



MZ Group's Approach to the Circular Economy for Refrigerants

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1. International Initiatives for Refrigerants(F-gas)

- Under the Montreal Protocol, ozone-depleting substances have already been completely phased out in terms of production and import in developed countries, including Japan and the EU. As a result, the ozone hole is gradually showing signs of recovery.
- With the Kigali Amendment, refrigerants with high global warming potential (GWP) are now subject to regulation, and significant reductions are set to be implemented moving forward.

Protection of the Ozone Layer

Specified F-gas
CFC



2009 : Complete
Phase-Out

Alternative CFCs

Specified F-gas
HCFC



Complete phase-out Schedule:
Developed Countries: by 2022
Developing Countries: by 2030

1986: Adoption of the Montreal Protocol



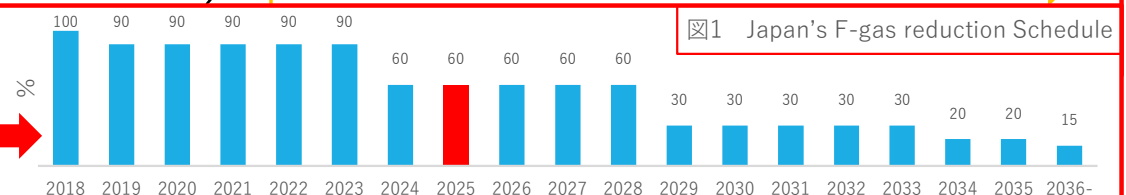
Prevention of Global Warming

Alternative F-gas

2016: Adoption of the Montreal Protocol Amendment (Kigali Amendment)

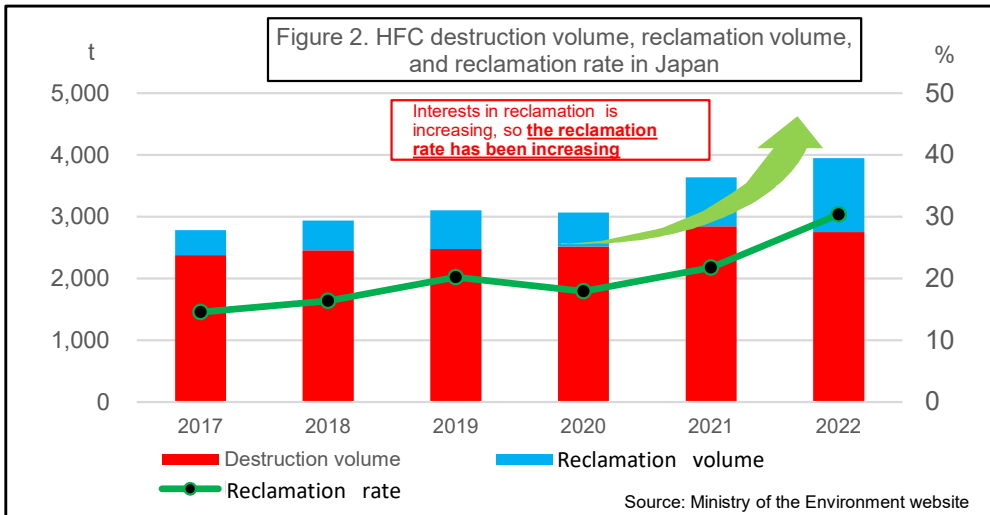
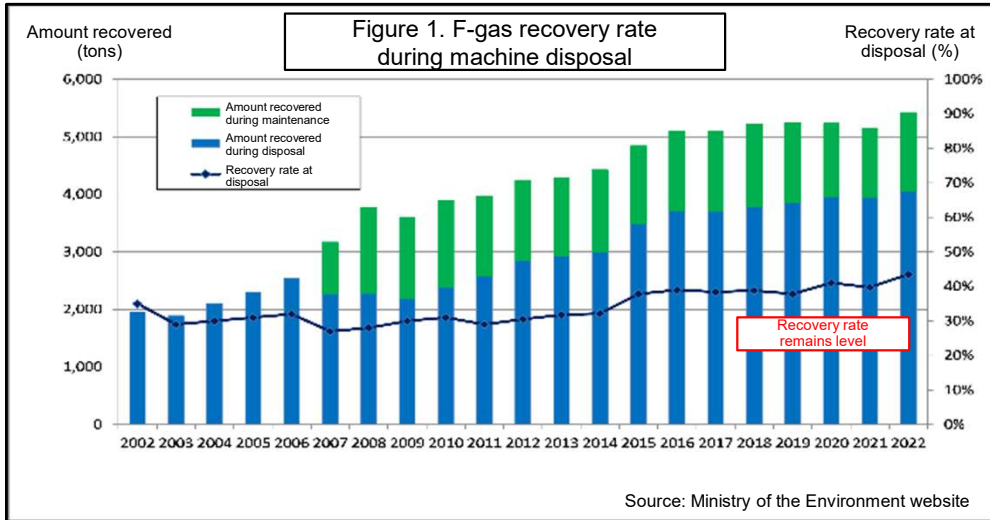
Specified F-gas
HFC(R410A · R32 etc...)

