

**Actual Energy Conservation by  
Using NewTon “NH<sub>3</sub>/CO<sub>2</sub>” in  
Cold Storage and Freezer**

**2014 Sep.**

**Mayekawa Mfg.Ltd.,Co.**

## **Contents**

- 1. Environment issue and Natural Refrigerants**
- 2. Characteristics of NewTon**
- 3. Energy conservation in Cold Storage**
- 4. Energy conservation in Freezer**
- 5. PCAS Monitoring System**

# **1. Environment issue and Natural Refrigerants**

**1-1 Environment issue and Natural Refrigerants**

**1-2 NATURAL FIVE**

**1-3 Examples of Natural Refrigerant Application**

# 1-1 Global Environment Issues

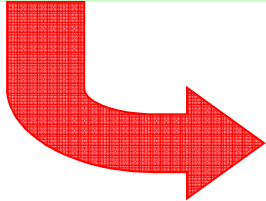
## Ozone Depletion

**Montreal Protocol**  
**CFC** : banned in 1996  
**HCFC** : Limited from 2004  
**Totally Banned in 2020**

## Global Warming

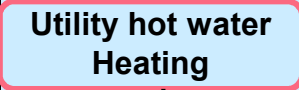







**Kyoto Protocol**  
Reduction of global warming gas by 6% from 1990 level in the first period of 2008 ~2012). **HFC are the target**

Freon Recycling Law: **CFC,HCFC,HFC**  
PRTR Law (chemical gas): **HCFC22,HCFC123**, Ethylene glycol, etc.  
Introduction of Environment Tax, Freon Tax to industries

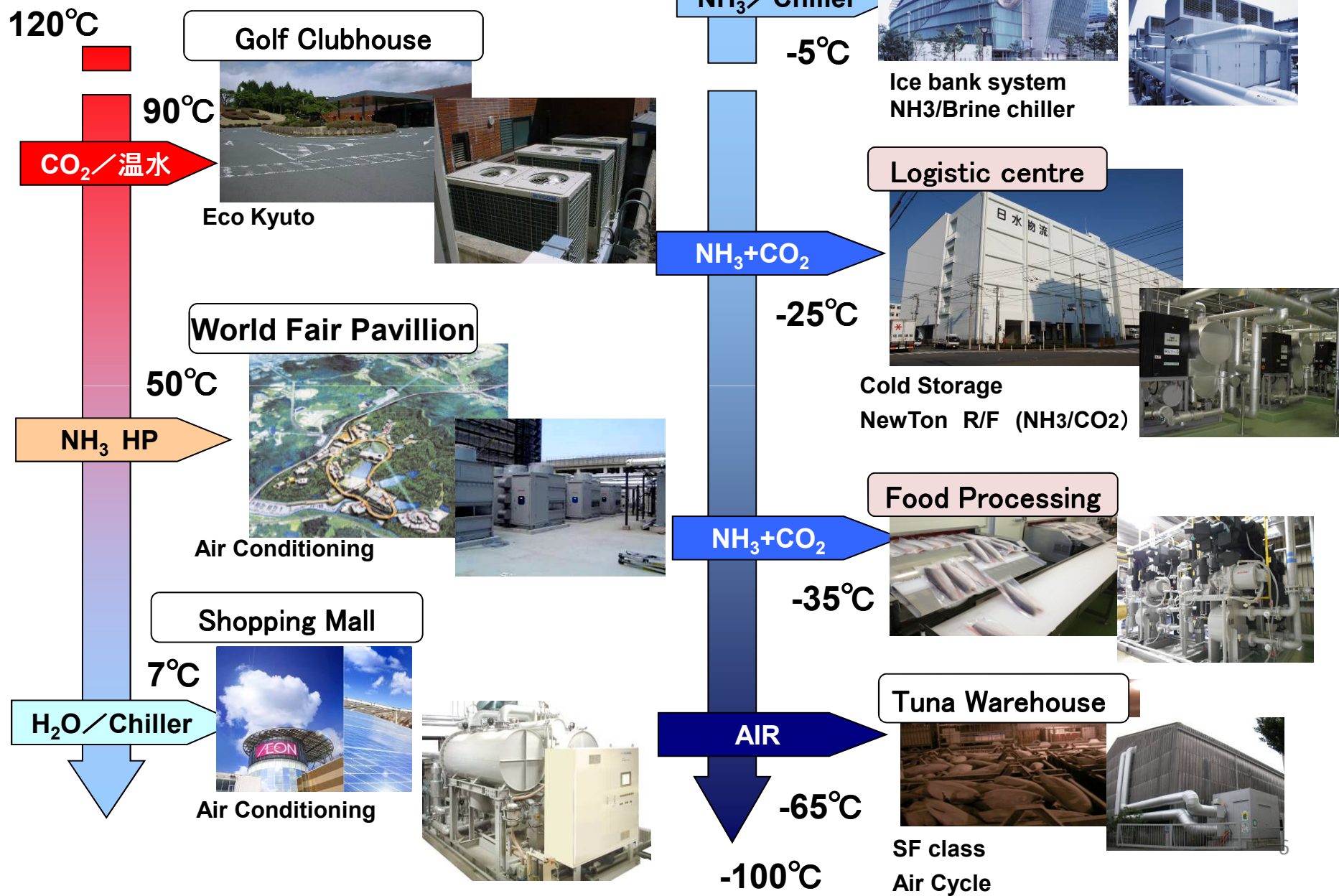


*Demand for use of Natural Refrigerant has increased*

# 1-2 “Natural Five” Refrigerants and Product Solutions

Refrigerant (Natural Five)	NH <sub>3</sub> Ammonia	CO <sub>2</sub> Carbon Dioxide	HC Hydro Carbon	H <sub>2</sub> O Water	Air
90°C 60°C 10°C -15°C -25°C -40°C -50°C -60°C -100°C	 Utility hot water Heating Chilled water Ice making Cold storage, Freezer, Fish boat <b>Specific Refrigeration needs</b> Freezer, Freezed-dry, Super Low temp storage 	 Utility hot water Chilled water Ice making Cold storage, Freezer, Fish boat <b>Specific Refrigeration needs</b> Freezer, Freezed-dry, Super Low temp storage 	Utility hot water Heating HVAC 	 Heat recovery Chiller 	 Cryogenics
Notes	<ul style="list-style-type: none"> <li>• Conventional system</li> <li>• National Projects</li> </ul>	<ul style="list-style-type: none"> <li>• Eco-Cute</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Butane + Propane</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Adsorption</li> <li>• Heat Recov.</li> </ul>	<ul style="list-style-type: none"> <li>• Nat'l Proj.</li> <li>• Air-cycle</li> </ul>

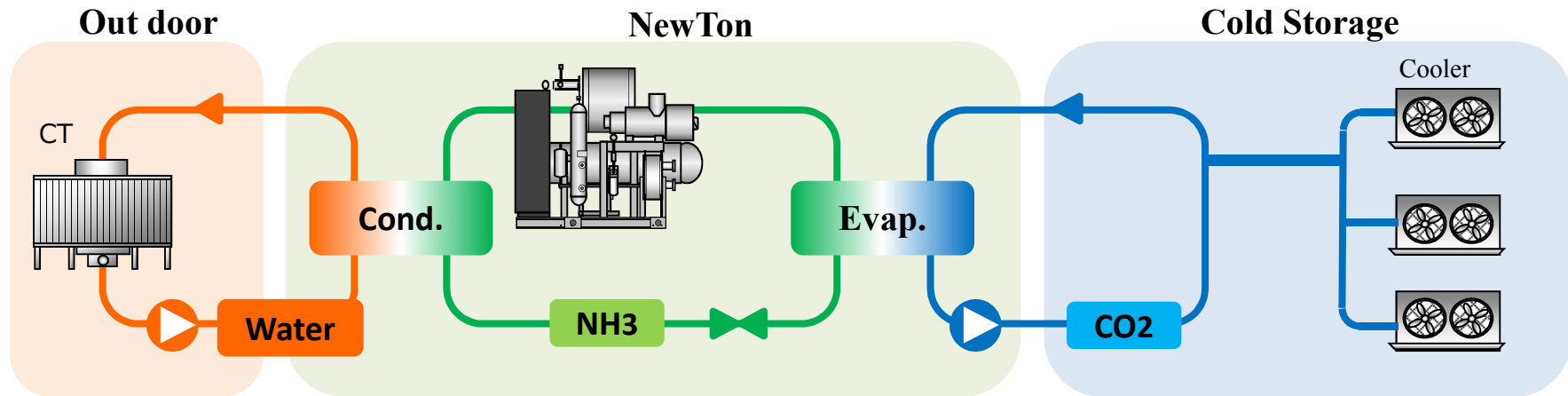
# 1-3 Natural Five Applications



## **2. Characteristics of NewTon**

- 2-1 Basic Concepts**
- 2-2 NH<sub>3</sub> New Screw Compressor**
- 2-3 IPM Motor**
- 2-4 New Rotor Profile ---**
- 2-5 Refrigeration Cycle**
- 2-6 Line Up**
- 2-7 Installation**

