

Current status of Japan's legislation on F-gases and RACHP using Low-GWP Refrigerants

Hideaki Kasahara

JRAIA

13 July 2018



- 0. Who is JRAIA?**
- 1. Timeline of Regulations and Protocols**
- 2. Regulations relate to F-gases in Japan**
- 3. Actions to shift low-GWP refrigerants**
- 4. Low-GWP Alternatives and Products**

0. Who is JRAIA?

The Japan Refrigeration and Air conditioning Industry Association

- **Established in 1949.** (2019 is the 70th anniversary)
- **168 member companies including the associate members.**
(as of 1st of April 2018)
- **The business fields of the member companies are :**
 - Air conditioning (residential, commercial, automotive)
 - Refrigeration (commercial, industrial, transport)
 - Ventilation
 - Heat pump system (HP water heaters)
 - Refrigerants
 - Parts

0. Who is JRAIA?

1) Previous side-events at OEWG

➤ **OEWG39** in Bangkok, 12 July 2017

**“Latest findings of A2L risk assessment conducted in Japan
and current status of A3 risk assessment”**

<https://www.jraia.or.jp/english/side/unep2017.html>

➤ **OEWG38** in Vienna, 10 July 2016

**“Implementation of alternative refrigerant management in Japan ;
Latest activities including risk assessment for A2L refrigerants ”**

<https://www.jraia.or.jp/english/side/index.html>



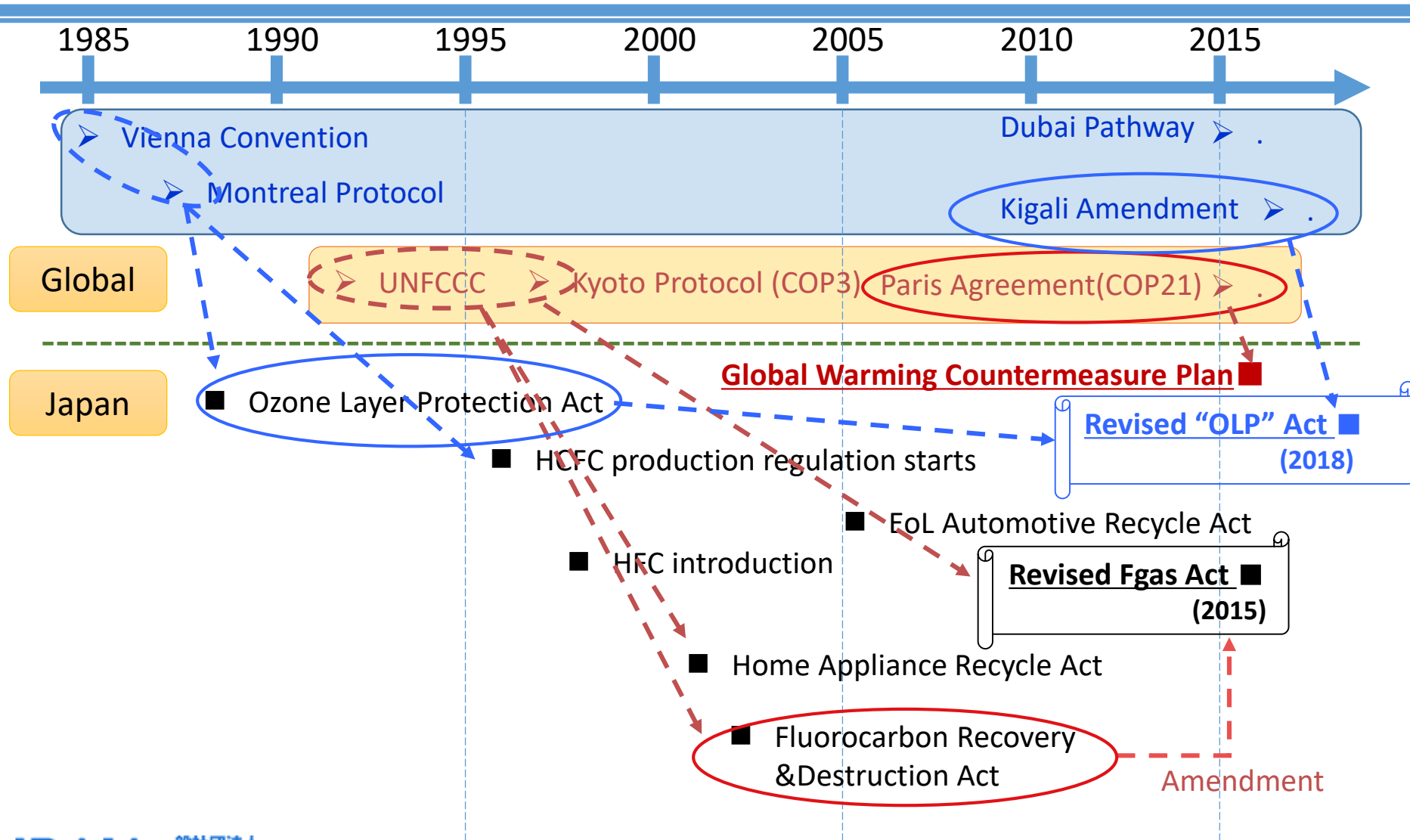
JRAIA side-event @OEWG39



JRAIA side-event @OEWG38

1. Timeline of Regulations and Protocols

1) Relation between Global and Japanese Acts



2. Regulations relate to F-gases in Japan

1) Overview

“Ozone Layer Protection Act” (revised in 2018)

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

“Act on Rational Use and Proper Management of Fluorocarbons” (revised in 2015)

- Regulation on emission of CFC/HCFC/HFCs (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”

“Global Warming Countermeasure Plan” (Cabinet Decision in 2016)

- Regulation on emission of energy origin CO₂

2. Regulations relate to F-gases in Japan

2) Regulation of refrigerant by “designated products”

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

**RACHP
sectors**

Designated Products	Target GWP (Weighted Average GWP)	Target year
Residential A/Cs (Mini-Split)	750	2018
Commercial A/Cs (Split / smaller than 6HP*)	750	2020
Mobile A/Cs	150	2023
Condensing unit & refrigerating unit	1500	2025
Cold storage warehouses	100	2019
Urethane foam	100	2020
Dust blowers	10	2019

* Capacity range of the category is defined as “smaller than 3 tons of refrigeration capacity per day” specified in “Refrigeration safety Regulation”. The value corresponds to approximately 6 HP models which has a rated cooling capacity of 15kW. The calculation formula of the tonnage can be found in the regulation.

