Refrigerant conversion activities including energy efficiency in Japan

The Japan Refrigeration and Air Conditioning Industry Association
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July. 3. 2019

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Contents :

1. Market Trend

1) Market Volume in each product sector in Japan

Product Category	Number of Units in 2018FY (x 1,000)	Y/Y Ratio (%)
Residential A/Cs	9,814.6	108.4
Commercial A/Cs	879.7	106.4
Residential H/P water heaters	480.6	107.6
Gas engine-driven A/Cs	28.7	100.0
Water chilling units	14.5	105.1
Air to air heat exchangers	111.2	100.0
Commercial ref. cabinets	283.6	93.9
Condensing units	87.2	93.3
Refrigeration units	28.7	99.5

1. Market Trend

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Record high!!

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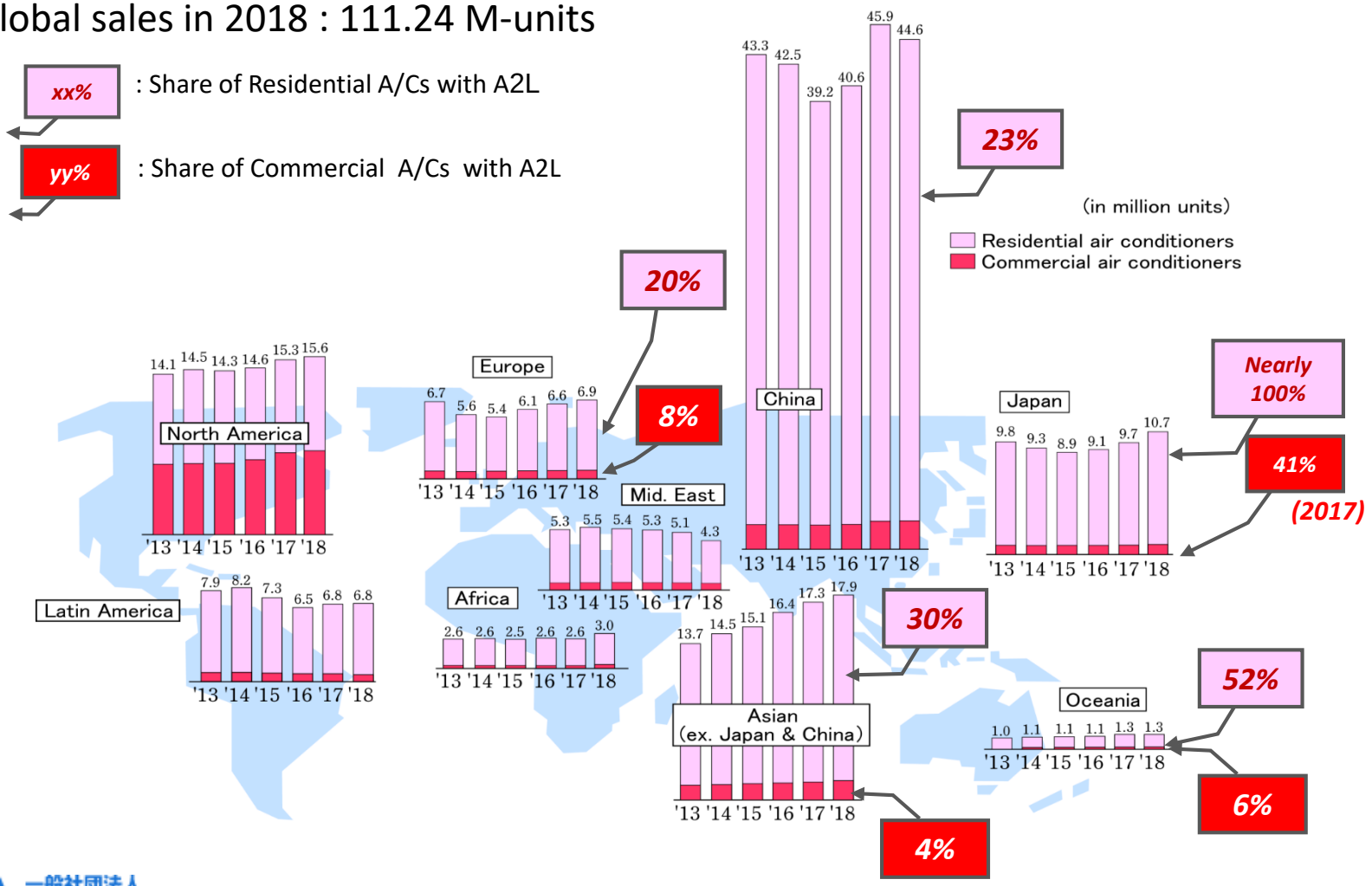
1. Market Trend