# Basic Concept of *NewTon*



## Water cooled

- Energy saving
- $NH_3$  charge min.
- Free layout
- Easy Maintenance



## $NH_3$ Package

- New Screw compressor
- Semi-hermetic IPM motor
- Flooded Evaporator
- Double economizer
- Automatic operation



## CO<sub>2</sub> brine

- Safety
- Low pump power
- No trouble by oil
- High heat transfer

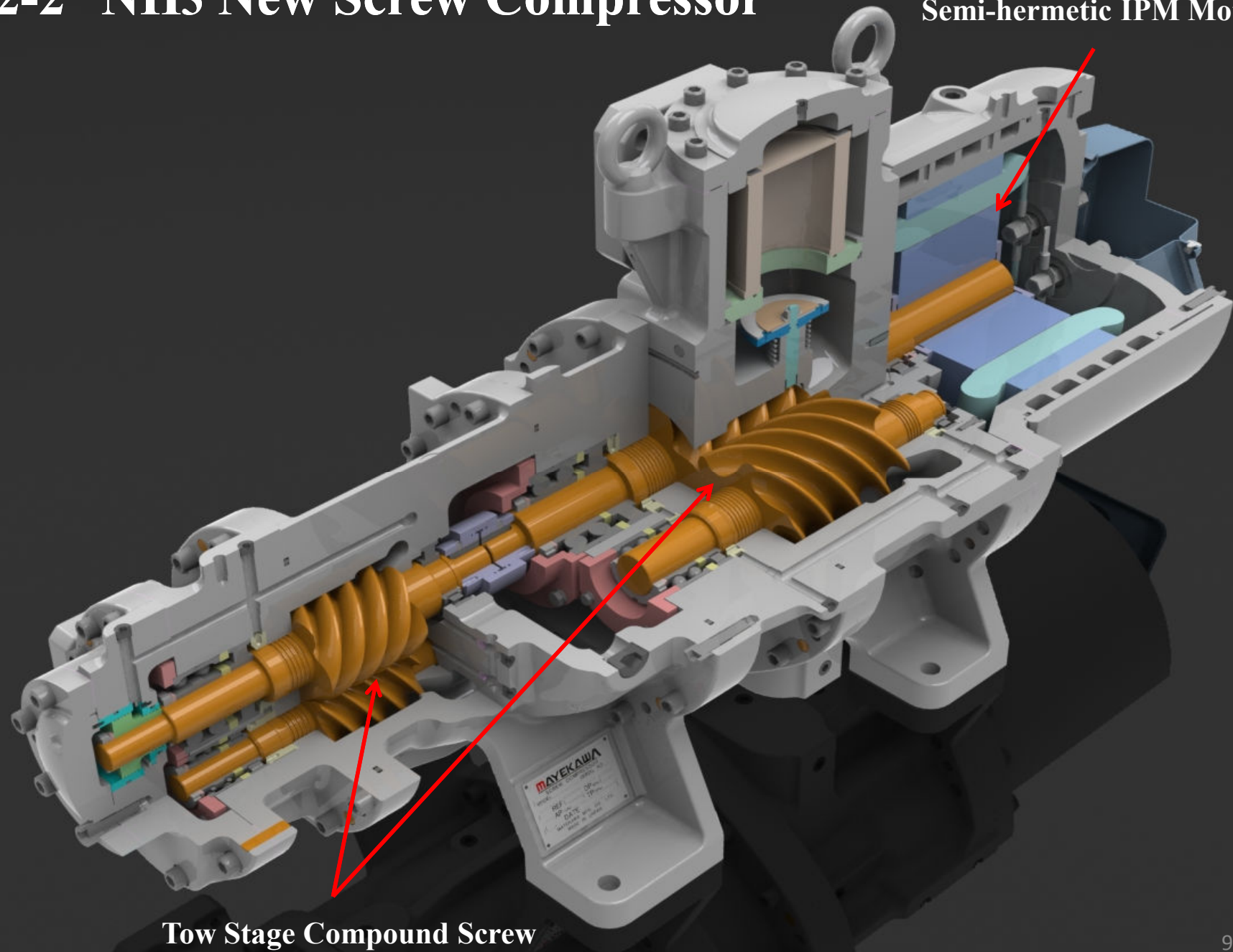


「Safety」 「Energy saving」 「Easy maintenance」



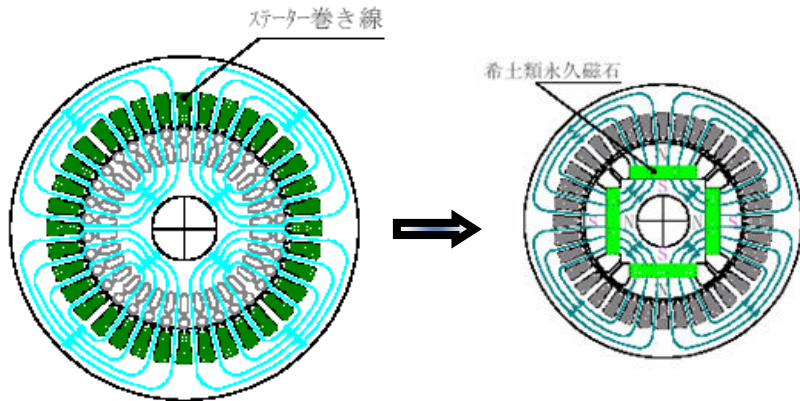
## 2-2 NH3 New Screw Compressor

Semi-hermetic IPM Motor



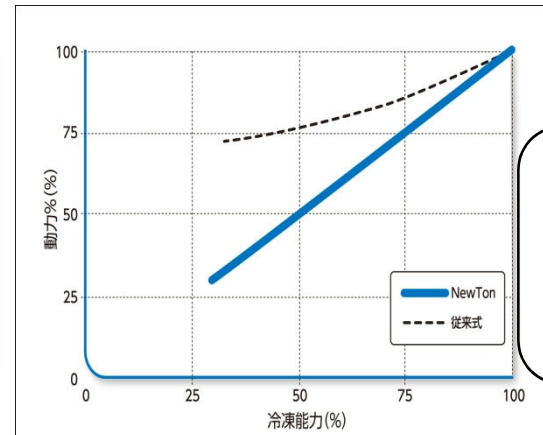
Tow Stage Compound Screw

# 2-3 High Efficiency Motor (IPM motor) - Semi-Hermetic for NH3 -



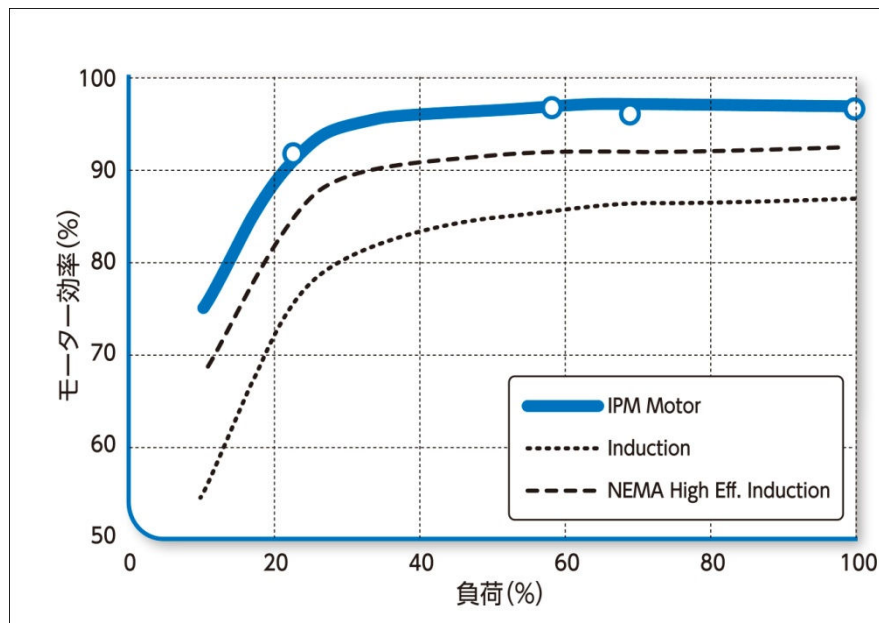
Conventional

IPM motor

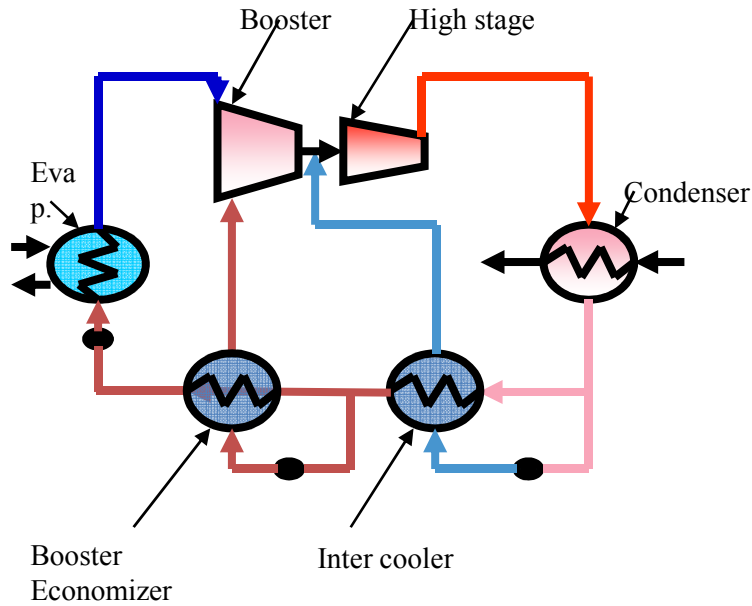


### Benefits of IPM motor

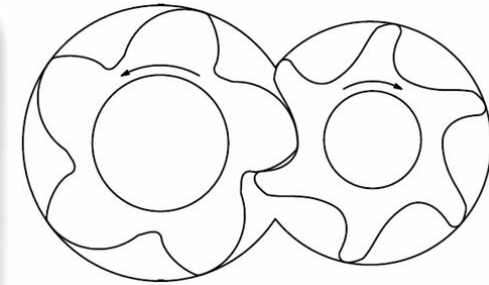
- 5~10% better in efficiency
- 40% smaller in size
- High speed is possible



