

# **Global status of Laws and Regulations for lower GWP alternatives**

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**Pacifico Yokohama, JAPAN**

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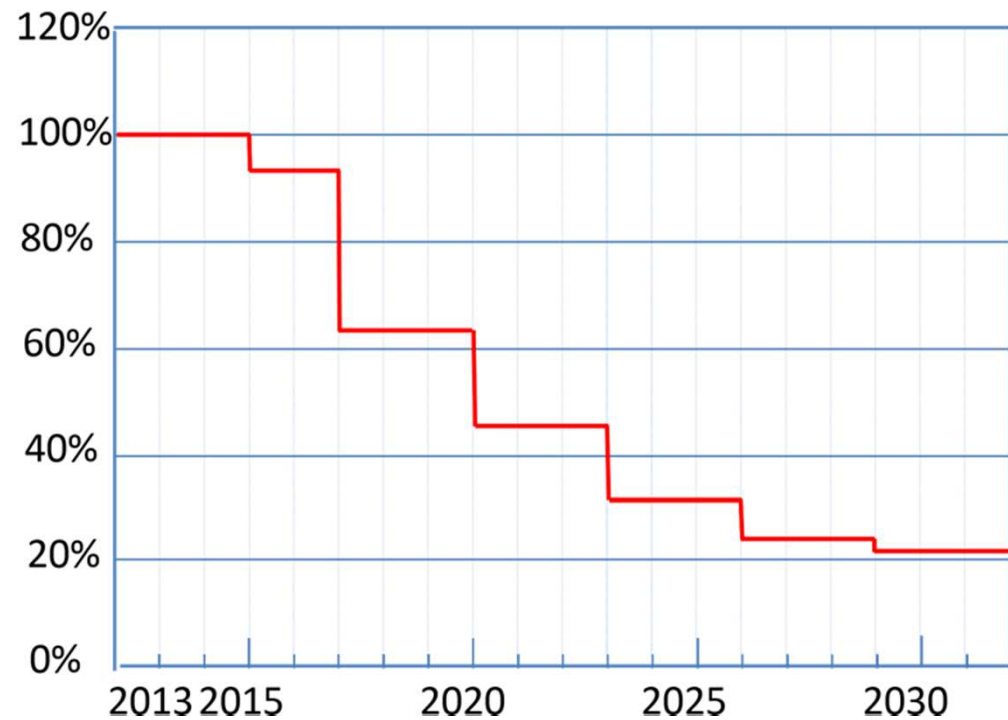
# 1. Latest situation of regulations for lower GWP alternatives

in the world

## (1) EU

### Phase-down timeline in EU

Year	CO2 equivalents place on the market (2009-2012)
2015	100%
2016-2017	93%
2018-2020	63%
2021-2023	45%
2024-2026	31%
2027-2029	24%
2030	21%