Regulation of F-gas In production,
import and consumption
based on 2016 levels



2. Current Status and Forecast for HFC (e.g., R410A and R32)

- The F-gas recovery rate in Japan has reached around 40% recently.
This may sound low, but is among the top globally, showing that Japan is taking advanced measures. (Figure 1)
- Over 70% of HFCs are destroyed, but interest in reclamation of HFCs is growing each year. (Figure 2)
- There are many challenges to develop next-generation refrigerants called natural refrigerants, and their future is still unclear. (Figure 3)



Area	Field	Current alternative fluorocarbon refrigerants (GWP)	Green refrigerants to substitute alternative fluorocarbon refrigerants
(1) Substitution is progressing or is expected to progress	Household freezer refrigerators	(HFC-134a (1,430))	Isobutane
	Vending machines	(HFC-134a (1,430)) (HFC-407C (1,770))	CO2 Isobutane HFO-1234yf
	Car air conditioners	HFC-134a (1,430)	HFO-1234yf
(2) There is an alternative candidate available, but increasing its use is difficult	Ultra-low temperature freezer refrigerators	HFC-23 (14,800)	Air
	Large commercial freezer refrigerators	HFC-404A (3,920)	Ammonia CO2
	Medium-sized commercial freezer refrigerators (separate showcases)	HFC-410A (2,090)	CO2
(3) Considering alternative candidates	Small commercial freezer refrigerators	HFC-404A (3,920) HFC-410A (2,090)	(Considering alternative refrigerant candidates)
	Commercial air conditioners	HFC-410A (2,090) HFC-32 (675)	
	Household air conditioners	HFC-32 (675)	

Current state

[Volume newly produced or imported]

The Kigali Amendment requires a **decrease in the amount of new HFCs supplied** from 2024.

[Volume recycled]

Only about 10% of the F-gas in the market **are reclaimed**.

[Switch to next-generation refrigerants]

F-gas demand will be sustained for air conditioning and freezer refrigerator equipment requiring construction work.

Forecast

The balance between supply and demand will be disrupted, **resulting in price hikes and hoarding**.

Figure 3. Use of substitute refrigerants

Source: Ministry of Economy, Trade and Industry website

3. MZ Group's F-gas Recovry Volume and Reclamation Rate

- The reclamation rate of F-gas collected by general construction companies is about 60-70% (by the Environmental Research Institute survey), The reclamation rate of F-gas recovered by the MZ Group is over 90% (Table 1 and 2).
- The reclamation rate can be up by improving the recovery method without special technologies.