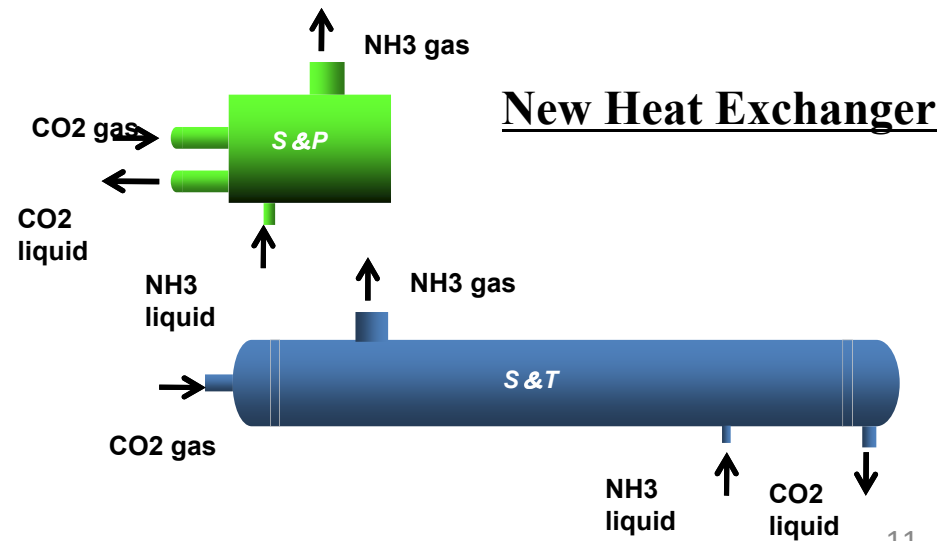
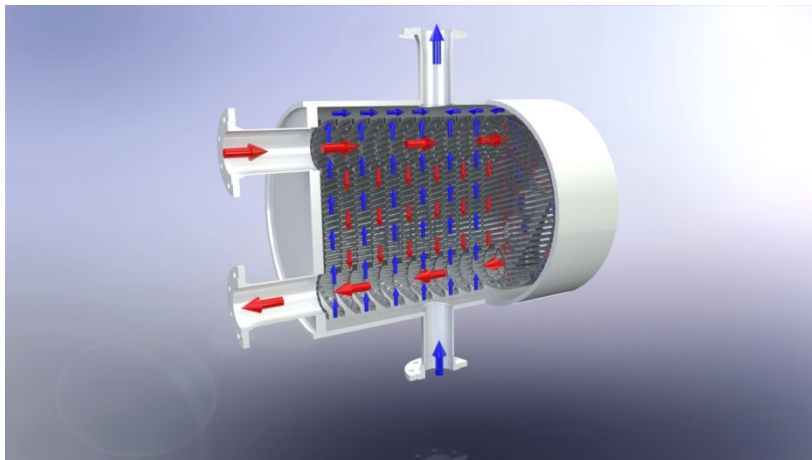
# 2-4 New Rotor Profile, Double Economizer and New Heat Exchanger



**Double Economizer**

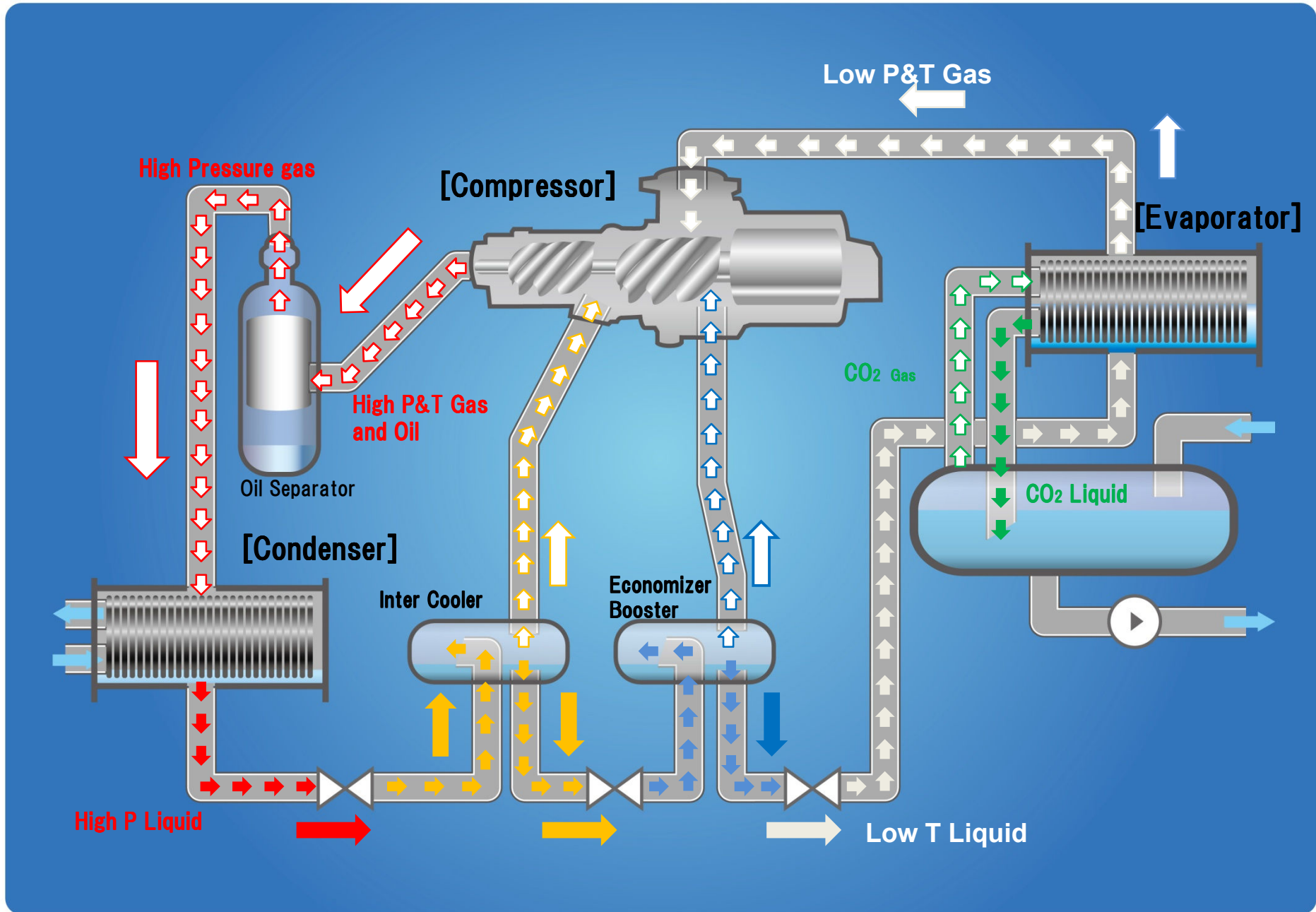


**New Rotor Profile for NH3**



**New Heat Exchanger**

## 2-5 Refrigeration Cycle



## 2-6 NewTon Lineup

Use		Model	Remarks
Cold Storage	-25C	<i>NewTon R-3000, R-6000, R-8000</i>	RT : -25°C
	0 C	<i>NewTon C</i>	platform
Freezer		<i>NewTon F-300, F-600, F-800</i>	RT:-35°C
Skate Rink		<i>NewTon S</i>	

