

MAYEKAWA's Natural Refrigerant Technology

13/02/2018
Akito Machida

MAYEKAWA's Proposal with [Natural Five]

[Natural Five] are natural refrigerants utilized for refrigerators & Heat Pumps to achieve both [Energy Saving] and [No use of Fluorocarbons]. Mayekawa has developed wide range of application with [Natural Five].



Air Cycle refrigerator
"PascalAir"



NH₃/CO₂ Indirect Cooling System
"NewTon"



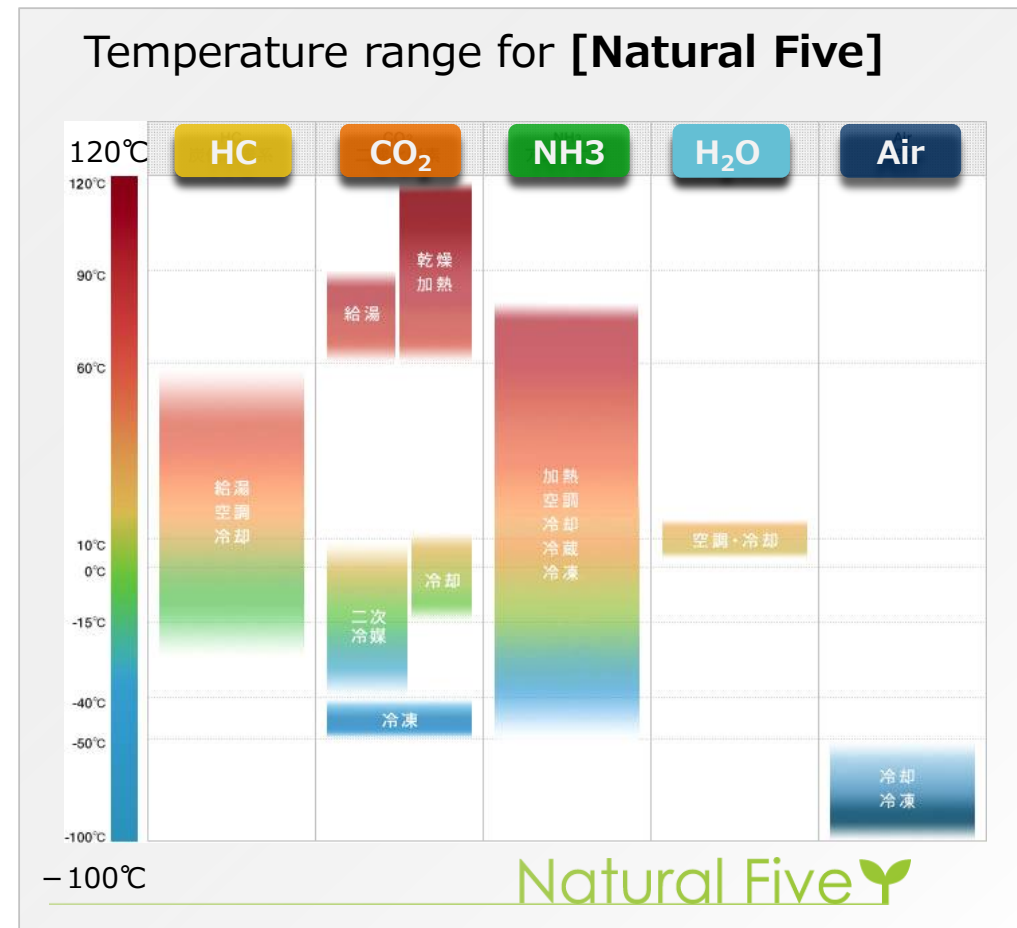
Adsorption Refrigerator
"AdRef-Noa"