2. Regulations relate to F-gases in Japan

2) Regulation of refrigerant by “designated products”

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

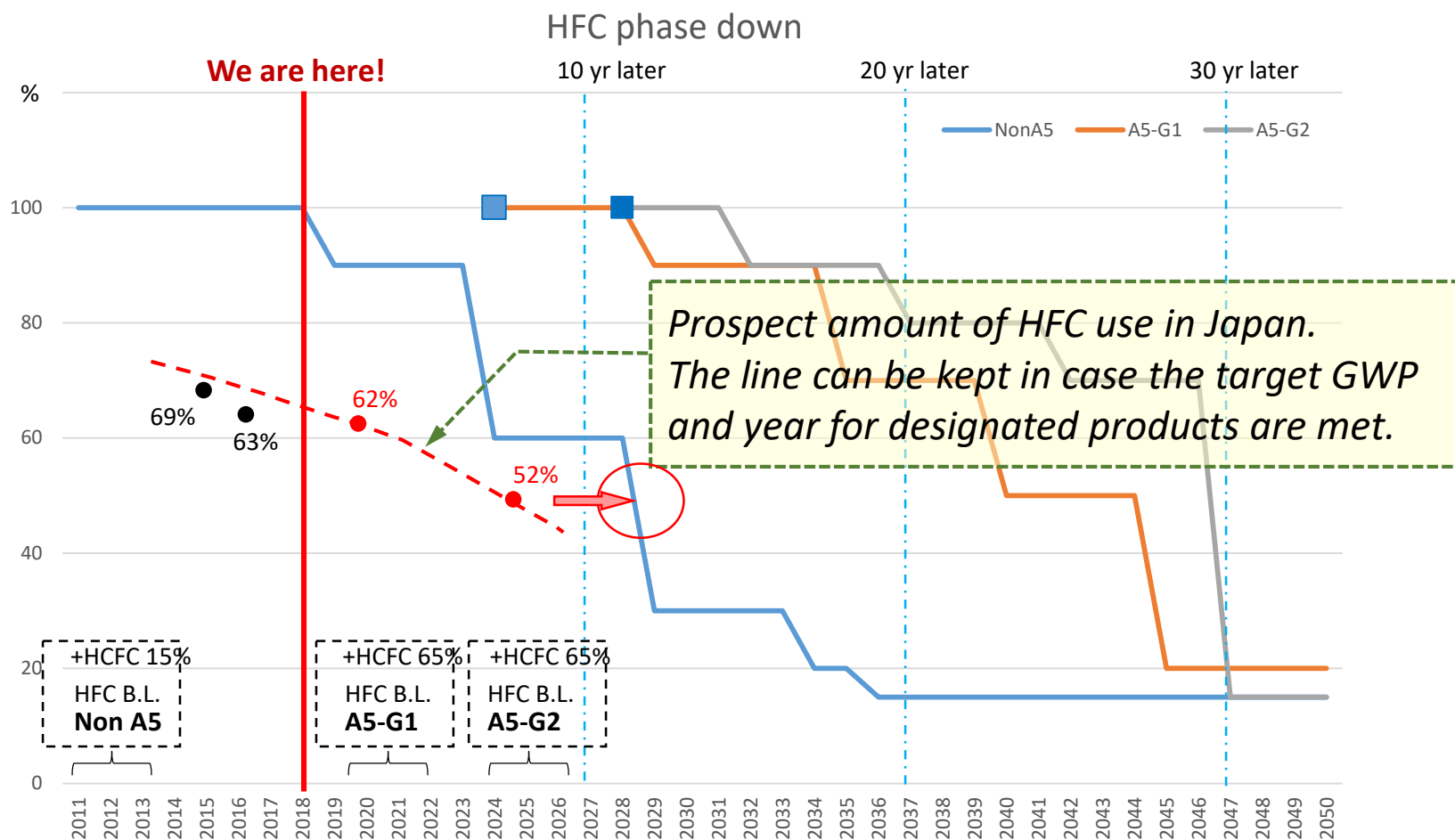
RACHP
sectors

Designated Products	Target GWP (Weighted Average GWP)	Target year
Residential A/Cs (Mini-Split)	750	2018
Commercial A/Cs (Split / smaller than 6HP*)	750	2020
Larger Commercial A/Cs (Split / exclude VRF)	750	2023
Centrifugal (Turbo) Chillers	100	2025
Mobile A/Cs	150	2023
Condensing unit & refrigerating unit	1500	2025
Cold storage warehouses	100	2019
Urethane foam	100	2020
Dust blowers	10	2019