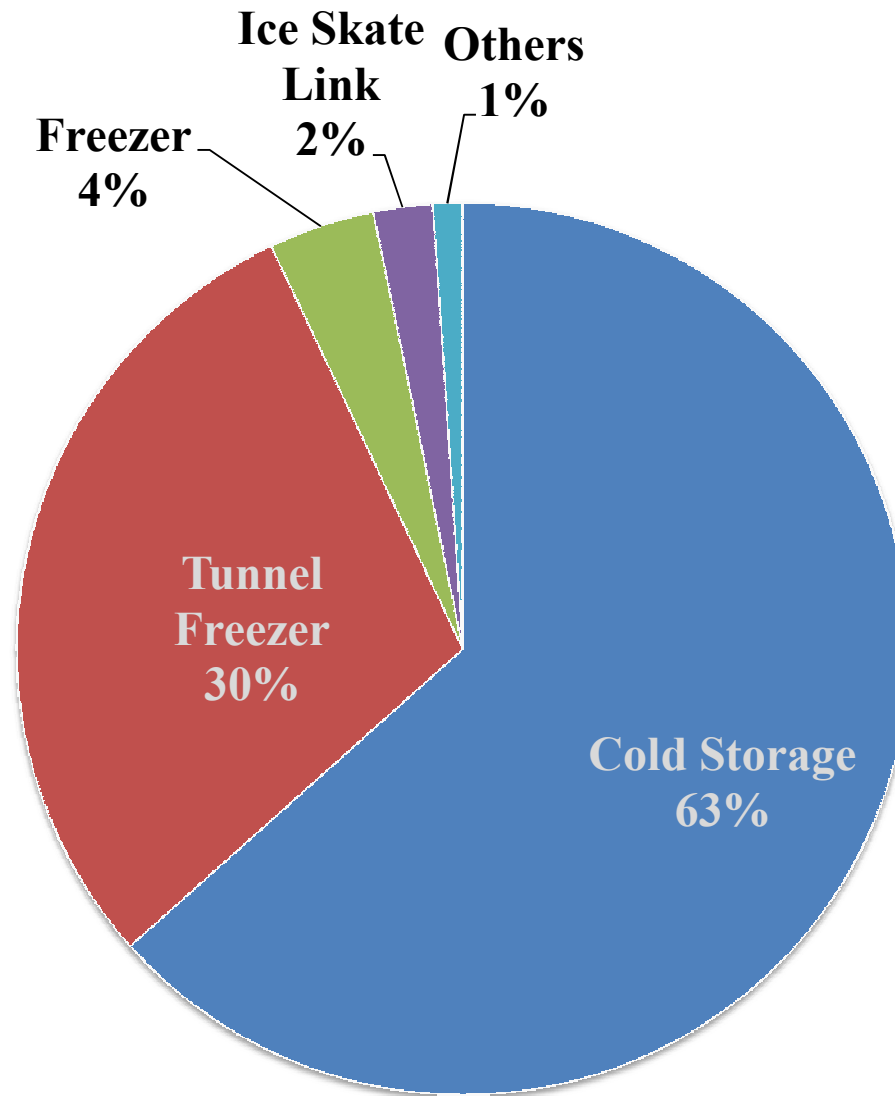


*NewTon R-3000, NewTon F-300*



*NewTon C, NewTon S*

## 2-7 Installations of NewTon in Japan



Total 600 sets are running

# **3. Energy conservation in Cold Storage**

**3-1 Main Installations**

**3-2 S.P.C. of Cold Storage**

**3-3 Power Reduction through Renewal**

**3-4 Sample of Renewal**

### 3-1 Main Installations of *NewTon*

Customer	Tonnage	Nr. of Newton	Installed
Nissui Logistics / Kawasaki	14,000	3	2008
Toyo Suisan / Nagoya	32,000	9	2009
Housui / Atsugi	8,000	2	2010
Yokohama Ritou / Osaka	27,000	8	2011
Coop / Onomichi	30,000	8	2012
Matsuoka / Kawasaki	80,000	11	2012
Nichirei Logistics / Kawasaki	(40,000)	1	2013
Maruha-Nichiro / Kawasaki	30,000	6	2014
QP Logistics / Tokorozawa	18,000	7	2014



Nissui Log. / Kawasaki



Toyo Suisan / Nagoya



Yokorei / osaka



Coop / Onomichi



Matsuoka / Kawasaki



Nichirei Log. / Kawasaki



Maruha-Nichiro / Kawasaki



QP Log. / Tokorozawa



# “Cold Storage” of 200,000m<sup>3</sup>



**Address 88 Higashi-ogijima, Kawasaki ward, Kawasaki city**

**Total ground 33,742m<sup>2</sup>**

**Building space 15,958m<sup>2</sup>**

**Floor space 53,910m<sup>2</sup>**

## **Characteristics**

**LED Lighting**

**Truck Yard x 70 units (with air shelters)**

**Vertical Lifters x 13 units, Elevators x 3 units**

**Refrigeration system operating with natural refrigerants (a subsidy by the Ministry of Environment)**



**NewTon R-8000 - 5sets**  
**NewTon F-600 - 1 set**  
**NewTon C - 4 sets**  
**NewTon B - 1 set**

# Cold Storage (-25°C) and Loading room (0 °C)



NewTon R-8000 × 5 sets

NH3 Charge 70kg / unit **Total 350kg**

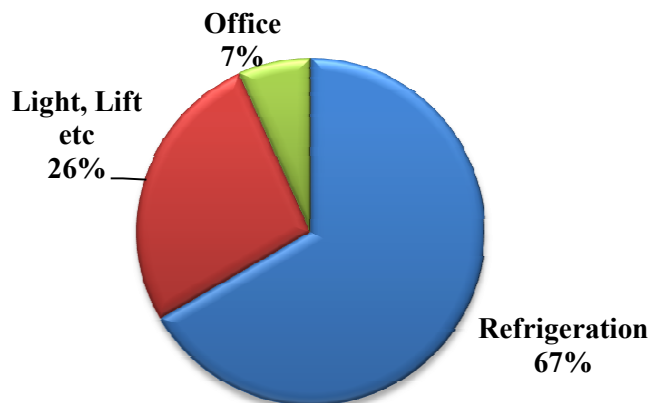
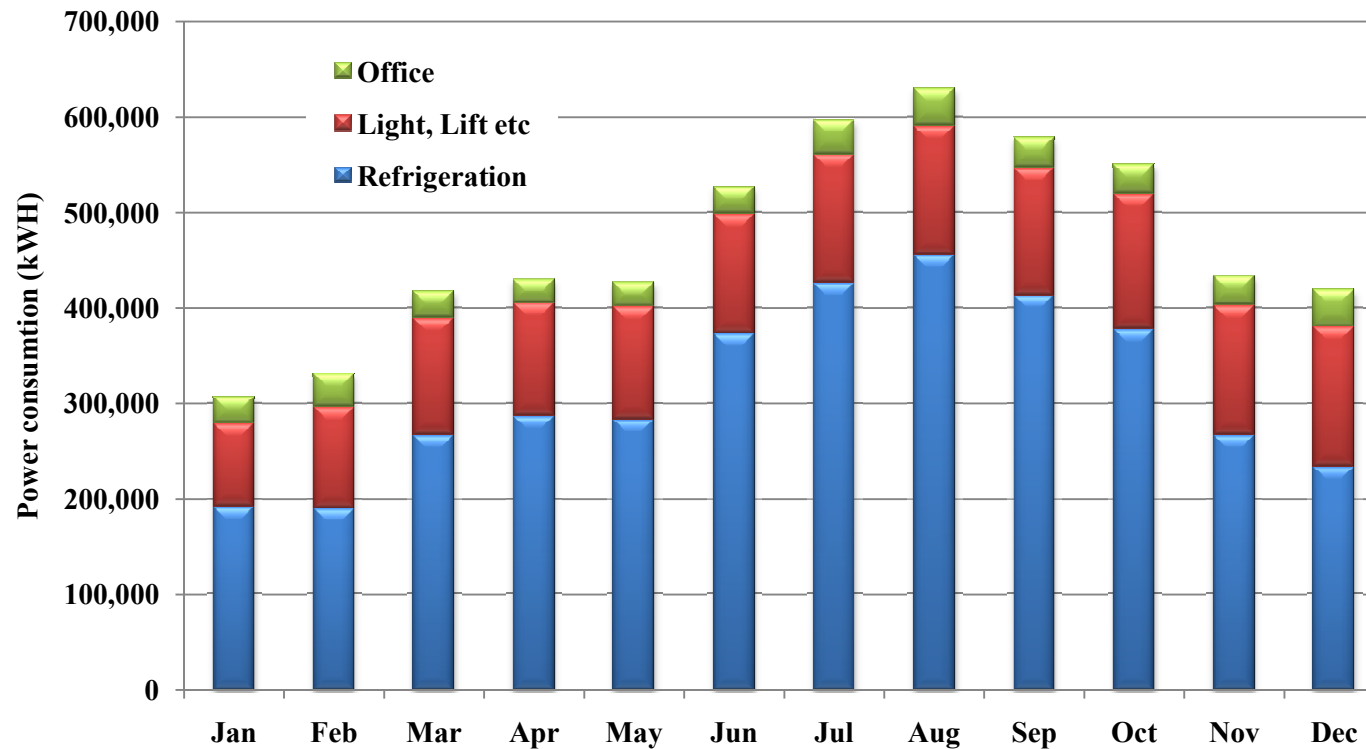


