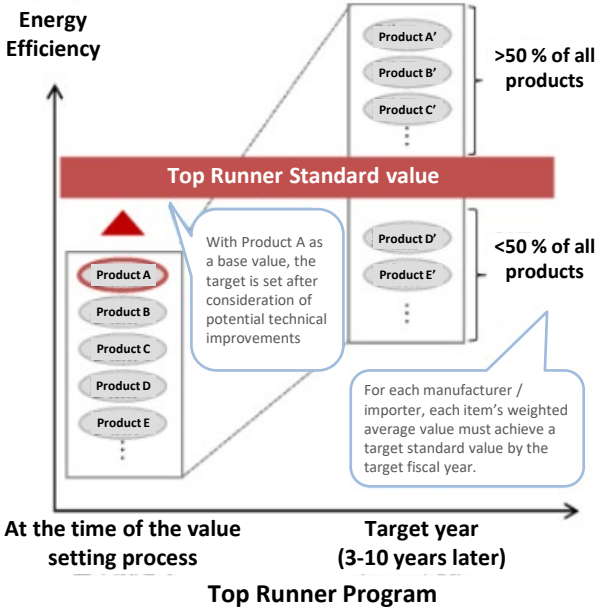
  Air Conditioners, Electric Refrigerators, Electric Freezers, Gas Water Heaters, Oil Water Heaters, Vending Machines, Electric (HP) Water Heaters, Showcases, etc.

"The uniform energy efficiency labels"

(Energy efficiency labeling)

- The evaluation metric of a 41-point scale (1.0, 1.1, …, 5.0) are now being used in retail outlets.
- The items mentioned above (except for vending machines and showcases) are covered as of March 2023.

A new labeling for EcoCute (Domestic HPWH) since Oct. 2021



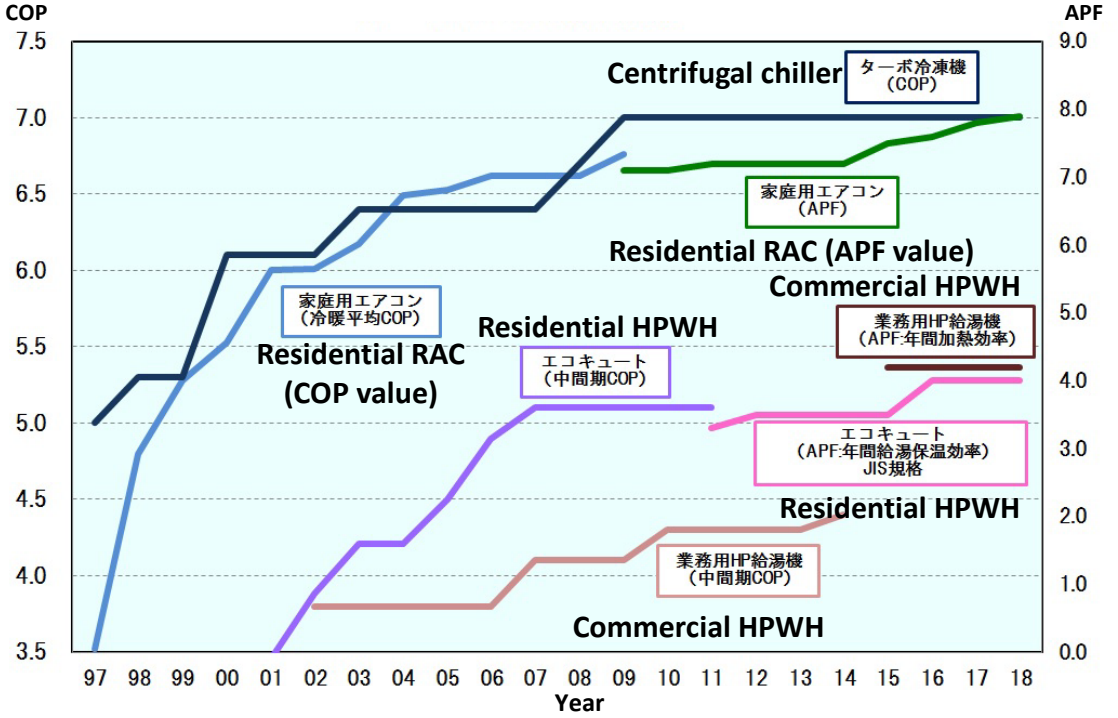
Source
- Efficiency improvement of HPs: Heat Pump and Thermal Storage Technology Center of Japan (HPTCJ) (JP)
- Energy Conservation Grand Prize Award: The Energy Conservation Center, Japan (ECCJ)
- Minister of the Environment's Award for Climate Action: MOEJ (JP)

Policy - Awards

Efficiency has improved due to energy efficiency policies.

