



ATMO
sphere

Latest NH₃ and CO₂ Technology in Industrial Sectors in Japan and South East Asia

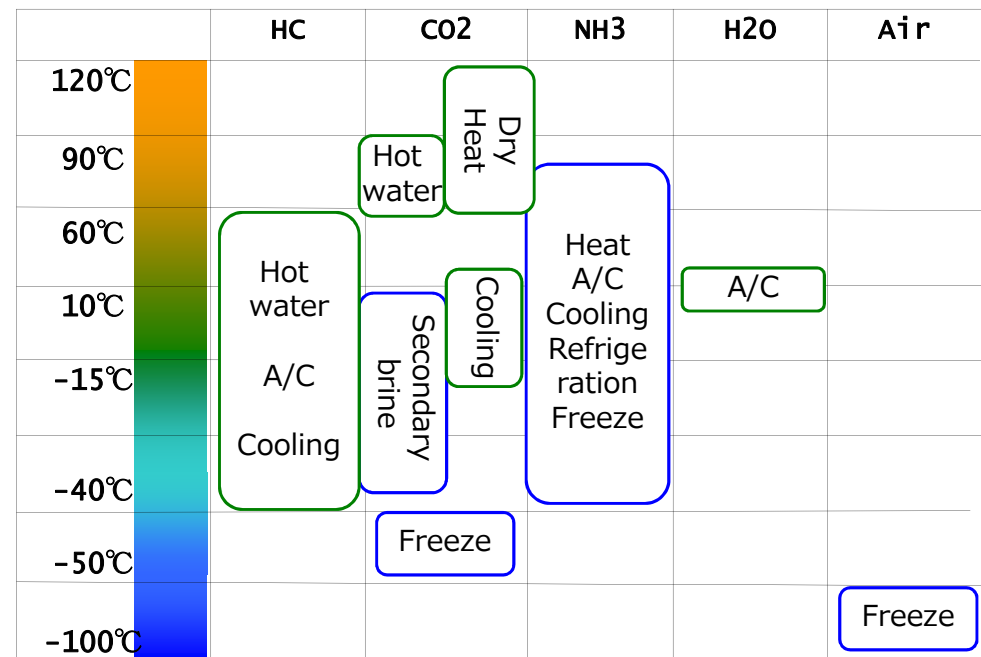
By

Kosuke Yamamoto
Mayekawa (Thailand) Co., Ltd.

6 September 2017

Stop GLOBAL WARMING

Mayekawa provides environmentally friendly refrigeration technology by using natural refrigeration, without losing efficiency.



NATURAL FIVE

HC



Heat pump package system for building air conditioning with hydro carbon refrigeration

CO₂



"UNIMO", a CO₂ heat pump system for industrial use. (hot water / hot air)

NH₃



"NewTon", NH₃/CO₂ refrigeration system for cold store and food processing factory.

