

# NEDO's Efforts in Research and Development of Low GWP Alternative Technology

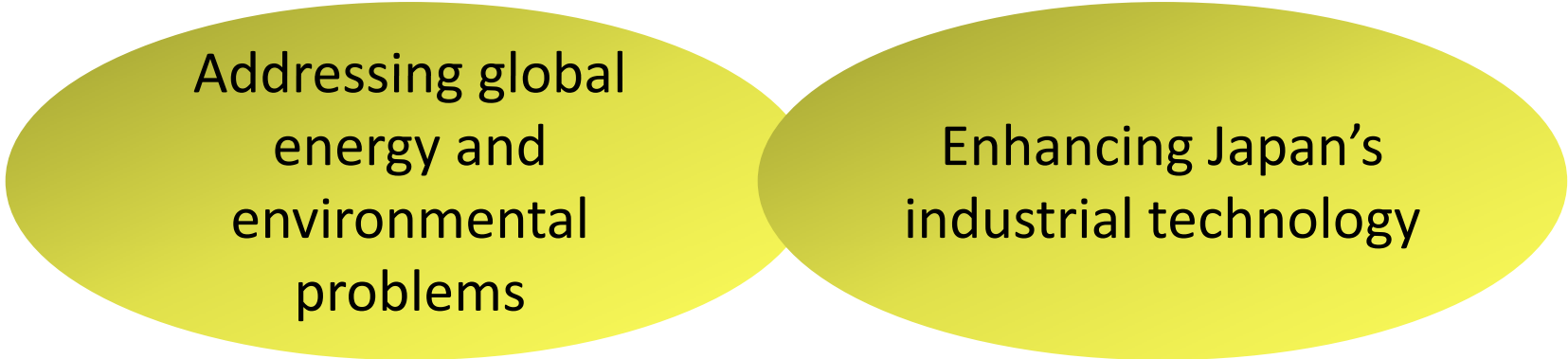
Shinji Kakuno  
Deputy Director General  
Environment Department  
New Energy and Industrial Technology Development Organization (NEDO)

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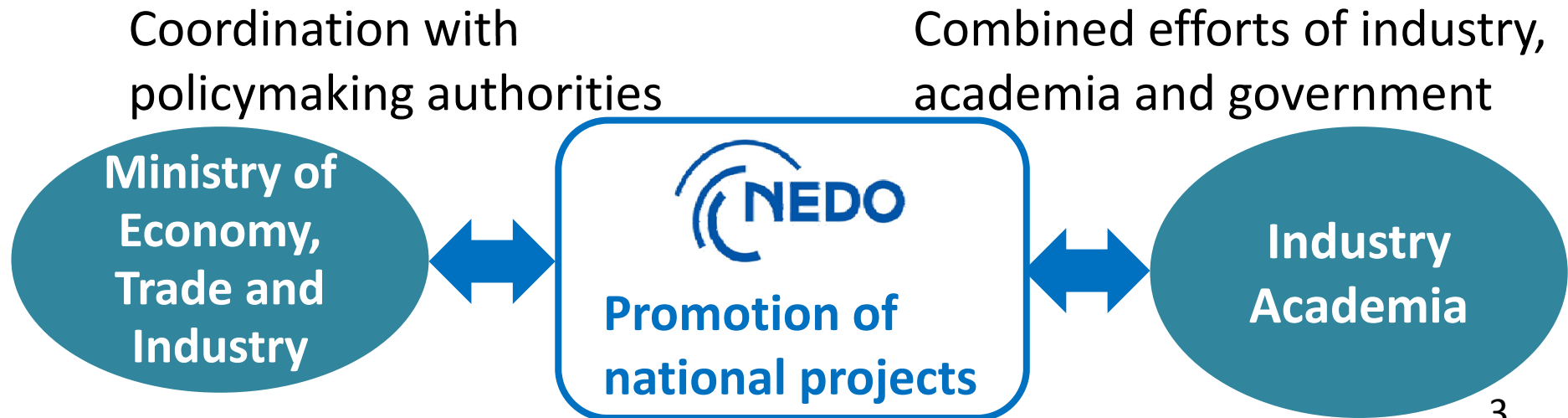
# 1. Introduction of NEDO