Awards are another driver for efficiency improvement

- **Energy Conservation Grand Prize Award**
  (Since 1990)
  awards excellent energy conservation activities and **advanced energy conservation products achieved by technological development at private companies**, …
- **Minister of the Environment's Award for Climate Action**
  (Since 1998)
  awards individuals or groups that have made significant contributions towards preventing global warming



Efficiency improvement of HPs

Policy - Subsidies

Source
- Subsidy for investments for advanced energy conservation project: Sustainable open Innovation Initiative (JP)
- Subsidy for residential high-efficiency DHW heaters : METI (JP)
- Subsidy for "Net Zero Energy Buildings" (METI): Sustainable open Innovation Initiative (JP)
- Subsidy for "Net Zero Energy Buildings" (MOEJ): Shizuoka Environment Resources Association (JP)

Subsidy for investments for energy conservation projects and equipment

- **A. Advanced equipment** (e.g. HP desiccant humidity control, centrifugal chiller, showcase, MVR, etc.)
- B. Custom-made solutions (e.g. specially designed facility, production line, etc.)
- **C. Specified equipment (e.g. AC, industrial HP, commercial HPWH, refrigerator, etc.)**
- **D. Energy management system and service** (Specified EM service and EMS needed for the service)

Subsidy for residential high-efficiency DHW heaters

- **HPWHs ("EcoCute")**	**50,000 JPY (345 EUR*)**
- **Hybrid HPWHs**	**50,000 JPY (345 EUR*)**
- Residential Fuel Cells ("Ene-Farm")	150,000 JPY (1035 EUR*)

* Exchange rate : 145 JPY / 1 EUR

HPWHs ("EcoCute")

Hybrid HPWHs

Residential Fuel Cells ("Ene-Farm")

Subsidy for "Net Zero Energy Buildings"

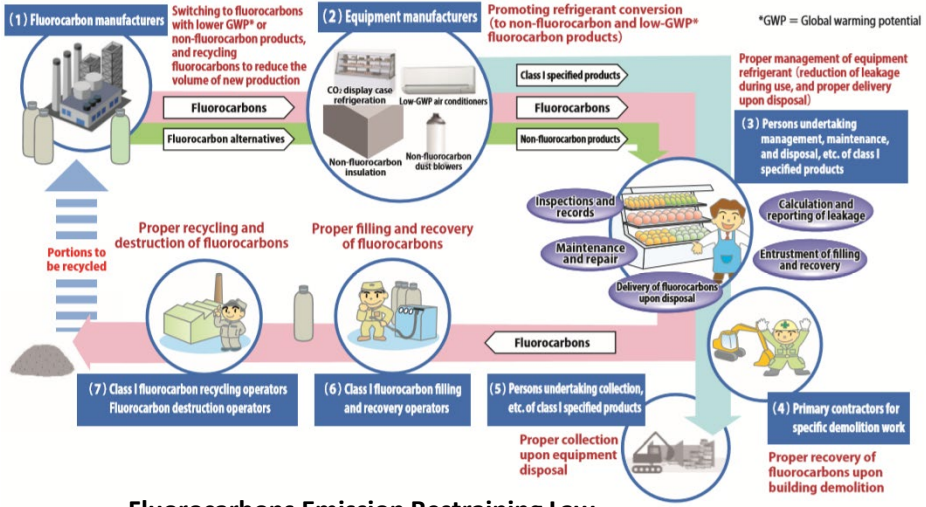
- **High efficiency ACs, water heaters, BEMS, etc. installed for "Net Zero Energy Buildings" projects (<50% energy consumption of the reference building)**

Source
- "Act on Rational Use and Proper Management of Fluorocarbons", MOEJ

Policy - F-gas Regulation

Laws and GWP target values and years

- **Ozone Layer Protection Law**
  aims to **control consumption and production of controlled substances** by regulating their productions and imports.
- **Fluorocarbons Emission Restraining Law**
  aims to **control emissions over the lifecycle of Fluorocarbons**.