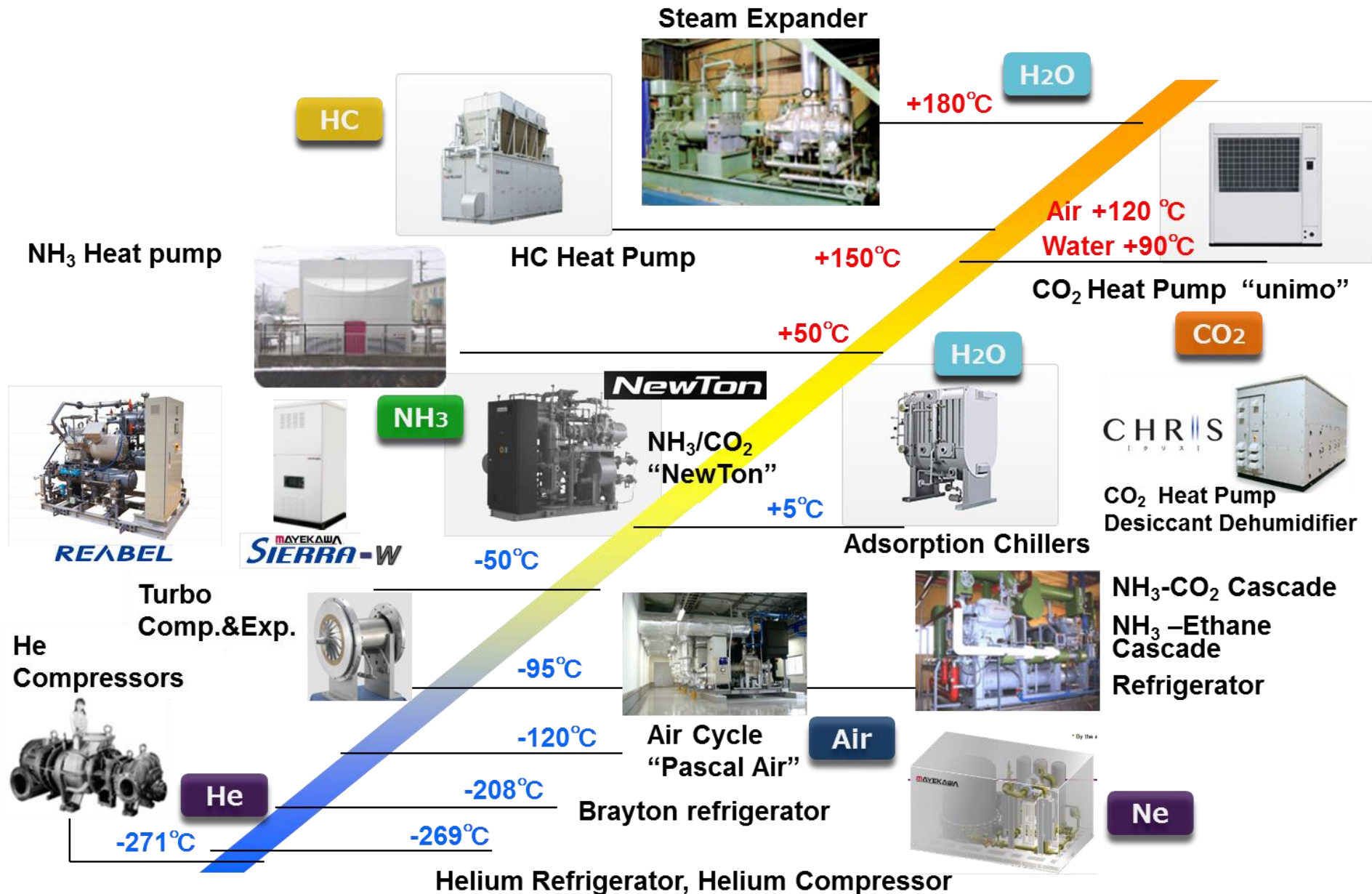
"Eco Cute" unimo

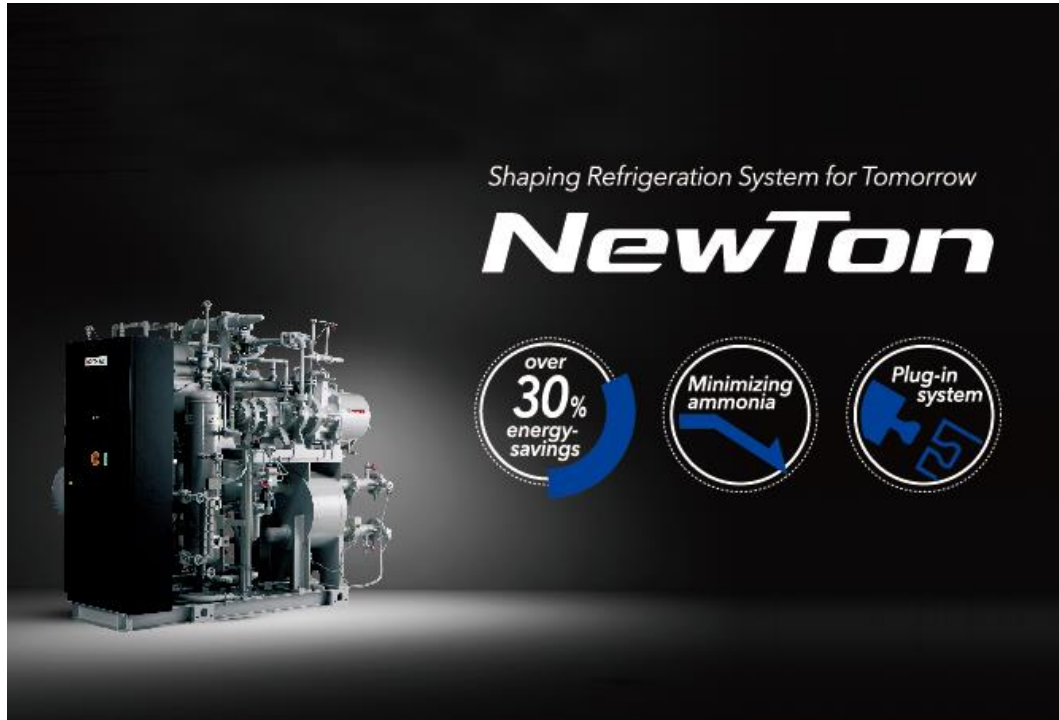


Heat Pump
with high efficiency



MAYEKAWA's Refrigerators and Heat Pumps using Natural Refrigerants





Compound Screw Compressor for **NewTon-R,F**



Single-stage Screw Compressor for **NewTon-C**

Energy Saving

- IPM Motor-driven Semi-Hermetic Screw Compressor
- Matrix Converter for IPM Motor
- New Screw Profile for NH₃
- Shell & Plate Heat Exchanger

Safety

- "Indirect Cooling" method minimizing NH₃ circulation area
- Minimum NH₃ Charge: 21kg (R-3000)
- Bellows valves

Compact

- Downsizing: 24% less in weight
- Packaging for shorter installation

Support

- Remote Monitoring for Predictive Maintenance
- Maintenance Support 24hr/365day

"NewTon" Products Line-up

| Application | | Type (Capacity) | | Liquid CO ₂ supply |
|----------------|---------|--|--|---|
| Cold Warehouse | Frozen | Reabel (37.6kW) R-3000 (94.7kW) R-6000 (189.4kW) R-8000 (270.0kW) | | CO ₂ supply: -32°C (in-house temp. : -25°C) |
| | Chilled | Sierra C (24.1kW) (237.0kW) | | CO ₂ supply: -5°C (in-house temp. : -2°C) |
| Freezer | | F-300 (70.0kW) F-600 (140.0kW) F-800 (170.0kW) | | CO ₂ supply: -42°C (inside freezer : -35°C) |
| Ice Rink | | S (185.0kW) | | CO ₂ supply: -11°C |