NewTon C × 4 units

NH3 Charge 60kg / unit **Total 240kg**



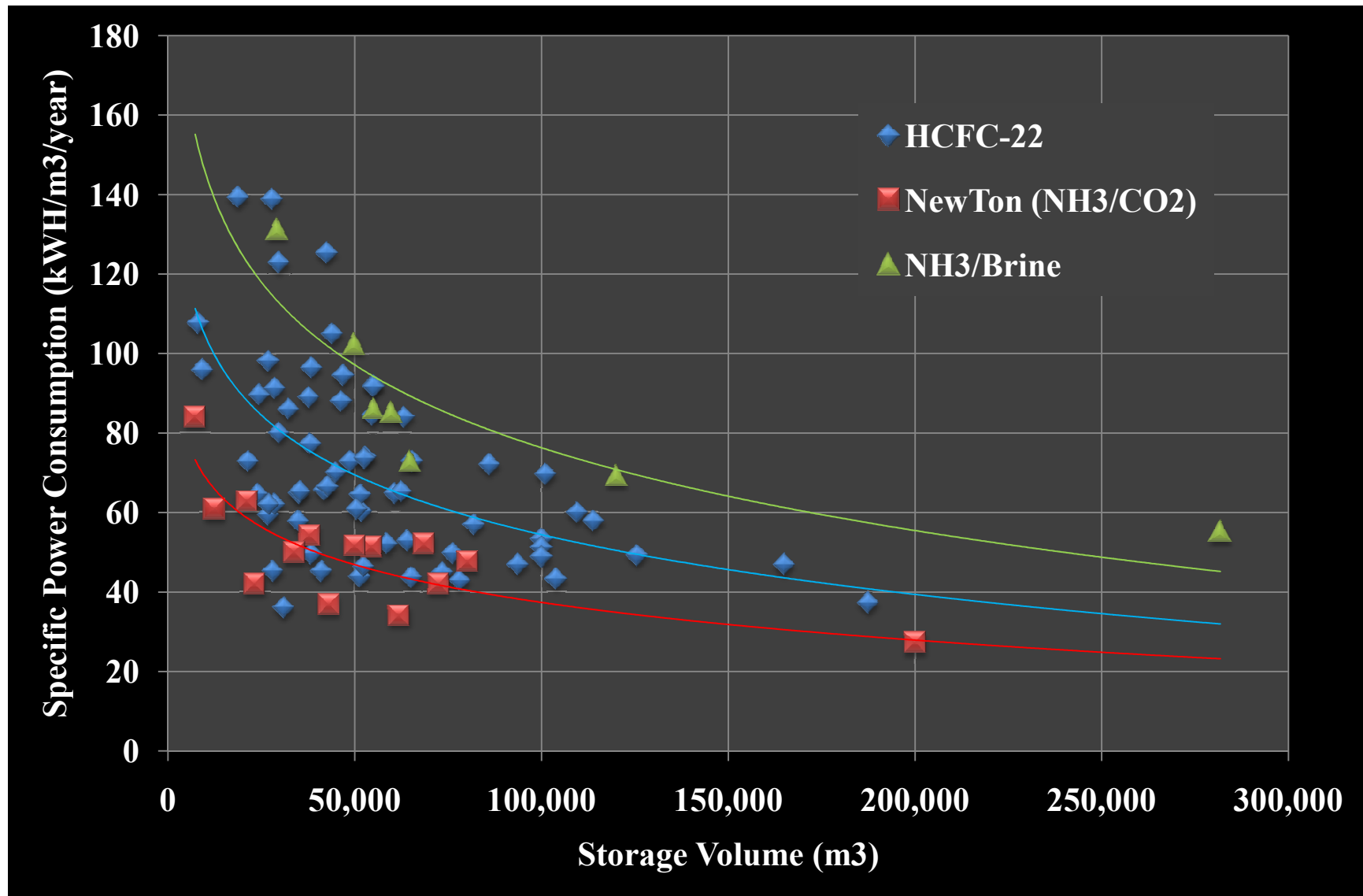
# Case 1 Power consumption data (2013)



Specific Power Consumption (kWh/m<sup>3</sup>/year)

Refrigeration	18.8
Light, Lift etc	7.9
Office	1.9
Total	28.2

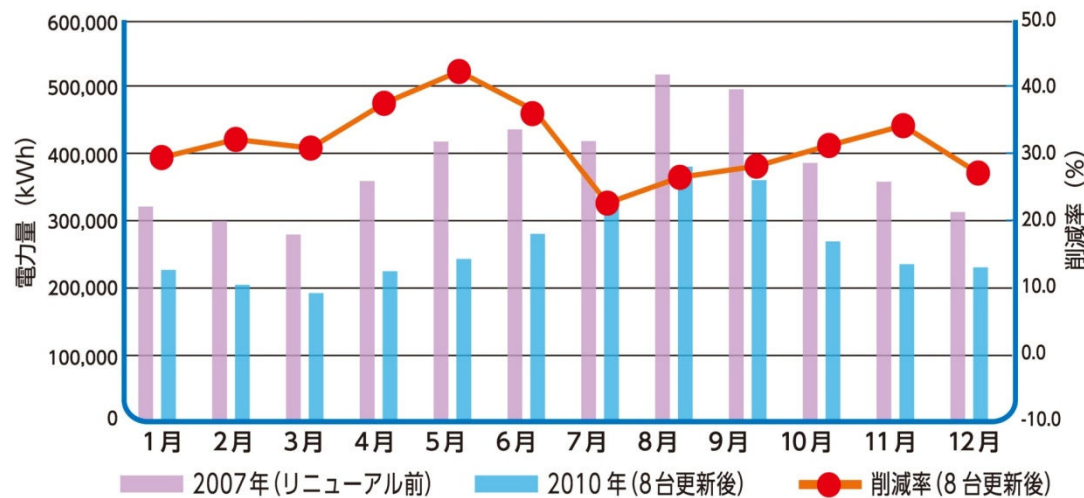
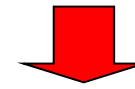
## 3-2 Specific Power Consumption in Cold Storage



### 3-3 Power reduction through renewal with NewTon

Customer	Volume	Age	Refrigerant formerly used		Power reduction
	(m3)	(year)	Refrig.	Comp.	(%)
Tokyo Toyomi	45,000	29	HCFC-22	Screw	31.1
Niigata Reizo	10,000	33	HCFC-22	Recip.	41.2
QP “Kewpie”	16,250	27	HCFC-22	Recip.	24.9
Sensui Reizo	6,125	38	HCFC-22	Screw	29.3
Ajinomoto	7,500	25	HCFC-22	Recip.	28.0
Gliko	30,000	30	HCFC-22	Screw	19.8
Showa Reizo	32,500	22	HCFC-22	Recip.	28.0
AMB Funabashi	30,000	25	NH3/Brine	Recip.	34.0

### 3-4 Tokyo Toyomi Reizo (Funabashi) “Renewal”



(average reduction -31.1%)

## **4. Energy conservation in Freezer**

**4-1 Bead dough**

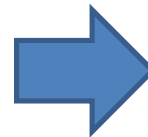
**4-2 Fish Paste**

# 4-1 Bread Dough / “Renewal”



<b>Customer</b>	<b>Kobeya Baking Co.,Ltd. / Chiba Factory</b>
<b>Product</b>	<b>Bread Dough</b>

	Previous	New
<b>Freezer Type</b>	<b>Spiral</b>	<b>Spiral</b>
<b>Compressor Type</b>	<b>F1612C</b>	<b>NewTon F600</b>
<b>Main Motor</b>	<b>130kW</b>	<b>90kW</b>
<b>Cooling Method</b>	<b>HCFC-22 DX</b>	<b>NH<sub>3</sub>/CO<sub>2</sub> L.P.</b>