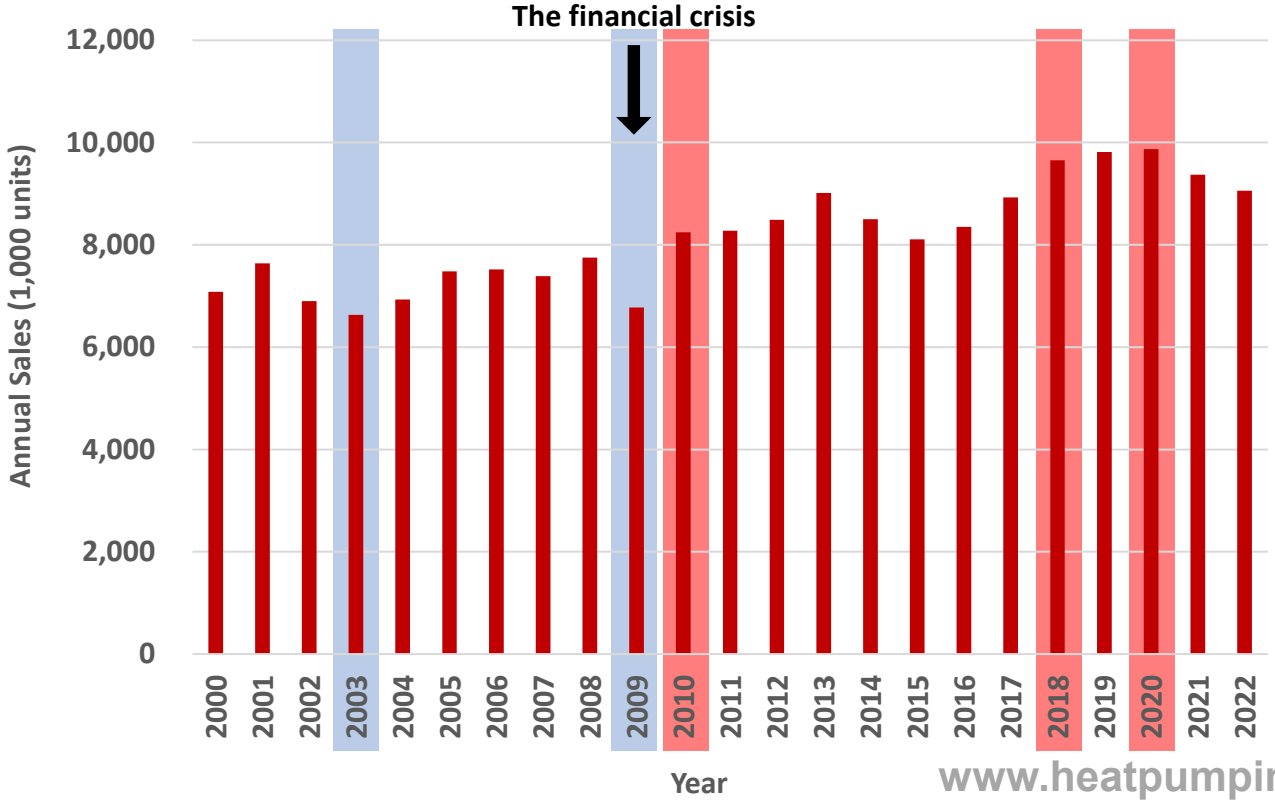
Fluorocarbons Emission Restraining Law

Specified product category	Main refrigerants currently used and GWP	Environmental impact target value	Target fiscal year
Household air conditioners (excluding through-the-wall types, etc.)	R410A(2090) R32(675)	750	2018
Air conditioners for stores and offices			
(1)Statutory refrigeration capacity of less than 3 tons, excluding floor-standing units, etc.	R410A(2090)	750	2020
(2)Statutory refrigeration capacity of at least 3 tons, excluding floor-standing units, etc., and excluding (3) below	R410A(2090)	750	2023
(3)Central air conditioners using turbo refrigerators	R134a(1430) R245fa(1030)	100	2023
Automotive air conditioners (excluding those installed in passenger cars having a capacity of 11 persons or more)	R134a(1430)	150	2023
Condensing units and stationary freezer-refrigerator units (excluding those having a compressor with rated output of 1.5 kW or less)	R404A(3920) R410A(2090) R407C(1770) CO_2(1)	1500	2025
Central refrigeration equipment (only those shipped for use in new refrigerated warehouses having effective volume of at least 50,000 m³)	R404A (3920) Ammonia (single digit)	100	2019
Rigid urethane foam (only on-site foaming materials for residential buildings)	HFC-245fa(1030) HFC-365mfc(795)	100	2020
Spray equipment filled with propellant only (excluding those for applications requiring non-combustibility)	HFC-134a(1430) HFC-152a(124) CO_2(1)、DME(1)	10	2019

Target GWP values and years for manufacturers/importers

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Residential Room Air Conditioners