Two product categories will be added in April 2019

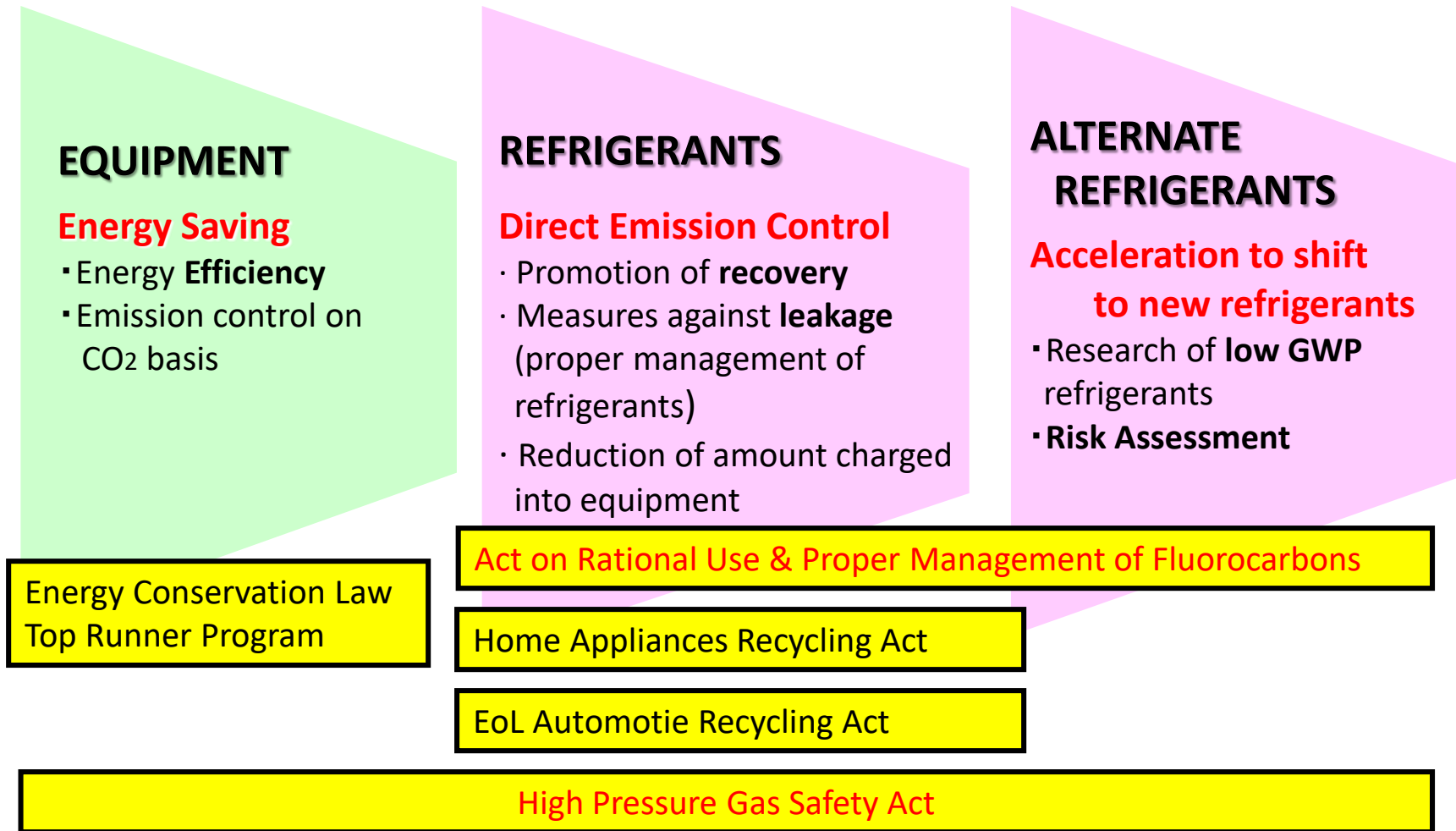
2. Regulations relate to F-gases in Japan

3) HFC phase down latest status in Japan under Kigali Amendment



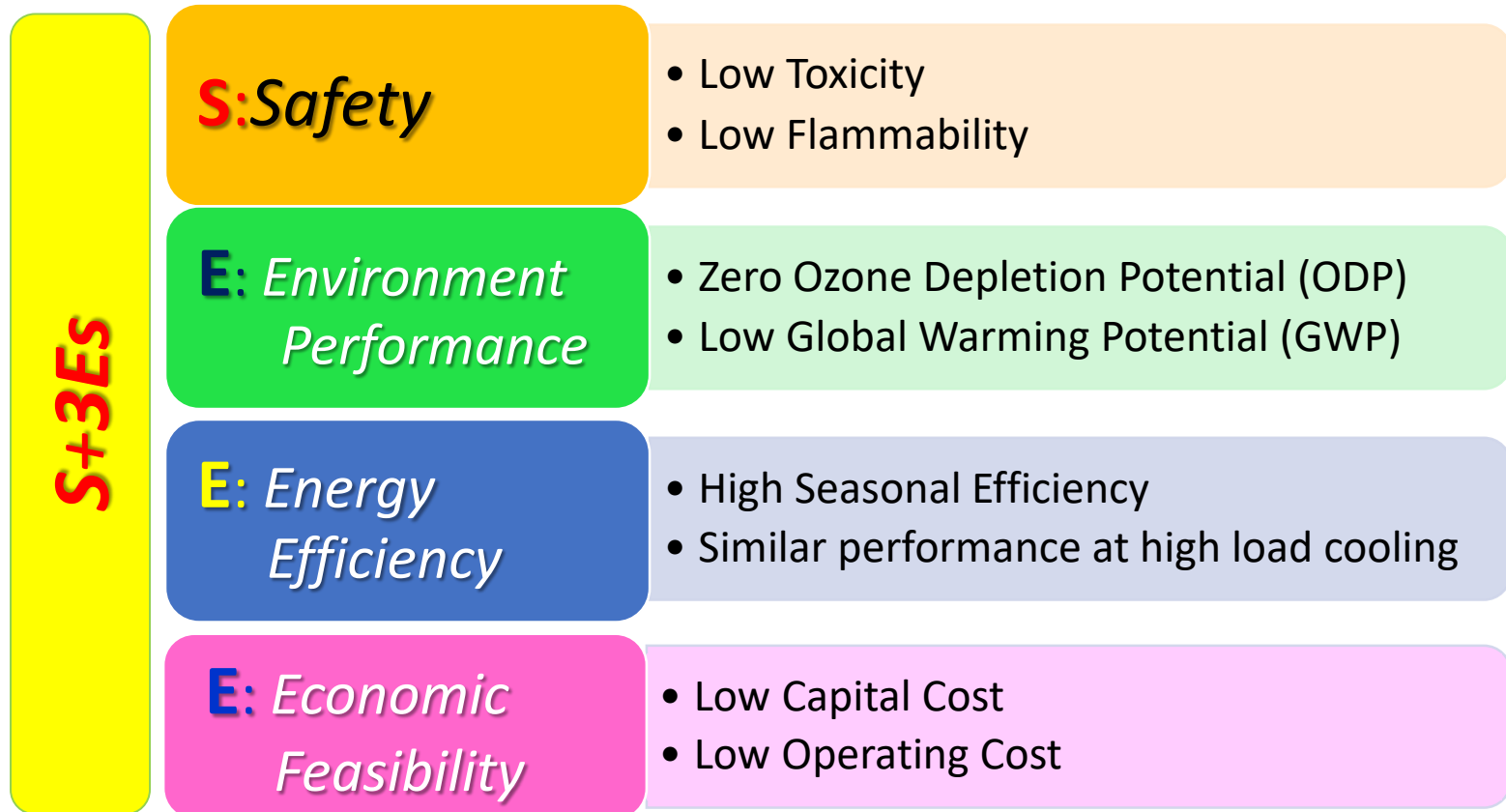
3. Actions to shift low-GWP refrigerants

1) JRAIA's Vision and Activities on Environmental Conservation



3. Actions to shift low-GWP refrigerants

2) Key Concept for Refrigerants Conversion



3. Actions to shift low-GWP refrigerants

3) 6 Steps to introduce products using alternative (flammable) refrigerant

Step1 : Selection of candidate refrigerants



- Efficiency, Reliability, Compatibility with lubricating oil, etc.