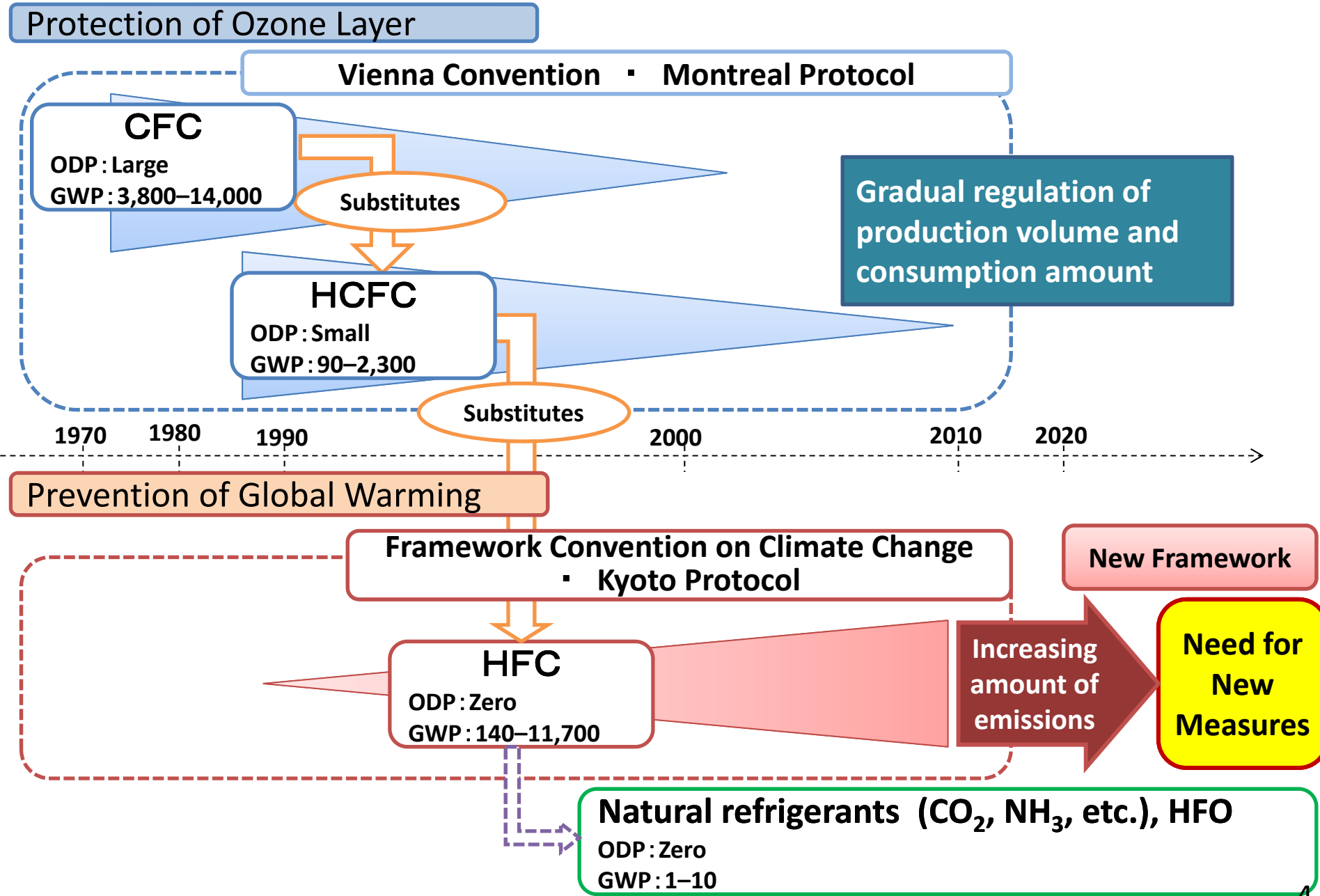
## NEDO'S mission



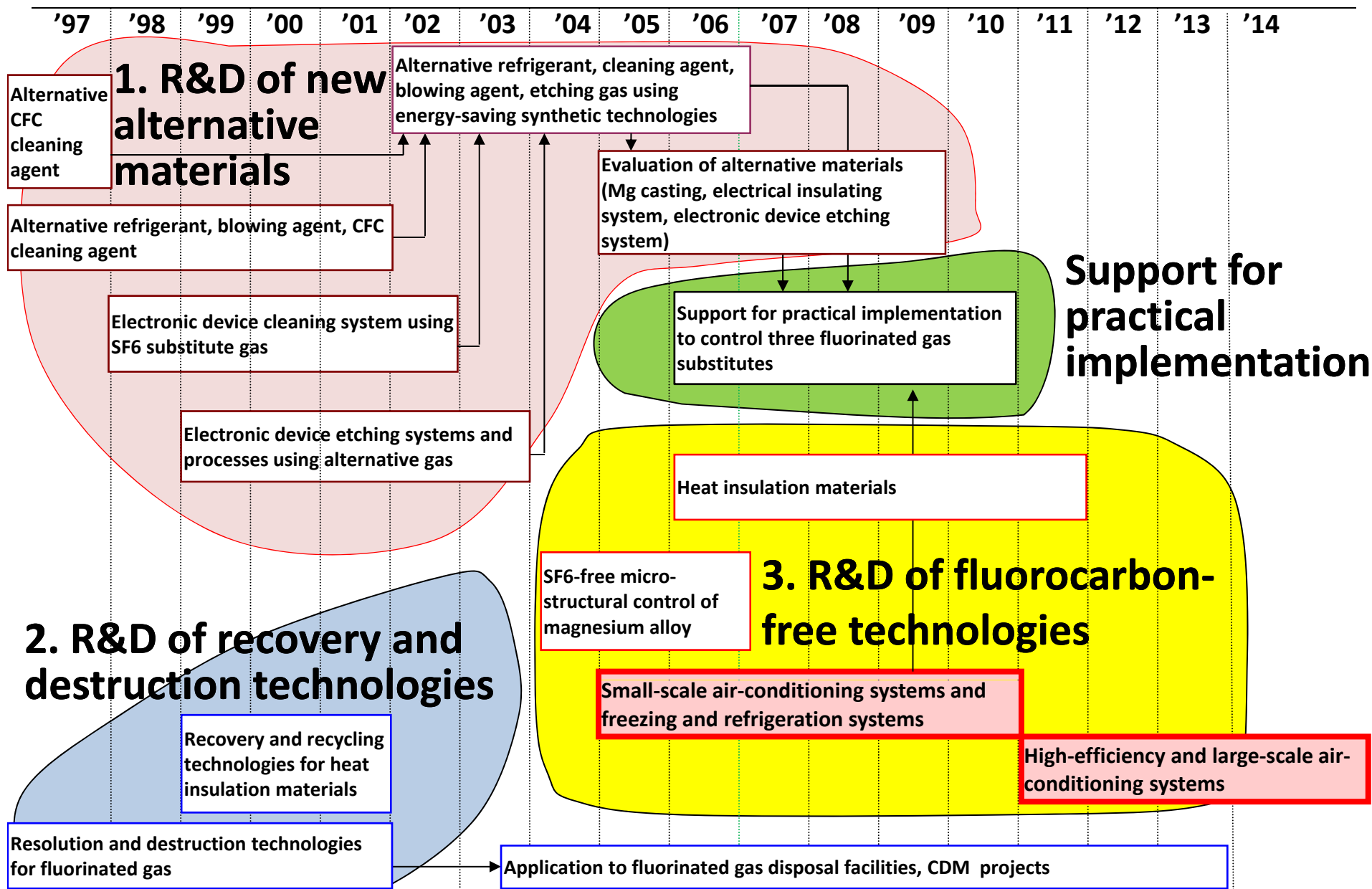
## Positioning of NEDO



## 2. Progress in Fluorinated Gas Regulations and Measures



# 3. NEDO Projects to Reduce Fluorinated Gas Emissions (1)



### 3. NEDO Projects to Reduce Fluorinated Gas Emissions (2)



| Classification                                 | Research and Development     |  |                                   | Support for Practical Implementation   |
|--|------------------------------|--|-----------------------------------|--|
|  | 1. New alternative materials | 2. Recovery and destruction technologies | 3. Fluorocarbon-free technologies | Demonstration and popularization<br><ul style="list-style-type: none"> <li>▪ Development and introduction of equipment</li> <li>▪ Field tests</li> </ul> |
| F-gas  | ✓                            | ✓  |                                   |  |
| Refrigeration and air conditioning             | ✓                            |  | ✓                                 | ✓  |
| Heat insulation materials                      | ✓                            | ✓  | ✓                                 | ✓  |
| Semiconductor and liquid crystal manufacturing | ✓                            |  |                                   | ✓  |
| Electronic device cleaning                     | ✓                            |  |                                   | ✓  |
| Magnesium alloy casting                        | ✓                            |  | ✓                                 | ✓  |
| Aerosol  |                              |  |                                   | ✓  |
| Electrical insulating system                   | ✓                            |  |                                   |  |