H₂O



"ADREF NOA", Adsorption chiller

AIR



"PASCAL AIR", air cycle system for replacing R22/R23 cascade system

Heat Pump Technology with CO₂



Air to Water
Type



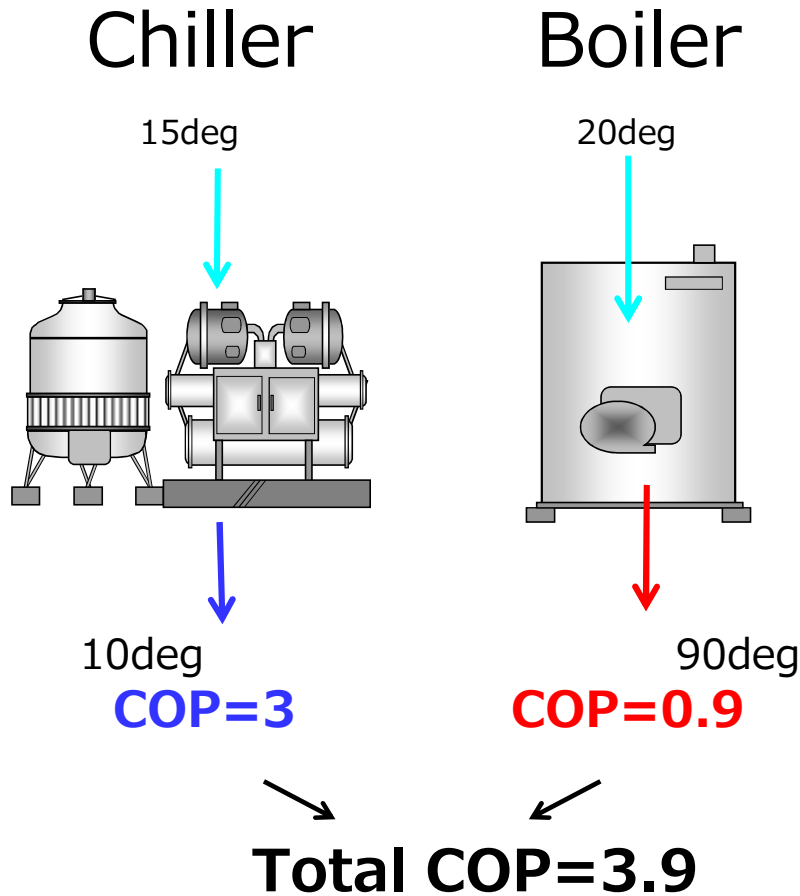
Water to Water
Type



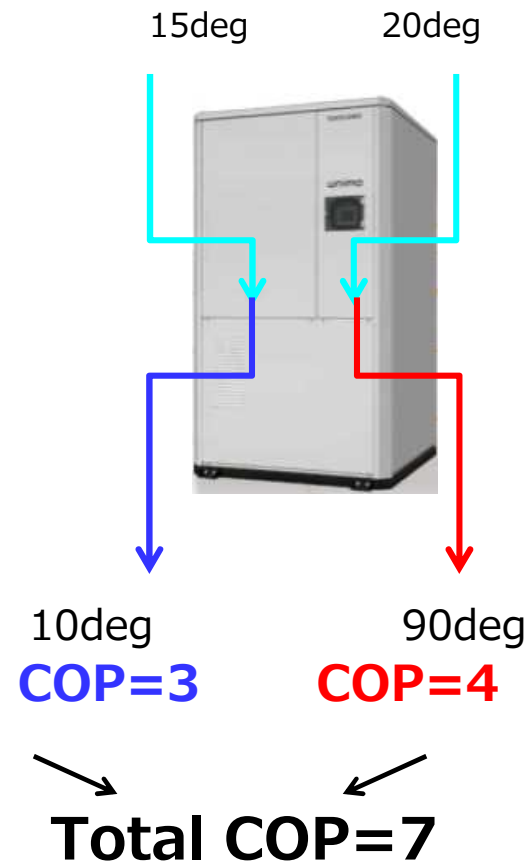
Water to Air
Type

Heat Pump Technology with CO2

Standard System



Heat pump System

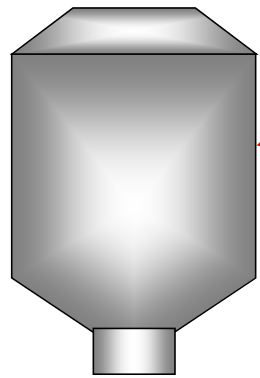


Pharmaceutical Company

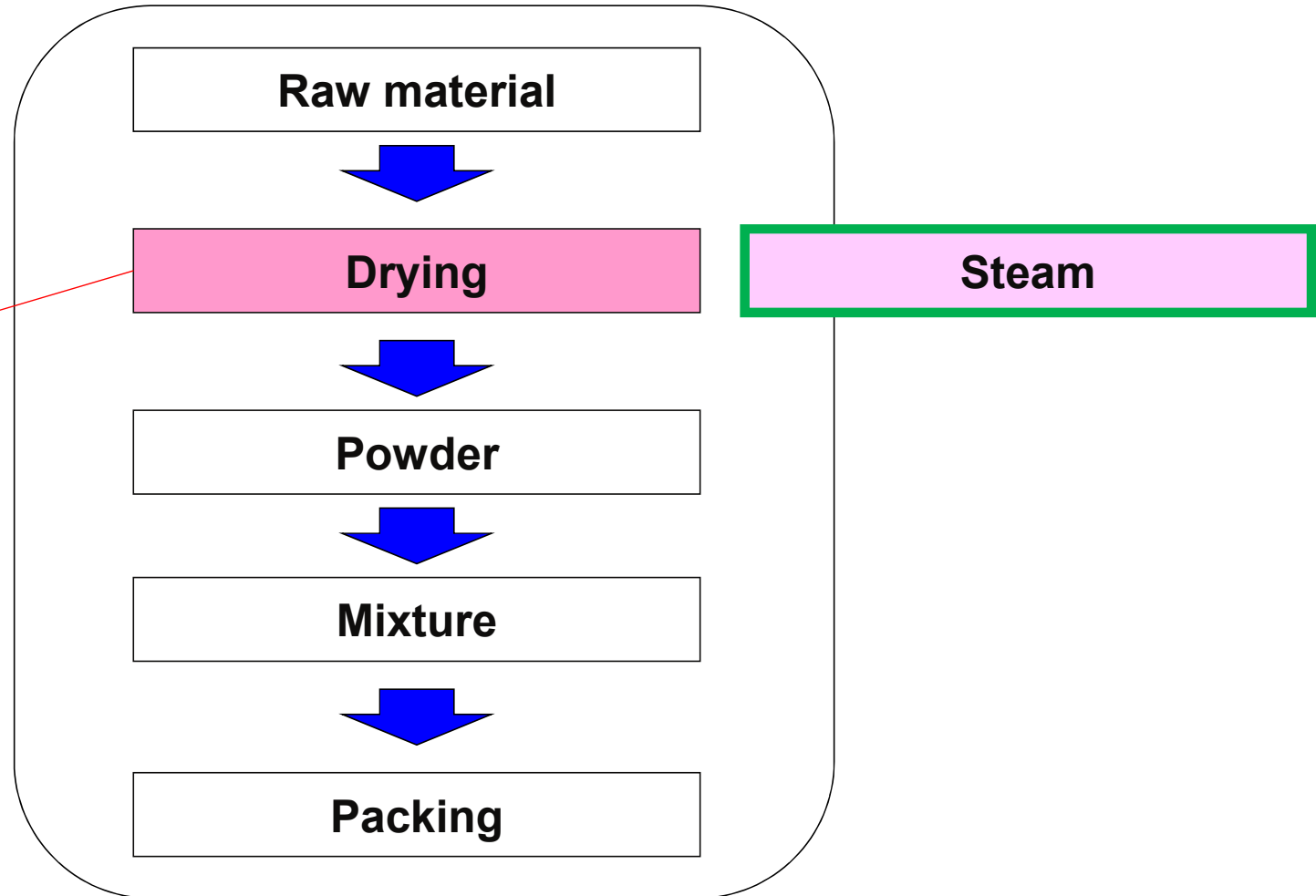
Processing Flow

Air conditioning

Enteral Nutrition

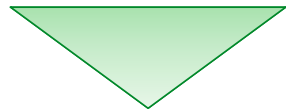
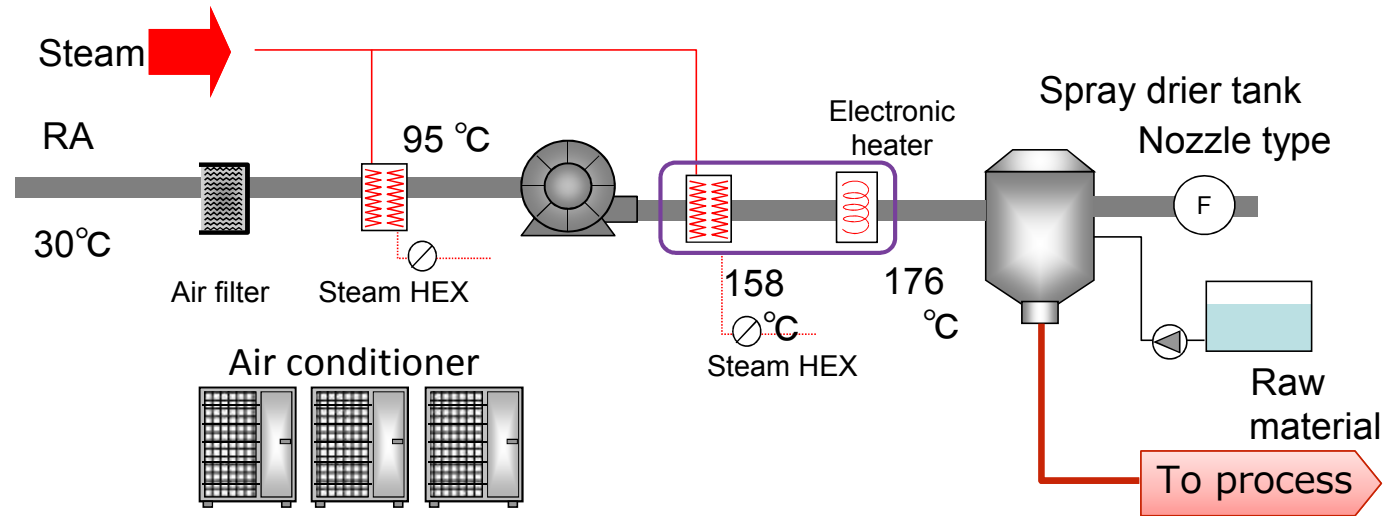