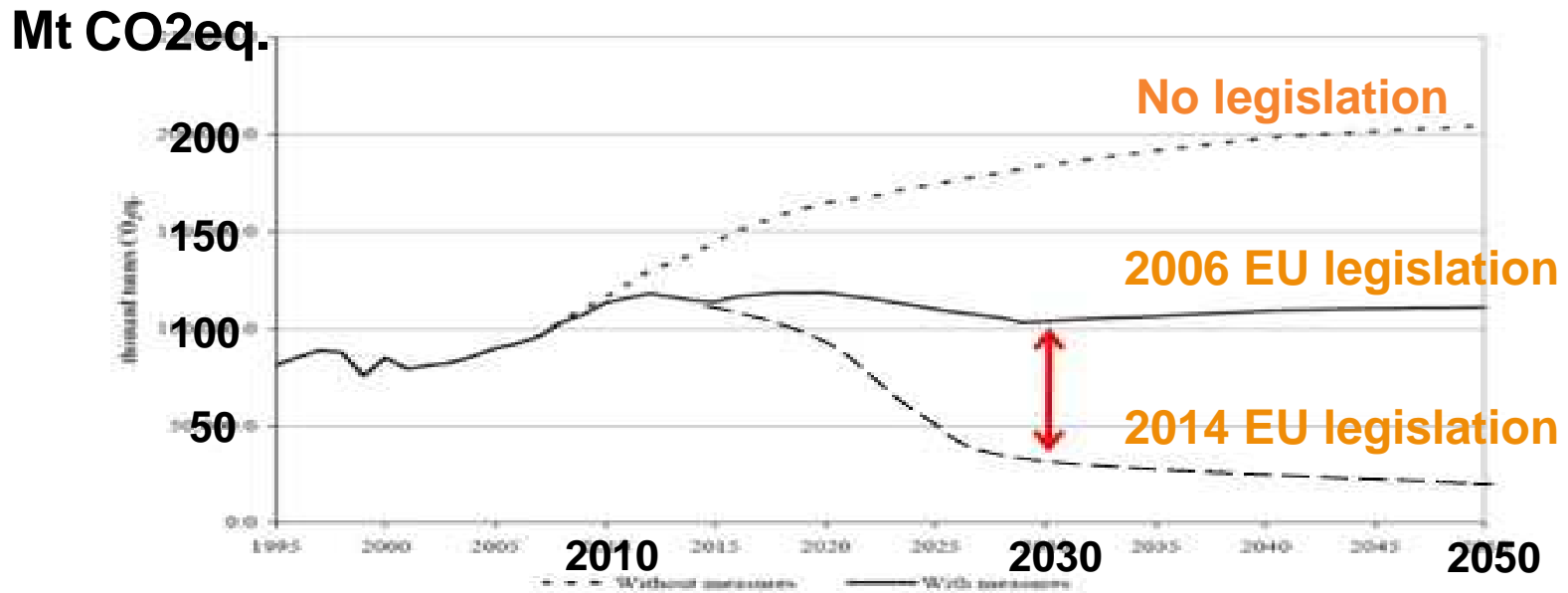
Source: EU Commission

# 1. Latest situation of regulations for lower GWP alternatives

in the world

(1) EU

## Projected EU F-gas emissions



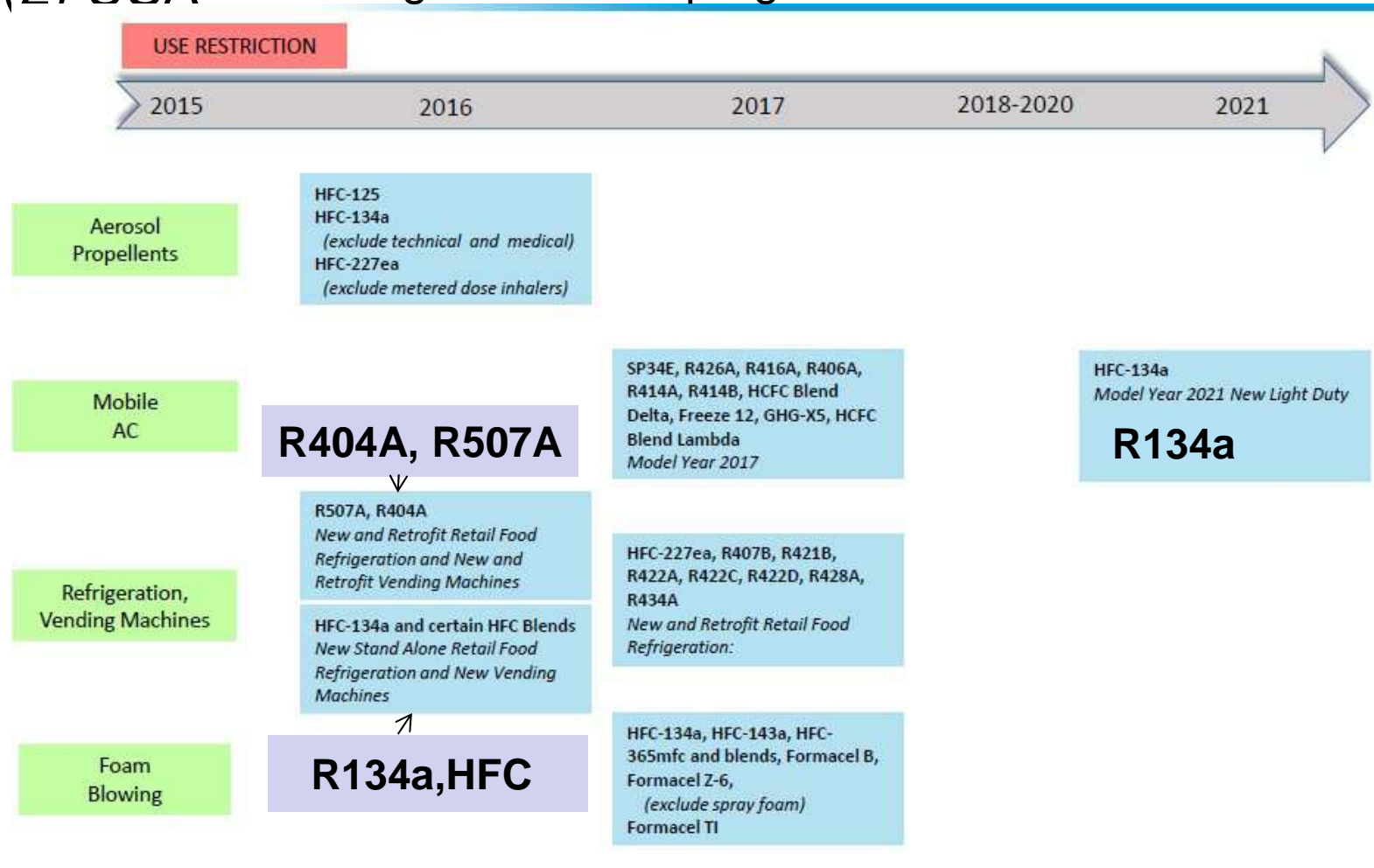
**Cumulative savings of 1.5 Gt by 2030 and 5 Gt by 2050!**

