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Transitioning to Alternatives and Challenges in Japan

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1. Who is JRAIA?

The **J**apan **R**efrigeration and **A**ir conditioning **I**ndustry **A**ssociation

- **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

2. 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)

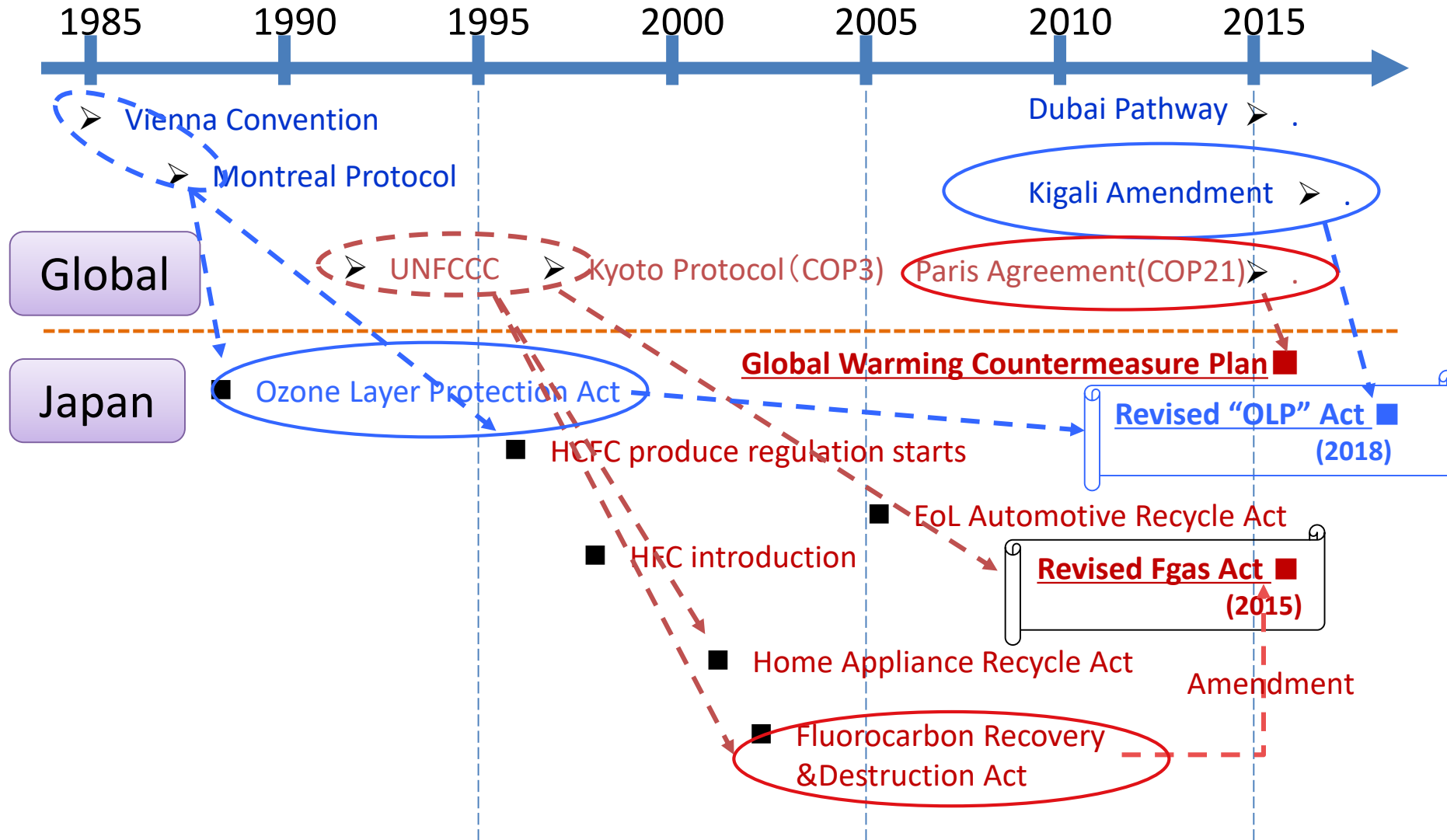
- Regulation on safety of flammable (toxic) gas
- Method of safe use of products and refrigerants
- A2L refrigerants are included as “particular inert gas”

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

- Regulation on emission of energy origin CO₂

2. Trend of legislation and Protocols

2) Timeline



3. 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, CO ₂
Refrigeration units	29.7	102.2	R22 ⇒ NH ₃ , (+CO ₂)