Spray Drier

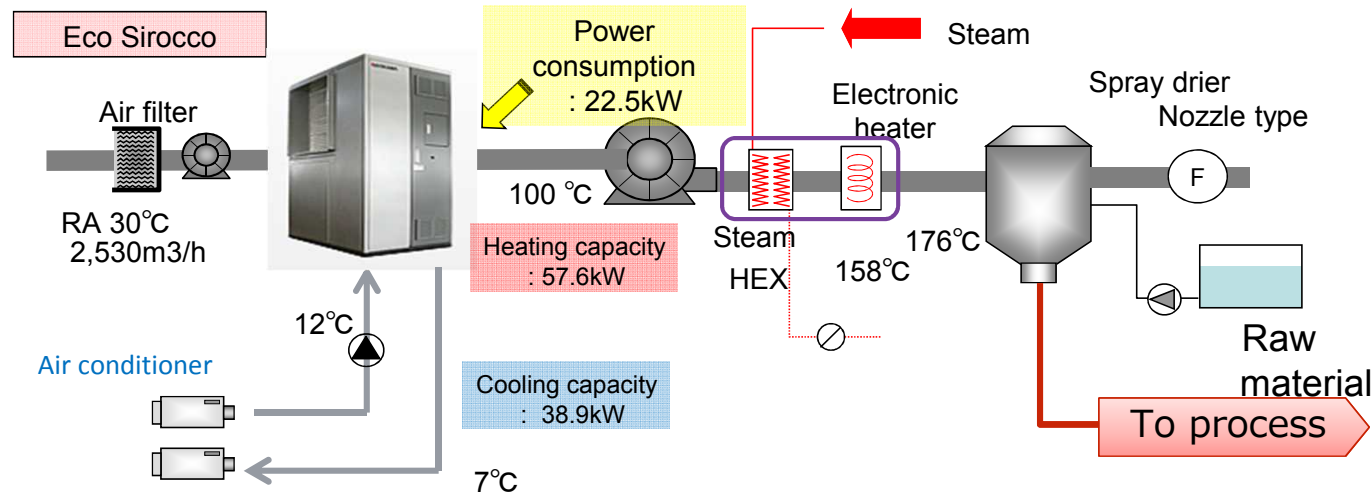


New System in a pharmaceutical process

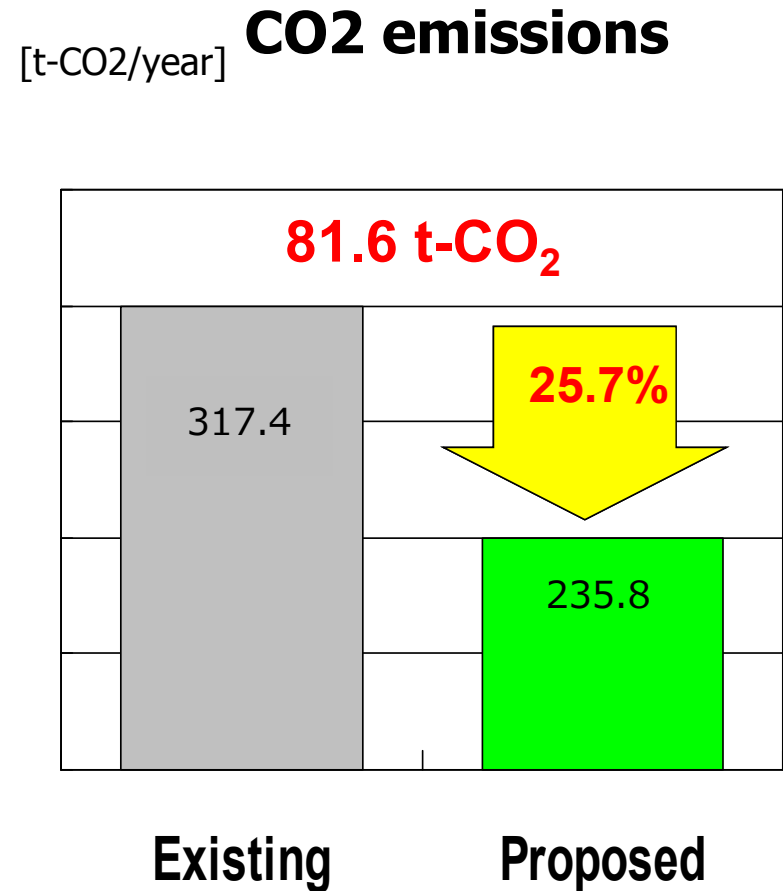
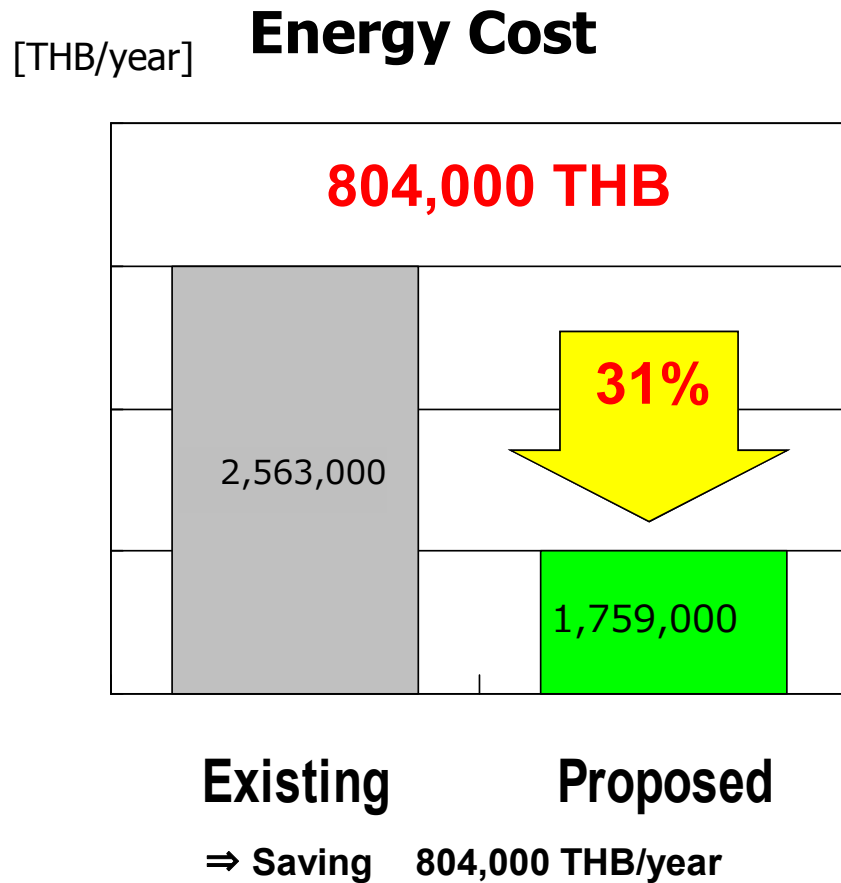
Conventional System