Source: EU Commission

# 1. Latest situation of regulations for lower GWP alternatives

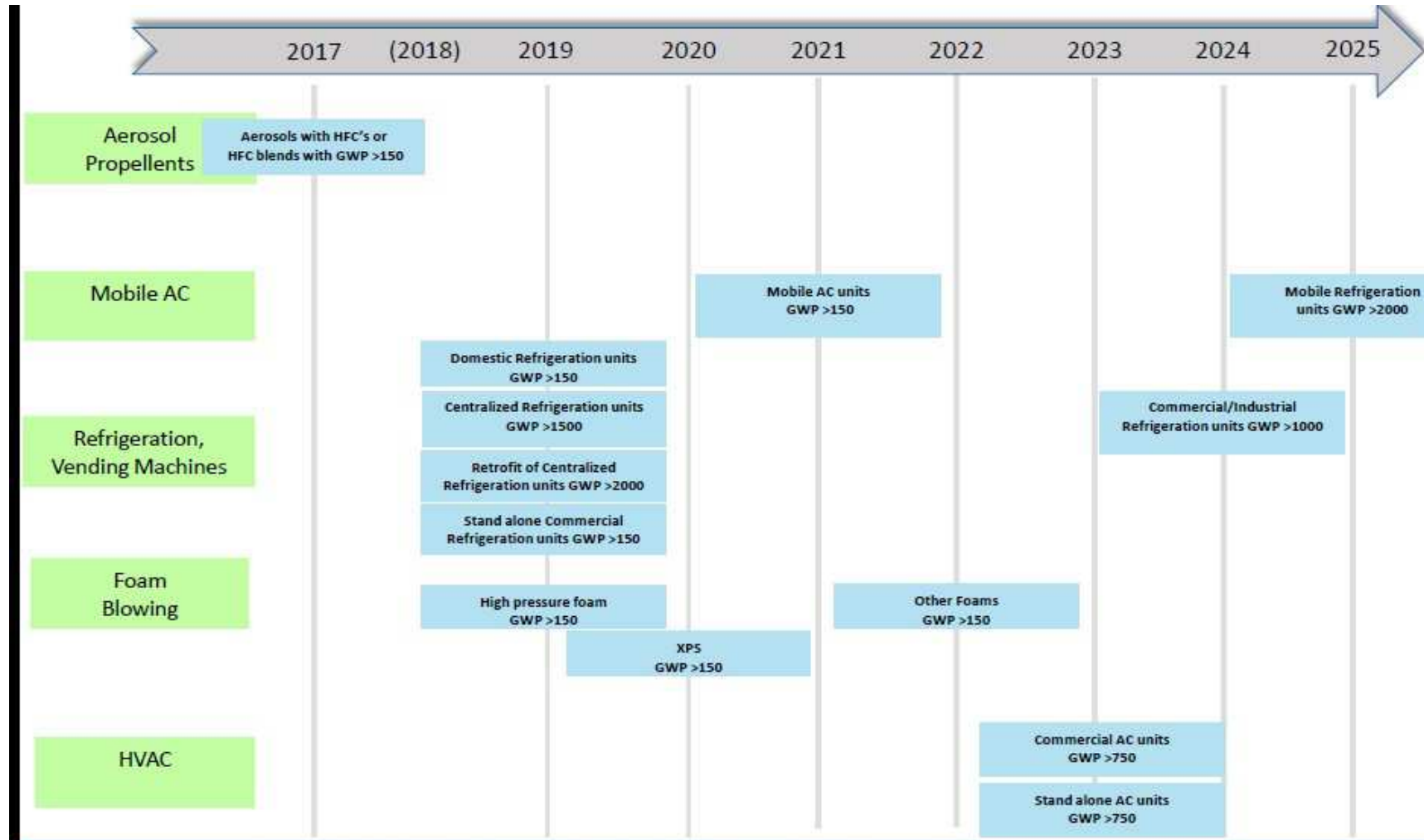
in the world

## (2) USA : de-listing from SNAP program



# 1. Latest situation of regulations for lower GWP alternatives

## in the world (3) Canada



# 1. Latest situation of regulations for lower GWP alternatives

in the world

## (4) Comparison: restriction of placing on the market

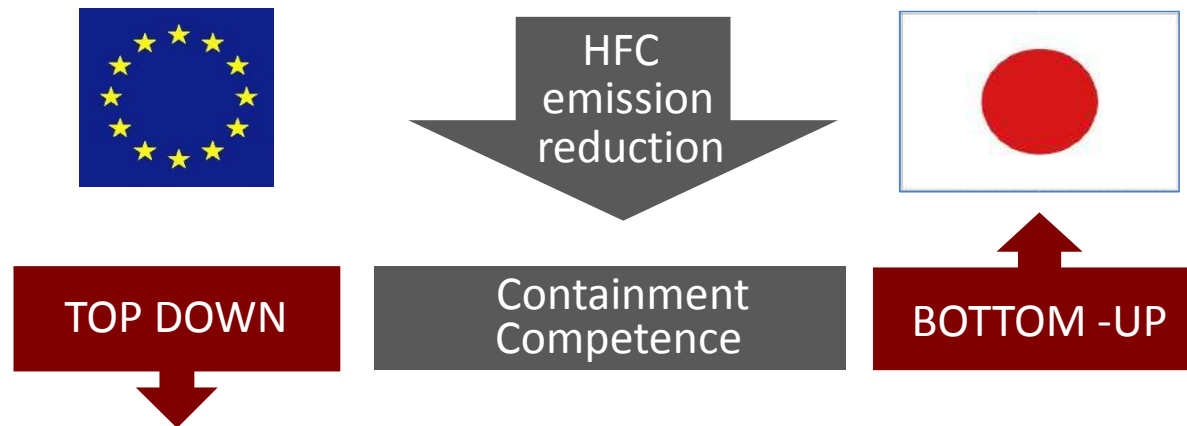
The restriction will start with similar GWP values and timing in the developed countries, sector by sector.

	Japan	EU	Canada	Applicable Refrigerants
<b>Residential</b>	750 (2018)	750 (2025) (charge amount<3kg)	750 (2023)	R32、Blended
<b>Commercial</b>	750 (2020) (<3 Ref tons)		750 (2023)	R32、Blended
<b>Refrigeration</b>	1500 (2025) (commercial and industrial)	2500 (2020) (stationary)	1500 (2020) (commercial and industrial)	R410A,R32, CO <sub>2</sub> , HC、Blended
<b>Automobile</b>	150 (2023)	150 (2017) (New car;2013)	150 (2021)	R1234yf

in the world

## (4) Comparison of approaches: EU and Japan

A phase-down can be achieved in a variety of different ways.



- The Phase-down targets Bulk refrigerant producers & importers in EU.
  - Start from Historic baseline 2009-2012 = CO<sub>2</sub>- equivalents placed on the market
  - Emissions increase due to market growth „compensated“ by containment & competence measures, end of life recovery
  - The shape of the Phase-down is **determined top-down** by calculating reduction steps from the historic baseline.
- The Phase-down targets **equipment** manufacturers & importers of equipment in Japan
  - **Target Index of weighted GWP** per equipment application segment
  - The shape of the phase-down is a **bottom-up result** of applying the Target Indexes, containment and competence measures, end of life recovery.
  - No top-down reduction steps are calculated from historic baseline