Step2 : Study on product safety



- Risk assessment by product, Development of new standards and guidelines, etc.

Step3 : Compliance with safety standards



- Ensuring safety to be complied with national and international standards.

Step4 : Consistency with safety regulations



- New standards and guidelines, Relaxation of Building Codes.

Step5 : Study on market acceptability



- Risk mitigation by safety devices (ventilator, gas sensor, shutoff valve, etc.)
- Education/promotion on additional safety measures to the market.

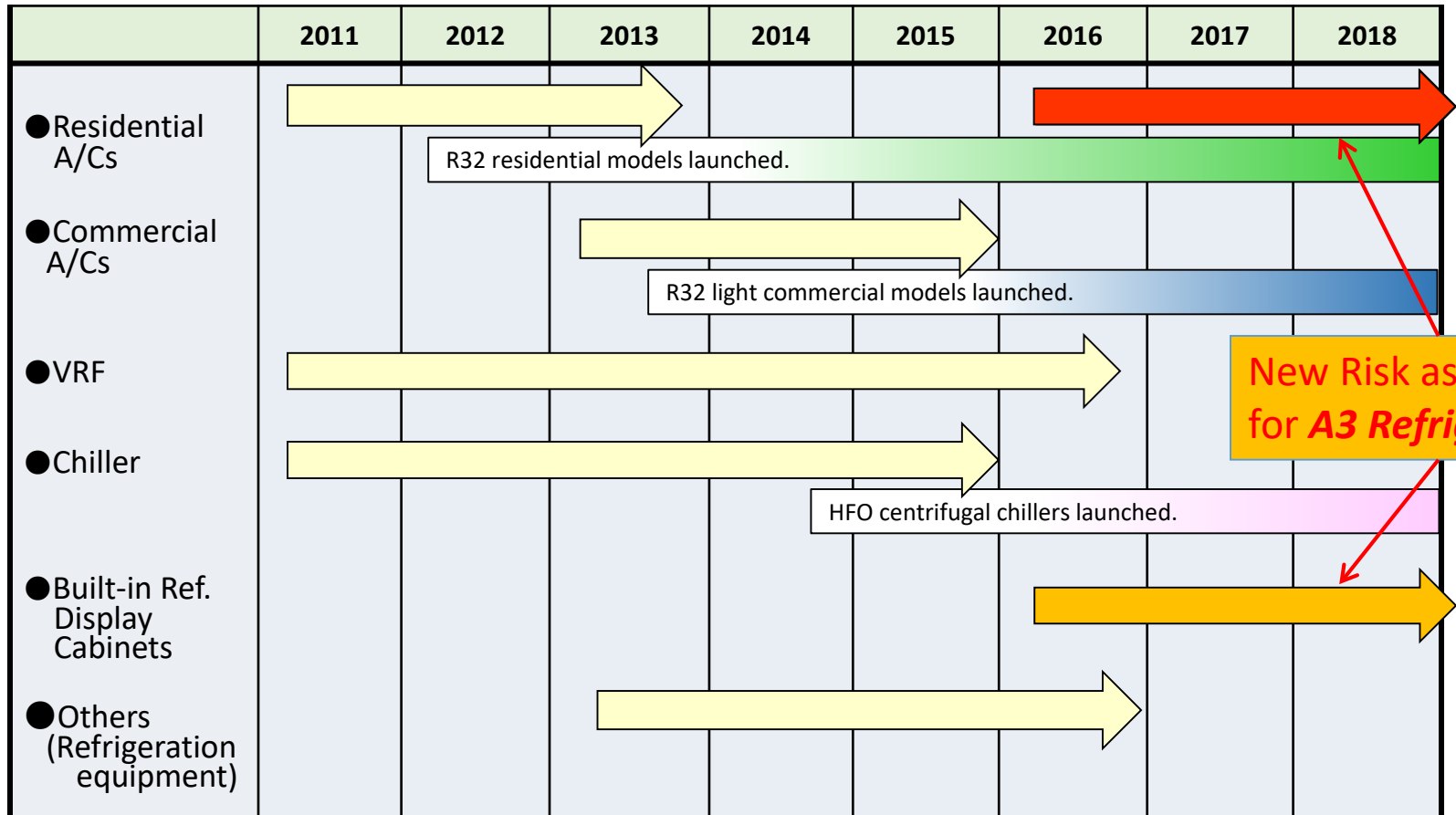
Step6 : Product launch

- Sales strategy against price hike, Subsidy, Service training, Spare parts supply, etc.