2) World market trend of Residential & Commercial A/Cs

Global sales in 2018 : 111.24 M-units



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1. Market Trend

3) Refrigerant transition status

Product Category	Number of Units in 2018FY (x 1,000)	Y/Y Ratio (%)	Refrigerant
Residential A/Cs	9,814.6	108.4	R410A ⇒ R32 (almost 100%)
Commercial A/Cs	879.7	106.4	R410A ⇒ R32 (only Small-size; 41%)
Residential H/P water heaters	480.6	107.6	CO_2, (R32) (almost 100%)
Gas engine-driven A/Cs	28.7	100.0	R410A
Water chilling units	14.5	105.1	R410A, R134A
Air to air heat exchangers	111.2	100.0	NA
Commercial ref. cabinets	283.6	93.9	R404A ⇒ R410A, CO_2
Condensing units	87.2	93.3	R404A⇒R410A, CO_2
Refrigeration units	28.7	99.5	R404A ⇒ NH_3, (+CO_2) R410A

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1. Market Trend

3) Refrigerant transition status

Product Category	Number of Units in 2018FY (x 1,000)	Y/Y Ratio (%)	Refrigerant
Residential A/Cs	9,81		R410A ⇒ R32 (almost 100%)
Commercial A/Cs			R410A ⇒ R32 (only Small-size; 41%)
Residential H/P water	0.6	107.6	CO_2, (R32) (almost 100%)
Gas engine-driven A/C	8.7		R410A
Water chilling units			R410A, R134A
Air to air heat exchangers	111.2	100.0	NA
Commercial ref. cabinets		3.9	R404A ⇒ R410A, CO_2
Condensing units		3.3	R404A⇒R410A, CO_2
Refrigeration units	28.7	99.5	R404A ⇒ NH_3, (+CO_2) R410A

VRF:
No Alternative yet

Turbo Chiller:
- R245fa⇒R1233zd
- R134a ⇒R1234ze(E)

Air cooling Type:
- R32

- R404A⇒R410A ⇒ R448A, 449A
- CO2(Cascade)

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2. Issues in Refrigerant Conversion

Key Concept for Refrigerants Conversion

S+3Es

S: *Safety*	• Low Toxicity • Low Flammability
E: *Environment Performance*	• Zero Ozone Depletion Potential (ODP) • Low Global Warming Potential (GWP)
E: *Energy Efficiency*	• High Seasonal Efficiency • Similar performance at high load cooling
E: *Economic Feasibility*	• Low Capital Cost • Low Operating Cost

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3. Regulations and Legislations in Japan

1) Overview of Legislation in Japan

Legislation on refrigerants

"Ozone Layer Protection Act" (1988) revised in 2018

- Regulation on **production and consumption of CFC and HCFC** (abbr. OLP Act)
- Maximum allowance of refrigerant consumption similar to Kigali amendment

"Act on Rational Use and Proper Management of Fluorocarbons" (revised in 2015, 2019)

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

"High Pressure Gas Safety Act" (revised in 2016)

- 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

"Global Warming Countermeasure Plan" (Cabinet Decision in 2016)

