SUSTAINABLE TECHNOLOGIES FOR AIR CONDITIONING WORKSHOP
INTERNATIONAL CIVIL AVIATION ORGANIZATION
MONTREAL, CANADA

Transitioning to Alternatives and Challenges in Japan

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JRAIA 一般社団法人 日本冷凍空調工業会
The Japan Refrigeration and Air Conditioning Industry Association

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1. Who is JRAIA?

The Japan Refrigeration and Air conditioning Industry Association

- **Established in 1949.**
- **170 member companies including the associate members.**
  (as of 1st of October 2017)
- **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

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2. Strategies to be taken as Japan

1) JRAIA's Vision and Activities on Environmental Conservation

EQUIPMENT

Energy Saving

Emission control on a CO_2 basis

REFRIGERANTS

Direct Emission Control

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

ALTERNATE REFRIGERANTS

Acceleration to shift to new refrigerants

- Research of low GWP refrigerants
- Risk Assessment

Top Runner Program

Act on Rational Use & Proper Management of Fluorocarbons

Home Appliances Recycling Act

EoL Automotie Recycling Act

High Pressure Gas Safety Act

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2. Strategies to be taken as Japan

2) Points for Refrigerants Conversion

Actions to phase-down HFCs have been started sector by sector in Japan by considering not only "environment performance" but also "safety", "energy efficiency" and "economic feasibility".

S+3Es

Safety (precondition)	・Low Toxicity ・Low Risk of Flammability
Environment performance	・Ozone Depletion Potential =0 ・Low Global Warming Potential(GWP)
Energy efficiency	・Superior for LCCP* value ・Similar performance at high load cooling
Economic feasibility	・Reasonable Cost ・Acceptable level in Developing Countries

* LCCP : Life Cycle Climate Performance

3. Trend of legislation and Protocols

1) Overview of Legislation in Japan

Legislation on refrigerants

"Ozone Layer Protection Act" (1988)

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

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

- 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"

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

- Regulation on emission of energy origin CO_2

4. HFC step down

1) Steps to execute HFC reduction plan : challenges and response (1/2)

Step 1

Selection of candidate refrigerant

- Basic physical properties (energy efficiency), compatibility with lubricating oil, etc.
- Efficiency evaluation, confirmation of reliability etc.
- Low GWP refrigerant has flammability.

Step 2

Confirmation of equipment safety

- Risk assessment by product (Life cycle perspective, region by region)
- Development of new standards and guidelines by risk assessment
- Association for Evaluation of A2L Refrigerant by Industry-Government-Academia Collaboration

Step 3

Confirmation of safety standards

- Design complying with IEC, ISO and national standards
- Amendment of standard itself
- Especially concerning the mildly flammability, it is a new concept

4. HFC step down

1) Steps to execute HFC reduction plan : challenges and response (2/2)

Step 4

Confirmation of safety regulations

- Partial relaxation of Building Codes, High Pressure Gas Safety Act (in Japan)
- Security guarantee based on the above new standards and guidelines
- Addition of new category from the viewpoint of flammability

Step 5

Market acceptability

- Overcoming the additional issues related to the rising product price by installation of risks and installation work, understanding of the market is indispensable
- Example of risk countermeasure: installation of ventilator, gas sensor, installation of shutoff valve etc.
- briefing sessions for the market, measures to promote penetration

