

JRAIA's Effort for Kigali Target

The Japan Refrigeration and Air Conditioning Industry Association

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1. Japanese regulation amendment trend

1) Overview of Legislation in Japan

Legislation on refrigerants

“Ozone Layer Protection Act” (revised in 2022)

- Regulation on production and consumption of CFC/HCFC/HFCs (abbr. OLP Act)
- National law to be ratified the Kigali agreement to the Montreal Protocol.

“Act on Rational Use and Proper Management of Fluorocarbons” (revised in 2019)

- Regulation on emission of CFC/HCFC/HFCs (abbr. Fgas Act)
- Target GWP and year for each product group (**Designated Products**).

“High Pressure Gas Safety Act” (revised in 2024)

- Regulation on safety of flammable (toxic) gas
- Method of safe use of products and refrigerants
- A2L refrigerants are included as “particular inert gas”

Legislation on energy efficiency

“Plan for Global Warming Countermeasure” (revised in Feb.,2025)

- Regulation on emission of energy origin CO₂

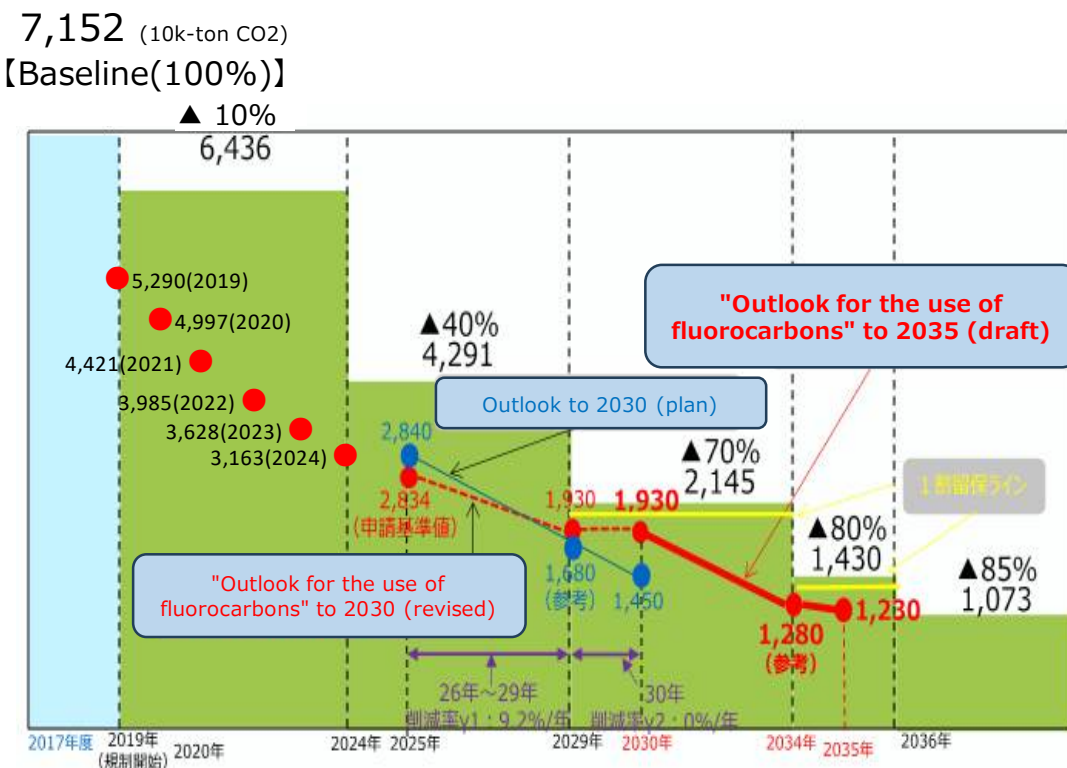
“Act on the Rational Use of Energy(Saving Energy Act)” (revised every 3-5 yr)

- Top Runner Program has been revised in 2022 (Target year for RAC (Wall) : 2027)

1. Japanese regulation amendment trend

2) HFC reduction in Japan

"Outlook for the use of fluorocarbons" to 2035 (draft)



2025-3-25 by materials of
Government of Japan Joint Council

Direction:

Japan has successfully met all interim targets under the Kigali Amendment by transitioning to R32.

Further to achieve the ultimate goal, we need to

- 1) Shift to green refrigerants by NEDO project in some products where appropriate.
- 2) Need to take measures for
 - a. Leakage prevention,
 - b. Recovery during service and EOL
 - c. Maximum utilisation of recycled refrigerants

Important to realize LRM with circular economy point of view to achieve our Kigali goal.