3. Actions to shift low-GWP refrigerants

4) Timeline of Step 2 : Risk assessment by product

A2L refrigerant risk assessment has difficulty and long period

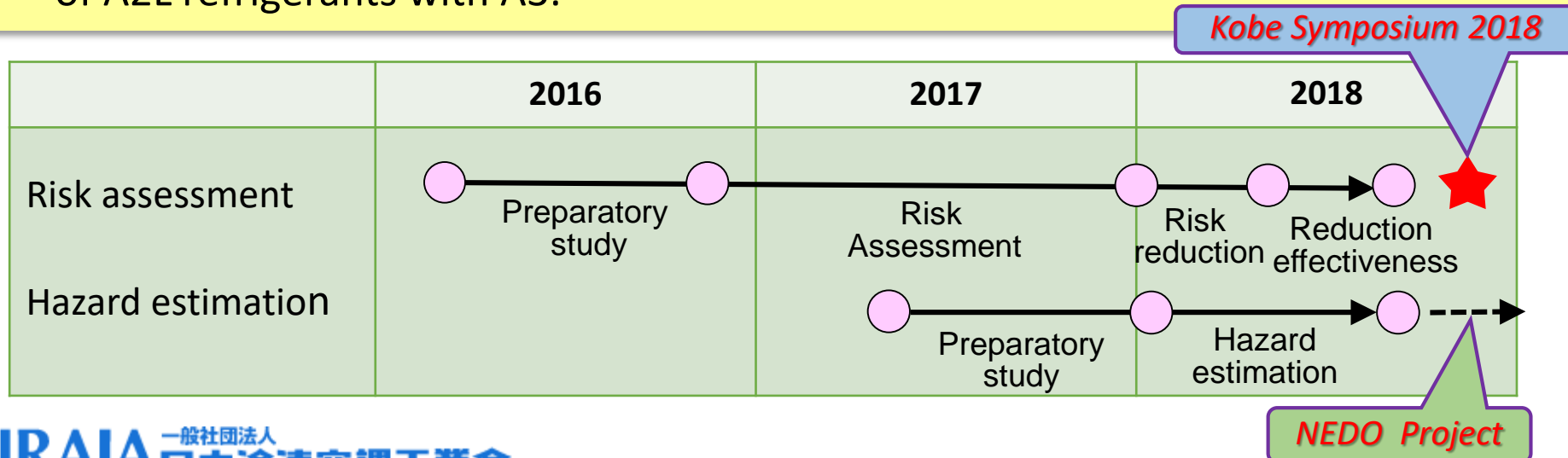


3. Actions to shift low-GWP refrigerants

5) Risk Assessment of Residential A/Cs using A3 Refrigerants - Outline (1/2)

Project Outline

- Along with the global trend to tackle with the safe use of A3 refrigerants, JRAIA will propose safety ensured air-conditioners using A3 for domestic application through this study.
- Based on the results of risk assessment of Residential A/Cs using A2L refrigerants, JRAIA also conducts risk assessment for A3 refrigerants and recommends measures to ensure safety of the products sold in Japanese market.
- JRAIA collaborates with universities and research institutes to compare hazards of A2L refrigerants with A3.



3. Actions to shift low-GWP refrigerants

5) Risk Assessment of Residential A/Cs using A3 Refrigerants - Outline (2/2)

Abstract of presentations at Kobe Symposium 2018

- Perform risk assessment based on the life cycle stage of Residential A/Cs.
 - ⇒ Study **ignition sources** exist in surroundings of indoor and outdoor units.
 - ⇒ Extract ignition sources used for transportation, installation, service, and recycle stages.
 - ⇒ Simulate the **flammable space-time volume** by CFD for each stage.
 - ⇒ Derive **ignition probability** from encounter rate of ignition source and flammable space-time volume.
- In order to use A3 refrigerants for Residential A/Cs, WG will present safe working procedures for safety-ensured equipment, installation and service, and will also provides concept of guideline of appropriate installation methods.