Proposed System



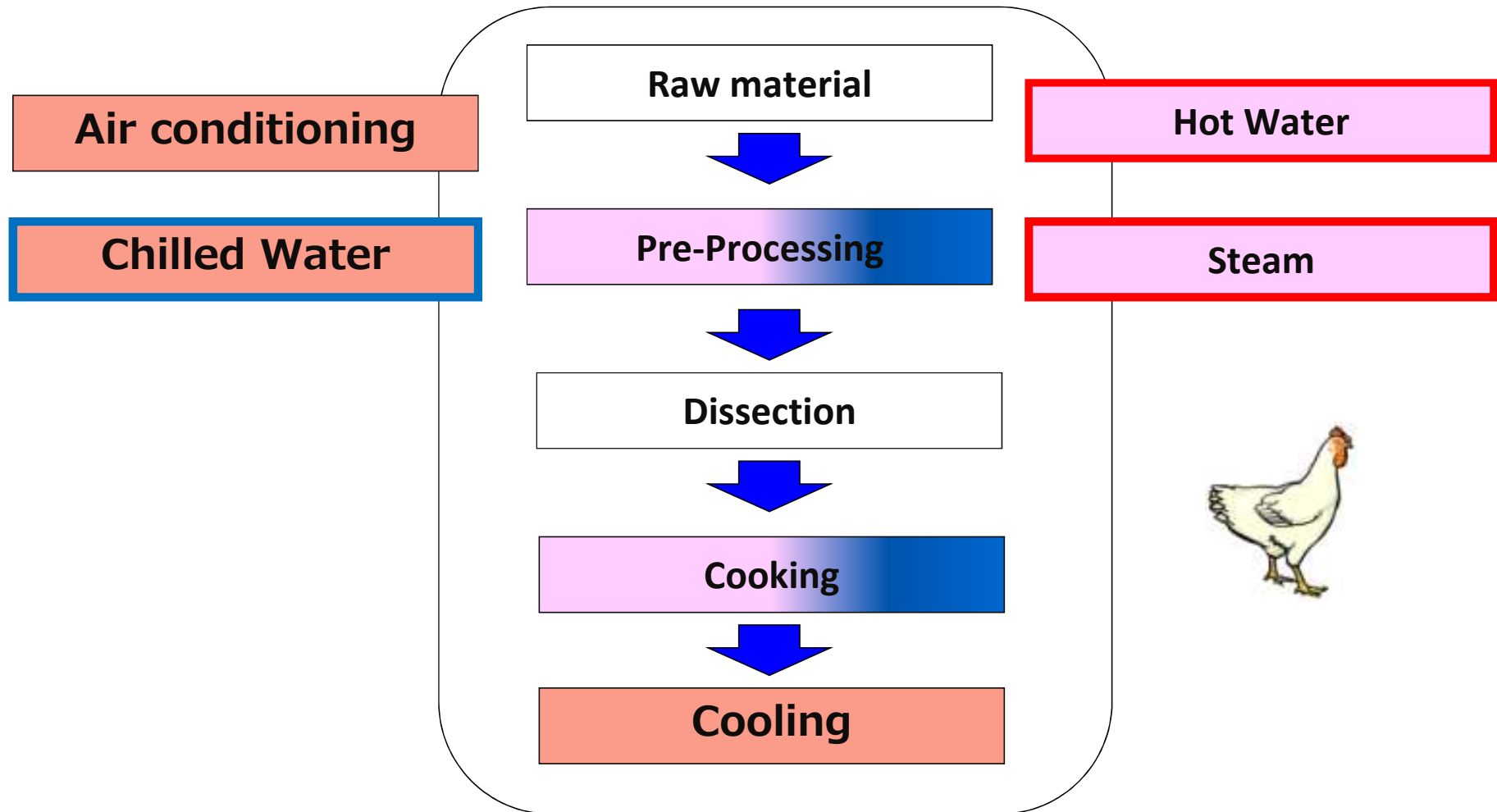
Energy Saving & CO2 emission



Energy Cost Rate : Electricity 3.32[THB/kWh], Heavy Oil 26.33 [THB/L]
 Calorific Value : Heavy Oil 0.0398 [GJ/L]
 CO2 Emission Rate : Electricity 0.511 [t-CO2/MWh], Heavy Oil 0.0755 [t-CO2/GJ]