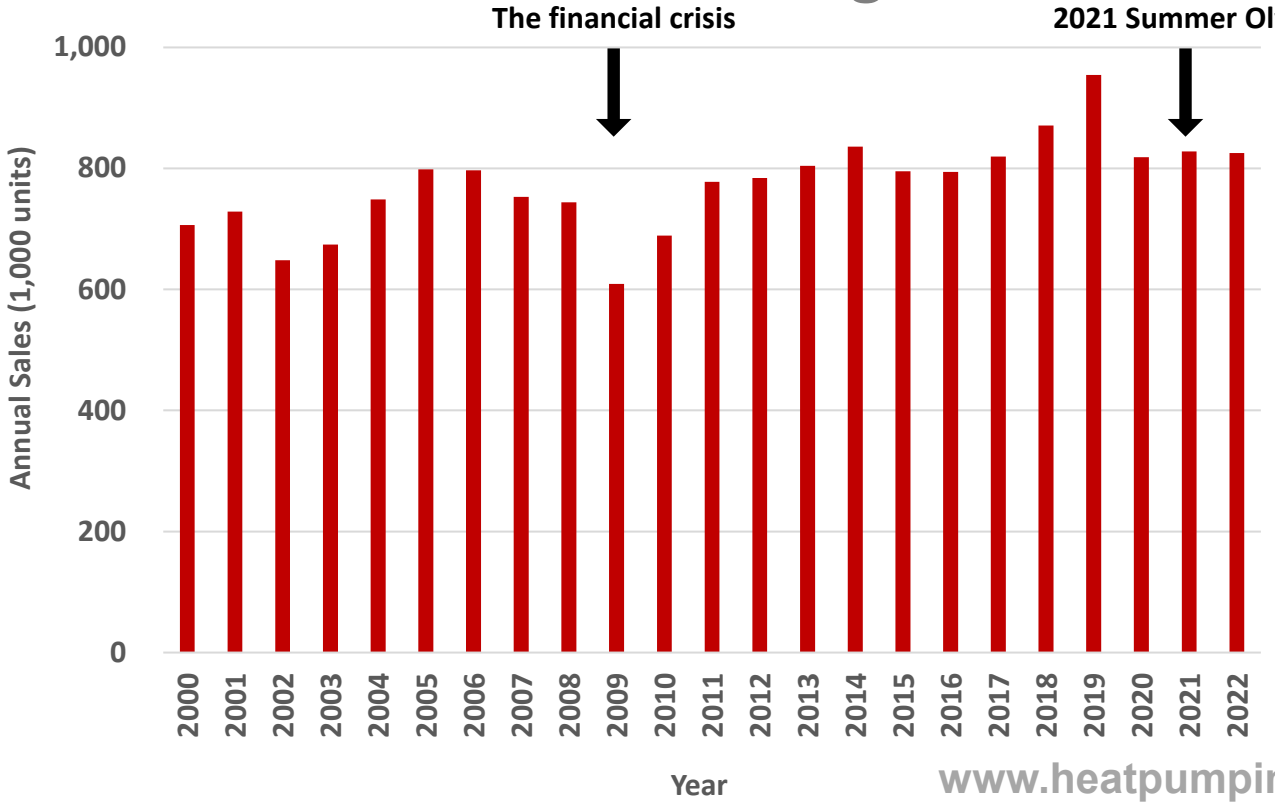


Stable at just below 10 million units annually.

Longer hours at home due to COVID-19 might have boosted the sales in 2020

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Commercial Packaged Air Conditioners