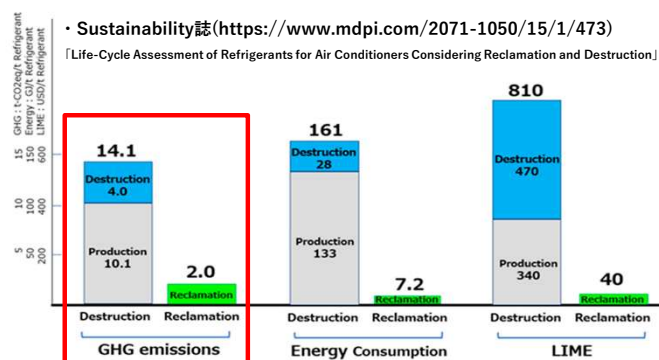
table1 Volume collected and reclaimed 2022/1-12

refrigerent	Volume Collected kg	reclaimed Volume kg	destroyed Volume kg	reclamation Rate %
R410A	9,424	9,116	308	96.7
R32	29	24	5	82.8
R404A	88	88	0	100.0
R407C	804	449	355	55.8
R22	4,012	3,713	299	92.5
R134a	364	364	0	100.0
その他	280	277	3	98.9
合計	15,001	14,031	970	93.5

table1 Volume collected and reclaimed 2023/1-12

refrigerent	Volume Collected kg	reclaimed Volume kg	destroyed Volume kg	reclamation Rate %
R410A	8,574.55	8,395.27	179.28	97.91
R32	453.96	441.52	12.44	97.26
R404A	79.71	76.88	2.83	96.45
R407C	2,200.06	1,623.64	576.42	73.80
R22	5,477.29	5,261.94	215.35	96.07
R134a	0.11	0.10	0.01	90.91
その他	2756.92	2,510.83	246.09	91.07
合計	19,542.6	18,310.18	1,232.42	93.69

Aiming for improvement



【Calculation of GHG emissions for R410A】

The figure on the left shows the results of a study comparing GHG emissions from “destruction” and “reclamation” treatment.

【Example in case of MZ about R410A in 2023】

*GHG emissions from reclamation: $8.39527 \text{ t} \times 2 \text{ tCO}_2 = 16.791 \text{ tCO}_2\text{-eq}$

*GHG emissions from destruction and new production:

$8.39527 \text{ t} \times 14.1 \text{ tCO}_2 = 118.373 \text{ tCO}_2\text{-eq}$

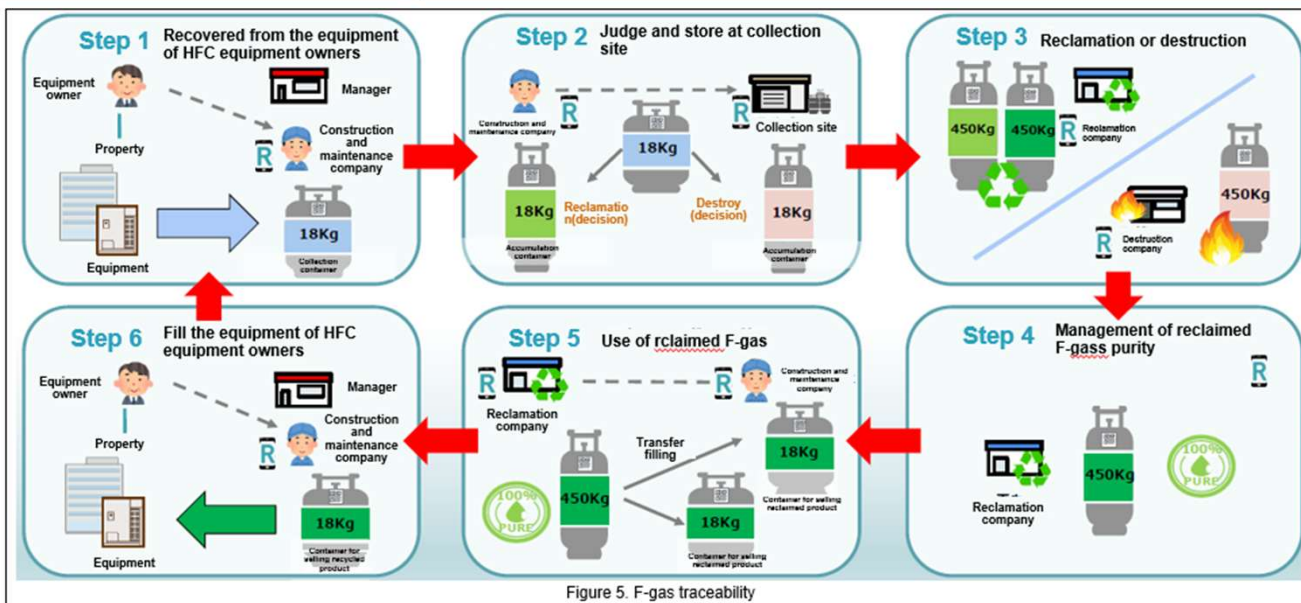
⇒ Reduction of CO2 emission is 101.582 tCO2-eq/year.