Source: EPEE



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in the world

## (5) Japan

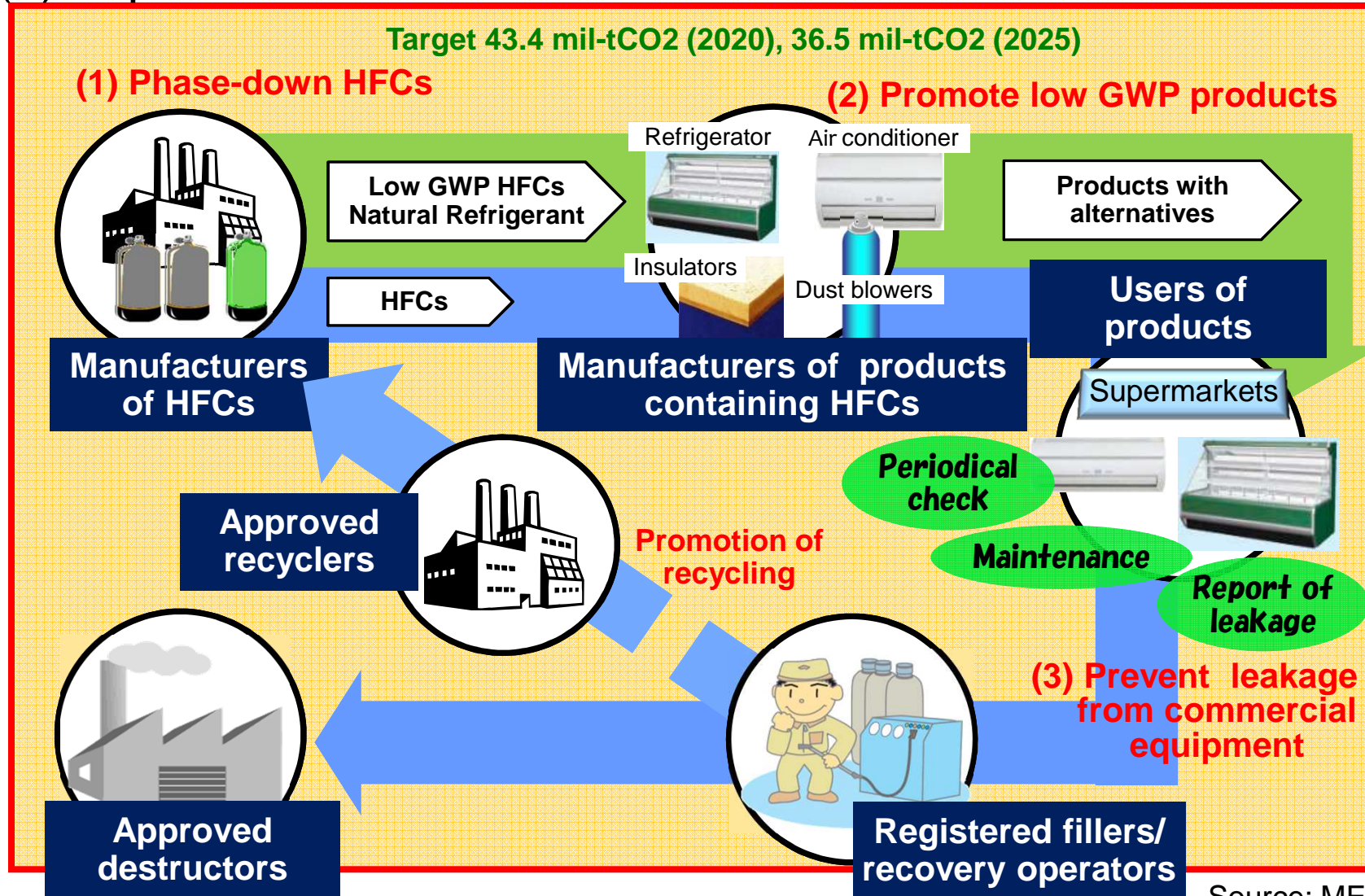
The new law “Act on Rational Use & Proper Management of Fluorocarbons” covers **total lifecycle**.

Refrigerants are managed in the whole of lifecycle, i.e. containment (leakage prevention), recovery, recycle.

# 1. Latest situation of regulations for lower GWP alternatives

## (5) Japan

## in the world



Source: METI

## 2. Global discussion: Montreal Protocol

Four proposed amendments to the Montreal Protocol submitted by EU, North America, India, and Micronesia.

KEY ELEMENTS	INDIA PROPOSAL	NORTH AMERICAN PROPOSAL	MICRONESIA PROPOSAL (2014)	EU DISCUSSION PAPER (2014)
<b>Listing of HFCs</b>	19 HFCs divided into four groups	19 HFC substances	21 HFC substances, including some HFOs	HFCs generally
<b>Grace Period for Article 5 Parties</b>	15 years	Up to 10 years	To be determined by the Parties	Up to 15 years
<b>Non-Article 5 Parties Baseline</b>	GWP weighted average of 2013-15 HFCs plus 25% of the Annex C Group I (HCFCs) baseline for Non-Article 5 Parties	100% average HFC and 75% HCFC consumption and production for 2011-13	2014-2016 average HFC and HCFC production and consumption	2009-2012 HFC production and consumption + 15% 19 HCFC baseline
<b>Non-Article 5 Parties Control Measures for Consumption and Production of HFCs</b>	2016 – 100% 2018 – 90% 2023 – 65% 2029 – 30% 2035 – 15%	2019 – 90% 2024 – 65% 2030 – 30% 2036 – 15%	2017 – 85% 2020 – 70% 2023 – 55% 2026 – 45% 2029 – 30% 2032 – 15% 2035 – 10%	2017 – 85% 2018 – 65% 2021 – 45% 2024 – 30% 2027 – 25% 2030 – 15%
<b>Article 5 Parties Baseline</b>	GWP weighted average of 2028-30 HFCs + 32.5% of Annex C Group I (HCFCs) baseline for Article 5 Parties	100% average HFC and 50% HCFC consumption and production for 2011-13	To be determined by the Parties	<i>Consumption:</i> 100% average HFC and HCFC in 2015-2016 <i>Production:</i> 100% HFC production 2009-2012 + 70% of HCFC in 2009-2010
<b>Article 5 Parties Control Measures for Consumption and Production of HFCs</b>	<ul style="list-style-type: none"> <li>• 2031 – 100%</li> <li>• 2050 – 15%</li> <li>• Phase down steps are to be decided 5 years in advance for the next 5-year period</li> </ul>	<ul style="list-style-type: none"> <li>• 2021 – 100%</li> <li>• 2026 – 70%</li> <li>• 2032 – 40%</li> <li>• 2046 – 15%</li> </ul>	To be determined by the Parties	<ul style="list-style-type: none"> <li>• 2019 freeze in consumption and production of HCFC/HFC combined</li> <li>• 2045 – 85% reduction in production</li> </ul>

Source: UNEP

## 2. Global discussion: Montreal Protocol

### (1) Listing of HFCs, Grace period for Article 5 Parties

KEY ELEMENTS	INDIA PROPOSAL	NORTH AMERICAN PROPOSAL	MICRONESIA PROPOSAL (2014)	EU DISCUSSION PAPER (2014)
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Source: UNEP

The significant difference can be found among these proposals regarding the listing of HFCs, the grace period for Article 5 Parties, the phase-down timelines and their base lines.

The possibility of harmonisation of proposals were discussed during OEWG held in Paris in July 2015. However, the further discussion would be needed.

The discussion on funding and technical issues will be also required to reach the global agreement.