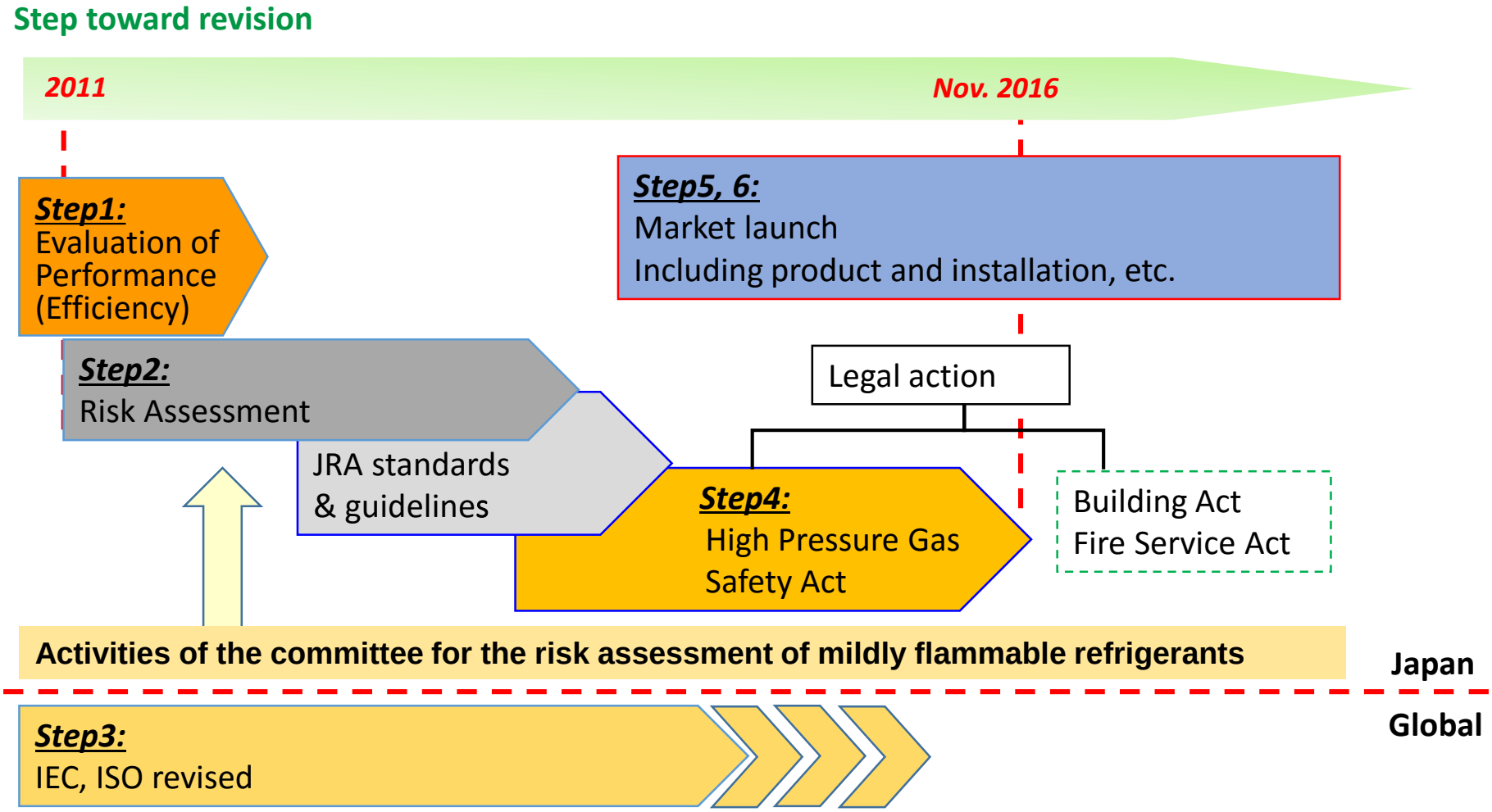
Step 6

Expanding penetration into the market

- Overcoming economic issues (cost increase etc.)
- Level of capital investment due to alternative refrigerant

4. HFC step down

2) Step toward revision of classification for A2L refrigerants (legislations to assure safety)