- 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 in 32 product categories

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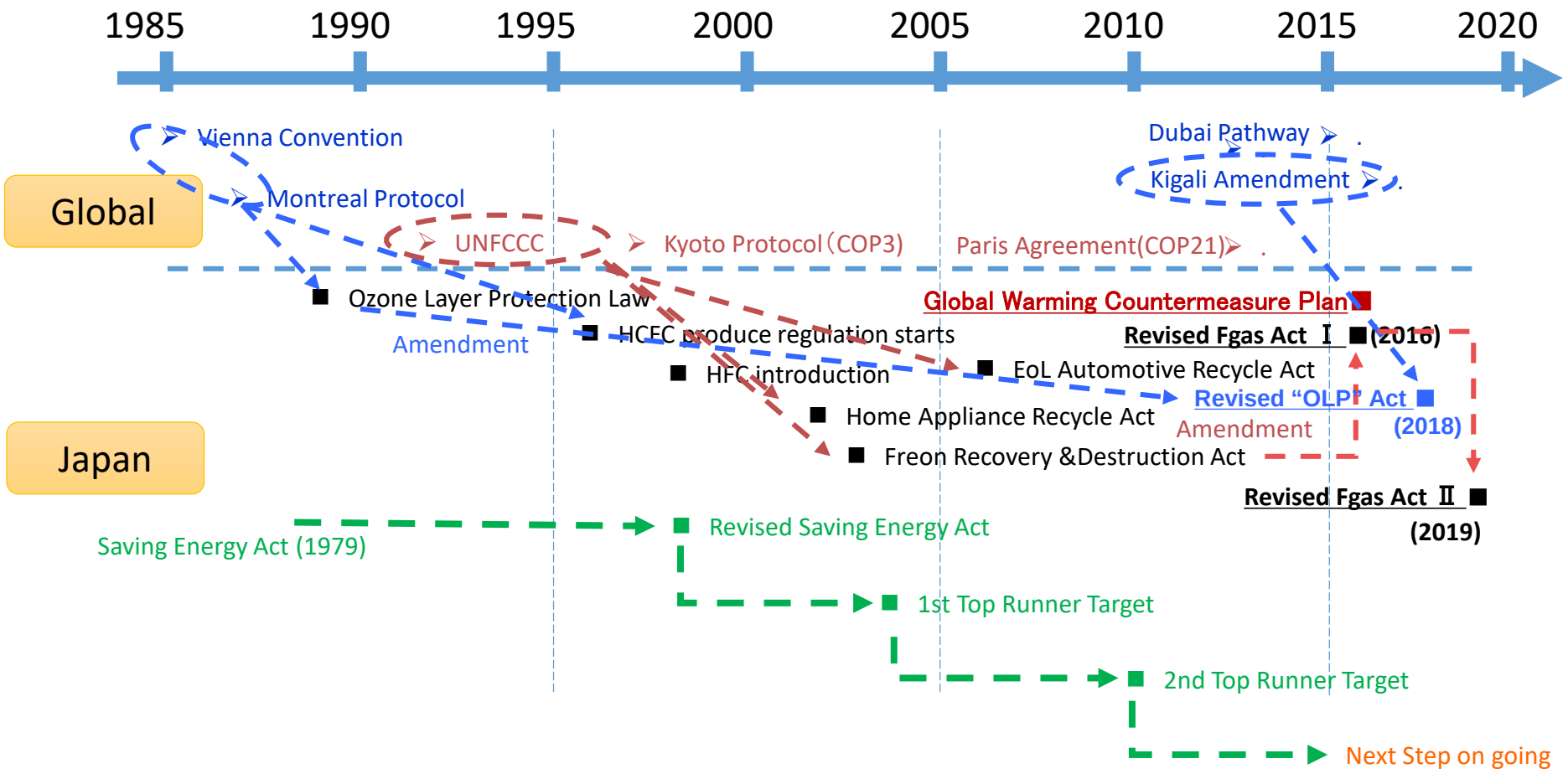
3. Regulations and Legislations in Japan

2) Timeline



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3. Regulations and Legislations in Japan

3) Regulation of refrigerant by "designated products"

Regulated by “Act on Rational Use and Proper Management of Fluorocarbons”

Designated Products	Target GWP (Weighted Average GWP)	Target year
Room A/C (Mini-Split)	750	2018
Commercial A/C (Split)	750	2020
Mobile A/C	150	2023
Condensing unit and refrigerating unit	1500	2025
Cold storage warehouses	100	2019
Urethane foam	100	2020
Dust blowers	10	2019

RACHP sectors

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3. Regulations and Legislations in Japan

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Designated Products	Target GWP (Weighted Average GWP)	Target year
Room A/C		
Commercial A/C (Split)	750	2020
Mobile A/C	150	2023
Condensing unit and refrigerating unit	1500	2025
Cold storage warehouses	100	2019
Urethane foam	100	
Dust blowers	10	