*And by using "RefNEXT" those data can be easily managed.

4 . F-gas Lifecycle Management

● Realization of F-gas traceability using “RefNEXT”.

- Visualization of the processes: collection from equipment ⇒ accumulation ⇒ treatment ⇒ sale of reclaimed F-gas ⇒ filling with reclaimed F-gas.
- Automatic issuance of [process control sheet],[reclamation certificates] and [annual reports] also enables a significant reduction in man-hours.



[Example of use]

- Headquarter-Branches
 - ⇒ To total up the collection results of each sales office
 - ⇒ To reduce the time and to make annual reporting or performance management
 - ⇒ To obtain certificates immediately ([Pickup Certificates])

• Account type

Each branch ⇒ Obtain an “Agency Account”
Subcontractors ⇒ Obtain a “construction store account”

※Currently available free of charge, but will be charged in the future.

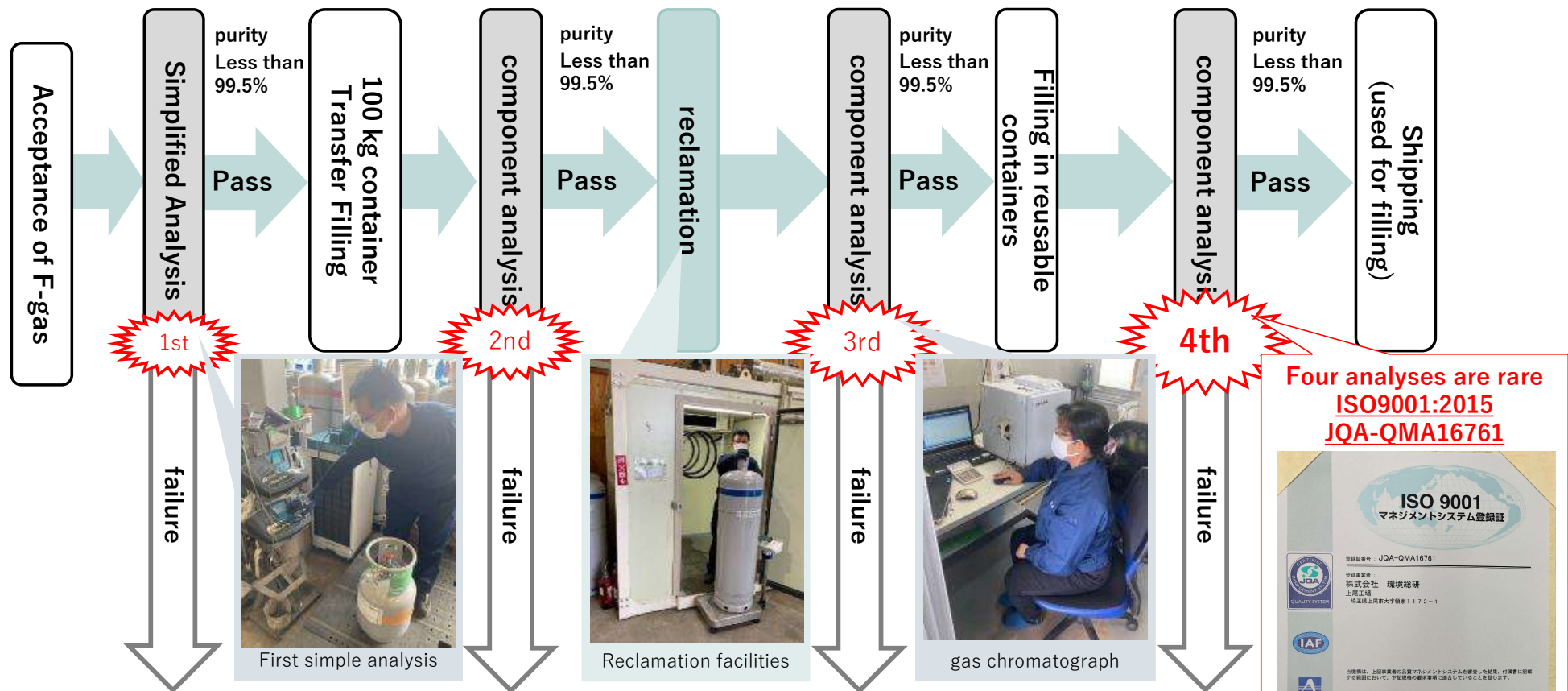
Figure 6. Actual smartphone input screen

