Contributions of equipment manufacturers supporting the LRM ecosystem

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3rd November, 2026



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1-1. LRM: What It Is and Why It Matter

Sustainable refrigerant lifecycle management is essential across the entire HVACR equipment lifecycle.

JRAIA Activities

(Premise) To harmonize environmental sustainability with people's quality of life

Product lifecycle: Production → Transport & Storage → Install → Use → Repair → Dismantle → Transport & Storage → Disposal

To handle refrigerant properly

- **Tools for joint: Leak detection/suppress**
- **Reclamation**
- **Recovery**
- **New refrigerant development***
- Risk assessment
- Co-operation with related stakeholders

* JRAIA supporting NEDO project with consideration of whole life cycle and S+3Es

To enhance evaluation for GHG emission

- Activities for Life Cycle Climate Performance (LCCP)
- Standardization for seasonal efficiency of AC/HP*

*To refine simulating “real life use” further

For quality

- Certification program for RAC/PAC in JPN

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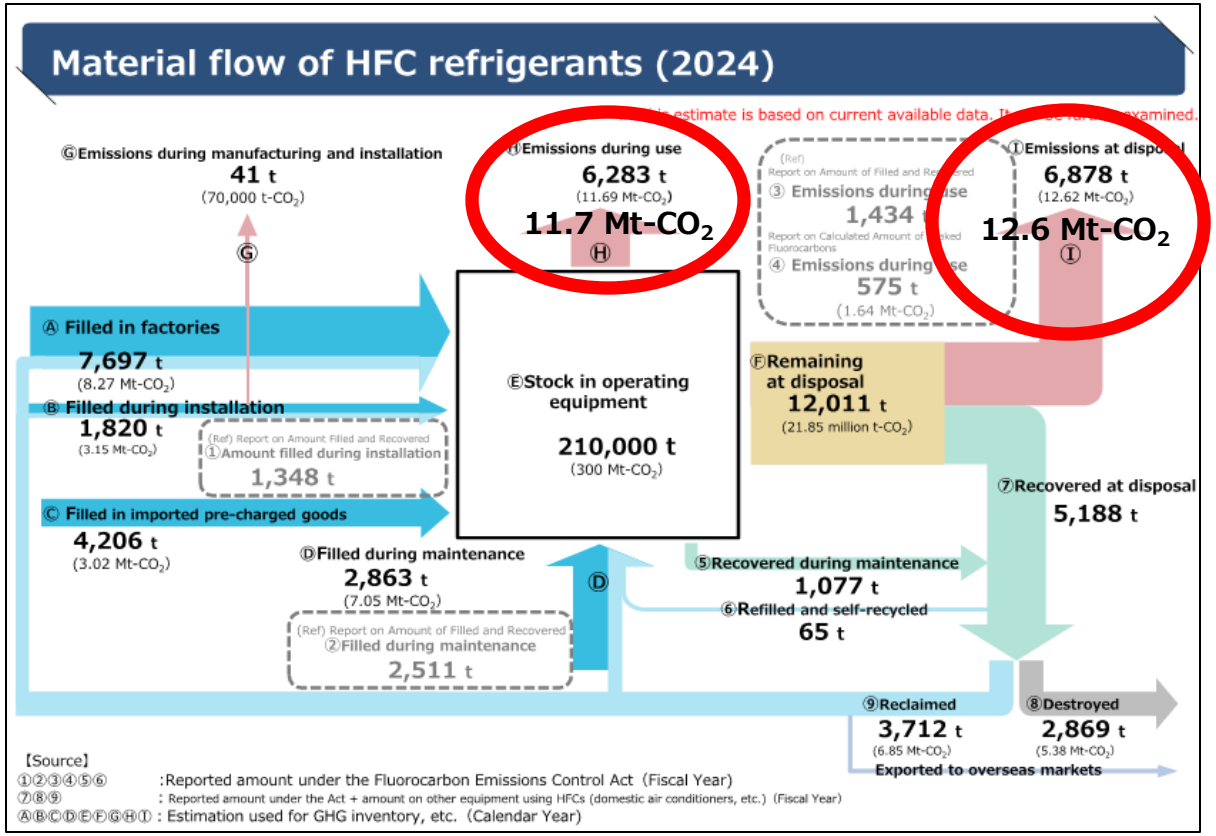
1-2. LRM: What It Is and Why It Matter