Commercial A/C **Large size**(only single type)>> **GWP:750, 2023**

Centrifugal (Turbo) Refrigerators>> **GWP:100, 2025**

RACHP sectors

Next Target :
- VRF
- Commercial Refrigerators
- Refrigerants for Service

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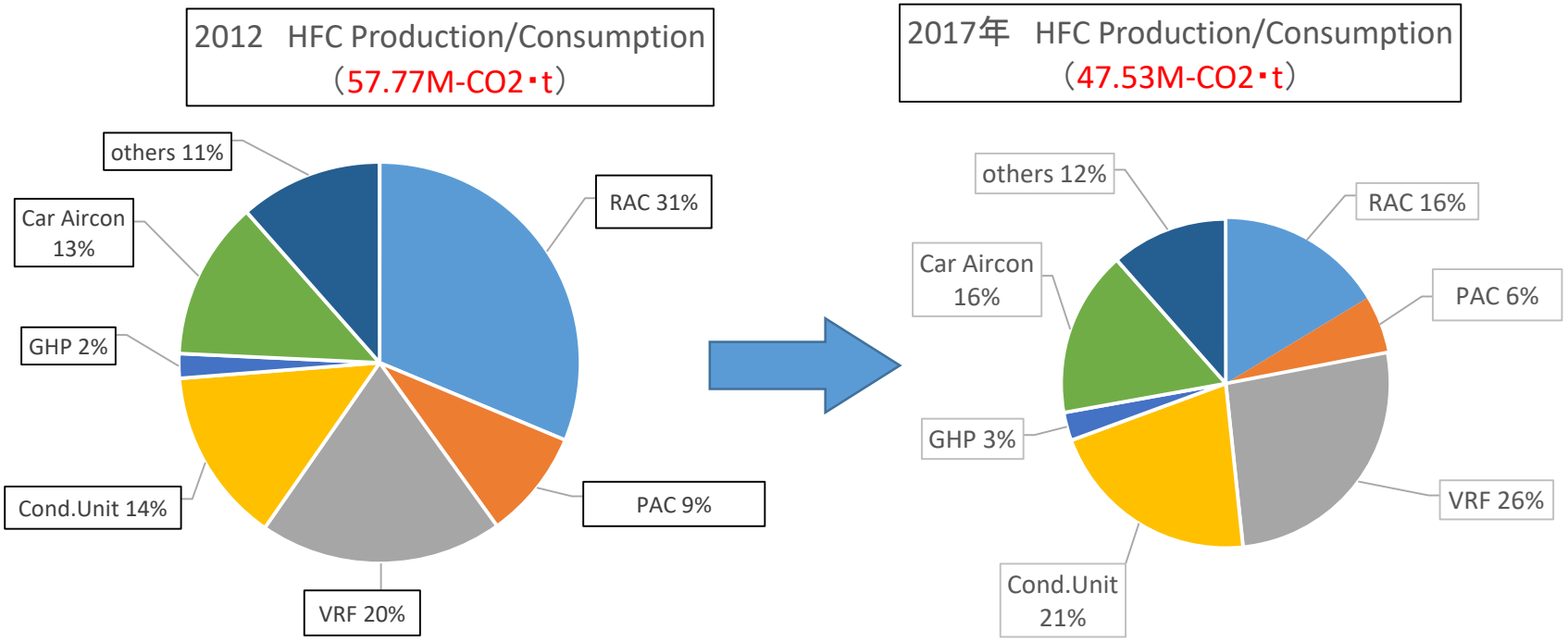
4. HFC Reduction in Japan



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5. Risk Assessment of A3 Refrigerant