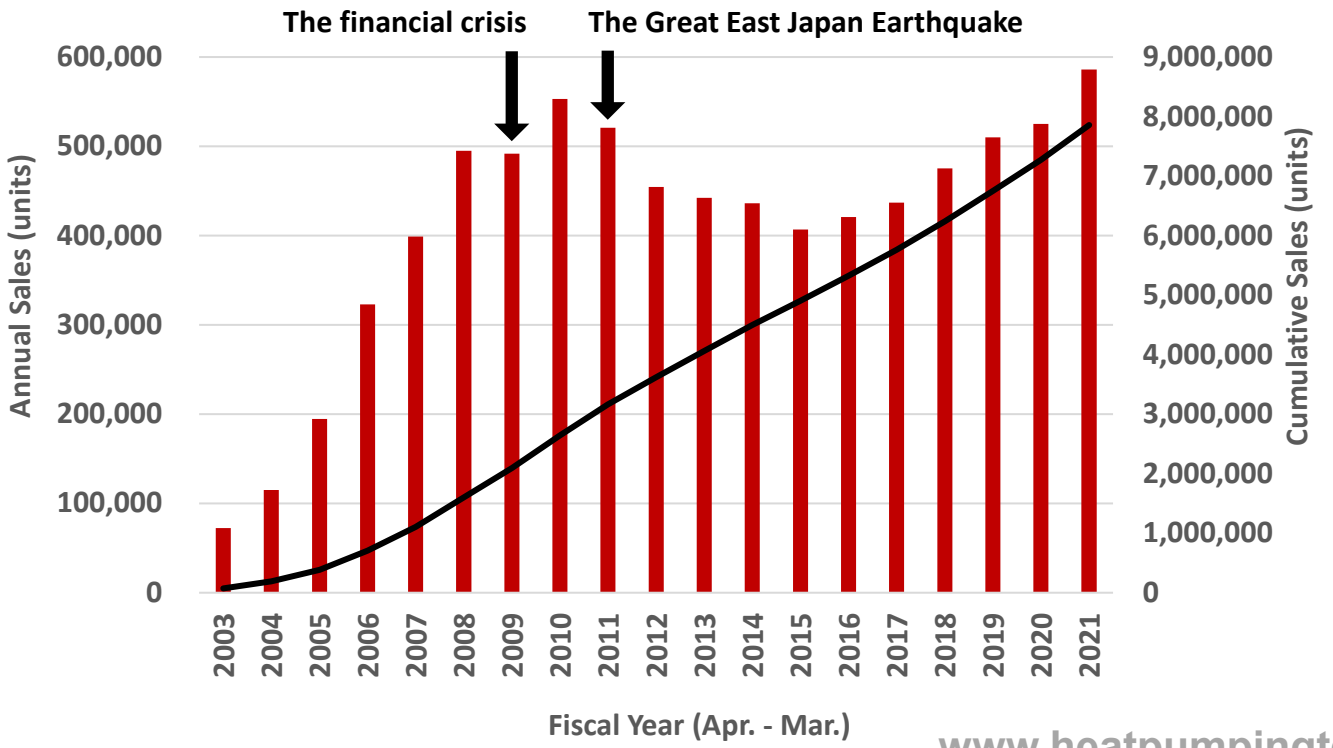


Stable at around 800,000 units annually.

The surge in sales in 2019 might be attributed to the demand for 2021 Summer Olympics held in Tokyo.

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Residential HPWH (EcoCute)

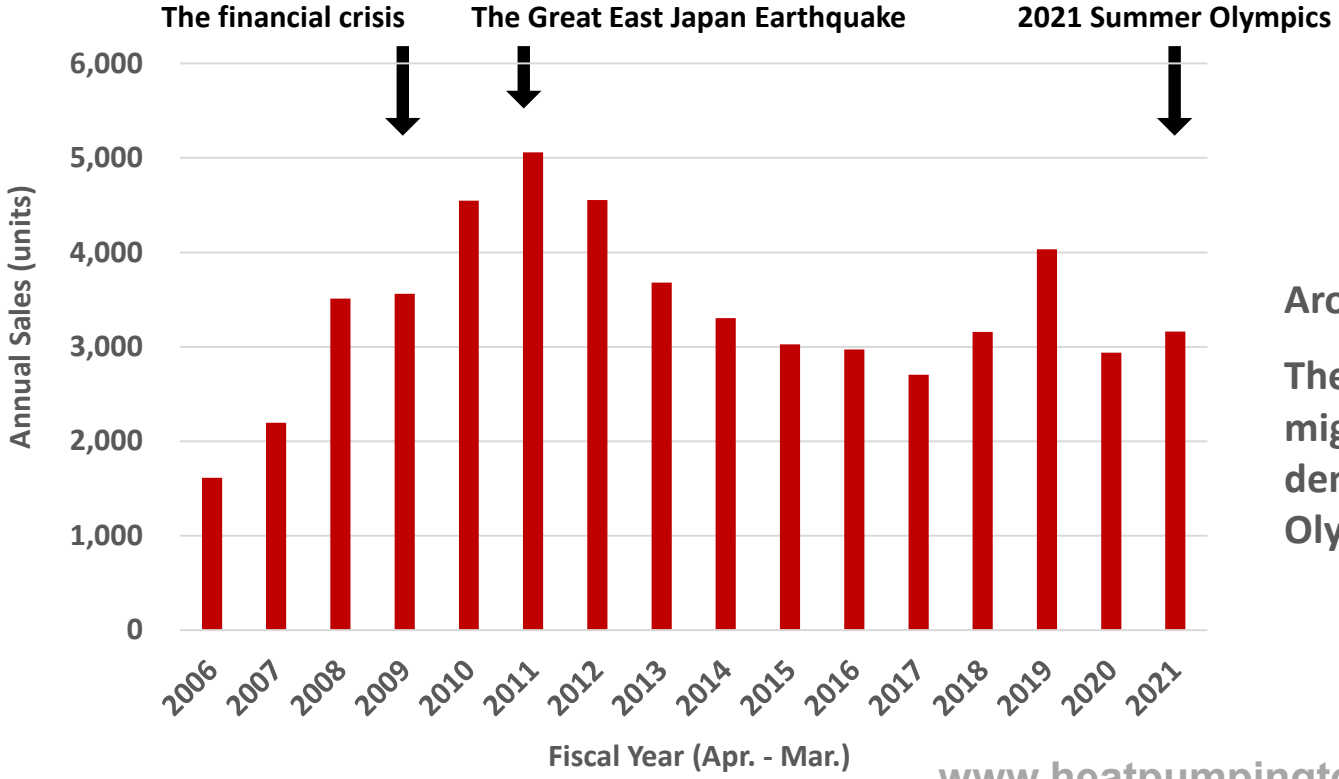


Around 500,000 units annually with an increase of 30,000 units annually.