- Japan's HFC emissions (2024)
  27.6 M tons-CO_2
  - During use: 11.7 Mt-CO_2 (42%)
  - At disposal: 12.6 Mt-CO_2 (46%)
  - Other than refrigerant: 3.3 Mt-CO_2 (12%)

- If the Leakage rate: 3.9% ➔ 2.7%
  - During use: 11.7 ➔ 8.1 Mt-CO_2 (△ 3.6)
- If the Recovery rate: 42% ➔ 70%
  - At disposal: 12.6 ➔ 6.5 Mt-CO_2 (△ 6.1)

a total reduction: 9.7 Mt-CO_2
Vs Japan's reduction target at 2030
18.7 M tons-CO_2 (More than half!)



Instead of simply waiting for the dream refrigerant, implementing "LRM" that can be done right now is essential.

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2. Refrigerant Transition: Balancing Safety, Environment, Energy Efficiency and Economic Feasibility (S+3Es)“

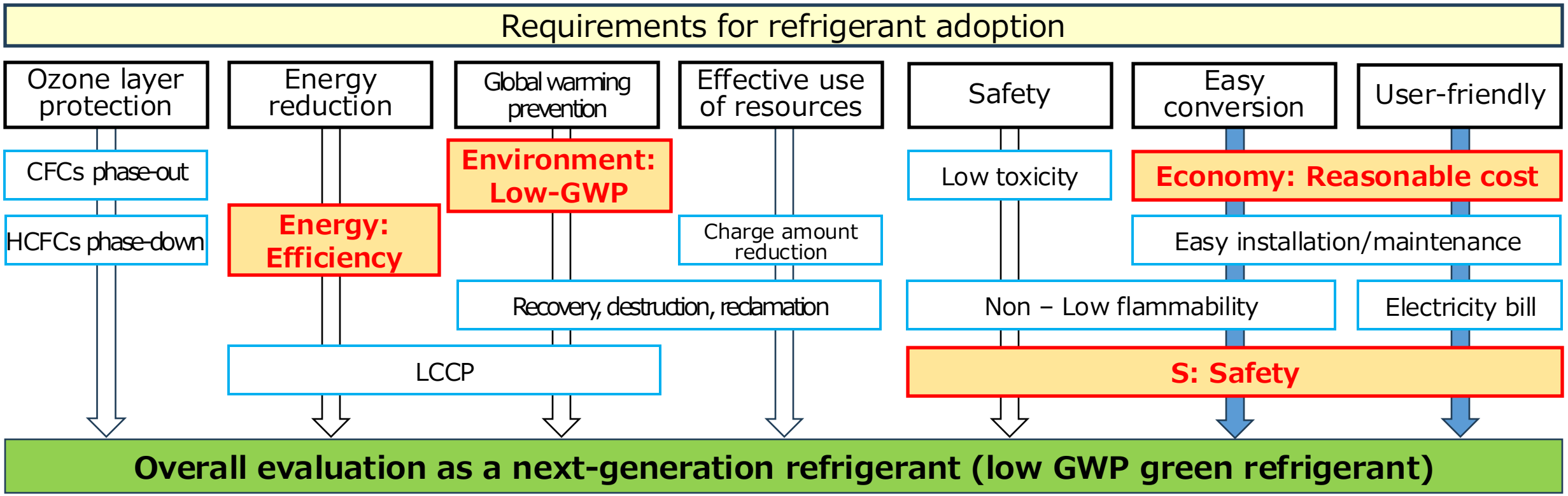

Fig. Schematic diagram of the next refrigerant selection process for air conditioning equipment.