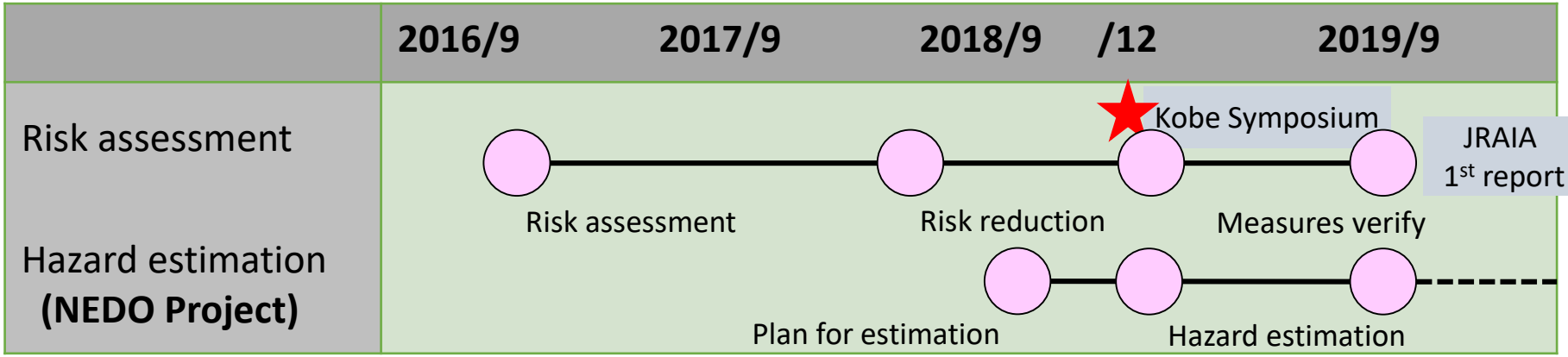
1) Direction and Schedule

■ Direction

- In the trend of deregulation of A3 refrigerants, JRAIA will propose air-conditioner be secured.
- Based on RAC's risk assessment method and results for A2L refrigerant , JRAIA also conducts risk assessment for A3 refrigerant and recommended measures to ensure safety from the evaluated result.

■ Schedule

- First year ; A3 refrigerant risk assessment
- Second year ; Estimation method and make plan for risk reduction
- Last year ; Making practical measures and verifying by risk assessment



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5. Risk Assessment of A3 refrigerant

2) RA step for A3 refrigerant

Establishment for safety specification of A3 refrigerant

Step	Terms
1: Evaluated product	•Setting of evaluated product and usage condition •Making the risk scenario •Manufacturing, Transportation, **Install**, Use, **repair, disposal**
2: Risk assessment	◎ Basic items of risk estimation • Installation case (leaky space model setting) • Refrigerant leak rate and leak speed • Ignition source existence probability ←Identification the ignition source • Flammable cloud ← CFD, simplified calculation
3: Measures	•Equipment measures: Air circulation and ventilation fan, shutoff valve, alarm • Document correspondence: Instruction manual, warning display • Regulatory compliance: regulations, industrial association manual
4: In market (Regulation）	•Regulatory compliance: regulations, industrial association manual •Document correspondence: Instruction manual, warning label •Maintenance of work procedures manual •Improvement of working accuracy in education and training

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6. Next-Generation Refrigerants

Development of Assessment Techniques for Next-Generation Refrigerant with Low GWP Values(NEDO's Support)

Project summary

Device : Mid-to-small size Refrigeration & Air-Conditioning

Refrigerants : "next-generation" low-GWP refrigerant
e.g) HC, HFO and HFO mixture

Objective :

- Establish the standard technique for the safety and risk assessment of low-GWP refrigerant and equipment
- Form the common basis for the development of equipment

Project term

2018 FY ～ 2022 FY
（5 years）

Budget

2018FY 250 M-Yen
(2 million USD)

R & D Contents

① **Data acquisition and evaluation for basic characteristic of next-generation refrigerants**

- **Evaluation test for basic characteristic of next-generation refrigerants**
- **Data acquisition and Assessment for test in practical environment**

② **Development of Safety & Risk Assessment methods for next-generation refrigerants**

- **Establish of Safety & Risk Assessment for flammability**

Disseminate information (Internationally)

Industry ⇔ opinion exchange ⇔ University Research Institute

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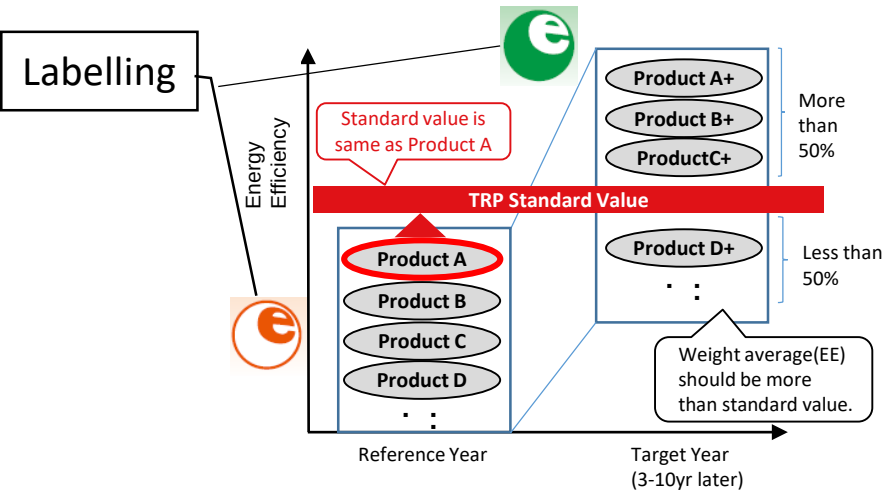
7. Energy Efficiency Improvement