The cumulative sales will reach 9 million units in fall 2023 at this rate.

Source
- The Japan Refrigeration and Air Conditioning Industry Association (JRAIA) (JP)

Market - Commercial HPWH



Around 3,000 units annually.

The surge in sales in 2019 might be attributed to the demand for 2021 Summer Olympics held in Tokyo.

R&D - HPT TCP Annexes (click the Annex number to visit the Annex websites)

Ongoing Annexes

Annex 54 “Heat pump systems with low GWP refrigerants”

This annex aims at promoting low GWP refrigerant application to accelerate phase down of high-GWP HFCs by developing design guidelines of optimized heat pump components and system for low-GWP refrigerants through the review of available low-GWP refrigerants, their properties and applicable standards, safety and flammability of refrigerants, and safe use of flammable refrigerants

ANNEX 54 — START DATE: 17 January 2019 — END DATE: 31 December 2021

Annex 58 “High-Temperature Heat Pumps”

This Annex gives an overview of available technologies and close-to-market technologies regarding high-temperature heat pumps.

ANNEX 58 — START DATE: 1 January 2021 — END DATE: 31 December 2023

Annex 61 “Heat Pumps in Positive Energy Districts”

The overall objective of the Annex is to evaluate the role of heat pumps in positive energy neighborhoods/districts. Efficiency potentials of the electric and thermal energy of neighborhoods/districts that can be unlocked with the use of heat pumps and are evaluated in order to reach a positive energy balance.

ANNEX 61 — START DATE: 1 September 2022 — END DATE: 31 December 2025

Completed Annexes

ANNEX 46 — START DATE: 1 August 2015 — END DATE: 30 September 2019

ANNEX 48 — START DATE: 1 April 2016 — END DATE: 30 June 2019

Annex 46 “Domestic Hot Water Heat Pumps”

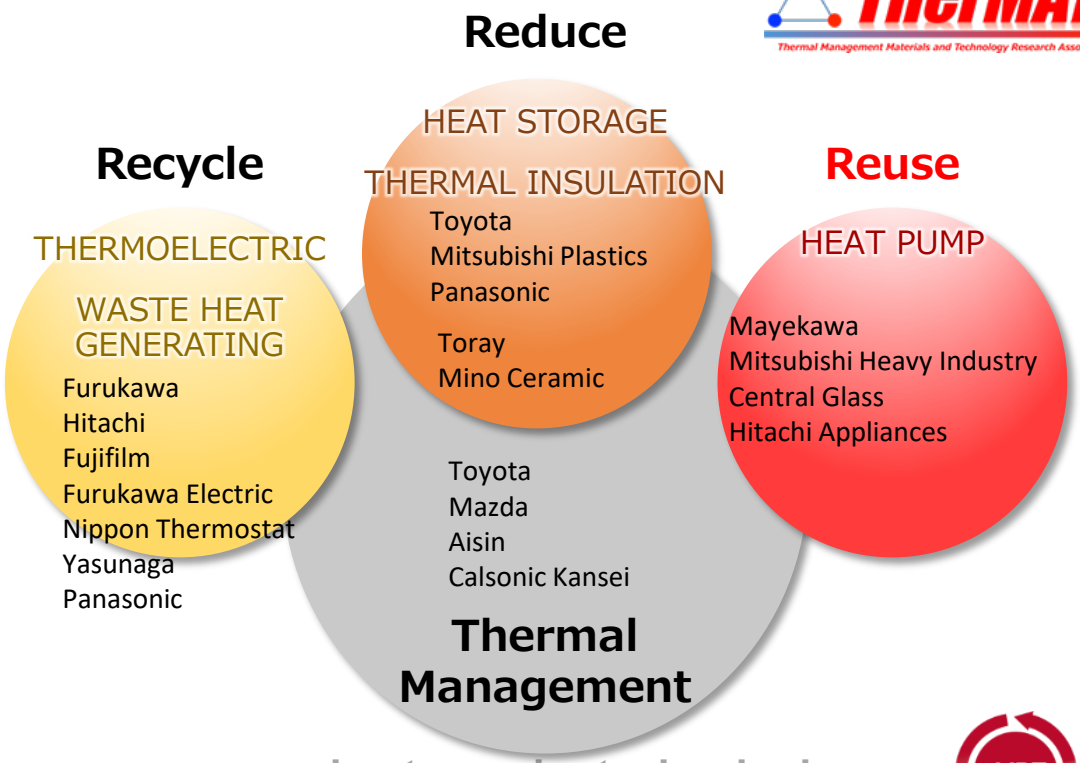
Annex 48 “Industrial Heat Pumps, Second Phase” …