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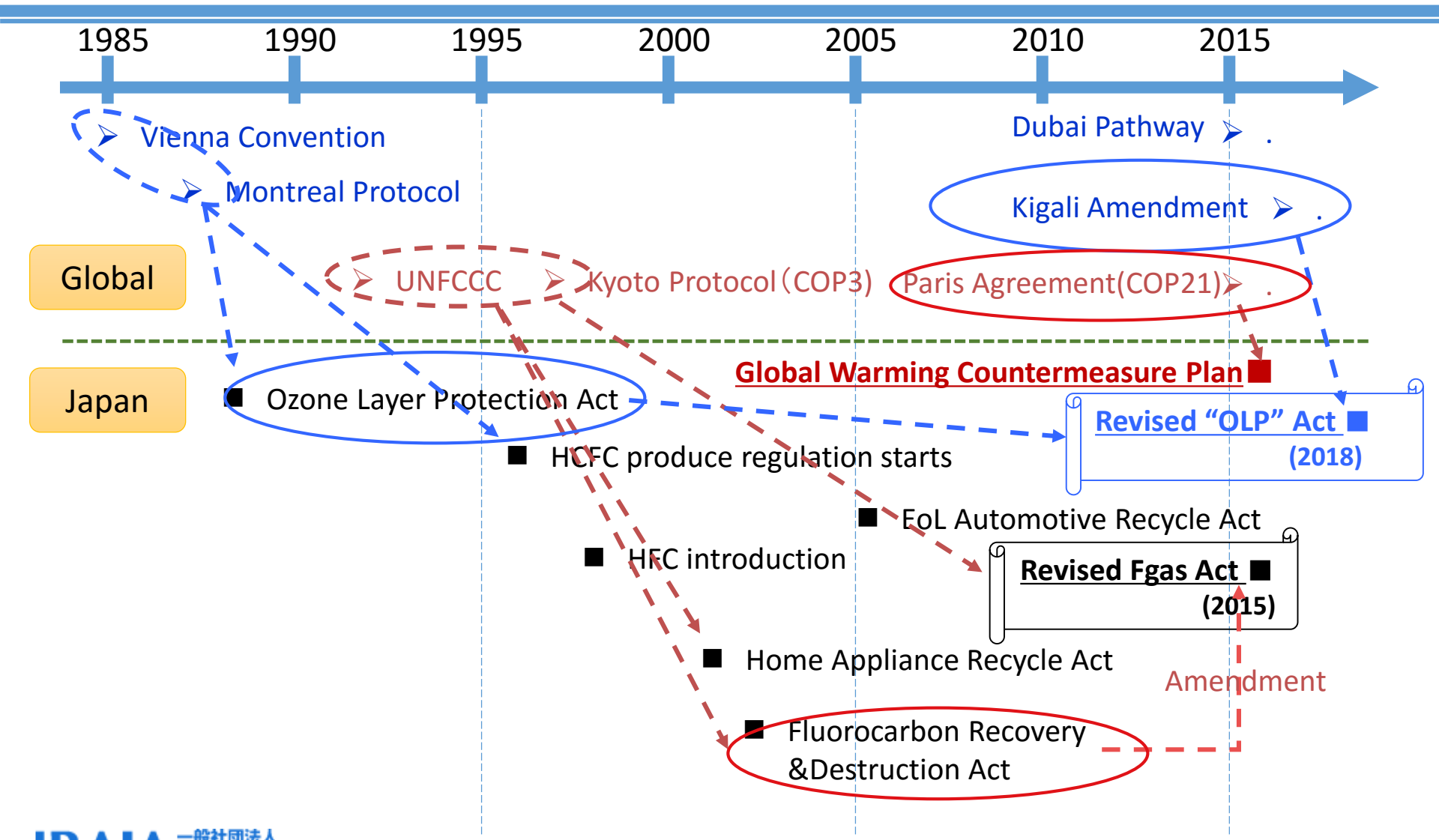
5. Legislation and Protocols in Japan

1) Timeline



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5. Legislation and Protocols in Japan

2) Overview of revised Fgas Act

"Act on Rational Use and Proper Management of Fluorocarbons"

Target
43.4 mil-tCO_2 (2020)
36.5 mil-tCO_2 (2025)