1. Japanese regulation amendment trend

3) Regulation of refrigerant by “Designated Products”

Designated Products			Target GWP (Weighted Average)	Target year
Residential A/Cs (Mini-Split)			750	2018
Commercial A/Cs	①	Split, except floor-mounted type (other than ④-⑨) < 16 kW	750	2020
	②	Split, except floor-mounted type (other than ④-⑨) ≥ 16 kW	750	2023
	③	with floor-mounted indoor units (other than ④-⑫)	750	2025
	④	Centrifugal (Turbo) Chillers	100	2025
	⑤	Chillers for Human comfort (with positive displacement comp)	750	2027
	⑥	Chillers other than ⑤ (with positive displacement comp)	750	2029
	⑦	VRF (New installation only & Heat or Cool switching type)	750	2025
	⑧	VRF (New installation only & other than ⑦)	750	2027
	⑨	GHP (New installation only & Heat or Cool switching type)	750	2027
	⑩	GHP (New installation only & other than ⑨)	750	2029
	⑪	A/Cs for facilities (New installation only & exclude specific utilities)	750	2027
	⑫	A/Cs for facilities (New installation only & other than ⑪)	750	2029

2. New refrigerant development

NEDO Project funded by Japan Government

NEDO Project (New Energy and Industrial Technology Development Organization)

Aim: Development of high-efficiency refrigeration and air conditioning technology for the practical use of next-generation low-GWP refrigerants

- 1) Duration : 2023 - 2027
- 2) Budget : 500 million yen (fiscal 2023)
- 3) Objective: Development of next-generation low-GWP refrigerants
- 4) Project Details :
 - Narrow down the HFO mixed alternatives mainly for residential-use air conditioners.
 - Develop fundamental technologies to utilize HFO alternatives in key component (heat exchangers and compressors)
 - Develop models and evaluation methods to assess safety and environmental impact

**Selection of
the
candidate
alternatives**

**Set guideline
for
the design of
heat
exchanger**

**Set guideline for
the design of
compressor &
R&D of
Refrigeration Oil**

**Develop
Evaluation
Equipment &
Impact
Assessment**

**Develop
Models and
Evaluation
Method**

**Product
R&D by
private
sector**

3. Refrigerant Leak Prevention measures

1) Background: Leakage Rate during Operation

MOEJ published refrigerant leakage rate during operation by application in 2025. JRAIA has been making efforts to further reduce the leakage rate.

Classification		Leakage Rate
Large refrigeration system	Centrifugal refrigeration	5.3%
	Screw refrigeration	8.9%
Medium-sized refrigeration system	Condensing unit	8.9%
	Split-type showcase	8.9%
Commercial air conditioning system	Commercial packaged air conditioners	1.0%
	Packaged air conditioners for buildings	2.9%
	Packaged air conditioners for facilities	1.8%
Chilling Unit	Chilling units for refrigeration and air conditioning	0.8%

Source: Ministry of Environment of Japan

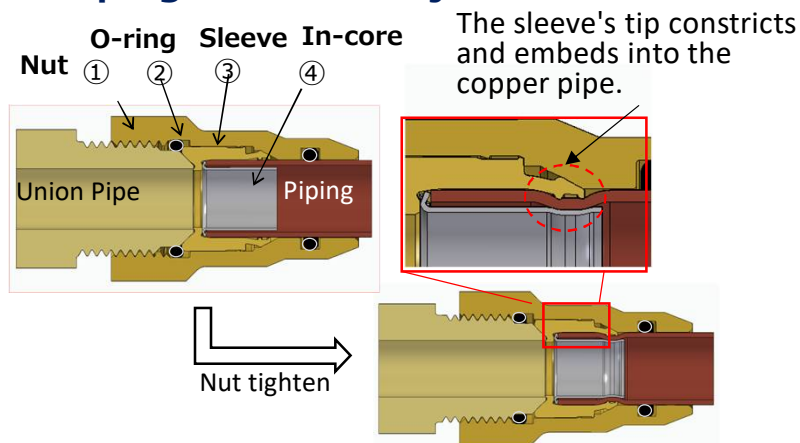
3. Refrigerant Leak Prevention measures

2) Tool development

- In Japan, **leakage rates** for air conditioners and heat pumps **are already low. However, further reduction remains important, partly due to the reliance on the skill level of installers.**
- **Japanese manufacturers** have been actively **developing measures to** help support installers and **minimize this dependency**

Contribution Example 1:

participating to develop ISO14903 and developing mechanical joints



Product name : S'B Nut by COCOMECH

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Contribution Example 2:

Leakage points revealed by fluorescent dye under UV light

- Fast leak identification aids installer skill and ensures brazing accuracy



by Mitsubishi Electric

3. Refrigerant Leak Prevention measures

3) Continuous monitoring system

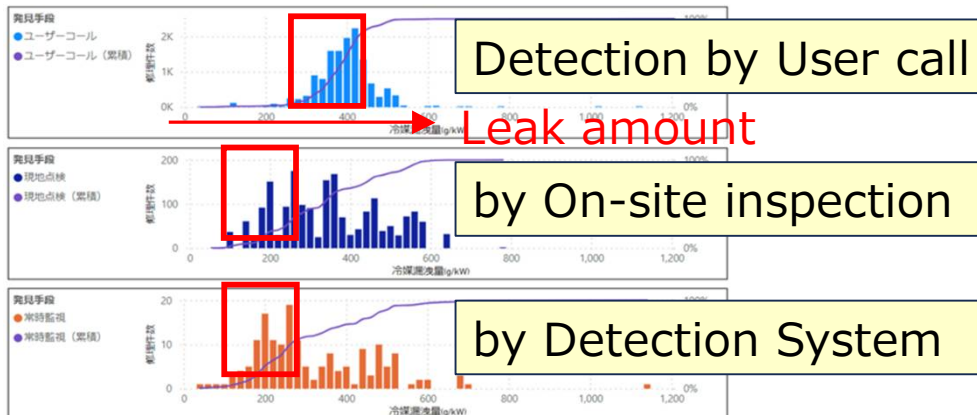
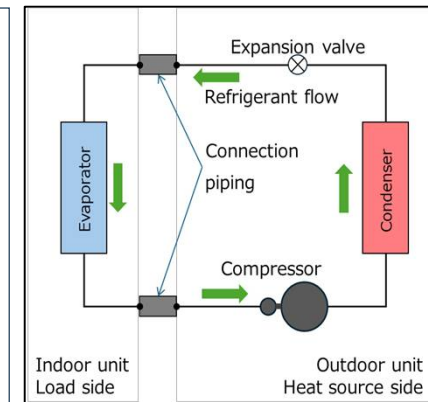
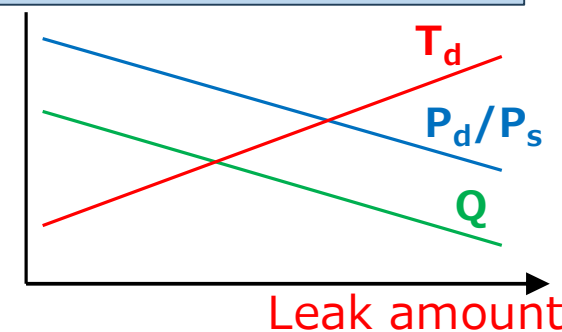
Refrigerant Leak Detection Concept

When Refrigerant leaks

1. **Comp. discharge temp. (T_d)** tends to rise
2. **Pressure of the compressor (P_d/P_s)** tends to decrease
3. **Performance (Q)** tends to decline
4. These changes are very difficult to detect because they depend on the ambient temp. and the load

Each company has independently built and equipped a mechanism to detect refrigerant leaks

Refrigeration cycle behaviour



The continuous monitoring system is capable of **early detection** of refrigerant leaks with an accuracy comparable to on-site inspections by experts.

- The system that meets certain requirements is recognized as **a Type of Simplified inspection** under the F-Gas Act in Japan.
- Furthermore, currently in discussion with the relevant authorities to have it recognized as **a Type of Regular inspection**.

4. Recovery and Reclamation of HFCs

1) Overview

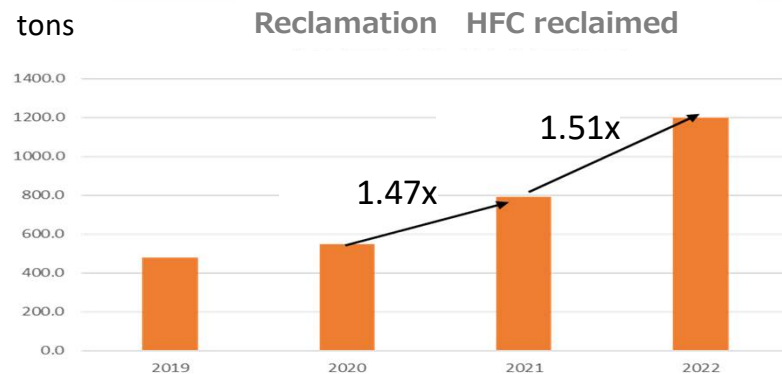
【Current status of reclamation of HFC】

Latest information and analysis

(Information published on February 1st)

Rapid expansion of HFC reclamation

- Approximately **1200** tons were reclaimed in 2022
- **51% increase** from the previous year
- **2.2 times increase** in 2 years