R&D - Utilizing Waste Heat (NEDO)

R&D Project on Innovative Thermal Management Materials and Technologies

(FY 2015 - 2022)

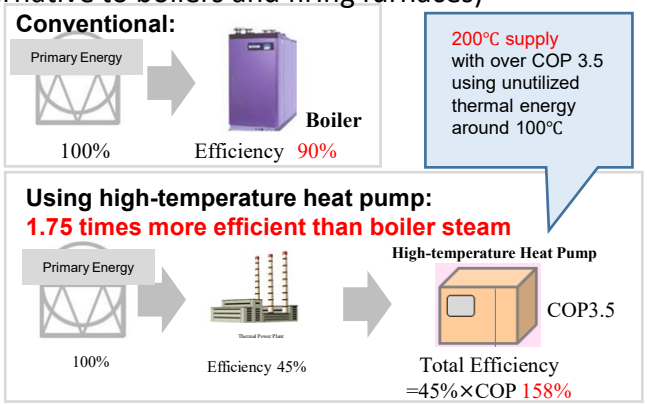
- Technology to effectively **reduce**, **recover** and **reuse** untapped thermal energy
- Crosscutting **heat management** technologies
- HPs play a role in reusing thermal energy (e.g. high temperature HPs, high-efficiency chiller…)



R&D - Utilizing Waste Heat (NEDO)

High temperature HP

(Alternative to boilers and firing furnaces)



Prototype of Heat Pump

◆ REMARK

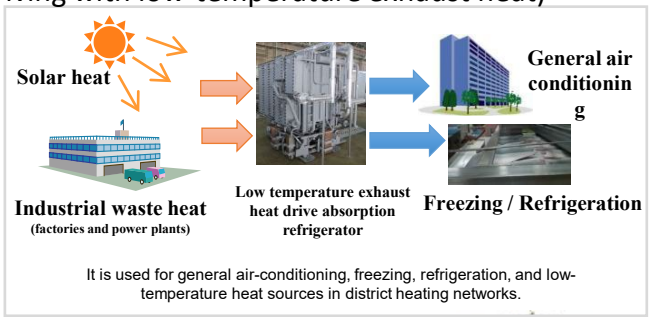
・160℃ supply with over COP3.5 using unutilized thermal energy around 80℃

・MAYEKAWA MFG. CO., LTD.

・Mitsubishi Heavy Industries Thermal Systems, Ltd.

Heat Recycle Absorption Chiller

(Driving with low-temperature exhaust heat)



Double Lift Cycle Absorption Chiller

With World's Highest Efficiency

◆ REMARKs

・The world's highest-efficiency double-lift cycle absorption chiller

・Expands the utilizing temperature (Before: 95→75℃ After:95→51℃)

Productization

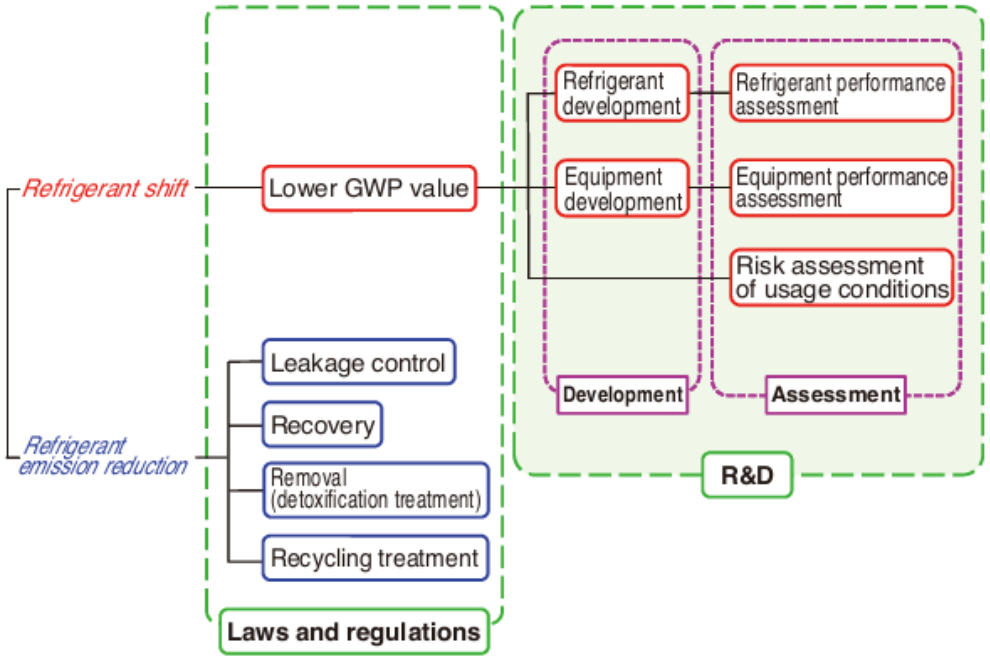
Hitachi Johnson Controls Air Conditioning CO., LTD.