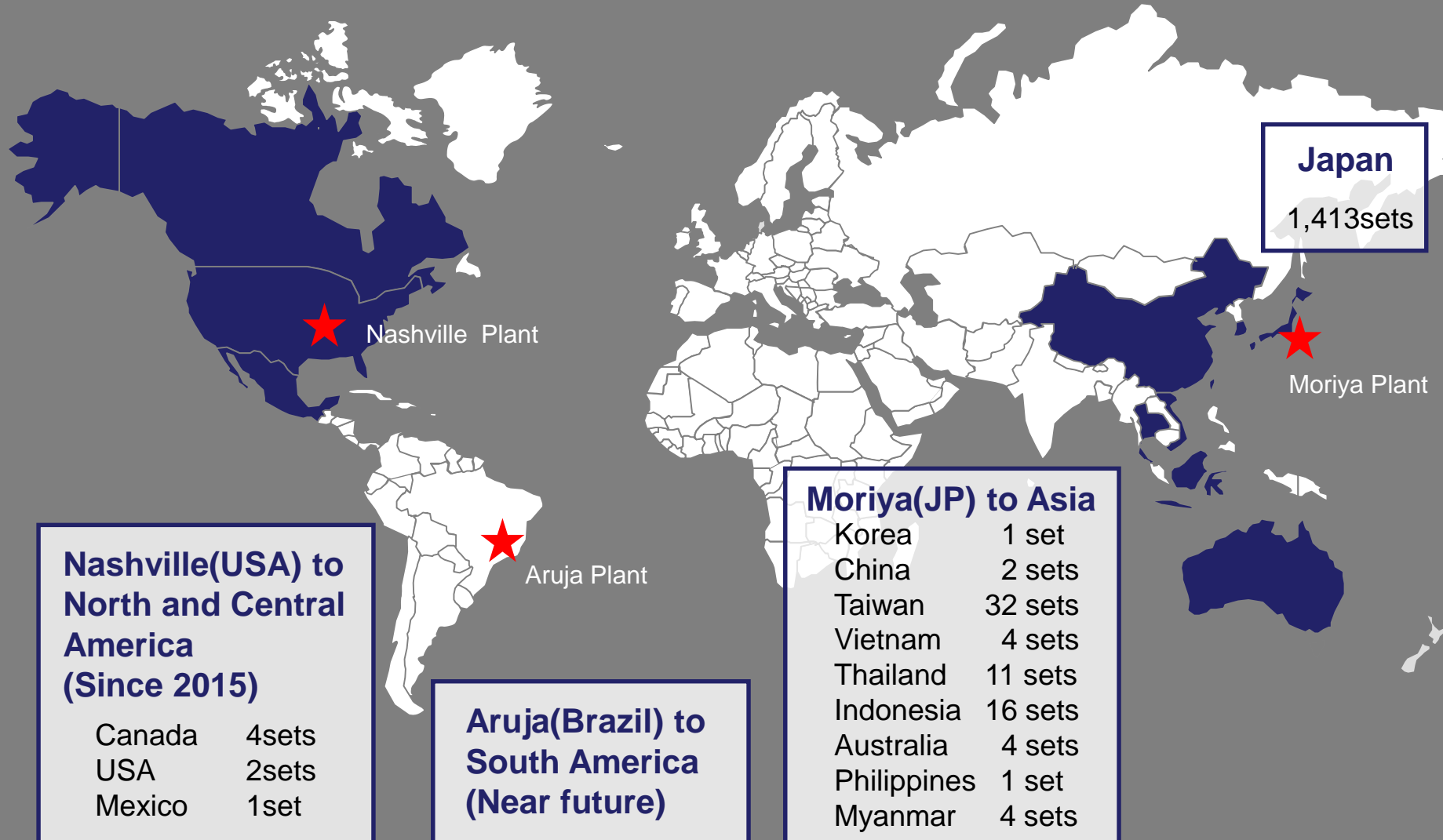
NewTon R-3000, NewTon F-300



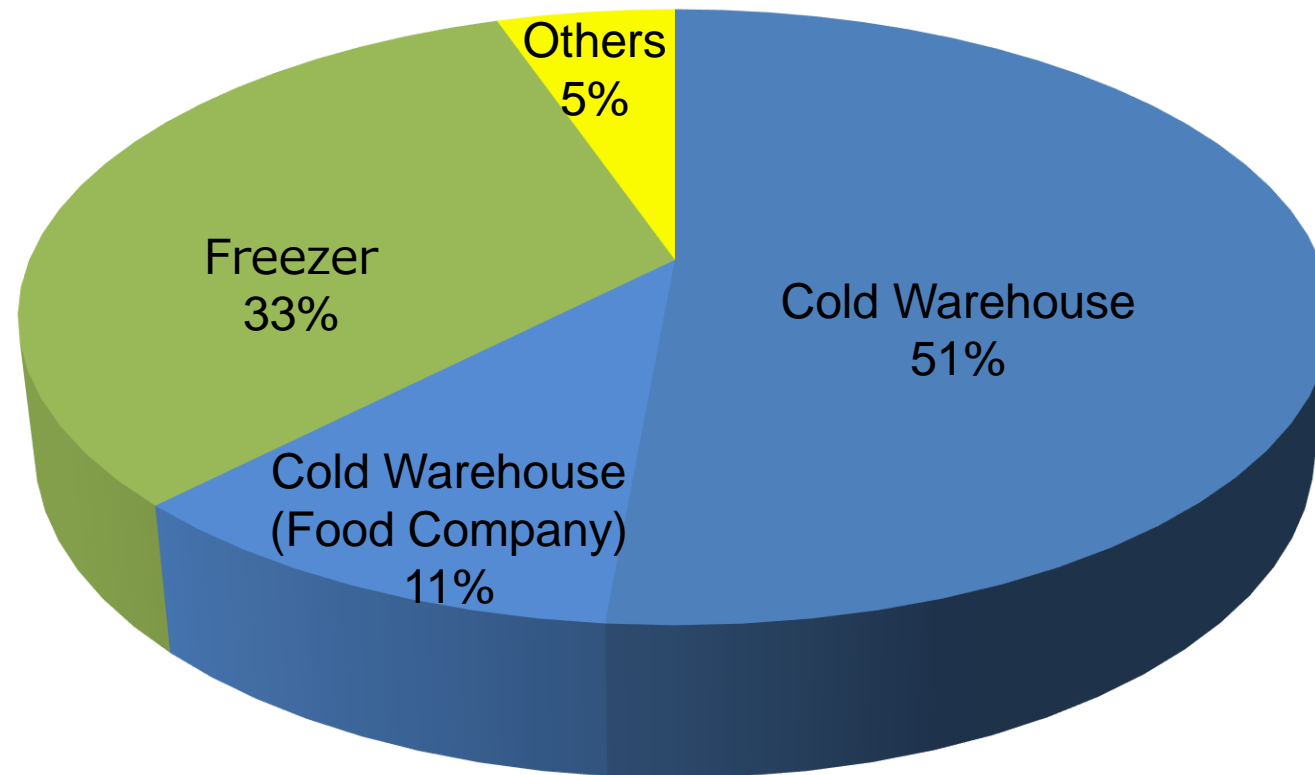
NewTon C, NewTon S

【Energy saving】
▲16~41%
【Installation】 as of 2017
1,495sets

NewTon to the World



Installation from 2014 to 2017, breakdown by market (Total 1103 sets)



NH₃/CO₂ Cooling System "REABEL" for Small-Scale institution

REABEL



W2,000×L2,830×H2,220

Energy Saving

- Semi-Hermetic Compound Reciprocating Compressor
- Capacity control with the Inverter

Safety

- "Indirect Cooling" method minimizing NH₃ circulation area
- Minimum NH₃ Charge: 18kg

| | |
|------------------------------------|---|
| CO ₂ Supply Temperature | -42 ~ -27°C |
| Legal Capacity | 9.80 RT |
| Compressor Type | Semi-Hermetic Compound Reciprocating Compressor |
| Nominal Power of Motor | 22kW |
| NH ₃ Charge | 18kg |

NH₃/CO₂ Chilling Package "SIERRA" Scroll NH₃/CO₂ Cooler Unit



MAYEKAWA
SIERRA-W
W800×L900×H1,630



MAYEKAWA
SIERRA-A
865W×1100 L ×H1,970







| | |
|------------------------------------|---------------------------------|
| CO ₂ Supply Temperature | -15~+5°C |
| Legal Capacity | 4.94 RT (Refrigerating Ton) |
| Compressor Type | Semi-Hermetic Scroll Compressor |
| Nominal Power of Motor | 8.9kW (IPM Motor) |
| NH ₃ Charge | 3.5kg |