***To find out results of the project, please come to
Kobe Symposium held in 6th - 7th December 2018 !***

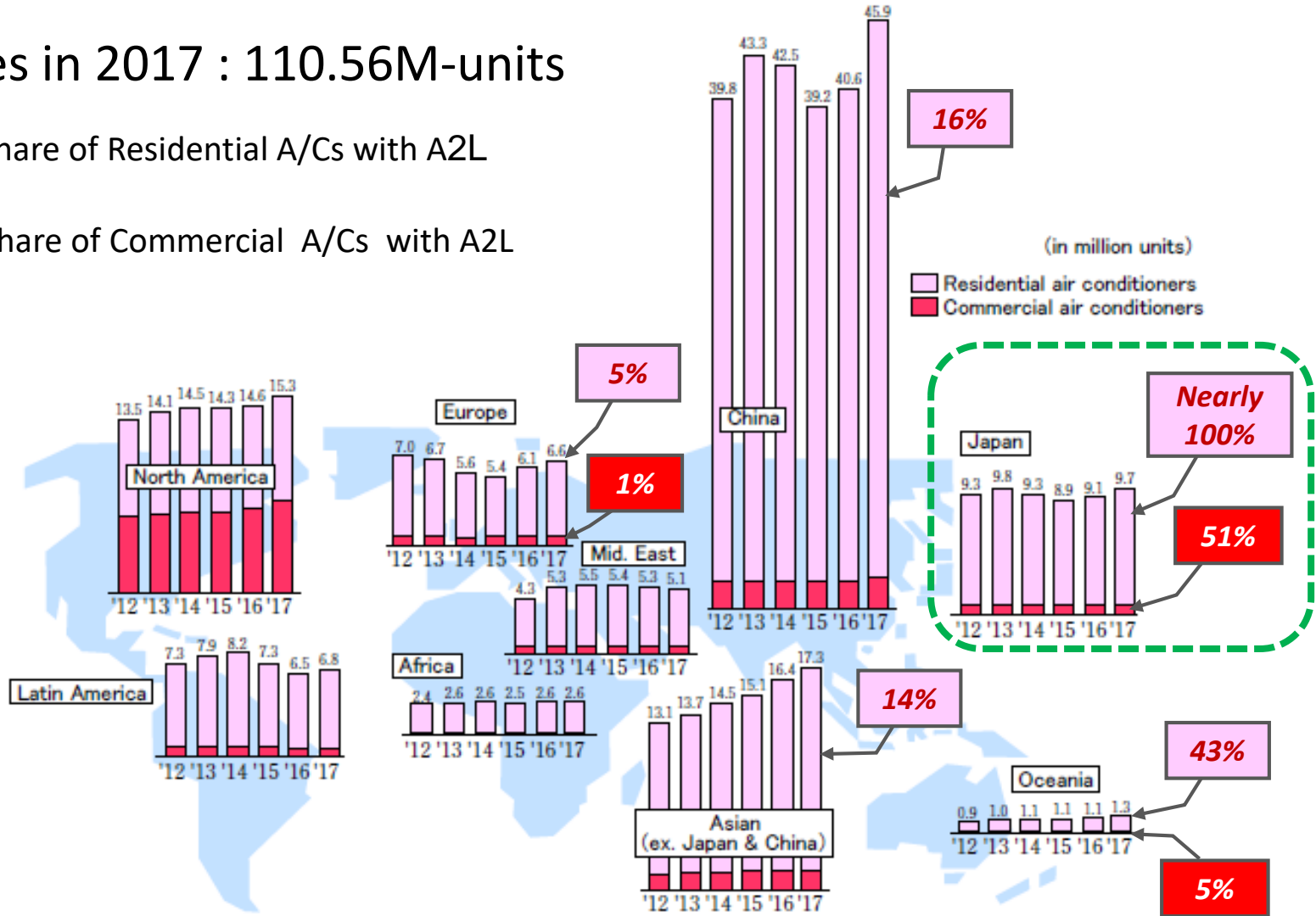


4. Low-GWP Alternatives and Products

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

Global sales in 2017 : 110.56M-units

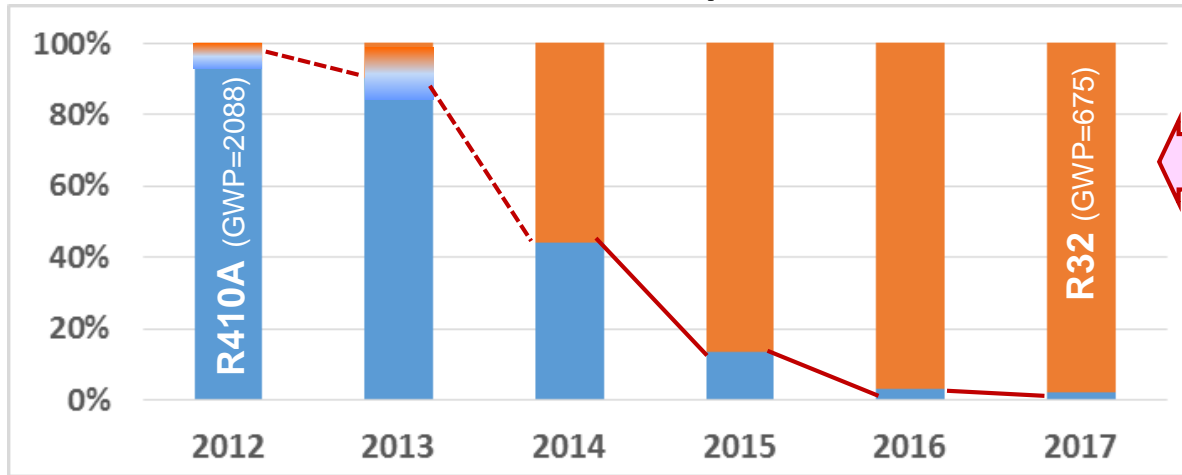
xx% : Share of Residential A/Cs with A2L
yy% : Share of Commercial A/Cs with A2L



4. Low-GWP Alternatives and Products

2) Market shift to A2L refrigerant in Japan

Residential A/Cs

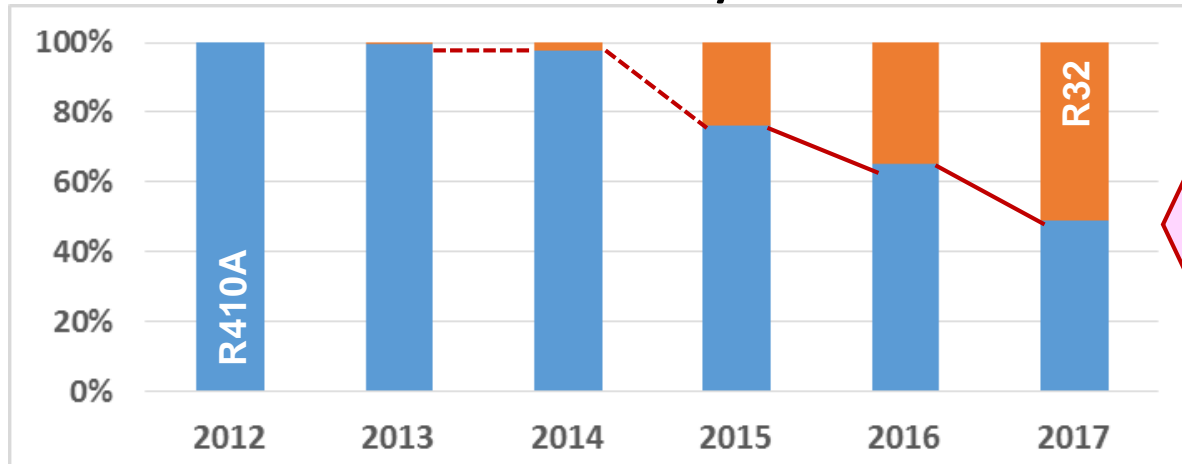


Requirement of Fgas Act

Target GWP : 750

Target year : 2018

Commercial A/Cs



**Requirement of Fgas Act
for under 6HP models**

Target GWP : 750

Target year : 2020

4. Low-GWP Alternatives and Products

3) Refrigerant conversion status in each product sector

Product Category	Number of Units in 2017FY (x 1,000)	Conventional Refrigerants ⇒ Alternatives
Residential A/Cs	9,054.6	R410A ⇒ R32 ⇒ ?
Commercial A/Cs	827.1	R410A ⇒ R32 (for small single split models) ⇒ ?
Gas engine-driven A/Cs	28.7	R410A
Residential H/P Water Heaters	446.7	CO ₂ (R744) / R32
Commercial H/P Water Heaters		R410A ⇒ CO ₂ (R744) / R454C
Water Chilling Units	12.2	R410A / R407C / R404A / R134a ⇒ ?
Centrifugal (Turbo) Chillers	0.266	LP : R245fa ⇒ R1233zd(E) / R1224yd(Z) / R514A HP : R134a ⇒ R1234ze(E) / R1234yf
Commercial Built-in Ref. Cabinets	184.8	R404A / R410A / R134a ⇒ ? R600a / CO ₂ (R744)
Commercial Ref. Cabinets / split	128.0	R404A ⇒ R410A ⇒ R448A / R449A / R407H / R463A ⇒ ?
Condensing Units	93.4	CO ₂ (R744)
Refrigeration Units	28.3	R404A / R410A / R134a ⇒ ?
Automobile A/Cs	(4,700)	R134a ⇒ R1234yf (CO ₂ (R744))
Vending Machines	(320)	R404A / R134a ⇒ R600a / CO ₂ (R744) / R1234yf
Domestic Refrigerators	(4,400)	R600a

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Residential mini-split Air Conditioners (Heat Pumps)

10 manufacturers

Capacity : 2.2 - 9.0 kW

POM : since 2012



➤ Light Commercial mini-split Air Conditioners (Heat Pumps)