3. Market trend

2) Trend of Alternative Refrigerants in Japan

1. Japanese government support the acceleration of R&D of alternative refrigerants (government subsidies to support the projects)
2. CO₂ refrigerants training programs for installers by manufacturers
3. R&D of alternative refrigerants by manufacturers
4. Research of overseas market trends

4. Characteristics of Refrigerants

1) Comparison of Alternative Refrigerants

	Vienna Covention Subject materials of Montreal Protocol			UNFCCC Subject materials of Kyoto protocol	
	Specific fluorocarbon		Substitute fluorocarbon	Alternative fluorocarbon	Natural refrigerants
	CFC	HCFC	HFC	HFO	HC,NH3
refrigerants	R12	R22	R410A	R1234yf	HC,NH3
ODP:R12=1.0	1.0	0.055	0.0	0.0	0.0
GWP: CO2=1.0	8,100	1,500	2,088	Below 1	Around 3
flammability	None	None	None or mildly flammable	Mildly flammable	Flammability (HC etc.)
toxicity	None	None	None	None	Toxicity (NH3)

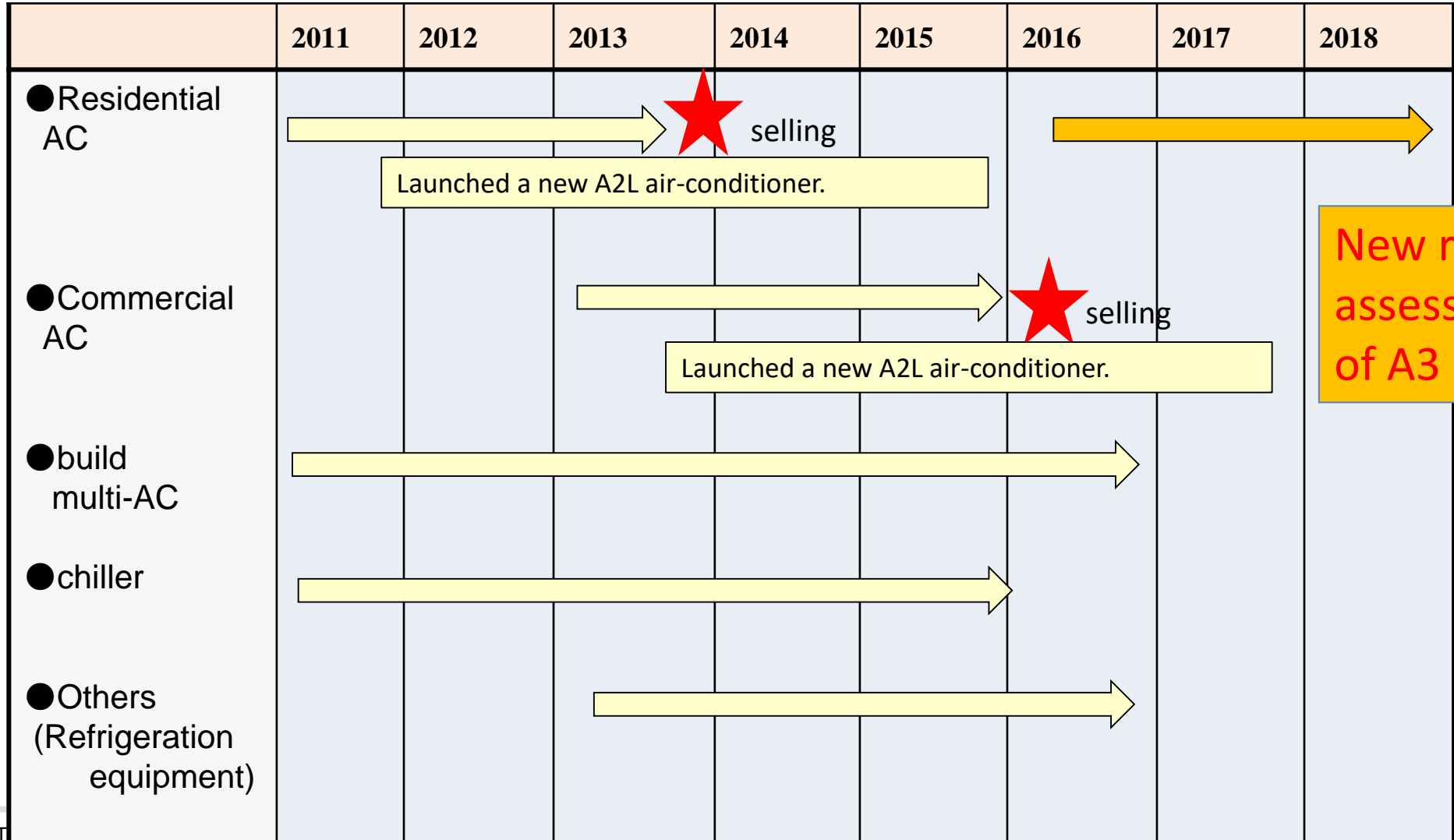
4. Characteristics of Refrigerants

NR	Characteristics	
	Pros	Cons
CO ₂	<p>High-efficiency on high temperature environment (HP water)</p> <p>GWP=1</p> <p>Non-toxic, odorless, non-flammable</p>	<p>High operating pressure</p> <p>Low critical temperature (31.1°C) resulting in lower thermal efficiency in case of high outdoor temperature</p>