Products Line-up

Food Plant, Manufacturing Plant
Hotel, Hospital, Spa, etc

| unimo ^{AW} | unimo ^{WW} | unimo ^{AWW} | "Eco Sirocco" |
|---|---|---|--|
| Air-source "Eco Cute" | Water-source "Eco Cute" | Air-source/Water-source "Eco Cute" | Water-source CO ₂ Heat Pump Supplying Hot Air |
|  About 700set |  About 200set |  About 50set |  About 100set |
| Supply of Hot water 65°C~90°C | Supply of Hot water 65°C~90°C And Cold water -9°C~35°C | Supply of Hot water 65°C~90°C or Supply of Hot water 65°C~90°C And Cold water -9°C~35°C | Supply of Hot air 80°C~120°C and Cold water -9°C~35°C |

CO₂ Heat Pump Desiccant Dehumidifier "CHRIS"

Combination of CO₂HP and Desiccant Dehumidifier

- Dehumidification in low temperature environment
- CO₂ Heat Pump for regeneration of desiccant material

Cargo handling yard in cold storage warehouse, Food Plant, Manufacturing Plant, Ice Rink

CHRIS
[クリス]



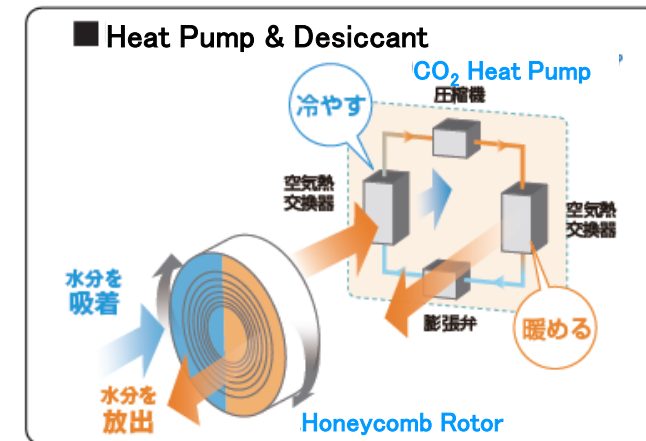
It was hazy and the visibility was not good.



Before



After



【Installation】 as of 2017.12 50sets

Snow Melting CO₂ Heat Pump

Energy Saving

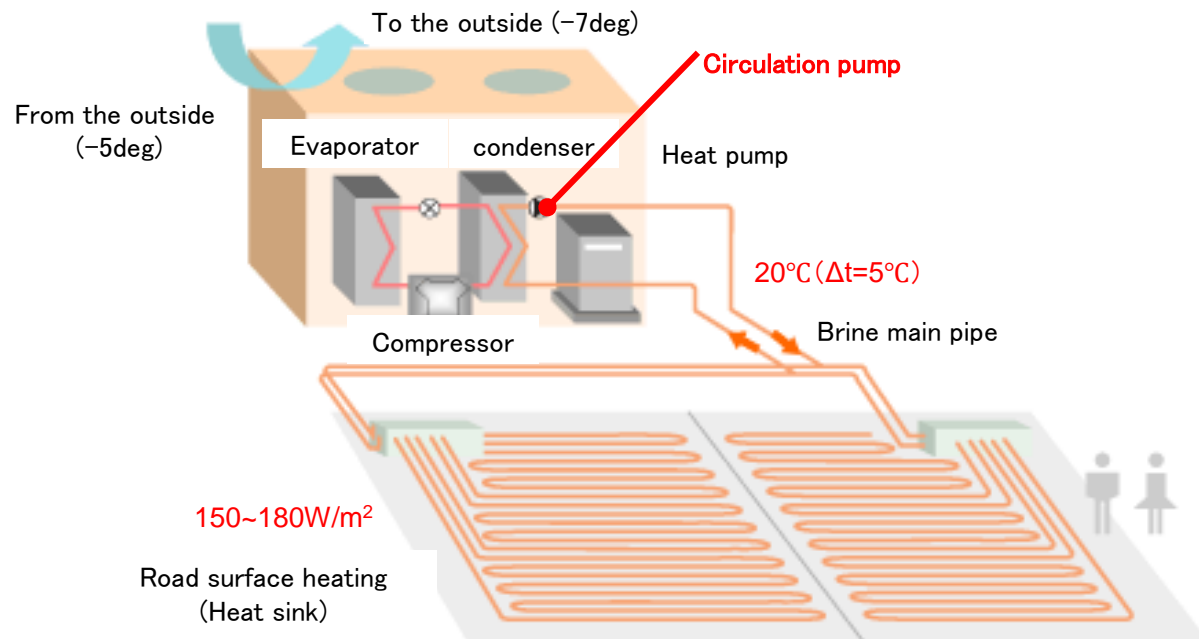
- Semi-Hermetic Reciprocating Compressor
- Energy saving compare to boilers or heaters