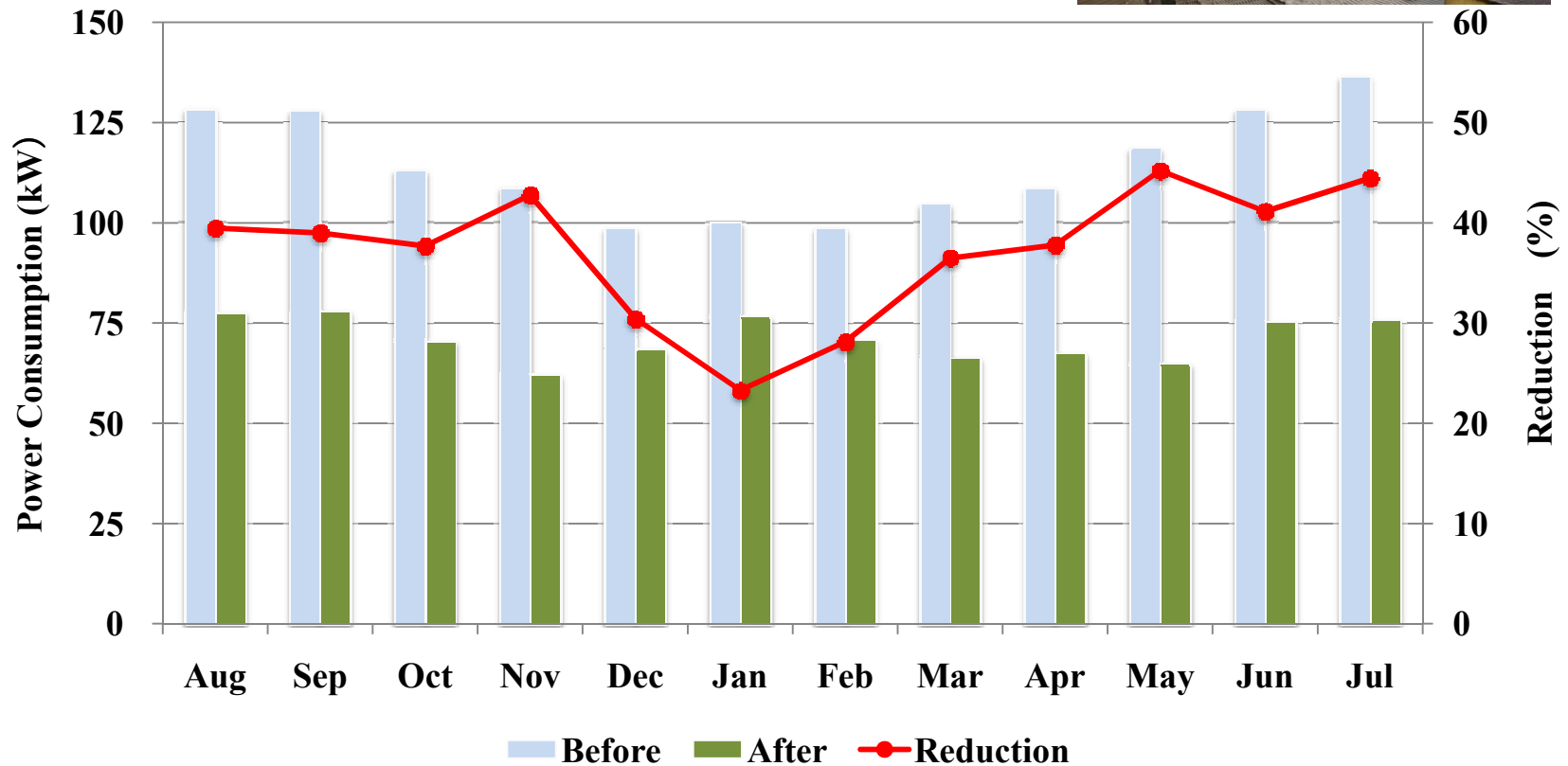




# 4-1 Bread Dough / “Renewal”



<b>Customer</b>	<b>Kobeya Baking Co.,Ltd. / Chiba Factory</b>
<b>Product</b>	<b>Bread Dough</b>



- Average power reduction of compressor was 38%

## 4-2 Fish Paste / “Extension”



<b>Customer</b>	<b>Kyokuyo Co.,Ltd.</b>
<b>Product</b>	<b>Fish Paste “Kamaboko”</b>

	<b>New</b>	<b>Existing I</b>	<b>Existing II</b>
<b>Freezer Type</b>	<b>Spiral</b>	<b>Spiral</b>	<b>Spiral</b>
<b>Compressor Type</b>	<b>NewTon F600、F300</b>	<b>N2016C</b>	<b>F62B x 2</b>
<b>Main Motor</b>	<b>135kW</b>	<b>230kW</b>	<b>180kW</b>
<b>Cooling Method</b>	<b>NH<sub>3</sub>/CO<sub>2</sub> L.P.</b>	<b>NH<sub>3</sub>/CO<sub>2</sub> L.P.</b>	<b>HCFC-22 DX</b>



**NewTon (NH<sub>3</sub>/CO<sub>2</sub>)**



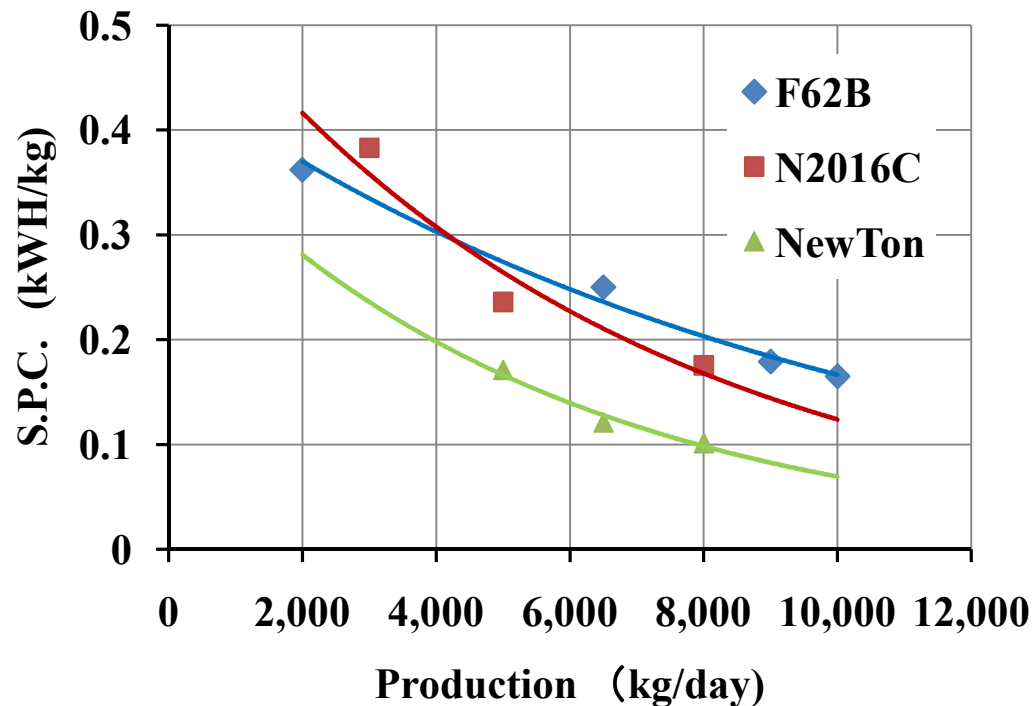
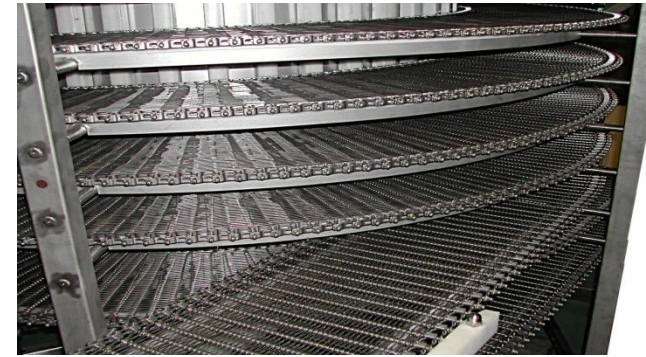
**N2016C (NH<sub>3</sub>/CO<sub>2</sub>)**



**F62B (HCFC-22)**

## 4-2 Fish Paste / “Extension”

<b>Customer</b>	<b>Kyokuyo Co.,Ltd.</b>
<b>Product</b>	<b>Fish Paste “Kamaboko”</b>



**Production vs Specific Power Consumption**

### **Comparison of S.P.C.** (at production of 8,000kg/day)

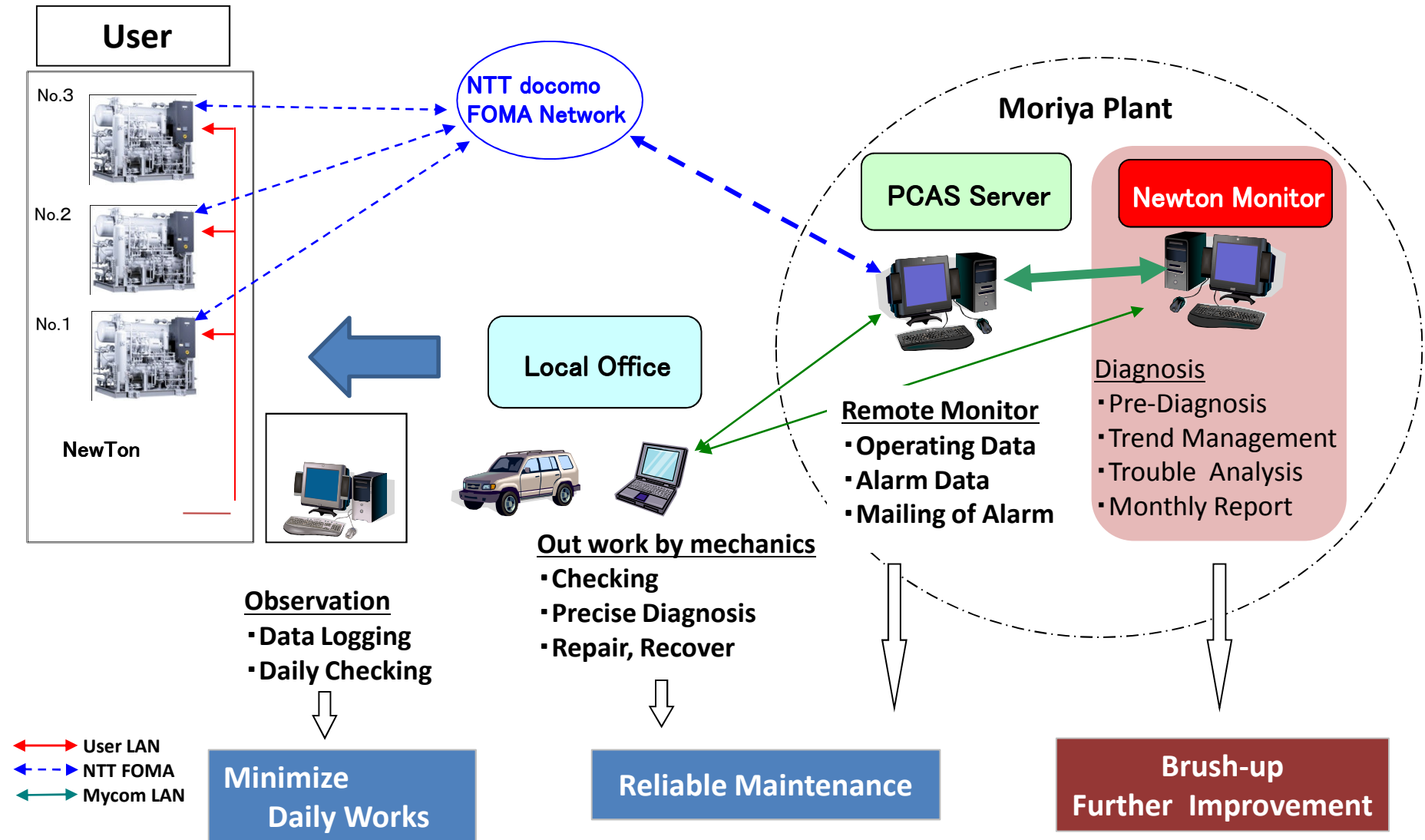
Machine	S.P.C (kWh/kg)	Ratio
F62B	0.200	1.00
N2016C	0.176	0.88
NewTon	0.101	0.51