## 4. Development of Refrigeration and Air-Conditioning Systems Using Natural Refrigerants



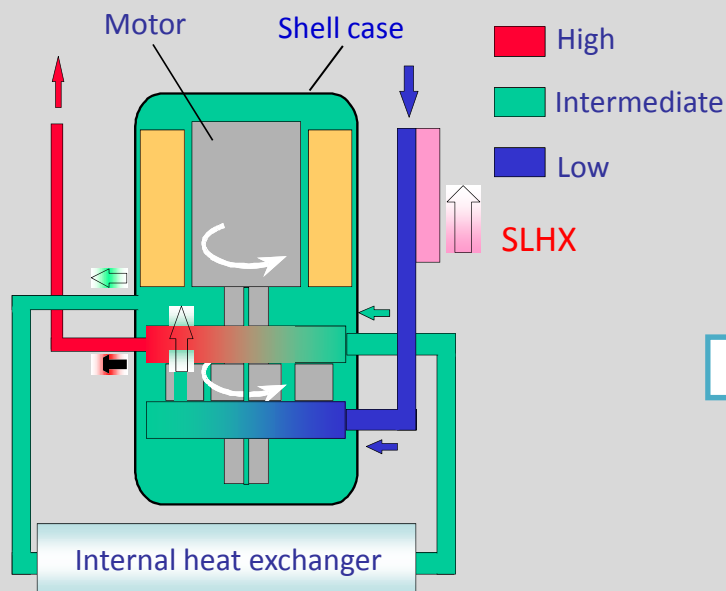
| Sector         | Refrigerant   | R&D Theme   | Company   |
|----------------|---|---|---|
| Residential    | CO <sub>2</sub>   | Development of a residential variable refrigerant volume (VRV) system                                   | Daikin Industries   |
| Commercial     | NH <sub>3</sub> /CO <sub>2</sub>  | Non-fluorinated energy efficient refrigeration and air-conditioning system for convenience stores       | Sanden  |
|                | HC/CO <sub>2</sub>  | Non-fluorinated refrigerator using mixed refrigerants of CO <sub>2</sub> and HC                         | Mac   |
|                |   | Propane/carbon dioxide cascade system for freezing, refrigeration and cold air conditioning             | Mitsubishi Heavy Industries Air Conditioning & Thermal Systems etc.           |
|                |   | Development of an air conditioner using supercritical CO <sub>2</sub> as a secondary refrigerant        | Mitsubishi Heavy Industries   |
|                | HC  | Development of a hydrocarbon-based refrigerant air conditioner for commercial use                       | Mayekawa Mfg.   |
|                |   | Development of high-efficiency heat pump chiller with a hydrocarbon refrigerant                         | Zeneral HeatPump  |
|                |   | CO <sub>2</sub>   | Air-conditioning system capable of simultaneous heating and cooling operation |
|                | Development of high-efficiency technology for a CO <sub>2</sub> refrigeration cycle |   | Panasonic   |
| Transportation | Air   | Development of an air cycle for mobile air conditioners and a desiccant system                          | Earthship   |
|                | CO <sub>2</sub>   | Development of a waste heat recycling mobile air conditioning system with a CO <sub>2</sub> refrigerant | Honda R&D   |

# 5. Development Examples

## (Freezer Showcases Using CO<sub>2</sub> Refrigerants)

### Research and Development (2005–2009)

- Two-stage rotary CO<sub>2</sub> compressor
- Circuit for CO<sub>2</sub> (sprit cycle)
- System demonstration



Two-stage rotary CO<sub>2</sub> compressor

Company: Panasonic

### Support for Practical Implementation (2010)

- Demonstration of Japan's first freezer showcases using CO<sub>2</sub> refrigerants in supermarkets and convenience stores
- Confirmation of reduction in power consumption and CO<sub>2</sub> emissions compared to conventional system