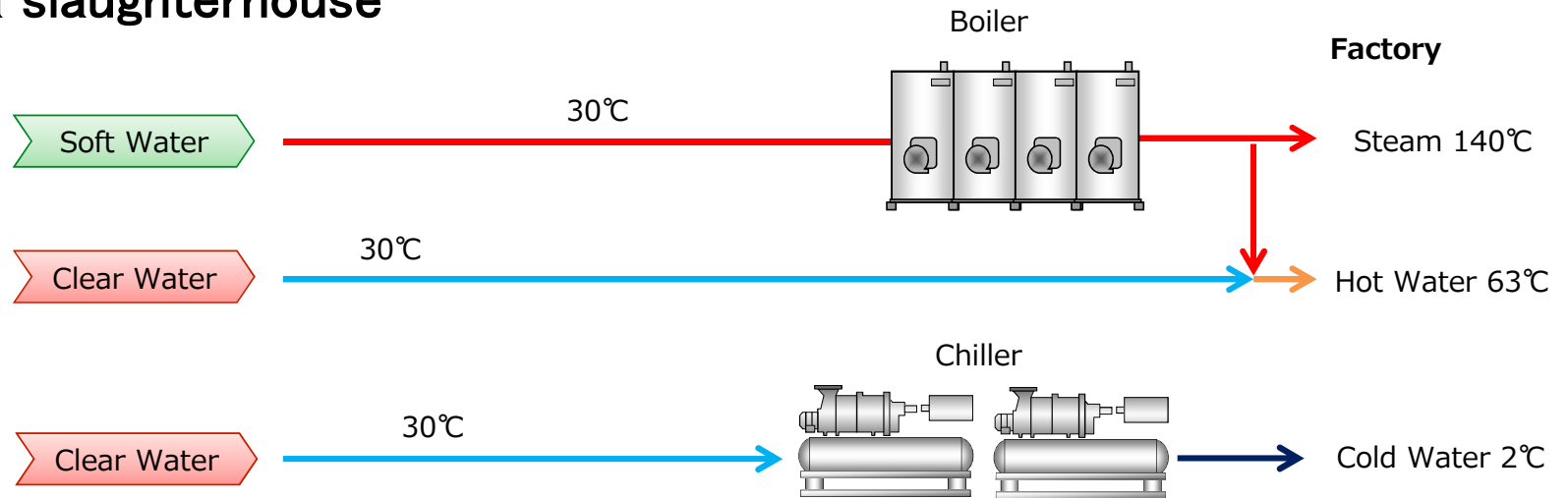
Poultry Slaughterhouse

Processing Flow

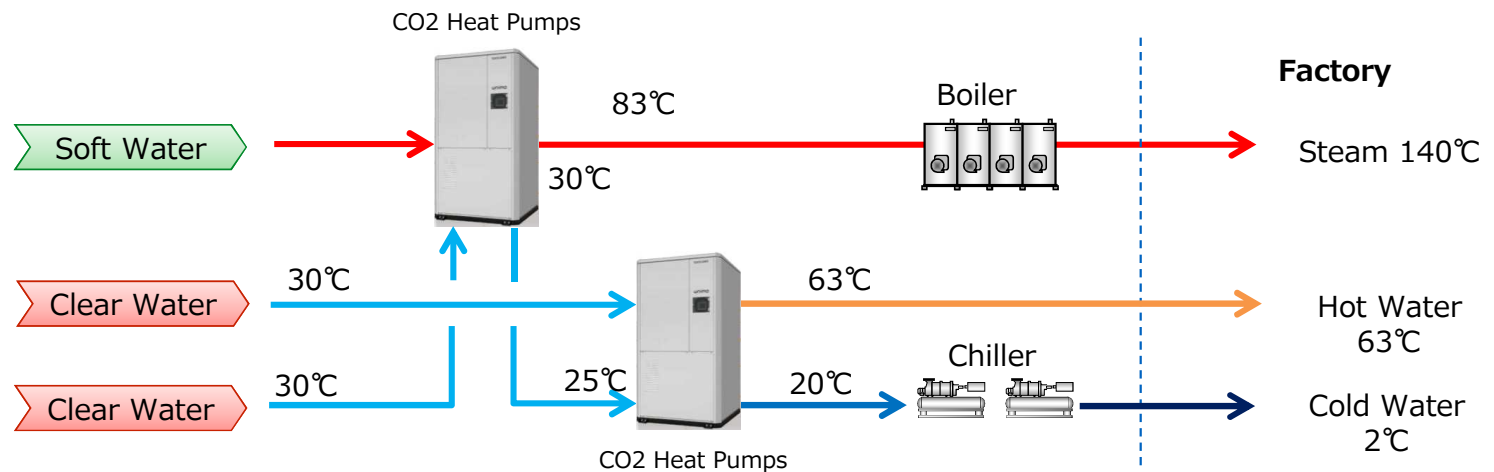


New System in a slaughterhouse

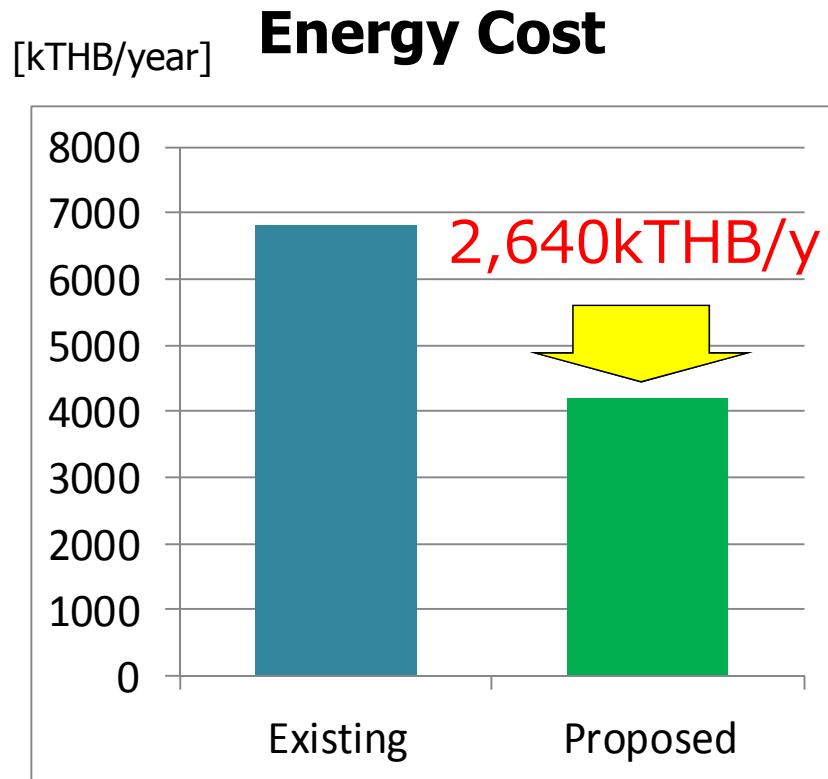
Conventional System



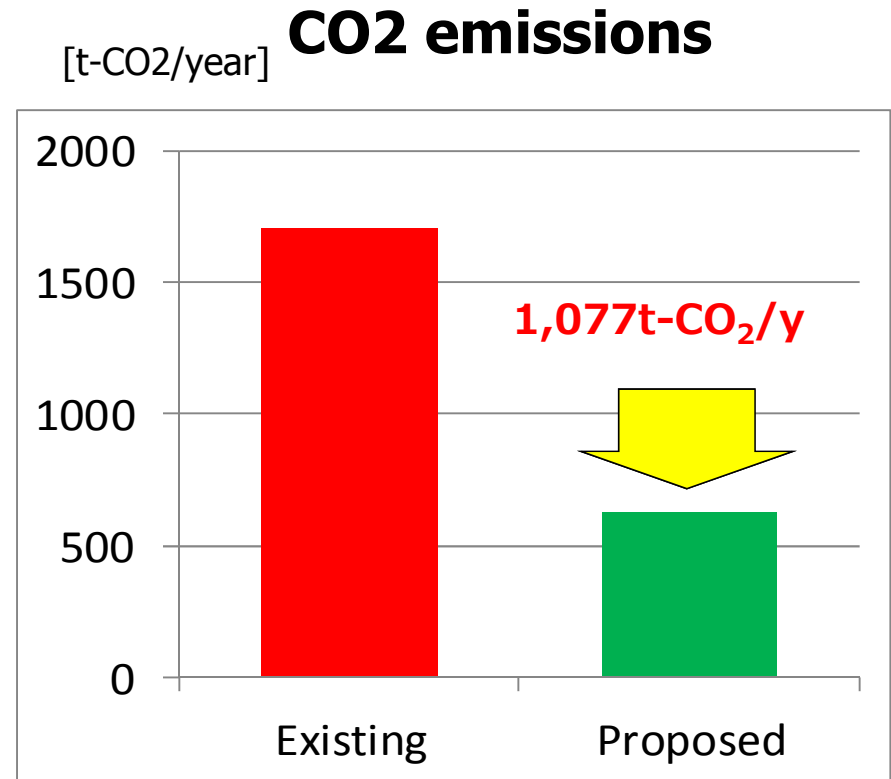
Proposed System



Energy Saving & CO2 emission



38% reduction



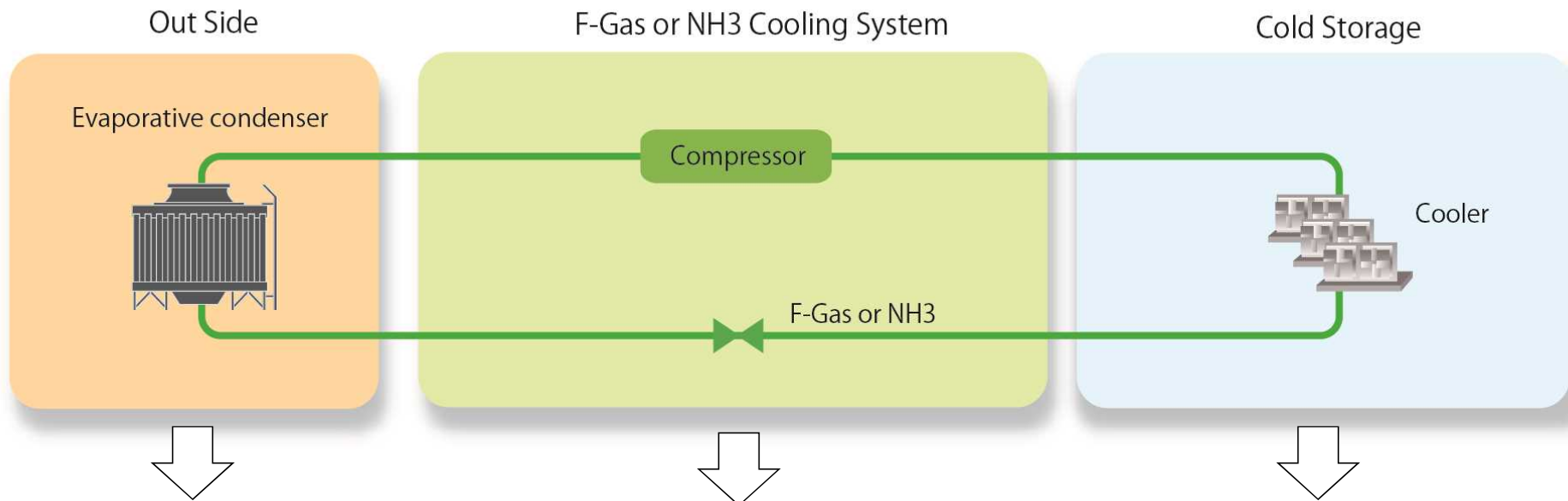
63 % reduction

Energy Cost Rate : Electricity **3.50THB/kWh, Heavy Oil 21.00 [THB/L]
 Calorific Value : Heavy Oil 0.03977 [GJ/L]
 CO2 Emission Rate : Electricity 0.14202778[t-CO2/GJ], Heavy Oil 0.0755t-CO2/GJ