1) Phase-down HFCs

2) Promote low GWP products

Low GWP HFCs
Natural Refrigerant

HFCs

Refrigerator

Air conditioner

Insulators

Dust blowers

Products with alternatives

Users of products

Manufacturers of HFCs

Manufacturers of products containing HFCs

Supermarkets

Medical

Maintenance

Report of leakage

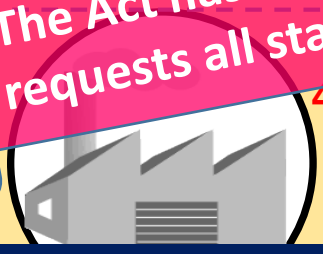
The Act has been implemented to cover entire life cycle since April 2015, requests all stakeholders to make efforts to reduce emissions of HFCs

Approved recyclers

Proper collection and recycling

4) Promote proper collection, destruction and recycling

3) Prevent leakage from commercial equipment



Approved destructors

Registered re-fillers/ recovery operators

Scope of previous Act

5. Legislation and Protocols 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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5. Legislation and Protocols in Japan

4) Comparison of safety act

	U.S.	Europe	Japan
Legislation/ Act	Clean Air Act SNAP	F–Gas Regulation, Act	・Act on Rational Use and Proper Management of Fluorocarbons ・**High pressure gas safety act**
Ir…			…ct
regulations (define ref types)	ASHRAE34	Relevant standards based on ISO	・**High pressure gas safety act**
Standard / regulations (safety)	ASHRAE15 UL60335-2-40 UL484, etc.	EN378 EN60335-2-40	・**High pressure gas safety act** ・JIS C9335-2-40 ・JRA standards, etc.

What is "High Pressure Gas Safety Act"?

This act is the regulation for high pressure gas, but covers toxicity and flammability of the refrigerants, and applies to HVAC equipment of the size above certain refrigerant volume.

6. High Pressure Gas Safety Act

1) Main Point of the mitigation of High pressure gas safety Act (1/2)

1. Revised classification A2L refrigerants.(R32, R1234yf, R1234ze)
2. Reference of JRA Standards and Guidelines.

Refrigerants(former)	
Fluorocarbon (inert gas)	No need of Notification or Approval for present refrigerant.
Fluorocarbon, NH_3 (excl. inert gas)	Notification or Approval for A2L are needed same as other refrigerants.
Others (CO_2, A3)	

6. High Pressure Gas Safety Act

2) Main Point of the mitigation of High pressure gas safety Act (2/2)

1. Revised classification A2L refrigerants.(R32, R1234yf, R1234ze)
2. Reference of JRA Standards and Guidelines.

Refrigerants(revised)
Fluorocarbon (inert gas, CO_2)
Fluorocarbon (particular inert gas) R32, R1234yf, R1234ze
Fluorocarbon, NH_3 (excl. inert gas)
Others (A3)

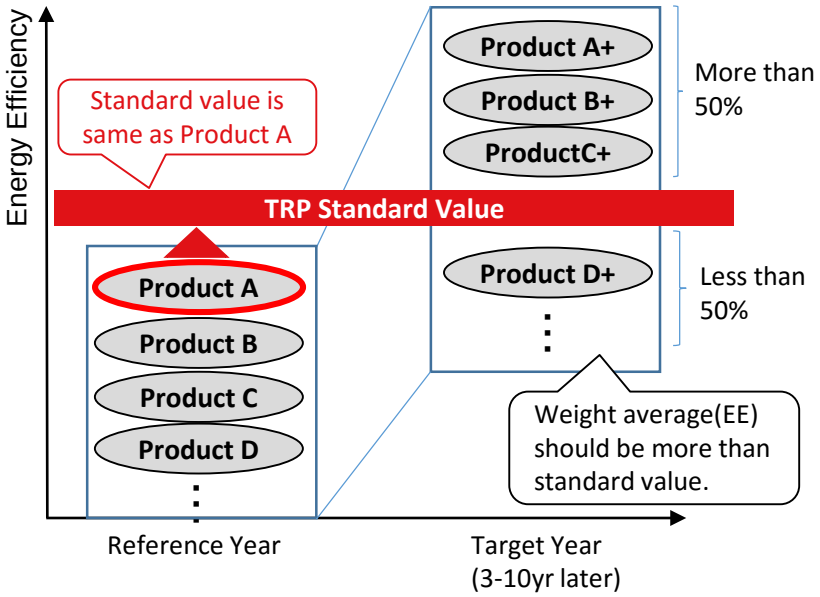
A2L:
Newly categorized

No need of Notification or Approval for A2L same as present refrigerants.