NH ₃	<p>High-efficiency (only requires small quantity)</p> <p>GWP=less than 1</p> <p>A good performance can be achieved in combination with other refrigerants</p>	<p>Toxic, odor</p>
HC	<p>Applications are already in the market for household refrigerators with small capacity</p> <p>GWP=less than 10</p>	<p>Higher Flammability→ Subject to legal restrictions for the construction of the building using the amount exceeding the specified limit</p>
H ₂ O	<p>Harmless, odorless, non-flammable</p>	<p>Efficiency is not very high</p>

5. Schedule of Risk Assessment for AC and others

1) Main Timeline

A2L refrigerant risk assessment has difficulty and long period



New risk assessment of A3 refrigerant.

5. Schedule of Risk Assessment for AC and others

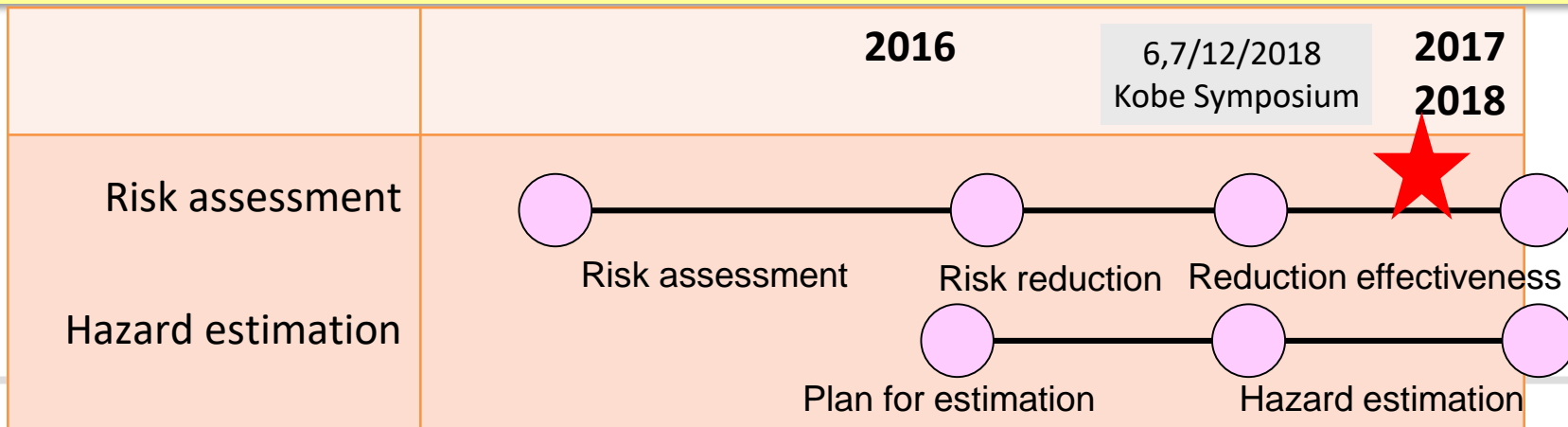
2) Abstract of A3 Refrigerants

■ Direction

- In the trend of deregulation of **A3 refrigerants**, JRAIA will propose **ACs and Showcases** 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.
- JRAIA collaborates with universities and research institutions to compare the hazards to the refrigerant of A2L and A3 refrigerants.