NH₃/CO₂ Circulation System for Cold Stores



Conventional Refrigeration System for Cold Storage



Evaporative condenser

- Large volume of NH₃
- Limited layout
- More maintenance

NH₃ Flooded or F gas system

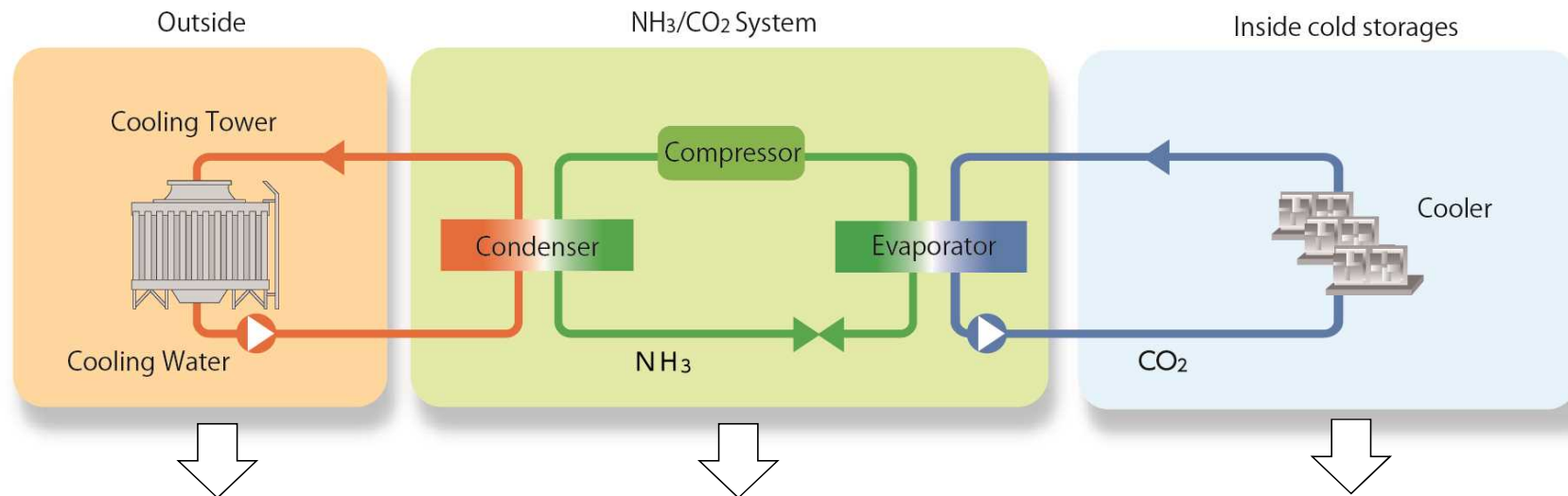
- Specialist is required by user for normal operation (manual operation)
- A risk to damage people if leakage occurs.

NH₃ inside the room

- A risk to damage products (& people) if leakage occurs.
- Oil may lower the heat transfer efficiency after years of operation

High-efficiency
refrigeration equipment
NH₃/CO₂ cooling system

New NH₃/CO₂ Circulation System for Cold Stores



Water cool condenser

- **Low NH₃ Volume**
- **Flexible layout**
- **Easier maintenance**
(closed type C/T)

NH₃ Refrigeration Package

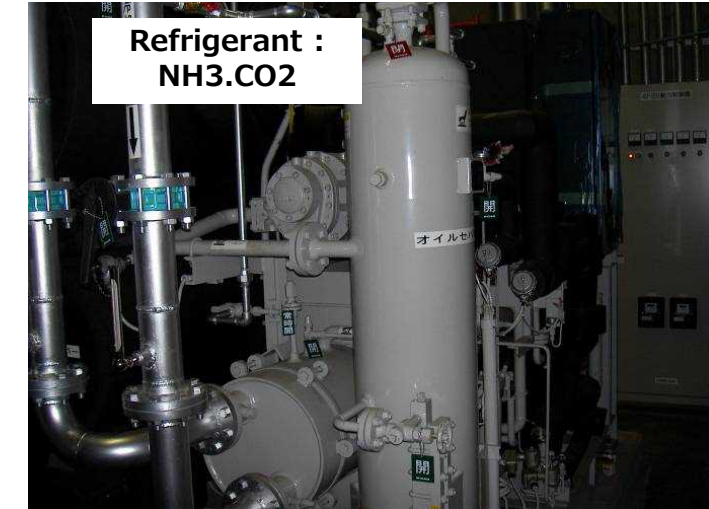
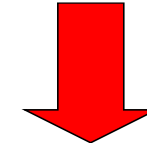
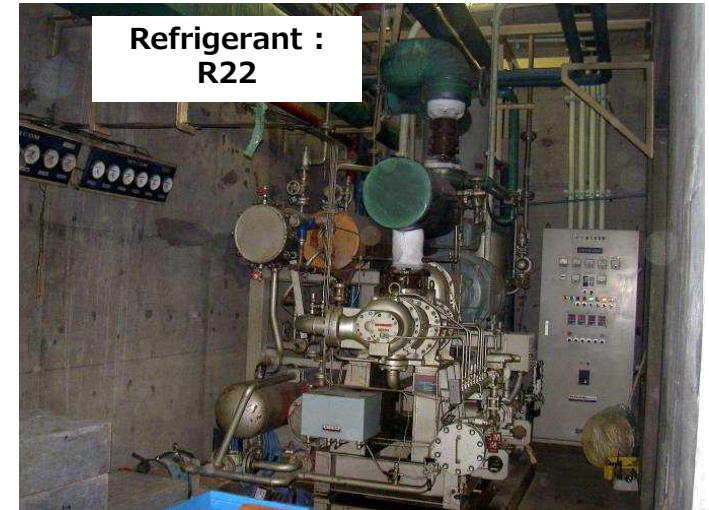
- **Better efficiency** with new technologies
(Special Screw Compressor/Semi-hermetic IPM motor/Flooded S&P evaporator/Double Economizer)
- **Auto operation, Network control**

CO₂ Brine Circulation

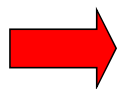
- **Harmless to products**
- **Low pump power**
- **No oil required (efficiency)**
- **High heat transfer efficiency with CO₂**