Companies: Panasonic, Lawson, Co-op Sapporo



# 6. Ongoing NEDO Projects

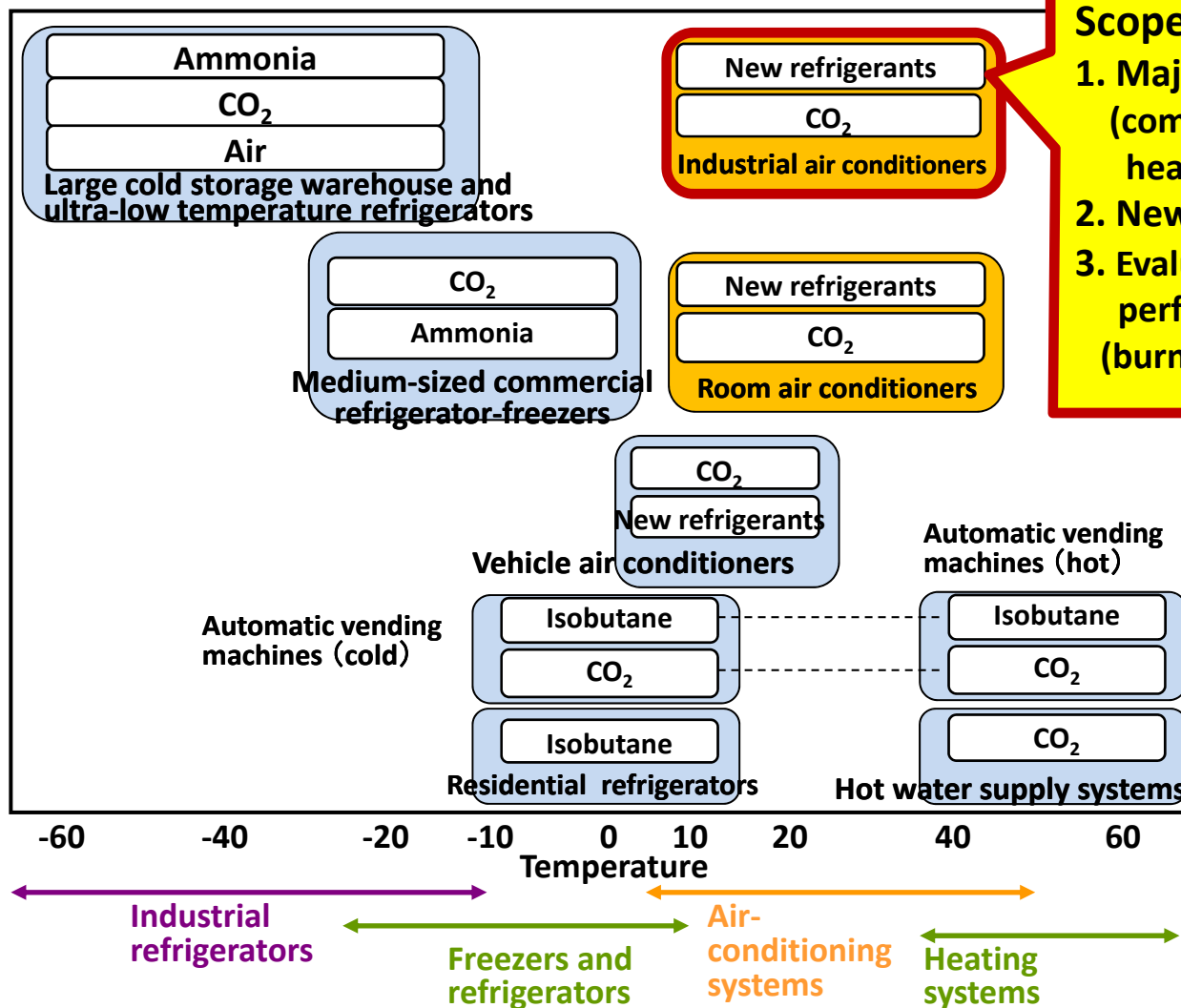


## Technology Development of High-Efficiency Non-Fluorinated Air Conditioning Systems (2011–2015)

Large amount of refrigerants



Small amount of refrigerants



**Scope of development**

1. Major equipment (compressors, heat exchangers, etc.)
2. New refrigerants
3. Evaluation of refrigerant performance and safety (burnability, toxicity, etc.)

Products not yet commercialized

Commercialized products

Alternative refrigerants for various types of equipment

## 7. Conclusions

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1. To reduce ODS emissions originating from fluorocarbons and GHGs, NEDO has carried out many projects based on the roadmap prepared by the Japanese government for over nearly 20 years.
2. NEDO is not only developing different kinds of refrigerating and air conditioning systems using natural refrigerant (CO<sub>2</sub>, ammonia, air, etc.). It also is assisting in the practical application of freezer showcases using CO<sub>2</sub>-based refrigerant in supermarkets and convenience stores through research, development and demonstration activities.
3. NEDO is carrying out technology development of commercial air conditioning equipment that uses low-GWP refrigerant (CO<sub>2</sub>, HFO-123yf, HFO-1234ze, etc.) and is evaluating the performance and safety of the refrigerant. We also consider that the results will be embodied in amendment of laws in the future .

*Thank you*

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Shinji Kakuno

New Energy and Industrial Technology Development  
Organization (NEDO), Japan