## 2. Global discussion: Montreal Protocol

### (2) Baselines and Phase-down timelines for non-Article 5 Parties

KEY ELEMENTS	INDIA PROPOSAL	NORTH AMERICAN PROPOSAL	MICRONESIA PROPOSAL (2014)	EU DISCUSSION PAPER (2014)
<b>Non-Article 5 Parties Baseline</b>	GWP weighted average of 2013-15 HFCs plus 25% of the Annex C Group I (HCFCs) baseline for Non-Article 5 Parties	100% average HFC and 75% HCFC consumption and production for 2011-13	2014-2016 average HFC and HCFC production and consumption	2009-2012 HFC production and consumption + 15% 1989 HCFC baseline
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Source: UNEP

## 2. Global discussion: Montreal Protocol

### (3) Baselines and Phase-down timelines for Article 5 Parties

KEY ELEMENTS	INDIA PROPOSAL	NORTH AMERICAN PROPOSAL	MICRONESIA PROPOSAL (2014)	EU DISCUSSION PAPER (2014)
<b>Article 5 Parties Baseline</b>	GWP weighted average of 2028-30 HFCs + 32.5% of Annex C Group I (HCFCs) baseline for Article 5 Parties	100% average HFC and 50% HCFC consumption and production for 2011-13	To be determined by the Parties	<i>Consumption:</i> 100% average HFC and HCFC in 2015-2016 <i>Production:</i> 100% HFC production in 2009-2012 + 70% of HCFC in 2009-2010
<b>Article 5 Parties Control Measures for Consumption and Production of HFCs</b>	2031 – 100% 2050 – 15% Phase down steps • are to be decided • 5 years in advance for the next 5-year period	2021 – 100% 2026 – 70% 2032 – 40% 2046 – 15%	To be determined by the Parties	2019 freeze in consumption and production of HCFC/HFC combined 2045 – 85% reduction in production

Source: UNEP

# 3. For Environmental Conservation

## JRAIA's Vision and Activities

■ 3 main pillars.

### EQUIPMENT

#### Energy Saving

Emission control on CO2 basis

Top Runner Program  
(Law Concerning the Rational Use of Energy)

■ Linked laws related to each factors.

### REFRIGERANTS

#### Direct Emission Control

- Promotion of recovery
- Measures against leakage (proper management of refrigerants)
- Reduction of amount charged into equipment

Fluorocarbons Recovery and Destruction Law  
⇒ **“Act on Rational Use & Proper Management of Fluorocarbons”** to address issues throughout the **lifecycle of fluorocarbons** (entry into force from April 2015)

Home Appliances Recycling Law

End-of-Life Vehicle Recycling Law

### ALTERNATE REFRIGERANTS

#### Acceleration to shift to new refrigerants

- Research of low GWP refrigerants
- Risk assessment

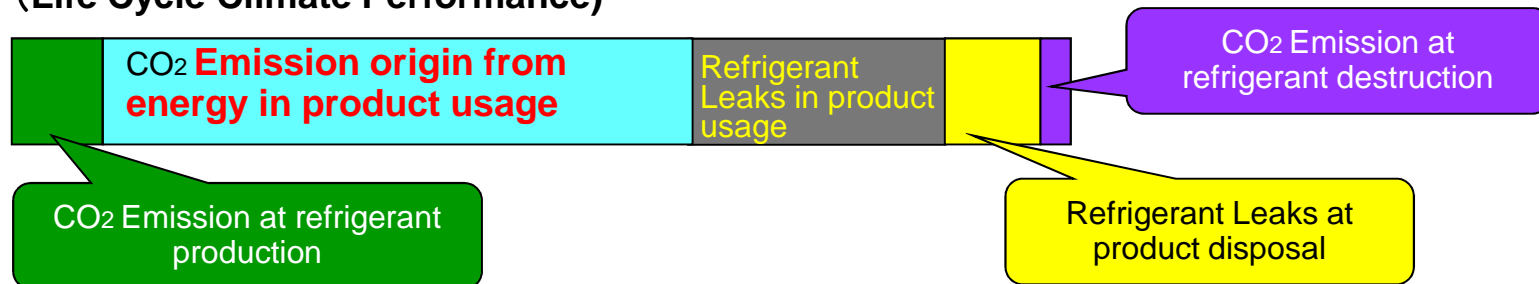
# 4. Alternative refrigerants

(1) Conditions to be considered for the next generation refrigerants

• Actions to switch refrigerants have been started sector by sector in Japan by considering not only GWP but also safety, economic feasibility and efficiency.

<b>Safety (precondition)</b>	<ul style="list-style-type: none"><li>• Low Toxicity</li><li>• Low Risk of Flammability</li></ul>
<b>Environment Performance</b>	<ul style="list-style-type: none"><li>• Ozone Depletion Potential =0</li><li>• Low Global Warming Potential</li></ul>
<b>Energy Efficiency</b>	<ul style="list-style-type: none"><li>• Superior for LCCP value</li><li>• Equivalent or Lower Energy Use at High Load Conditions</li></ul>
<b>Economic Feasibility</b>	<ul style="list-style-type: none"><li>• Reasonable Cost</li><li>• Acceptable level in Developing Countries</li></ul>

LCCP (Life Cycle Climate Performance)

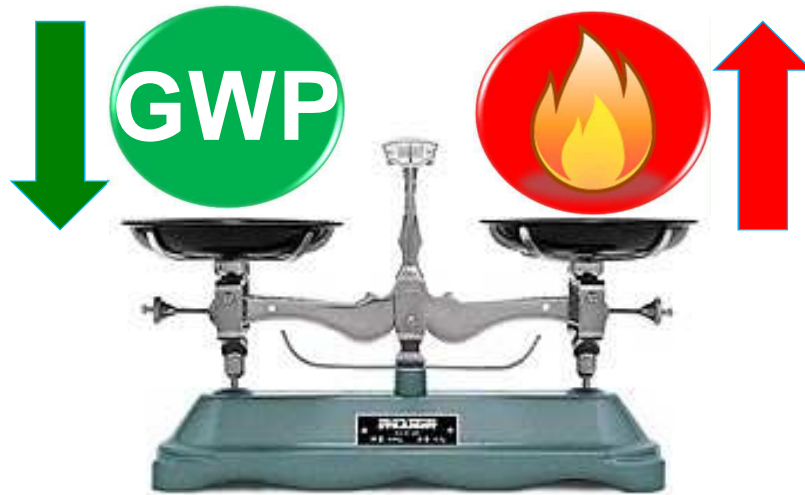




## 4. Alternative refrigerants

(1) Conditions to be considered for the next generation refrigerants

GWP and flammability



- Safety is non-negotiable.
- **Standards and codes need adaptation** to allow for increased use of flammables.
- Workforce needs skills.