Safety

- CO₂: Eco-friendly and safe

Compact

- Smaller footprint for the installation



[Installation] more than 25sets

Air cycle refrigeration system

PascalAir



No air cooler
No fan motors
No defrost
Ducts easily installed

Super-low temperature Warehouse
Food Plant, Pharmaceutical Plant

■ Super-low temperature Warehouse (Bonito, Tuna fish)

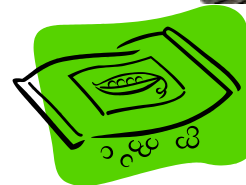
circulation of super-low temperature air
to keep in-house temperature

■ Freezer for Food

quick freezing with super-low temperature air

■ Brine Cooler

cold brine cooled by super-low temperature air



【Installation as of 2017.12】

PAS30-R x81sets

PAS30-F x 7sets

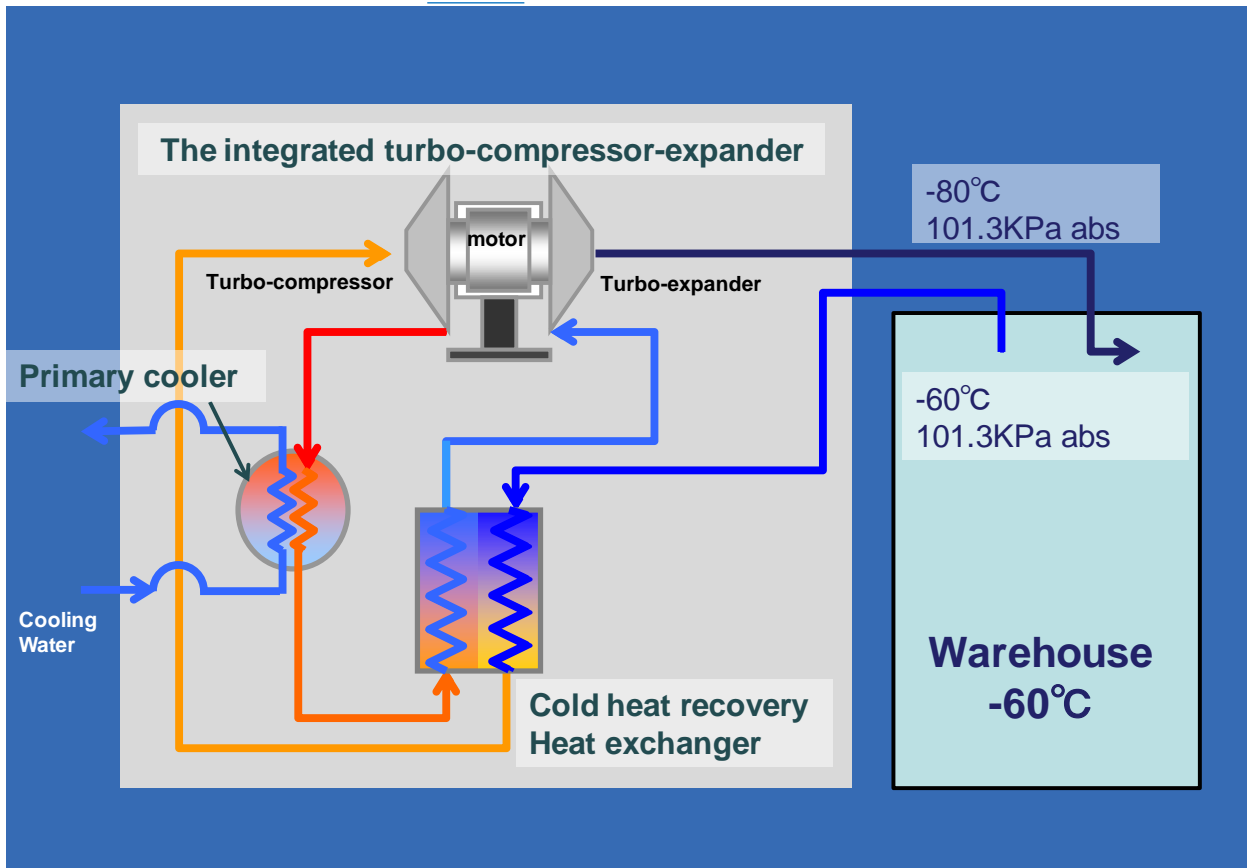
PAS30-B x 4sets

PAS15-R x 6sets

Total 98 sets

Air cycle refrigeration system "Pascal Air"

PascalAir



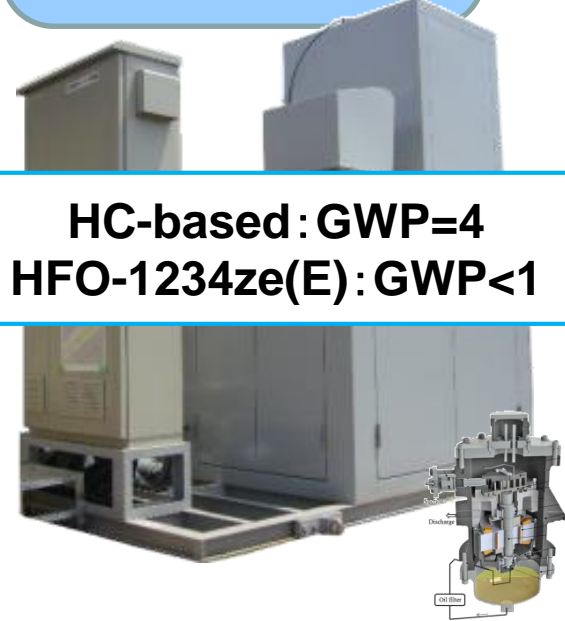
- ◆ Refrigerant is "Air" **Global environment load : Zero**
- ◆ **50% Energy conservation**, compared with HFC23/HCFC22 cascade system
- ◆ The **safest** system for product, worker and neighborhood
- ◆ **No regulation** by the "high-pressure gas preservation law"
- ◆ No air cooler, and air duct in a room

Development of High temperature Heat Pumps



90°C Circulation HP

Supply of Hot water:
65°C~90°C
Heat capacity: 35kW
Compressor: Scroll
Circulation heating



HC-based: GWP=4
HFO-1234ze(E): GWP<1

150°C Supplying HP

Supply of Hot oil:
(heating medium)
120°C~150°C
Heat capacity: 260kW
Compressor: Screw
Circulation heating



n-Pentane
GWP=3

Sponsored by NEDO

200°C Supplying HP

Supply of Hot oil:
(heating medium)
160°C~200°C
Heat capacity: 500kW
Compressor: Turbo
One-way heating



n-Butane
GWP=15

Sponsored by METI & NEDO

※ GWP values based on the IPCC's 5th report or Ministry of the Environment report.



ATMO
sphere

Business Case for
Natural Refrigerants

13/02/2018 – Tokyo

MAYEKAWA
MYCOM

**Thank you
for your attention**

MAYEKAWA

株式会社 前川製作所

Web Site of MAYEKAWA

<http://www.mayekawa.co.jp/>