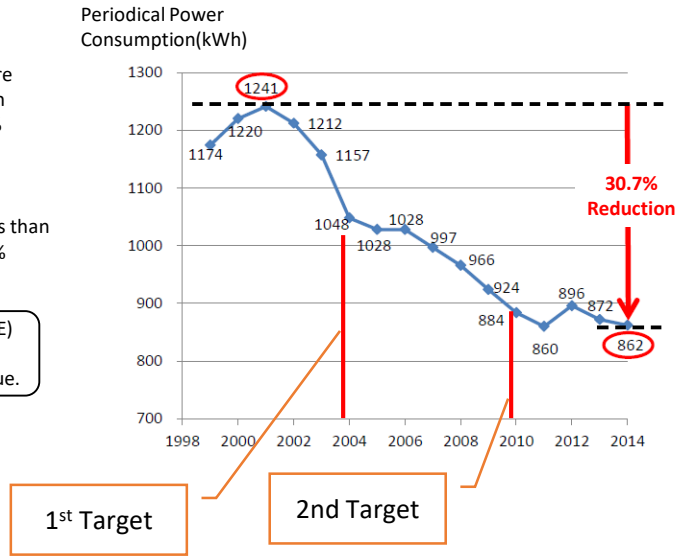
1) Top Runner Program and Results

Overview of Top Runner Program



32 items: 2017 Home appliances, Cars, Office appliances etc.

Trend of Periodical Power Consumption <Residential ACs>



In case of Domestic ACs, Target values were set twice.(2004, 2010)

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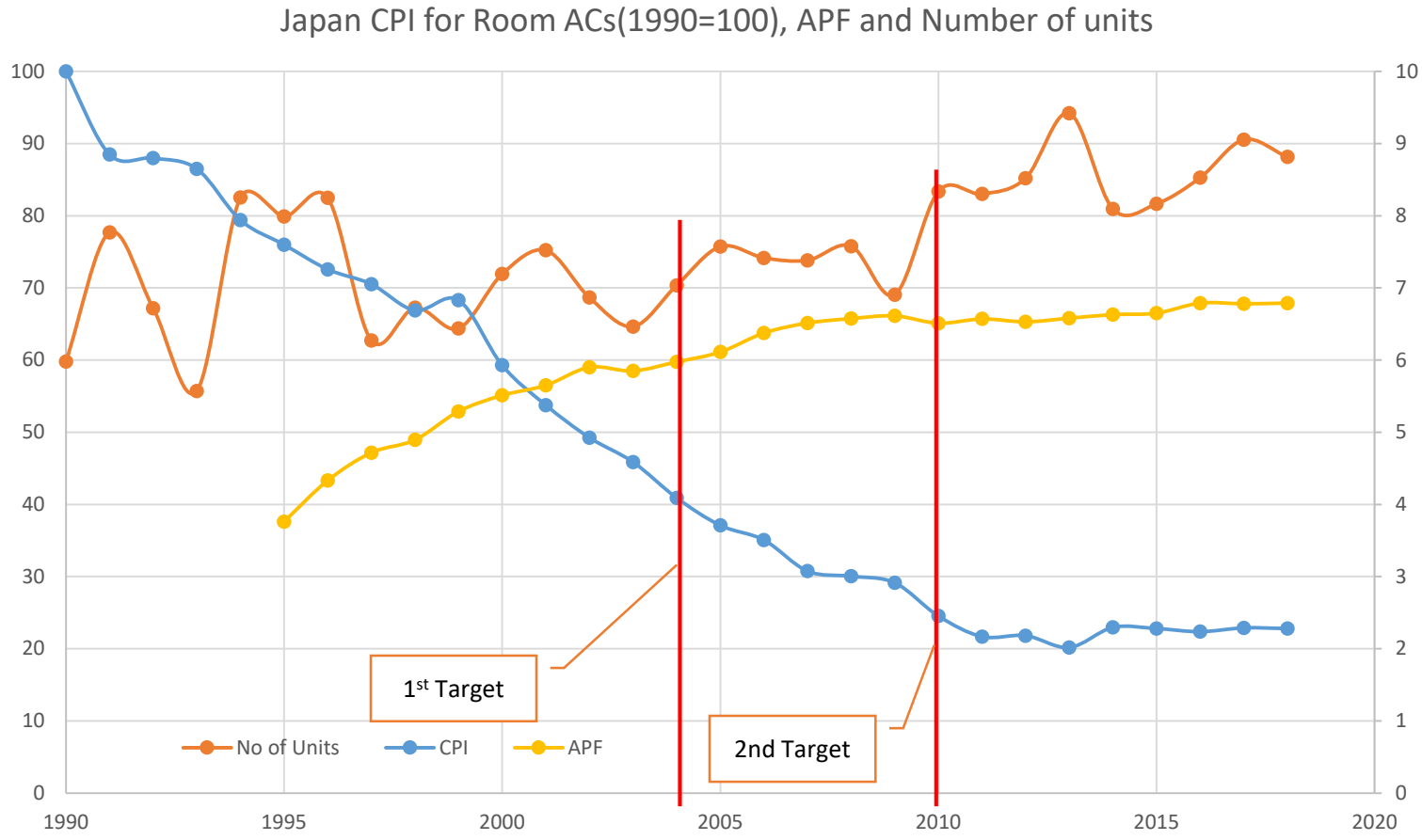
7. Energy Efficiency Improvement