R&D - Low-GWP Refrigerants (NEDO)

Development of Technology and Assessment Techniques for Next-Generation Refrigerants with a Low GWP Value

(FY 2018 - 2022)

- The development of assessment techniques for performance, safety, and risks of next-generation refrigerants used in refrigeration and air conditioning equipment
- dissemination of next-generation refrigerants through the development of technologies to address technological roadblocks in certain domains



Technological challenges in the area of reducing fluorocarbon emissions

R&D - Low-GWP Refrigerants (NEDO)

List of project themes
Acquisition and evaluation of fundamental characteristics of next-generation refrigerants
Assessment of thermophysical properties, heat transfer characteristics and basic cycle performance of next-generation refrigerants used for small and medium sized refrigeration and air-conditioning
Safety evaluation of low GWP, low flammability blend refrigerants
Research and development of the evaluation of practical use of the next-generation refrigeration and air-conditioning technologies applying low GWP refrigerants
Development of safety and risk assessment methods for next-generation refrigerants
Development of next-generation refrigerants and their application technologies
Research of large cooling unit applying natural refrigerants and ultra-low GWP refrigerants
Development of the technologies for applying next-generation low GWP refrigerants to condensing
Development of the energy-saving refrigerator system using the CO2 refrigerant in the low temperature equipment, and their evaluation in commercial buildings
Development of mildly flammable refrigerants（under GWP10 for direct expansion air-conditioning

Apparatus to measure flammability limits, essential for safety and risk assessment

Project term: FY2018-FY2022
Project participants: WASEDA University, Kyushu University, National Institute of Advanced Industrial Science and Technology, The University of Tokyo, Tokyo University of Science Suwa, Mitsubishi Electric Corporation, Toshiba Carrier Corporation, Panasonic Corporation, DAIKIN INDUSTRIES, Ltd.,

Key Actors (click the logo to visit the official websites*) *JEHC's website is available only in Japanese

JRAIA (since 1949)

The Japan Refrigeration and Air Conditioning Industry Association

- An industrial association of HVAC&R
- "Kobe Symposium" (International Symposium on New Refrigerants and Environmental Technology)
- 165 corporate members

JSRAE (since 1925)

The Japan Society of Refrigerating and Air Conditioning Engineers

- A non-profit academic organization in a field of refrigeration, air conditioning, food refrigeration etc.
- Education, training, survey, research, certification, awards, international exchanges (e.g. IIR), etc.
- 230 corporate and 3,600 individual members

JEHC (since 2006)

Japan Electro-Heat Center

- An industrial association
- Promoting thermal technologies, including industrial HPs
- Policy recommendation, communication, training, etc.

NEDO (since 1980)

New Energy and Industrial Technology Development Organization

- A national R&D agency, promoting technical development necessary for a sustainable society.
- Signatory body of IEA HPT TCP

ExCo delegate Mr. Iwatsubo
ExCo alternate delegate Mr. Goto

HPTCJ (since 1986)

Heat Pump and Thermal Storage Technology Center of Japan

- An industrial association of HPs
- Promotion, training, research, survey, policy recommendation, etc.
- Secretariat of IEA HPT TCP

ExCo alternate delegate Mr. Asahi

Summary

- **Decarbonization:** HPs are seen as one of key technologies to achieving Japan's net-zero 2050 commitment. Quantitative targets for 2030 are set for further deployment of IHPs and commercial and residential HPWHs.
- **Energy:** Cleaner electricity mix including nuclear power is the challenge on the supply side. On the demand side, HP efficiencies have been and will be improving thanks to EE policies like "Top Runner Program" and awards.
- **Incentives:** The government is offering subsidies for HPWHs and other efficient appliances / equipment. Local governments are also starting to subsidize HPs.
- **Market:** Japan's AC market is stable. We need to further deploy IHPs and HPWHs in line with the government's target.
- **Technology**: R&Ds of such as Low-GWP refrigerants and high temperature HPs are being carried out both in HPT TCP Annexes and domestic research projects.

Thank you for your attention!

Takahiro ASAHI (Executive Committee alternate delegate of Japan)

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