Source: EPEE

**Refrigerant should be selected appropriately depending on the application by considering not only safety but also impact on the global environment, economic feasibility and efficiency.**

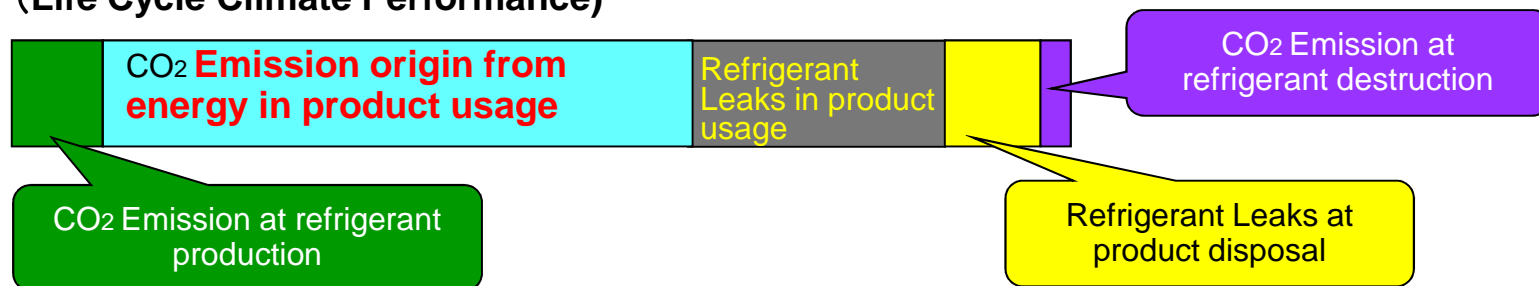
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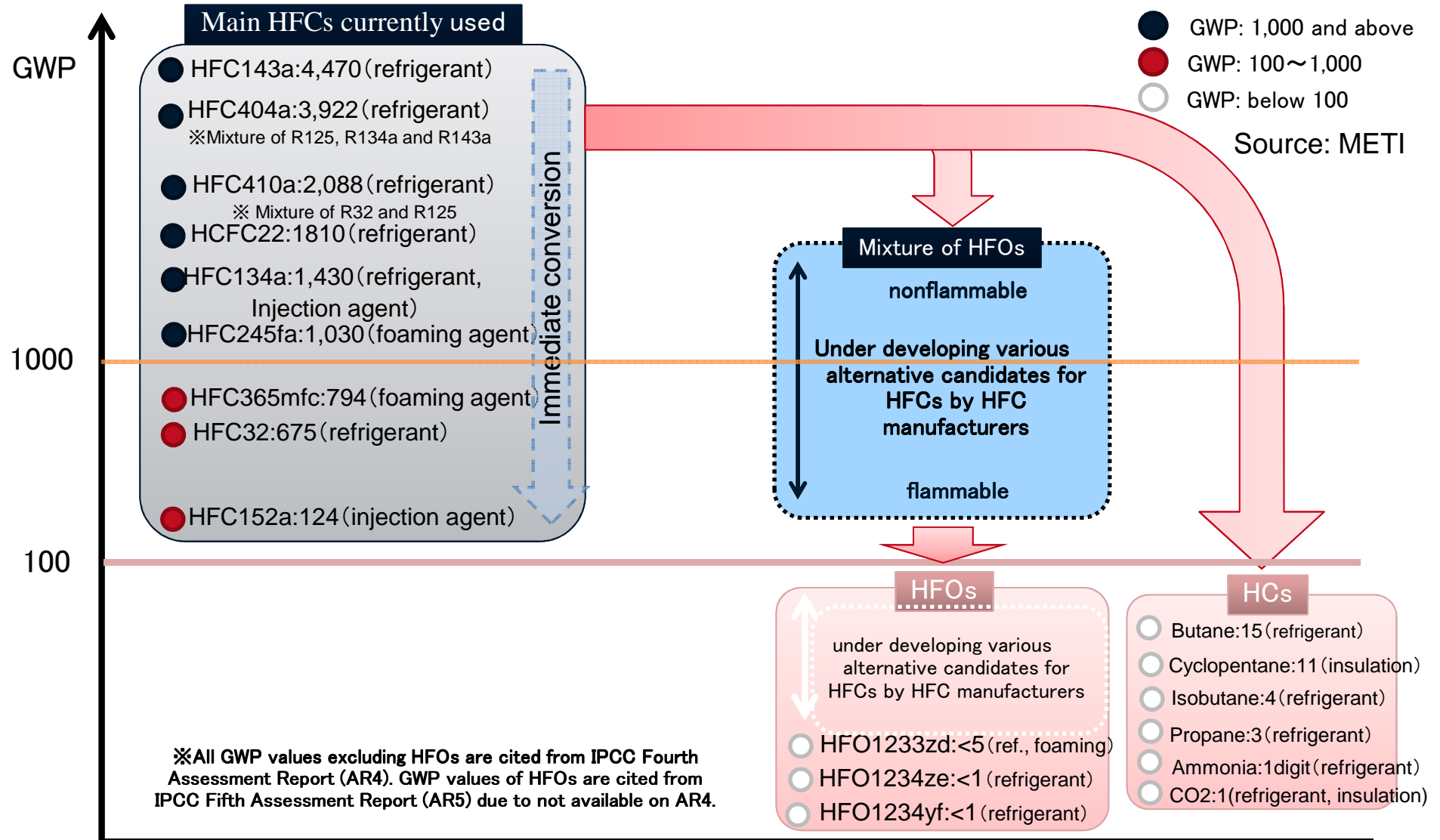
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LCCP (Life Cycle Climate Performance)