7. Energy Efficiency Improvement

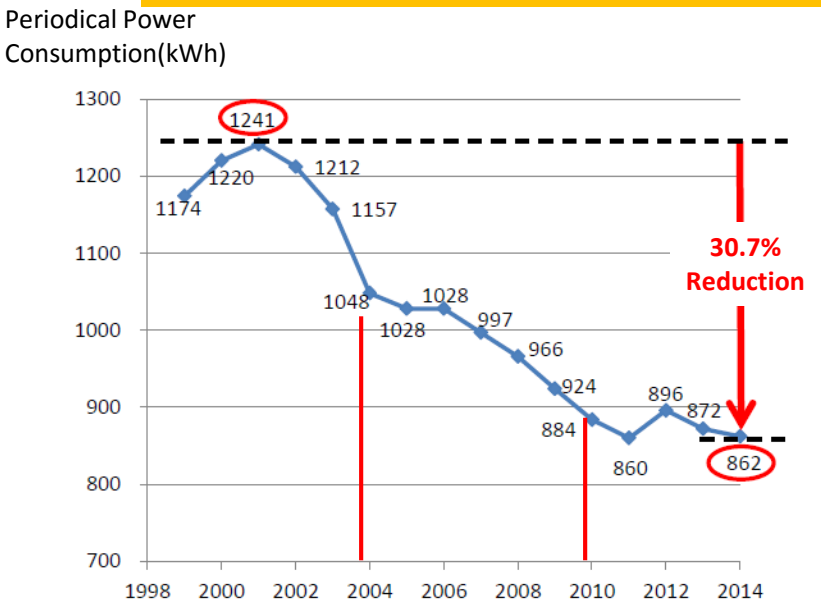
1) Top Runner Program and Results

Overview of Top Runner Program



31 items: 2016
Home appliances, Cars,
Office appliances etc.