The transition to next-generation refrigerants requires a **balance of "S+3Es** (Safety, Environment performance, Energy efficiency, and Economic feasibility)."

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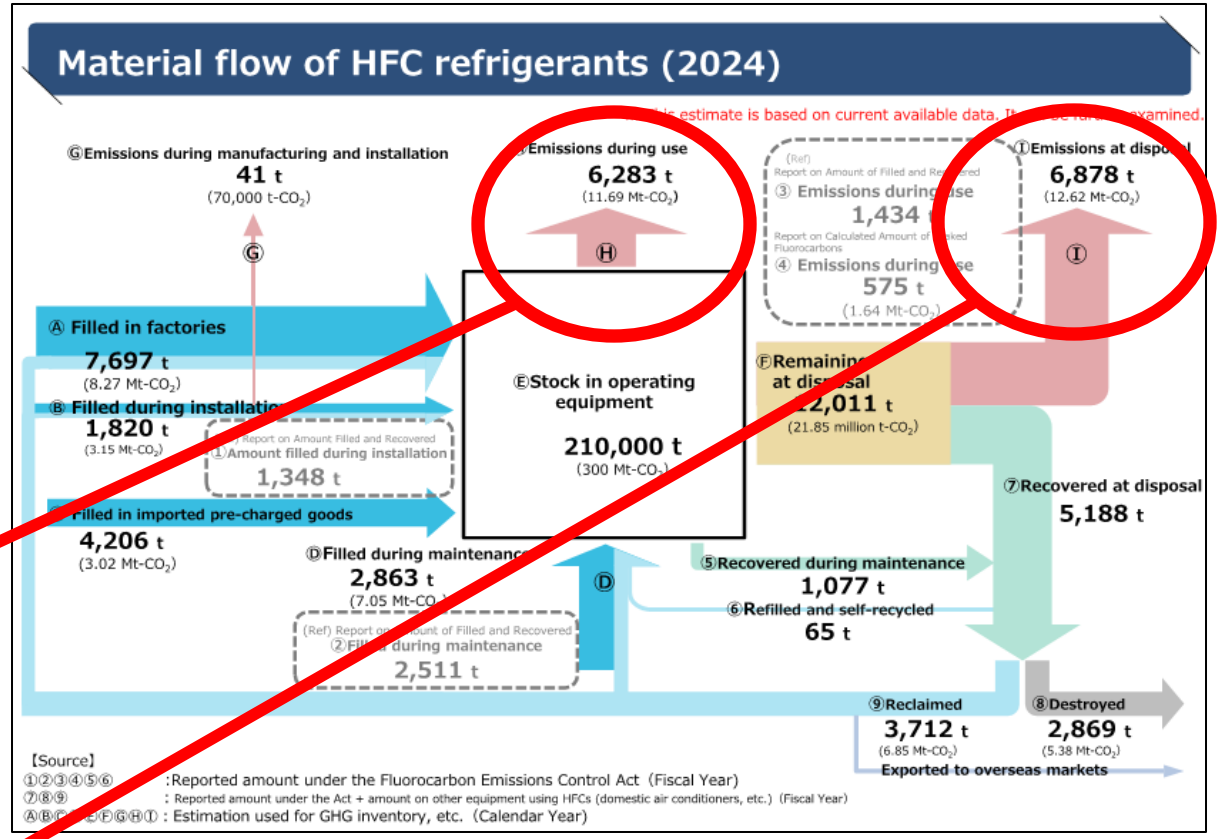
3. The Role of Equipment Manufacturers in Supporting LRM

It is important to reduce leakage **during use** and emissions into air **at disposal**, which are the primary causes of HFC refrigerant emissions.

Initiatives as Equipment Manufacturers

- Leakage prevention during use
  ← IoT continuous monitoring system
- Reliable refrigerant recovery during disposal
  ← Refrigerant recovery mode



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4. Practical Examples of How Manufacturers Support LRM
1) Leakage prevention during use - monitoring system

JRAIA is promoting the introduction of "continuous monitoring system" that can detect leaks early and dramatically reduce the amount of leakage.