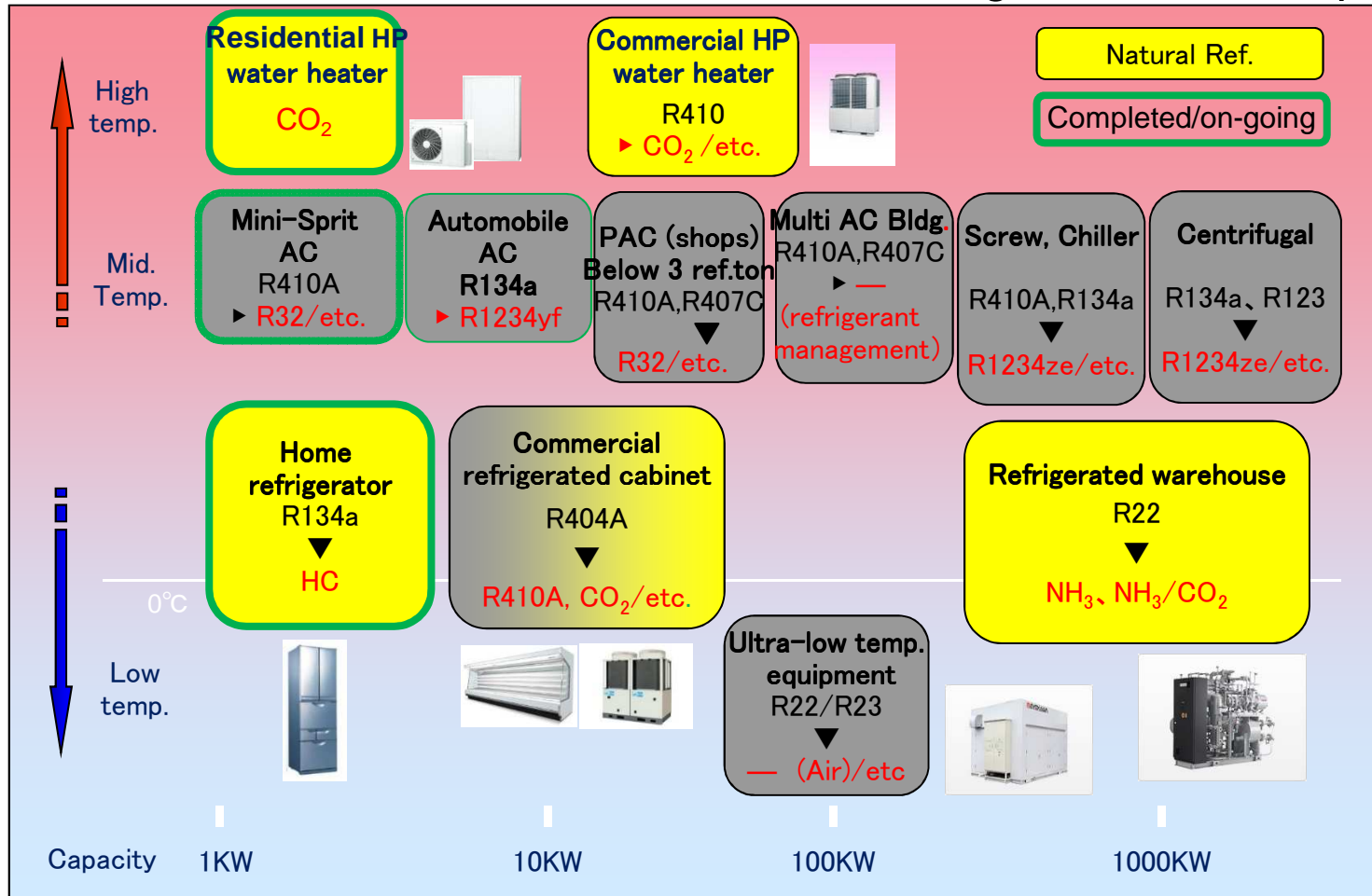
# 4. Alternative refrigerants

## (2) Future vision: Refrigerants for next generation and GWP



# 4. Alternative refrigerants

## (3) Current situation and candidates for the next generation in Japan

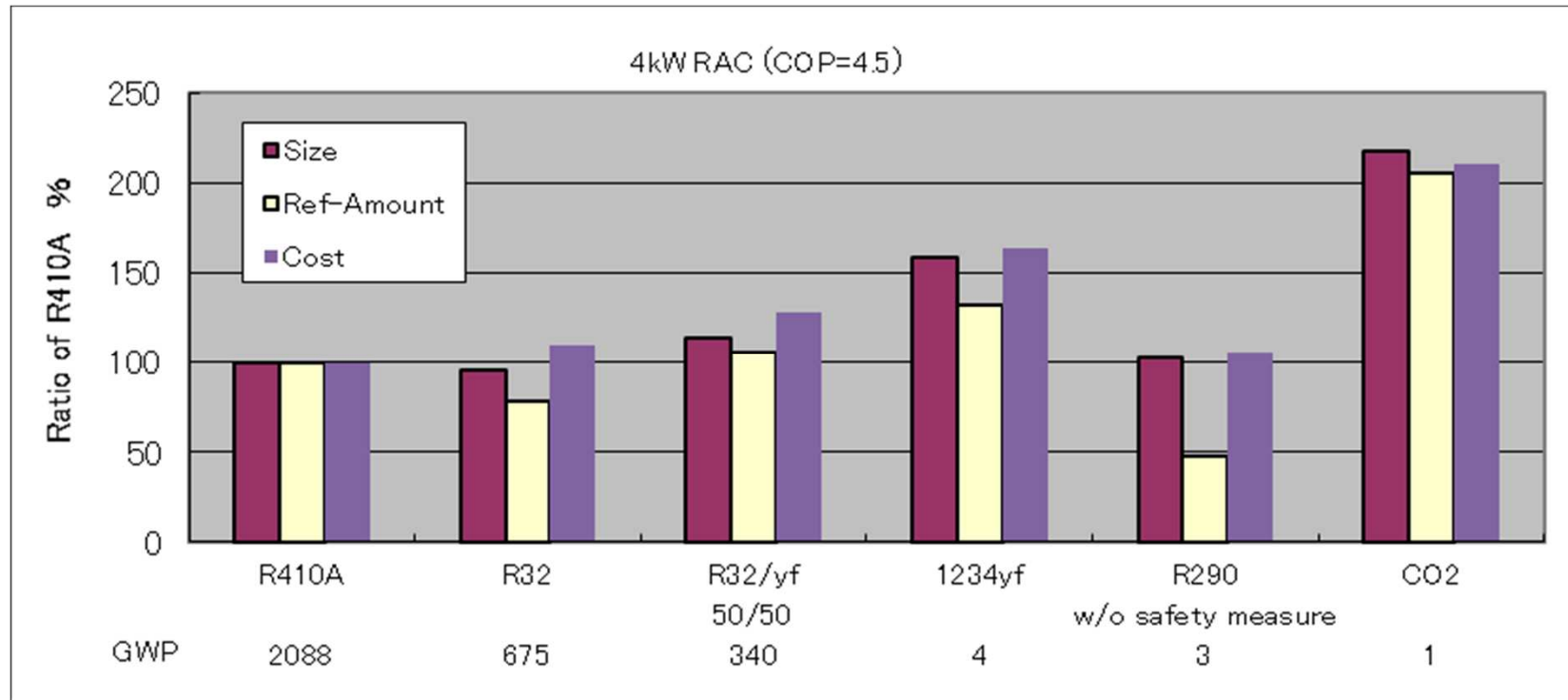


Natural refrigerants are also applied in some sectors.