Estimation of the reasons

(1) Improved recovery rate

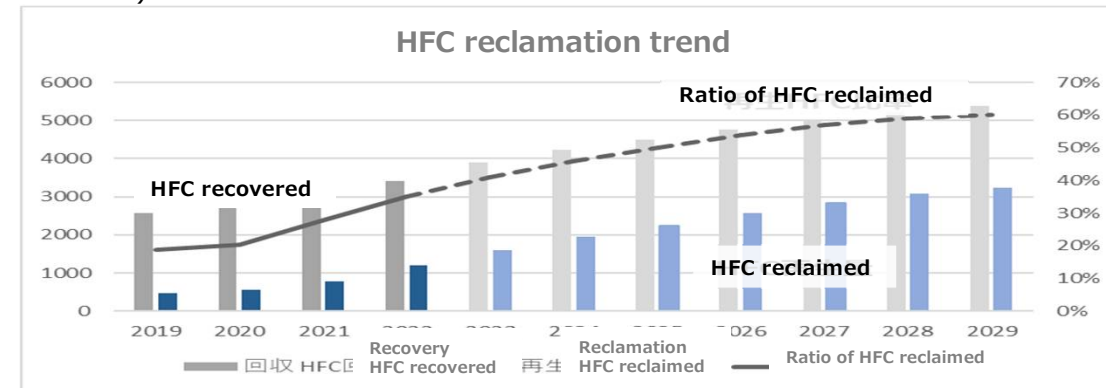
Improved from 40% to 44%. This might be the effect of the revised Act on Rational Use and Proper Management of Fluorocarbons?

(2) HFC ratio expands in the recovery

(Expanded from 52% to 63% in 2 years; natural flow)

(3) Recovered refrigerant is reclaimed

(Increased from 20% to 35% in 2 years. Awareness-raising activities have been successful??)



In Japan, refrigerant reclamation is projected to rise significantly, **potentially covering nearly 30% of consumption by 2029. This supports a circular economy and recovery of high-GWP refrigerants.** Japan's progress with refrigerant reclamation **shows it's worth thinking about for other countries too.**

4. Recovery and Reclamation of HFCs

2) Industry effort to enhance recovery

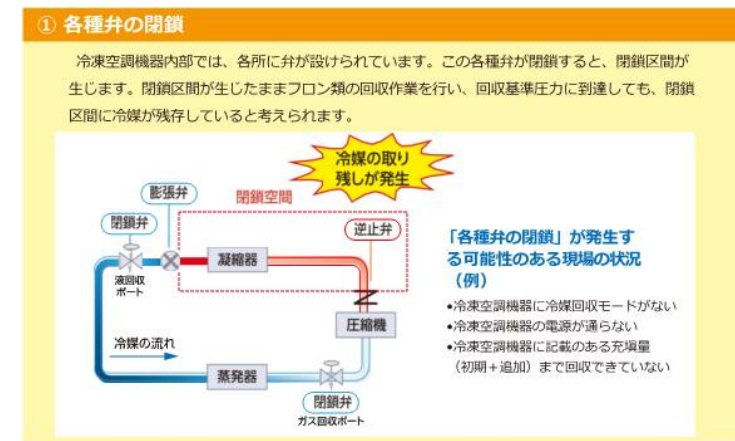
Refrigerant recovery mode

Purpose: To promote the recovery of fluorocarbons, we aim to standardise the recovery mode in the industry against the "closure of various valves," which is one of the factors that hinders refrigerant recovery work.

Recovery mode: Forcibly open various valves so as not to create a closed space in the refrigerant circuit (when there is power and the equipment is not broken)

When there is no power or the equipment is broken, the condition varies by each company

- Next steps:
- 1) Grasp the current situation and sort out the issues for each equipment group
 - 2) Consider standardized refrigerant recovery mode for each equipment group
 - 3) Standardization in the industry ⇒ Reflect to JRA standards and GL



Source; MOEJ -Guidebook for Reliable Recovery of Fluorocarbons from Multi-Air Conditioners for Buildings-

https://www.env.go.jp/earth/furon/files/r05_guidebook.pdf

5. Summary

Achieving the Kigali Amendment goals requires close collaboration among public, private, and academic sectors, guided by S+3Es: Safety, Environment, Energy Efficiency, and Economy.

- Industry must work with academia and government to identify safe, ultra-low GWP refrigerants.
- Efforts to prevent leakage and promote reclamation should involve all stakeholders.
- As electricity-related CO₂ is major part of LCCP. Even with clean power and low-GWP refrigerants, user costs still remains as burden.

Each factor—safety, GWP, flammability, toxicity, energy performance, and equipment scale—may involve trade-offs. Decisions should reflect lifecycle impacts, not GWP alone.