\* S.P.C. of NewTon was 51% compared with HCFC-22, 88% compared with existing NH<sub>3</sub>/CO<sub>2</sub>.

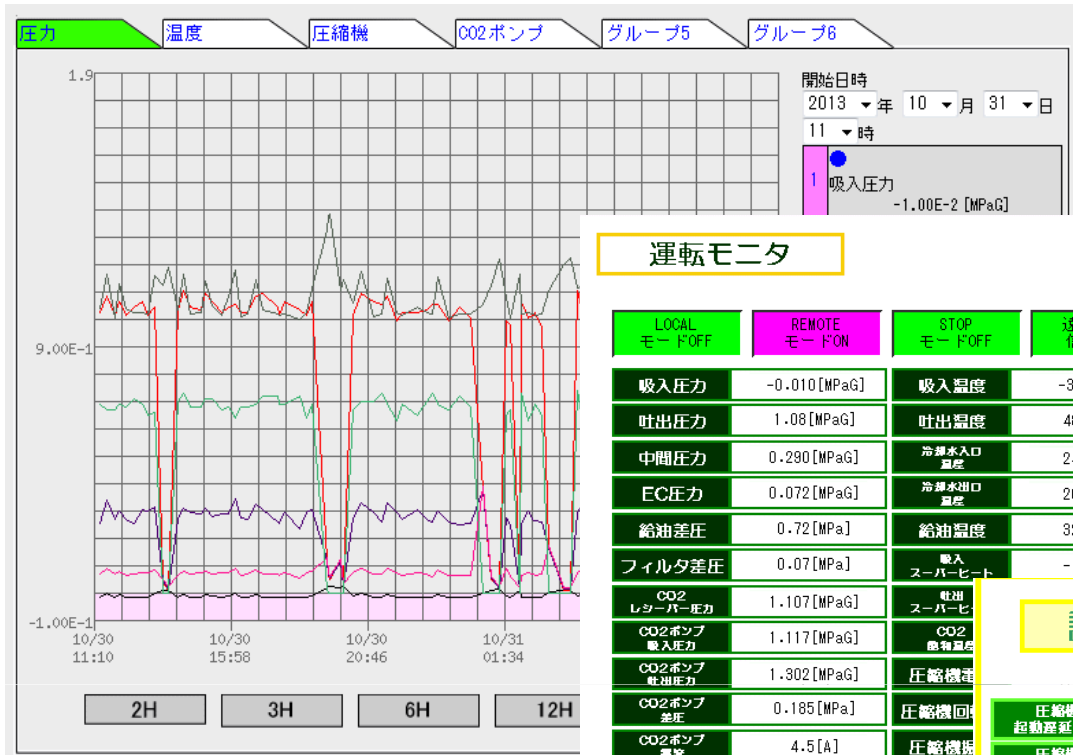
\* Power consumption data was only of Compressor.

## **5. PCAS Monitoring System**

# NewTon Monitor and Backup Network



# PCAS Server



Trend Data

## 運転モニタ

LOCAL モードOFF	REMOTE モードON	STOP モードOFF	遠隔運転 信号OFF	保持運転 信号ON	イベント 信号ON	ユニット正常
吸入圧力 -0.010 [MPaG]	吸入温度 -36.5 [°C]	吐出圧力 1.08 [MPaG]	吐出温度 48.2 [°C]	圧縮機運転 信号ON	圧縮機 運転アプON	通水確認 信号ON
中間圧力 0.280 [MPaG]	汚濁水入口 温度 24.9 [°C]	EC圧力 0.072 [MPaG]	汚濁水出口 温度 26.7 [°C]	CO2P運転 信号OFF	CO2ポンプ 運転アプOFF	イカロック 信号ON
給油差圧 0.72 [MPa]	給油温度 32.6 [°C]	フィルタ差圧 0.07 [MPa]	吸入 スーパーヒート -1.0 [°C]	補機運転 信号ON	給液 電磁弁ON	
CO2 レターバー圧力 1.107 [MPaG]	CO2 ポンプ 吸入圧力 1.117 [MPaG]	CO2ポンプ 吐出圧力 1.302 [MPaG]	CO2ポンプ 差圧 0.185 [MPa]	CO2ポンプ 電流 4.5 [A]	NH3膨張弁 開度 45.8 [%]	