Appropriate refrigerants are selected by considering the application of products in Japan.

## 4. Alternative refrigerants

### (4) Mini-split AC case in Japan



Unit size, refrigerant amount, and cost were evaluated by JRAIA member manufacturers by their simulation under the conditions, that the unit can perform (1) capacity: 4kW and (2) efficiency: COP = 4.5. The results were averaged over the data obtained from the members (R410 = 100%).

## 4. Alternative refrigerants

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### (4) Mini-split AC case in Japan

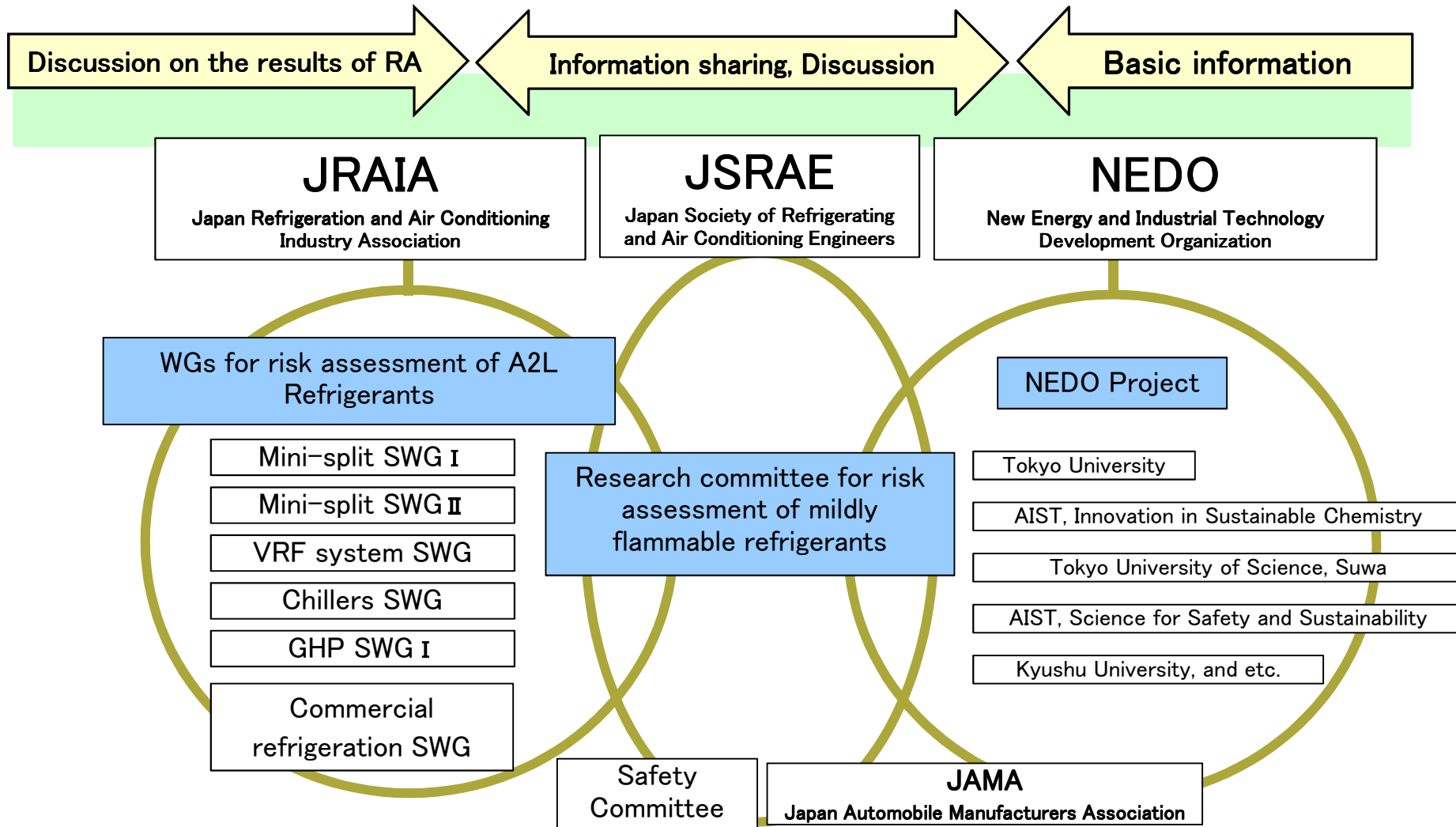
Not R290 but R32 was selected from safety point of view for mini-split ACs below 3 refrigeration tons, and has been widely spread out in Japanese market after the completion of thorough risk assessment for mild flammable refrigerants (A2L) such as R32, R1234yf, R1234ze(E), et.al.

Risk assessment of A2L refrigerants are also being carried out for large capacity ACs. Standardisation and legislation to secure safety will be completed before their placement into market.

# 4. Alternative refrigerants

## (5) Framework for risk assessment of mildly flammable refrigerants

Cooperative structure among Industry, JSRAE and NEDO



## 5. Conclusions

HVAC&R industry has been proceeding with the development of products with lower GWP refrigerants for next generation to mitigate the impact of HFCs on global warming.

- **Though we have not reached the final solutions, we will keep on our activity to obtain ideal refrigerants.**
- **Every candidate of next generation refrigerants has advantage and disadvantage. Most of promisingly applicable candidates are mildly flammable at this moment.**
- **Refrigerant should be selected appropriately depending on the application by considering comprehensive point of views: safety, global impact on the global environment, economic feasibility and efficiency.**



Thank you for your kind attention.