Renewal Project

Actual case study in Japan

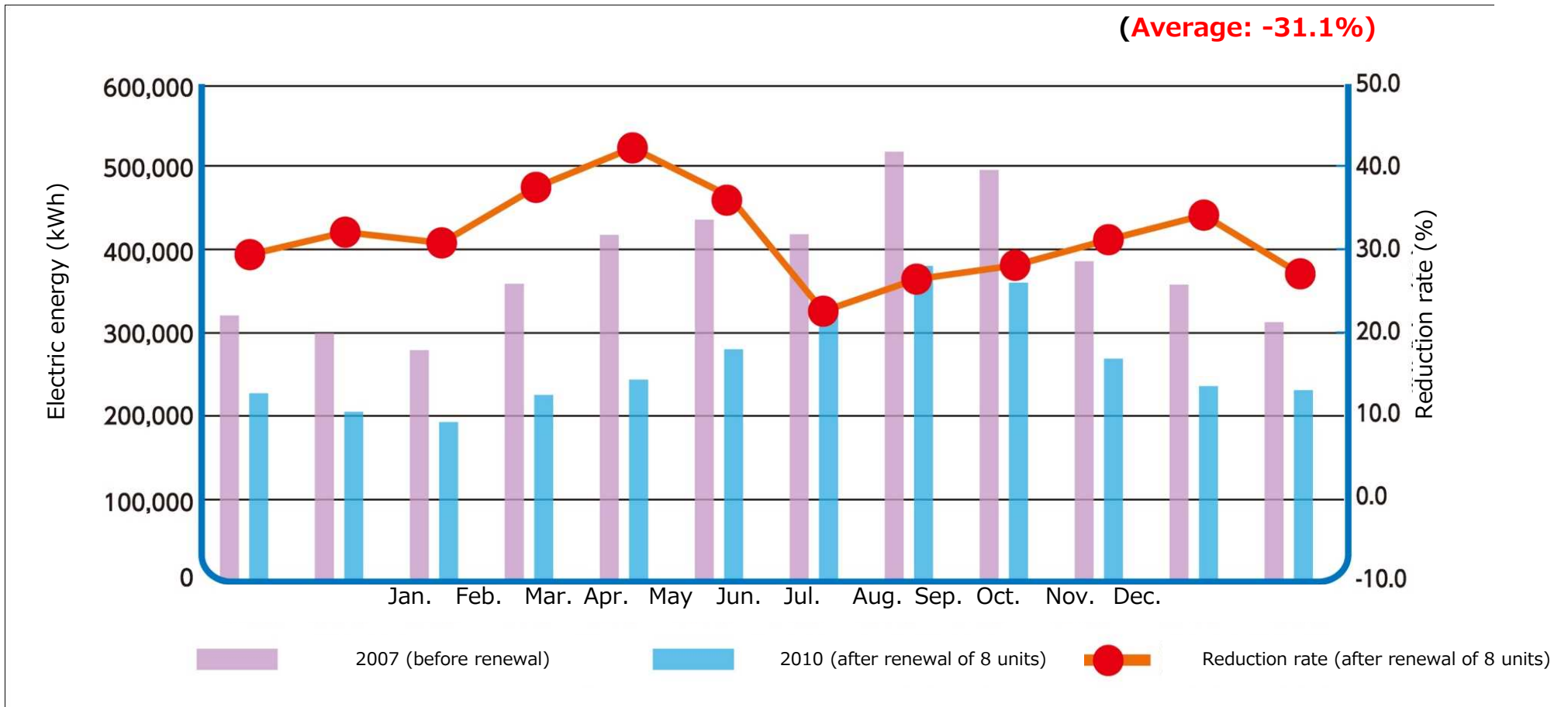


Existing
 Refrigerant: HCFC-22
 Machine: F1610C, 8 sets
 System: Dry expansion



8sets of NewTon 3000 were replaced.
 4sets: In 2008
 4sets: In 2009

Energy reduction with NH₃/CO₂ Circulation System



* Based on the bills of Tokyo Electric Power Co., Inc.

* Total Power consumption, including carriers, lights, office machines, etc.

* Storage capacity: "1 ton = 0.4 m³"

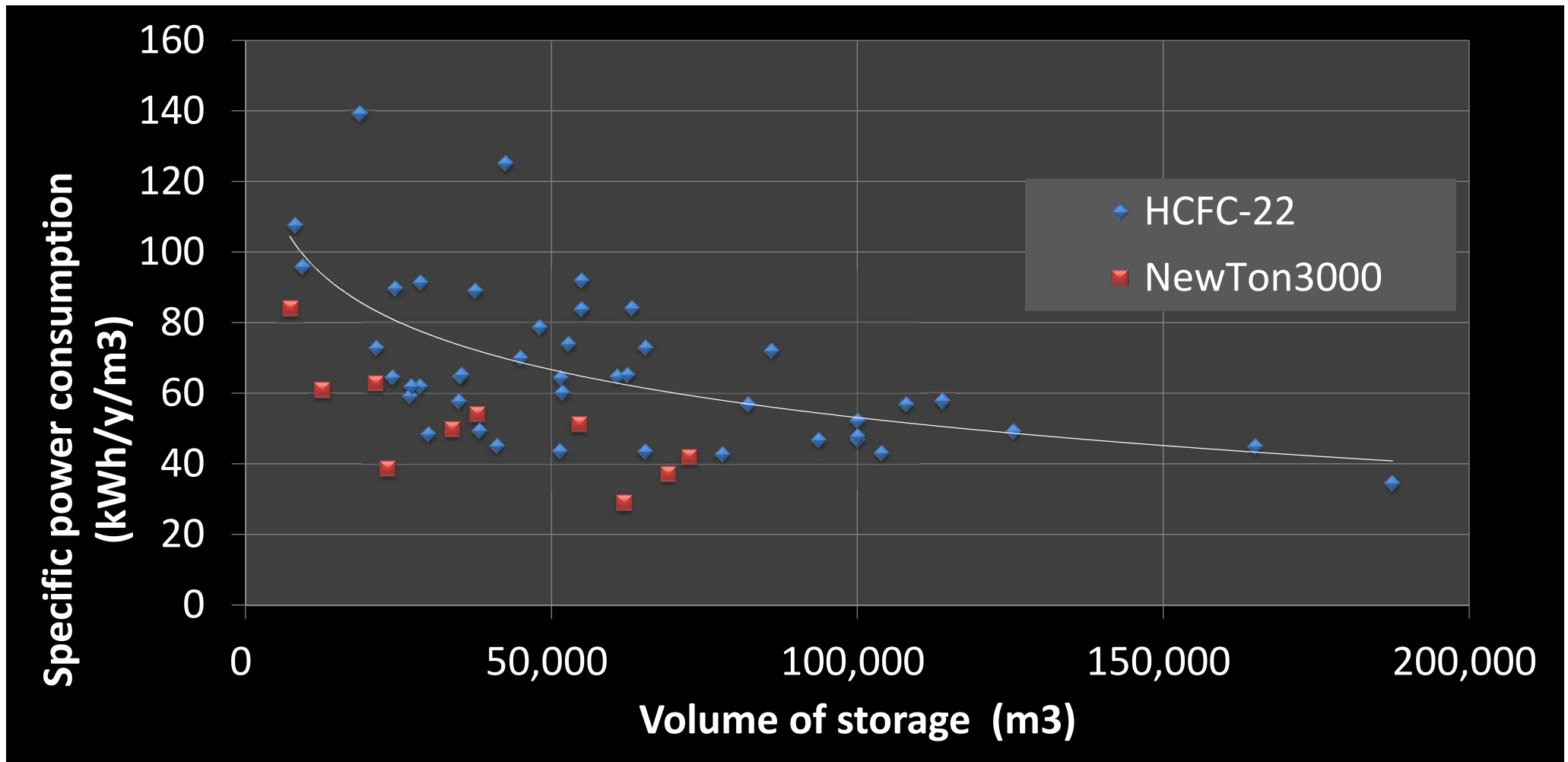
Actual case study in Japan

User	Volume	Age	Before		Power consumption		Reduction
	(m ³)	(year)	Ref.	Type	Before (kWh/y)	After (kWh/y)	(%)
Tokyo Toyomi Reizo Co., Ltd.	45,000	29	HCFC-22	Screw	4,594,056	3,164,703	31.1
Niigata Reizo Co., Ltd.	10,000	33		Recipro.	1,513,481	889,450	41.2
QP Logistics Co., Ltd.	16,250	27		Recipro.	2,345,782	1,761,836	24.9
Sensui Reizo Co., Ltd.	6,125	38		Screw	1,340,445	947,625	29.3

* Including light, office, lift, etc.