- "Guidelines for Fluorocarbon Leak Detection Systems by Continuous Monitoring (JRA GL-17)“ has been established.
- Already certified as a form of “Simplified inspection" under the F-gas Act in Japan.
- JRAIA is promoting to have it recognised as a “Regular inspection” as the next step.
  - A "hybrid" approach combining direct method by specialist and continuous monitoring by a system.
  - Considering a legal system to completely replace Regular inspections with a continuous monitoring system alone.

Table. Revision plan of Regular inspection

Method	**Current**		**Revision plan – Step1**			**Revision plan – Step2 (Final)**	
	Conducted by	Frequency	Conducted by		Frequency	Conducted by	Frequency
Direct*	Specialist	Every 1(or 3) year(s) or more	**Hybrid**	Specialist	Relaxed (Every X years)	-	-
Indirect*	Specialist	Every 1(or 3) year(s) or more		**Monitoring System**	**Daily**	**Monitoring System**	**Daily**

* Direct method : Directly finding the leak location using detection fluids, gas detectors, etc., in order to identify the leak location.
* Indirect method : Determining whether or not there is a leak from the state values (temperature, pressure, etc.) of various parts of the equipment during operation.

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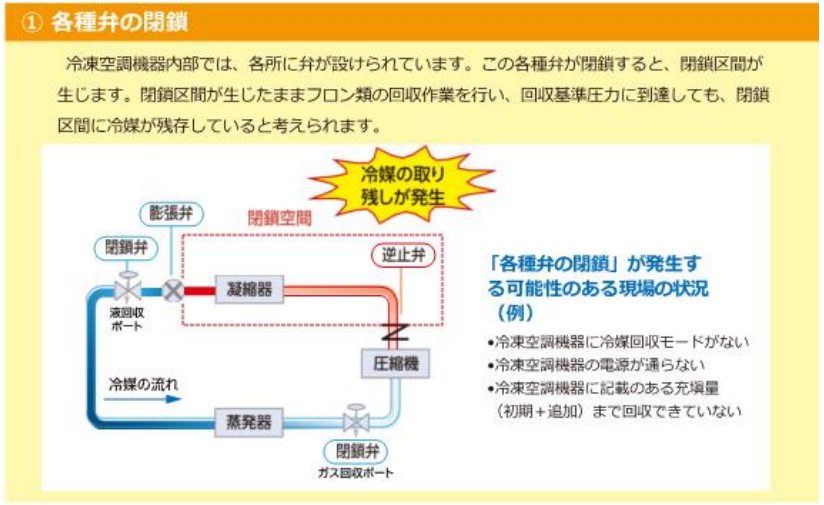
4. Practical Examples of How Manufacturers Support LRM
2) Refrigerant recovery during disposal

【Issues】

- If various valves inside refrigeration and air conditioning equipment are closed, a "closed space" is created, resulting in residual refrigerant even after recovery work, which can lead to its emission into the atmosphere.

【Action from equipment manufacturers】

- To facilitate refrigerant recovery for on-site workers by equipment design, supporting an increase in refrigerant recovery rates.



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

◎RACs, Commercial Acs, Refrigeration equipment: (Equipment NOT create a “closed space)
⇒ By pump-down (a function that recover refrigerant in the ODU).
◎VRF: (Equipment that may create a “closed space”)
⇒ Refrigerant recovery mode (forcibly open various valves) + pump-down

Note: Refrigerant recovery mode requires a power source (power for the equipment)

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5. Key Takeaways

- Refrigerant transition and LRM must advance together
- LRM delivers immediate emission reduction
- S+3Es balance is essential
- There are no fit-for-all perfect refrigerant
- Each country should develop its own LRM ecosystem

Refrigerant Transition ＋LRM = Sustainable Kigali Amendment!

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Thank you

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