6 manufacturers

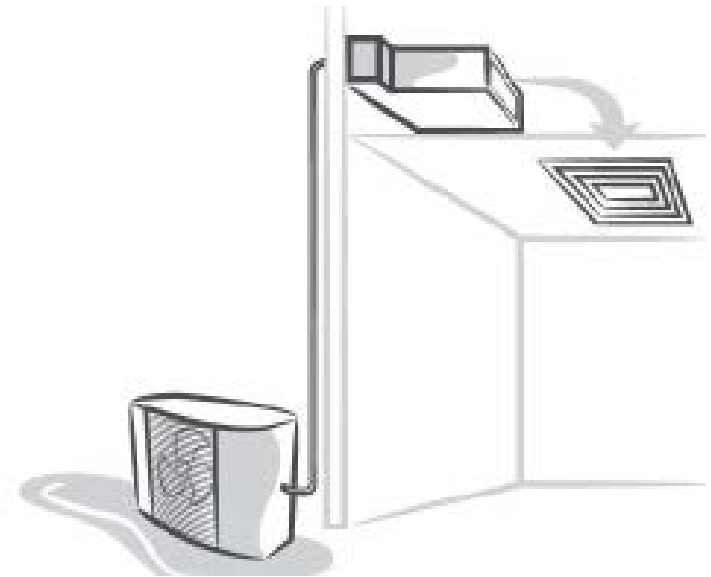
Capacity : 3.5 - 14.0 kW

POM : since 2013

Refrigerant : R32 [A2L / GWP675]

* Conventional ref. : R410A (GWP2088)

GWP 68% down !



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Residential Water Heater - Air Source Heat Pumps (Eco Cute)

8 manufacturers

Capacity(@65°C) : 4.5 - 7.5 kW

POM : since 2001

➤ Commercial Water Heater - Air Source Heat Pumps (Eco Cute)

8 manufacturers

Capacity (@65°C) : 4.4 - 74.0 kW

POM : since 2006

Refrigerant : CO₂ (R744) [A1 / GWP1]

* Conventional ref. : R410A (GWP2088)

Natural refrigerant !



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Panasonic Refrigeration (Condensing Unit)

Model : OCU-CR series

Capacity (@ $T_e = -10^\circ\text{C}$) : 4 – 30 kW

POM : September 2010

Refrigerant : CO₂ (R744) [A1 / GWP1]

Natural refrigerant !

*Also available in
Europe*

Panasonic
BUSINESS

ノンフロン冷凍機システム

CO₂冷媒採用
二酸化炭素排出量
冷媒漏洩による直接影響

ZERO 0 への挑戦

OCU-CR2001MVF
OCU-CR1501MVF
15・20HP

OCU-CR1001VF
10HP

OCU-CR1001VF5
10HP

OCU-CR200VF
2HP

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Toshiba Carrier

Refrigeration (Condensing Unit)

Model : TAM_AT-SV series

Capacity (@Te= -10°C) : 0.8 - 6.3 kW

POM : November 2016

Refrigerant : R448A [A1 / GWP1387]

* Conventional ref. : R404A (GWP3922)

GWP 65% down !

TOSHIBA
Carrier

R407C

R404A

+

R448A

安全性・経済性・環境性 3つの配慮でお客さまに貢献

屋外設置形DCインバータ冷凍機



TAM130AT-SV



TAM200AT-SV/TAM350AT-SV

新たに低GWP冷媒 (R448A) に対応

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Hitachi Appliance Refrigeration (Condensing Unit)

Model : KX-T_AMV series

Capacity (@Te= -10°C) : 14 – 18 kW

POM : September 2017

Refrigerant : R448A [A1 / GWP1387]

* Conventional ref. : R404A (GWP3922)

GWP 65% down !

スクロール
冷凍機

スクロール冷凍機 NEW
屋外設置型(空冷一体型)

DCインバーターシングルタイプ[冷蔵用]
4.5kW(6馬力)・5.2kW(7馬力)・6.0kW(8馬力)

新冷媒R448Aの
採用とCOPの向上



KX-T7AMV

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Mitsubishi Electric Refrigeration (Condensing Unit)

Model : EcoV DUAL series

Capacity (@ $T_e = -10^\circ\text{C}$) : (17 kW)

POM : Q3-Q4 2018

Refrigerant : R463A [A1 / GWP1494]

* Conventional ref. : R404A (GWP3922)

GWP 62% down !

世界初
新冷媒
R463A
採用

地球温暖化係数(GWP)
1494

※2018年2月時点
スクロールコンデンシングユニットにおいて

現在主流のR410Aに
比べて地球温暖化係数を
約28%低減

フロン排出抑制法
で定められた
目標値を達成

フロンレベル
この商品で使用しているガスの
地球温暖化への影響は？

地球温暖化への
影響度

地球温暖化への
影響度

C B A AA AAA S
3000以上 1000~3000 1000~1000 1000以下 100以下

目標年度 2025年
使用ガスの地球温暖化係数 1494

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Mitsubishi Heavy Industries Thermal Systems Refrigeration (Condensing Unit)

Model : HCCV1001,2001M

Capacity (@Te= -10°C) : 16 - 32.5 kW

POM : April 2017

Refrigerant : CO₂ (R744) [A1 / GWP1]

* Conventional ref. : R404A (GWP3922)

Cpuzzle
CO₂ Condensing Unit

ノンフロン
明日のために、ノンフロン。



Natural refrigerant !



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Daikin Industries Module Chiller

Model : HEXAGON Force 32 series

Capacity : 85 – 180 kW

POM : November 2018

Refrigerant : R32 [A2L / GWP675]

* Conventional ref. : R410A (GWP2088)

GWP 68% down !

DAIKIN
HEXAGON
Force 32
MODULE CHILLER



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Mitsubishi Heavy Industries Thermal Systems Industrial and Commercial Water Heater Heat Pump

Model : EQA401

Capacity : 40 kW (max50 kW)

POM : December 2018

Refrigerant : R454C [A2L / GWP148]

* Conventional ref. : R410A (GWP2088)

GWP 93% down !