2) Trend of Energy Efficiency and Price



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8. JRAIA's efforts to accelerate introduction of lower GWP refrigerants

1) Collaboration to UNEP/UNIDO: PRAHA-II Project

2016 : The HFC-32 study tour: provided participants with a background on designing and working with A2L refrigerants. Included plants visits, the risk assessment workshop, as well as attending the JRAIA International Symposium on "New Refrigerants and Environmental Technology".- Tokyo, Shizuoka, Shiga, Kobe

2017: International Roundtable Meeting on Risk Assessment Model for use of lo-GWP Refrigerants in High Ambient Temperature Countries – Kuwait

2018: Special Expert Meeting: Risk Assessment Model for the Use of Lower-GWP Refrigerants in High Ambient Temperature Countries – Cairo

2019: Workshop to support Praha-II members for the development of risk assessment model for air-conditioning applications of A2L refrigerants at high ambient temperature countries - Tokyo

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8. JRAIA's efforts to accelerate introduction of lower GWP refrigerants

2) ASEAN

2018: Workshop on risk assessment and safety measures for RACHP using flammable refrigerants (Workshop supported by NEDO) toward conversion to lower GWPs in ASEAN countries (Indonesia, Malaysia, Philippines, Thailand, Vietnam and Japan).
Ozone officers and members of Industry Association discussed regulations, policies, and urgent challenges for refrigerant conversion and alternative refrigerants in each country. - Kobe, Japan

2019: Workshop on HFC phasedown for RACHP to meet Kigali Amendment in each countries) (Indonesia, Malaysia, Philippines, Thailand, Vietnam and Japan) TBD - Bangkok, Thailand

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Summary

1. The global environment countermeasures (policy, product policy, etc.) in the refrigeration and air conditioning sector in Japan were clarified.

2. In considering future refrigerant conversion, it is necessary to consider the balance of various factors. In particular, verification of the safety of flammable refrigerants is very important.

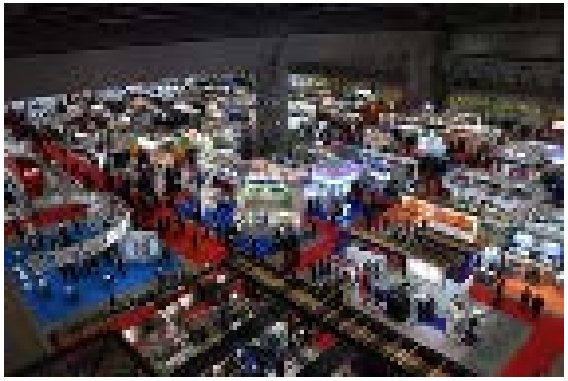
3. Optimization is required for many parameters, including energy efficiency. (In terms of policy and products)

4. Regarding HFC reduction, not only individual product discussions but also efforts across the refrigeration and air conditioning sectors are required

HVAC&R 2020

Date: 3-6 March, 2020
Place: Makuhari Messe, Chiba, Japan

For further detail: https://www.jraia.or.jp/hvacr/en/index.html



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Thank you for your kind attention!!

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