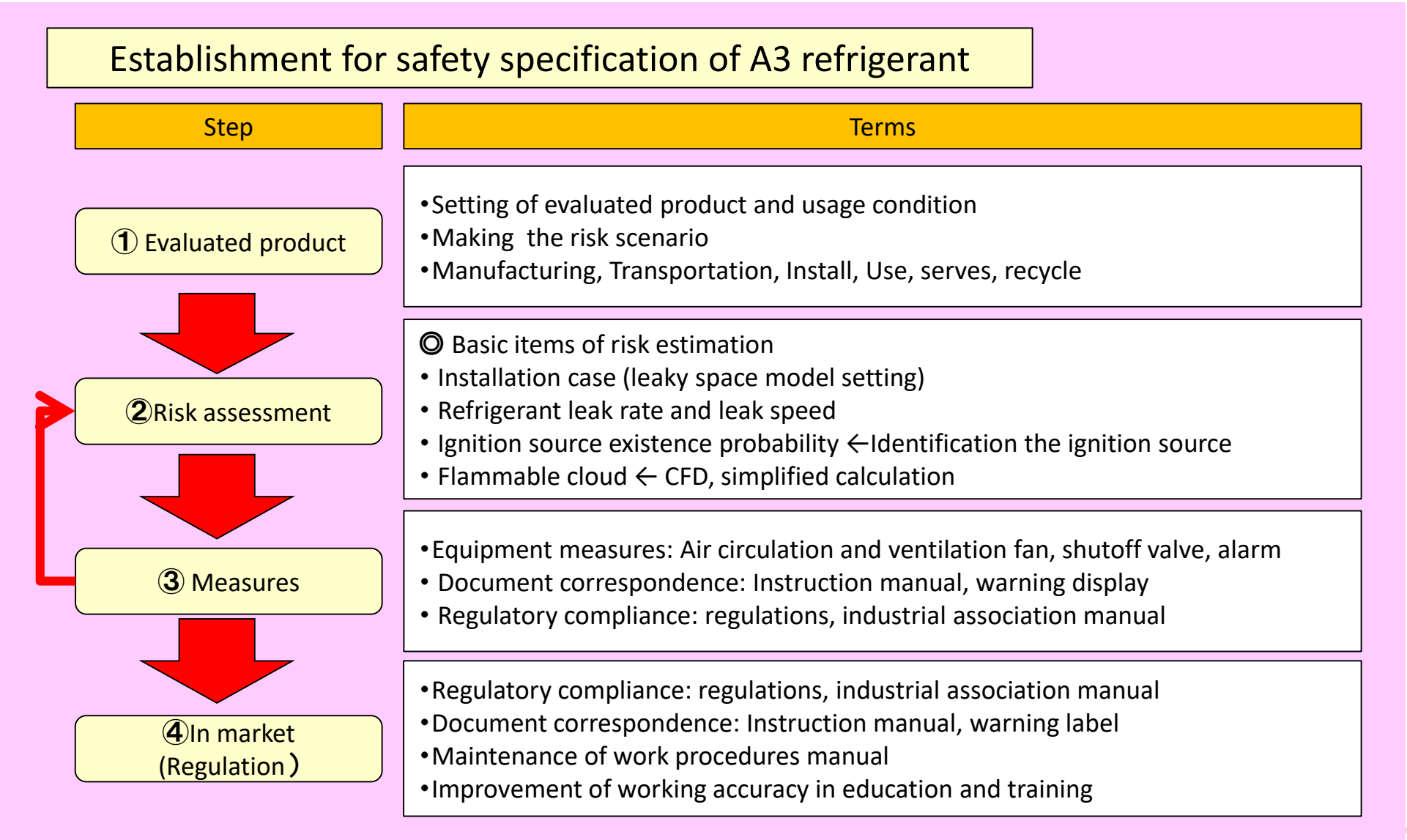
■ Schedule

- First year ; A3 refrigerant risk assessment and countermeasure
- Second half year ; Estimation method and make plan for estimation
- Last year ; Practical estimation for risk assessment.



5. Schedule of Risk Assessment for AC and others

3) RA Step for A3 refrigerant



7. JRA-4076: Safety Code

- JRA-4076: “ Safety Code for small refrigerating equipment using R744(CO₂) refrigerant”
- Officially published in Oct. 2017.
- Contents:
 - for less than 5 legal refrigeration ton
 - for separated show case
 - regulation on design pressure, intensity, materials, structure, safety equipment, testing and so on.

- Main legislation in Japan and the relation with the global protocols was shown.
- Market trend in Japan was shown.
situation of transition to alternatives.
- Challenges for the alternative refrigerants(Natural refrigerants).
- Risk assessment A3 refrigerants was shown.
(RA for A3 refrigerants is on going.)
- Challenges for CO₂ refrigerants were shown.



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Thank you very much!

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