Q-ton
Circulation

循環加温ヒートポンプ

三菱重工

75℃の出湯温度で循環加温が可能。
地球環境にやさしい**低GWP冷媒R454C**採用。

中部電力株式会社共同開発

日本初[®]
R454C
冷媒採用

※2018年7月現在(当社調べ)

キュートン
サーキュレーション



定格COP: **3.3**
L2-Tech基準値クリア

※外気温-25度(相対湿度は70%)、温水入口60℃、温水出口65℃の条件における値

直列2台の圧縮機。
高効率な温水循環を実現

2台の圧縮機を直列に接続し圧縮機の仕事を分散することで圧縮機の損失を軽減し、高効率な温水供給運転を実現。



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Trane (Ingersoll Rand) Centrifugal Chiller

Model : CVHH / CDHH series

Capacity : 800 - 4000 USRt

POM : November 2014

Refrigerant : R1233zd(E) [A1 / GWP1] (IPCC-AR5)

* Conventional ref. : R123 (GWP77)

Available
Worldwide

Model : CVHE / CVHG / CVHF series

Capacity : 200 - 1200 USRt

POM : March 2017

Refrigerant : R514A [B1 / <GWP2] (IPCC-AR5)

* Conventional ref. : R123 (GWP77)

Available Worldwide
except Europe & China



Simplex
(single compressor)



Duplex™
(dual compressor)



Simplex
(single compressor)



Duplex™
(dual compressor)

4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Mitsubishi Heavy Industries Thermal Systems

Centrifugal Chiller

Model : ETI-Z series

Capacity : 150 - 7000 USRt

POM : September 2015

Refrigerant : R1233zd(E) [A1 / GWP1] (IPCC-AR5)

* Conventional ref. : R134a (GWP1300)

Model : GART-ZE / ZEI series

Capacity : 300 - 5000 USRt

POM : April 2017

Refrigerant : R1234ze(E) [A2L / <GWP1] (IPCC-AR5)

* Conventional ref. : R134a (GWP1300)

ETI-Z series



GART-ZE & ZEI series



4. Low-GWP Alternatives and Products

4) RACHP products using lower GWP refrigerants sold in Japan

➤ Ebara Refrigeration Equipment & Systems Centrifugal Chiller

Model : RTBA / RTBA-V series

Capacity : 220 - 1250 USRt

POM : April 2018

Refrigerant : R1224yd(Z) [A1 / <GWP1] (IPCC-AR5)

* Conventional ref. : R245fa (GWP1030)



#13 International Symposium for New Refrigerants and Environmental Technology 2018



**THE INTERNATIONAL SYMPOSIUM
NEW REFRIGERANTS and
ENVIRONMENTAL
TECHNOLOGY 2018**

December 6 (Thu) – 7 (Fri) . 2018

International Conference Center Kobe, Main Hall,
Kobe, Japan

Save the date!

Contents

- Environment Issue
- New Refrigerants and Their System
- Safety of Refrigerants / Risk Assessment
- Energy Conservation
- Compressors and Lubricants

Organizer

The Japan Refrigeration and Air Conditioning Industry Association (JRAIA)
Kikai Shinko Bldg. 201, 5-8, Shibakoen 3-chome, Minato-ku, Tokyo 105-0011, JAPAN
Tel : +81-3-3432-1671 Fax : +81-3-3438-0308
<http://www.jraia.or.jp/english/index.html>

To find out the latest information.
← please visit the Web site !

JRAIA
KOBESYMPOSIUM

English, Japanese
(Simultaneous Interpretation)

#13 International Symposium for New Refrigerants and Environmental Technology 2018

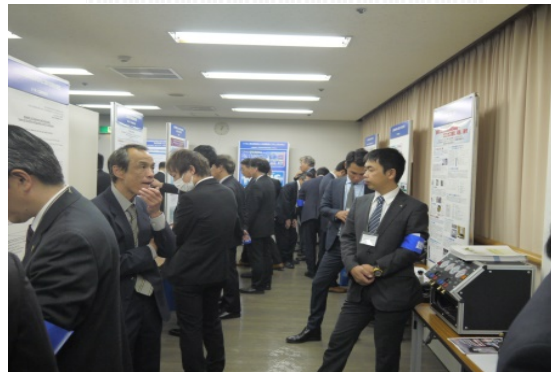
JRAIA hosts the Symposium, so-called “**Kobe symposium**”, which has been held **every two years** since 1994.

Photos below are from #12 Symposium held in December 2016 .

Seminar



Technology Exhibits



Q&A



Reception



**Luminaire Festival starts
7th Dec at city center !**



Appendix.

1) JRA Standards and Guidelines (1)

products	No. of Std. or GL.	Title	References
the refrigerant charge equipment	JRA GL20	“Appropriate measures to prevent combustion against refrigerant gas leakage from the refrigerant charge equipment using semi-inert gas”	ISO 817 ISO 5149-1, -3:2014 IEC 6033-2-40 61D/338/INF:2016
refrigerant leak detector and alarm	JRA 4068	“Requirements of refrigerant leak detector and alarm for air conditioning and refrigeration equipment”	ISO 5149-1, -3:2014
refrigerant leakage from refrigerating and air conditioning equipment	JRA GL14	“Guideline for prevention of refrigerant leakage from refrigerating and air conditioning equipment and systems using fluolocarbon”	ISO 14903
chiller	JRA GL15	“Guideline of design construction for ensuring safety against refrigerant leakage from chiller using lower flammability(A2L) refrigerants”	ISO 5149-2, -3, -4 IEC 60335-2-40 IEC 60079-10-1
commercial air conditioners	JRA 4070	“ Requirements for ensuring safety against refrigerant leakage from commercial air conditioners using lower flammability(A2L) refrigerants”	ISO 5149-1, -2, -3, -4 ISO 5149-1/Amd1
	JRA GL16	“Guideline of design construction for ensuring safety against refrigerant leakage from commercial air conditioners using lower flammability(A2L) refrigerants”	ISO 5149-1, -2, -3, -4 ISO 5149-1/Amd1

Appendix.

1) JRA Standards and Guidelines (2)

products	No. of Std. or GL.	Title	References
commercial refrigeration equipment	JRA 4072	“ <u>Requirements</u> for ensuring safety against refrigerant leakage from commercial refrigeration equipment using lower flammability(A2L) refrigerants”	ISO 14903 IEC 60079-10-1:2015 IEC 60335-2-40:2013
	JRA GL18	“ <u>Guideline</u> of design construction for ensuring safety against refrigerant leakage from commercial refrigeration equipment using lower flammability(A2L) refrigerants”	ISO 5149-1 IEC 60079-10-1:2015 IEC 60335-2-40:2013 IEC 60335-2-40 61D/338/INF:2016
commercial packaged air conditioner	JRA 4073	“ <u>Requirements</u> for ensuring safety against refrigerant leakage from commercial packaged air conditioner for facilities using lower flammability(A2L) refrigerants”	IEC 60335-2-40 61D/338/INF:2016
	JRA GL19	“ <u>Guideline</u> of design construction for ensuring safety against refrigerant leakage from commercial packaged air conditioner for facilities using lower flammability(A2L) refrigerants”	IEC 60335-2-40 61D/338/INF:2016

Thank you for your attention!!