作work items	Account					
	Machine owner	mediator	contractor	#49recovery operator	Reclamation operator	Desraction operator
Container registration	×	×	○	○	○	○
Recovery company Entry number registration	×	×	○	×	×	×
Recovery result	×	○	○	×	×	×
Filling result	×	○	○	×	×	×
Rental container Delivery request	×	○	○	×	×	×
Rental container Return without use	×	○	○	×	×	×
Rental container Move request	×	○	○	×	×	×
Rental container delivery	×	○	○	×	×	×
Recovered CFCs Treatment request	×	○	○	×	×	×
Result confirmation	○	○	○	○	○	○
Certificate download	○	○	○	○	○	○
Annual report	×	○	○	○	○	○
#49 process	×	×	×	○	×	×
Reclamation request	×	×	×	○	×	×
Reclamation process	×	×	×	×	○	×
Desraction request	×	×	×	○	×	×
Desraction process	×	×	×	×	×	○
Rental container shipping	×	×	×	○	○	○

Figure3 Availability by account

5. MZ Group's F-gas Reclamation Process

- We conduct component analysis four times before sales, and sell products that conform to JIS standards as “reclaimed F-gas”.
- In order to reclaim F-gas, it is essential to have a correct F-gas recovery procedure.
- We are ISO9001:2015 certified for “F-gas receiving → reclamation treatment → product storage”.