## Current Operating Conditions

設定値モニタ 警報記録

## 設定値モニタ

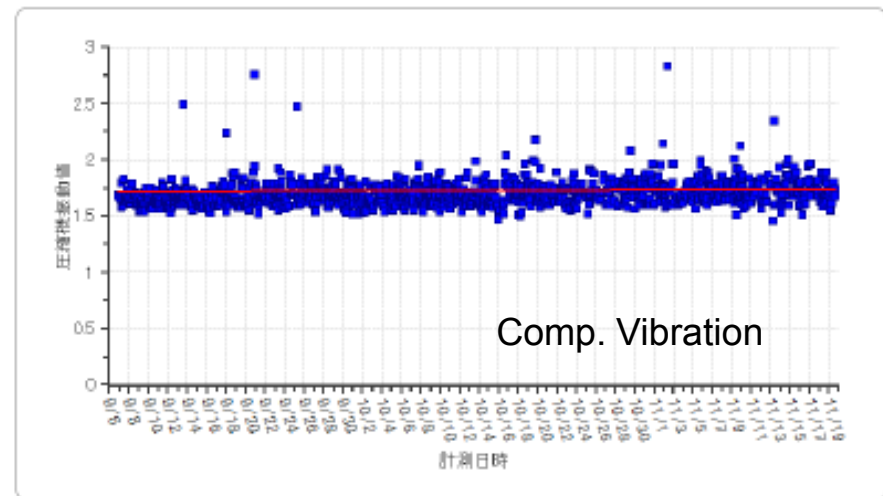
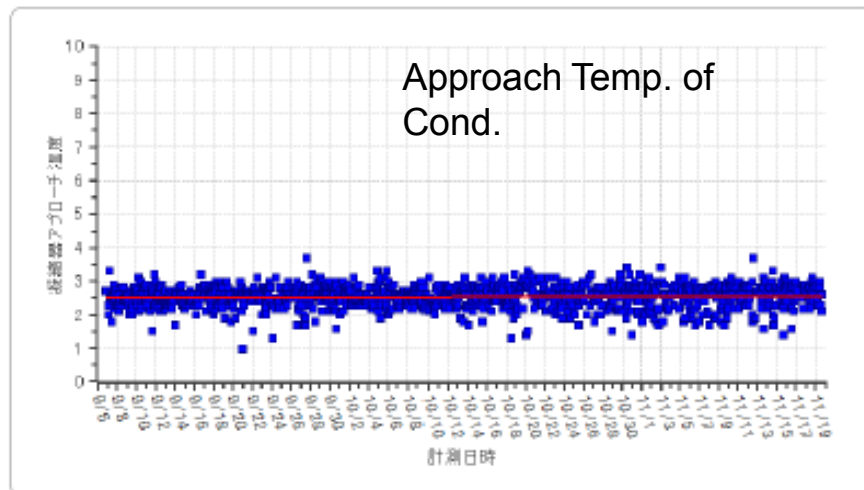
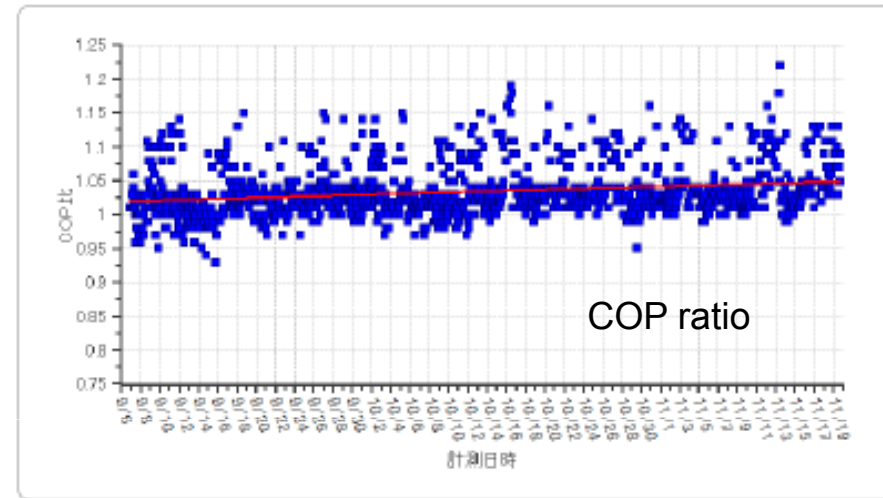
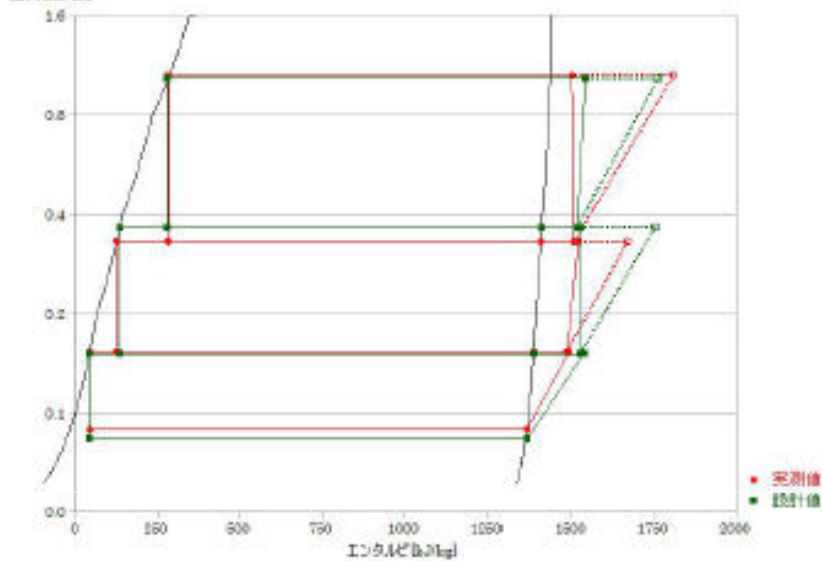
圧縮機 起動遅延時間	10.0 [sec]	中間SV低段EC 制御遅延時間	80.0 [sec]	給液制御弁 制御開始遅延時間	0.1 [sec]
圧縮機 回転遅延時間	5.0 [sec]	中間SV 開圧力	0.010 [MPaG]	給液制御弁 最大開度	100.0 [%]
圧縮機ハンチング 防止時間	600.0 [sec]	中間SV 開圧力	0.025 [MPaG]	給液制御弁 最小開度	30.0 [%]
圧縮機 インターバル時間	80.0 [sec]	中間液レベル 確認時間	5.0 [sec]	給液制御弁 初期開度	100.0 [%]
圧縮機 アイドル時間	10.0 [sec]	中間SV 開遅延時間	120.0 [sec]	給液制御弁 変化量	0.2 [%]
CO2圧力保持 運転開始圧力	1.500 [MPaG]	低段ECSV開時 中間SV開遅延時間	180.0 [sec]	圧縮機回転数制御 目標値(SP)	-32.0 [°C]
CO2圧力保持 運転停止圧力	0.900 [MPaG]	低段ECSV 開圧力	0.016 [MPaG]	圧縮機回転数制御 比例係数(Kp)	300
吸入圧力保持運転 開始圧力	0.200 [MPaG]	低段ECSV 開圧力	0.030 [MPaG]	圧縮機回転数制御 積分時間(Ti)	30.0 [sec]
吸入圧力保持運転 停止圧力	0.000 [MPaG]	低段EC液レベル 確認時間	5.0 [sec]	圧縮機回転数制御 微分時間(Td)	0.00 [sec]
圧力保持 運転回転数	4000 [rpm]	低段ECSV 開遅延時間	120.0 [sec]	圧縮機回転数制御 操作量上限	100.0 [%]
圧縮機 自動停止圧力	0.600 [MPaG]	中間SV開時低段 ECSV開遅延時間	180.0 [sec]	圧縮機回転数制御 操作量下限	50.0 [%]
圧縮機 自動運転圧力	0.700 [MPaG]	容量制御SV 開圧力	0.20 [MPa]	圧縮機回転数 増加量	0.3 [%]
圧縮機油排出 運転時間	30.0 [sec]	容量制御SV 開圧力	0.40 [MPa]		

Set point Data

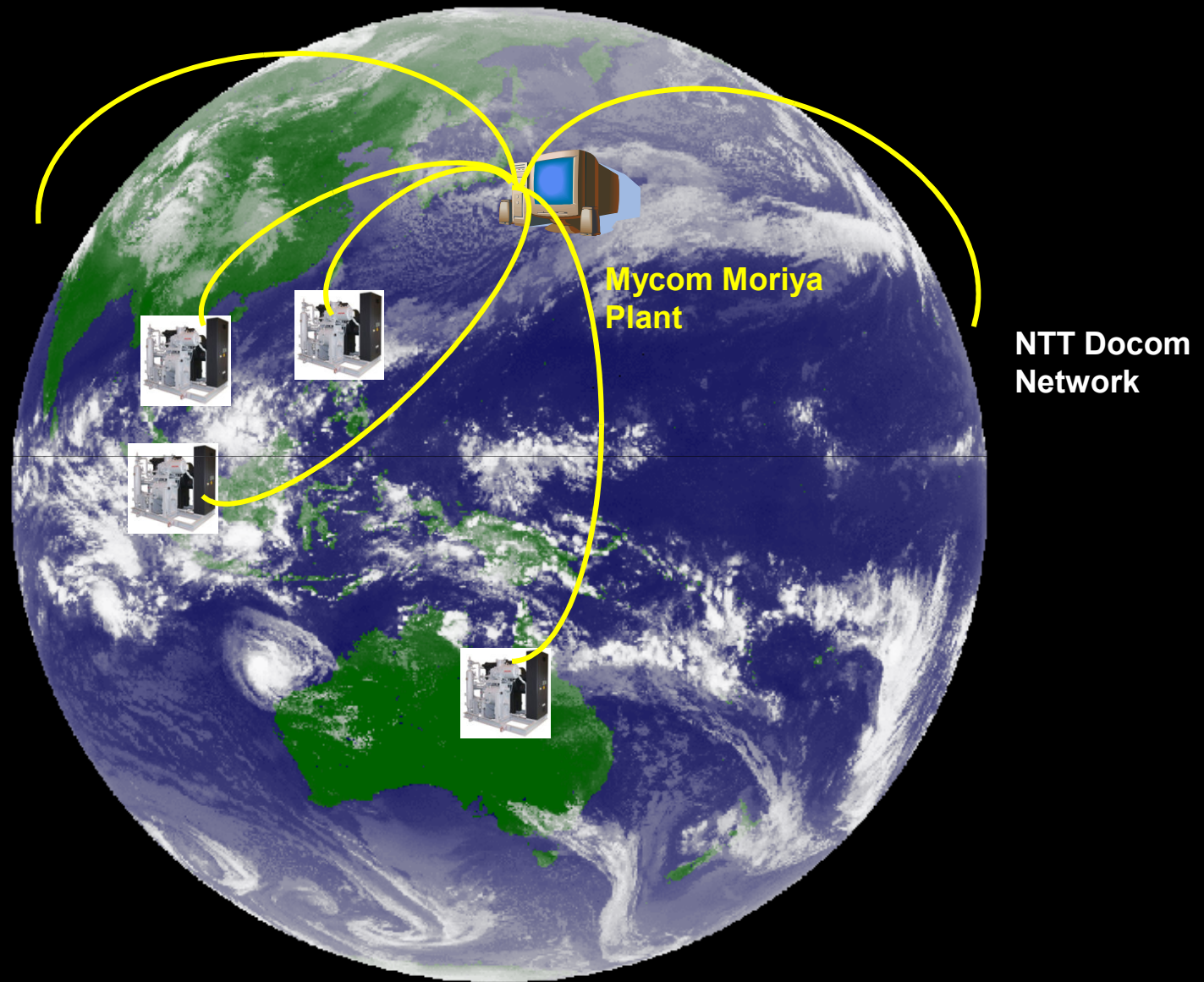


# Trend Diagnosis and Management

ph図 Comparison of ph-diagram between actual / design conditions



# PCAS Global Network





**Thank you very much !**