Trend of Periodical Power Consumption <Domestic ACs>



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

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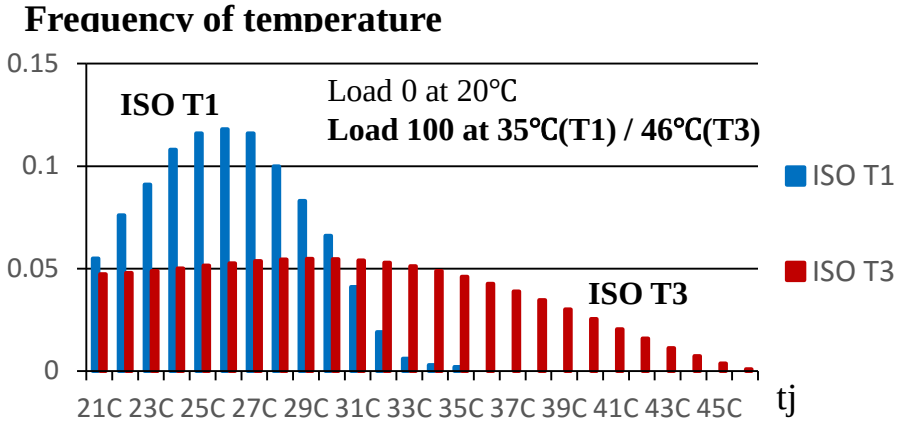
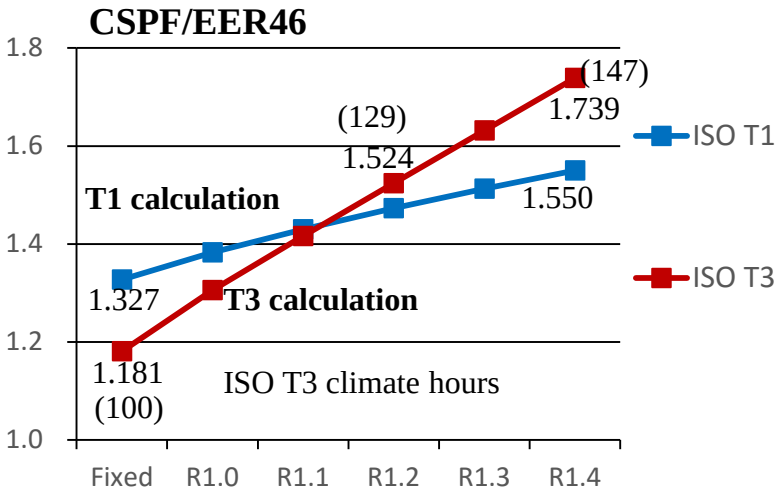
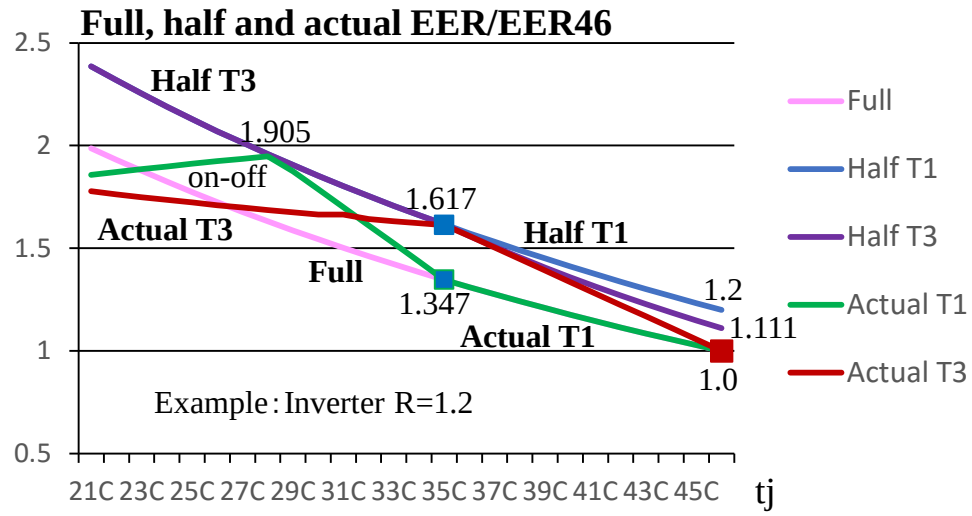
7. Energy Efficiency Improvement

2) High Ambient T3 climate calculation







tj: Outdoor temperature (℃)
EER46 means full EER at 46℃.
EER35 means full EER at 35℃.

R = [Half EER/Full EER] at 35℃
C = [Half capacity/Full capacity] at 35 = 0.5

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8. Market trend

1) Refrigerant conversion status in each product sector

Product Category	Number of Units in 2016FY (x 1,000)	Y/Y Ratio (%)	Refrigerant
Residential A/Cs	8,527.5	104.4	R410A ⇒ R32 (almost 100%)
Commercial A/Cs	793.9	102.6	R410A ⇒ R32 (only Small-size; 41%)
Residential H/P water heaters	424.4	104.1	CO_2, (R32) (almost 100%)
Gas engine-driven A/Cs	30.5	98.1	R410A
Water chilling units	12.9	98.8	R410A, R134A
Air to air heat exchangers	109.2	93.2	NA
Commercial ref. cabinets	312.4	101.4	R404 ⇒ R410A, CO_2
Condensing units	91.3	98.3	R410A
Refrigeration units	29.7	102.2	R22 ⇒ NH_3, (+CO_2)

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Summary

1. Successful example of measures for HFC step down in Japan.
   (efforts by industry-academia-government collaboration)

2. Risk assessment is key issue for each product sector and each country. (especially refrigerant life cycle and regionality)

3. Results of risk assessment in each region need to be shared.

4. Ensuring safety and relaxation of national safety codes based on risk assessment results are very important.

5. Energy Efficiency also very important,
   and the seasonal efficiency is one of the effective measures.

Thank you for your kind attention!!