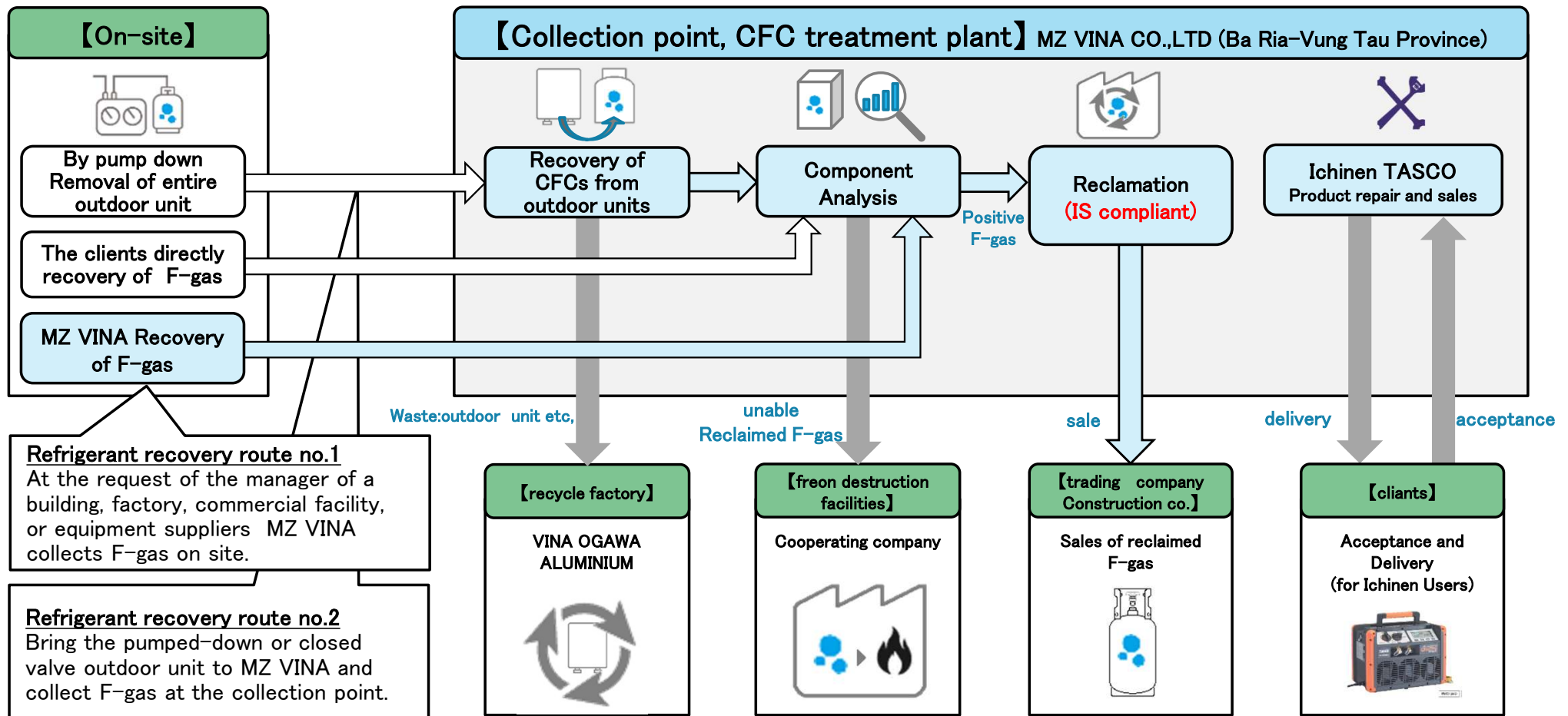
Less than 99.5% purity: Destructive process

【Cautions】

- (1) Even if “Reclamation” is selected when requesting treatment, it may be switched to “Destruction” depending on the analysis results.
- (2) “Reclamation” requires, in principle, the use of rental collection containers provided by our company.

6. Initiatives Abroad(MZ VINA)

- MZ VINA COMPANY LIMITED (Ba Ria-Vung Tau Province, Vietnam) was established on June 1, 2023.
- Participating in the JCM project “2023 Demonstration Project for Establishment of CFCs Recovery Scheme and Introduction of Mixed Combustion Facilities in the Socialist Republic of Vietnam”



6. Overview of MZ Group's Efforts

- We will contribute to the reduction of global warming by reclaiming the limited amount of F-gas in Japan.
- We will also change our containers from NRC containers (disposable) to reusable containers to contribute to the reduction of industrial waste.
- We will provide priority to companies that promote this initiative with us in the sale of reclaimed F-gas.