Average reduction: 31%

Comparison in Specific Power Consumption



Actual case study in Indonesia

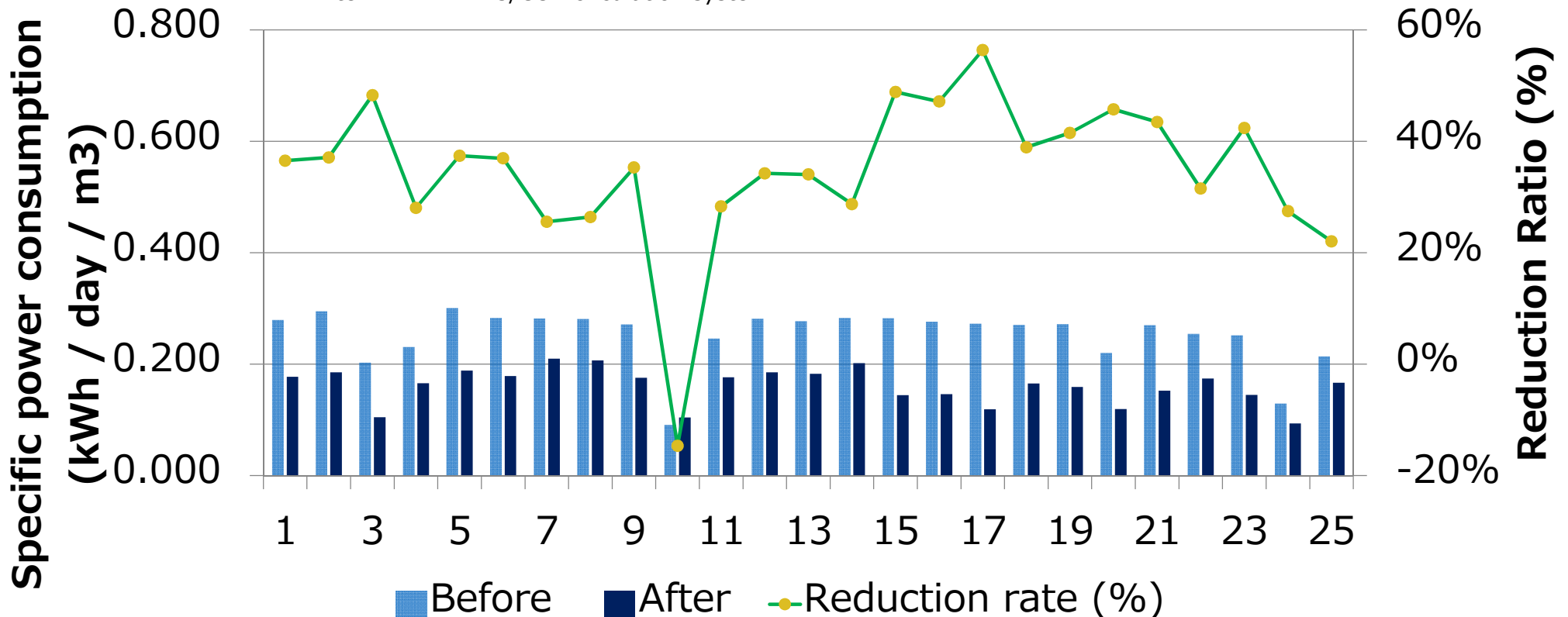
Capacity of Cold Storage : 11,000 m³ (before), 15,800 m³ (after)

Comparison with

Before : Conventional NH₃ circulation system

After : NH₃/CO₂ circulation system

(Average: -34.7%)



Actual case study in Thailand

Country : Thailand

Comparison with

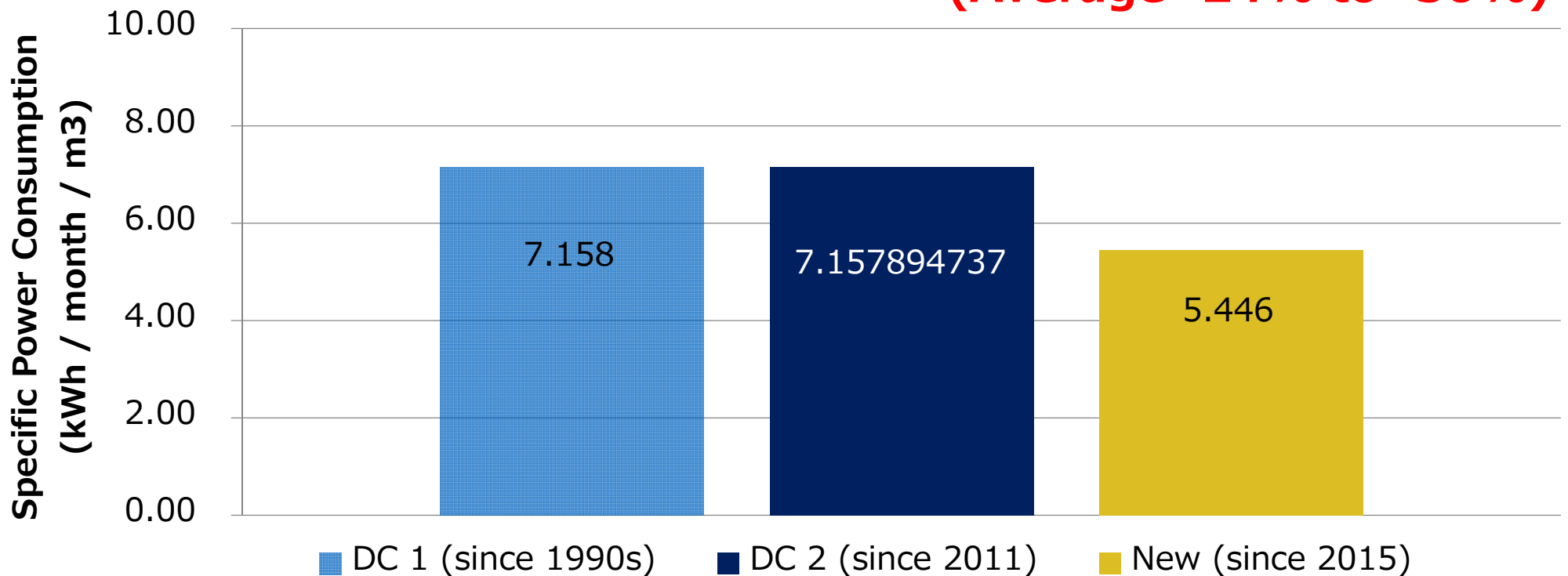
Before : Conventional NH3 Liquid pump system

(DC 1 = 29,000m3 since 1990s, DC 2 = 44,000 m3 since 2010s)

After : NH3/CO2 circulation system (67,600 m3)

Monthly record
(June 2017)

(Average -24% to -30%)



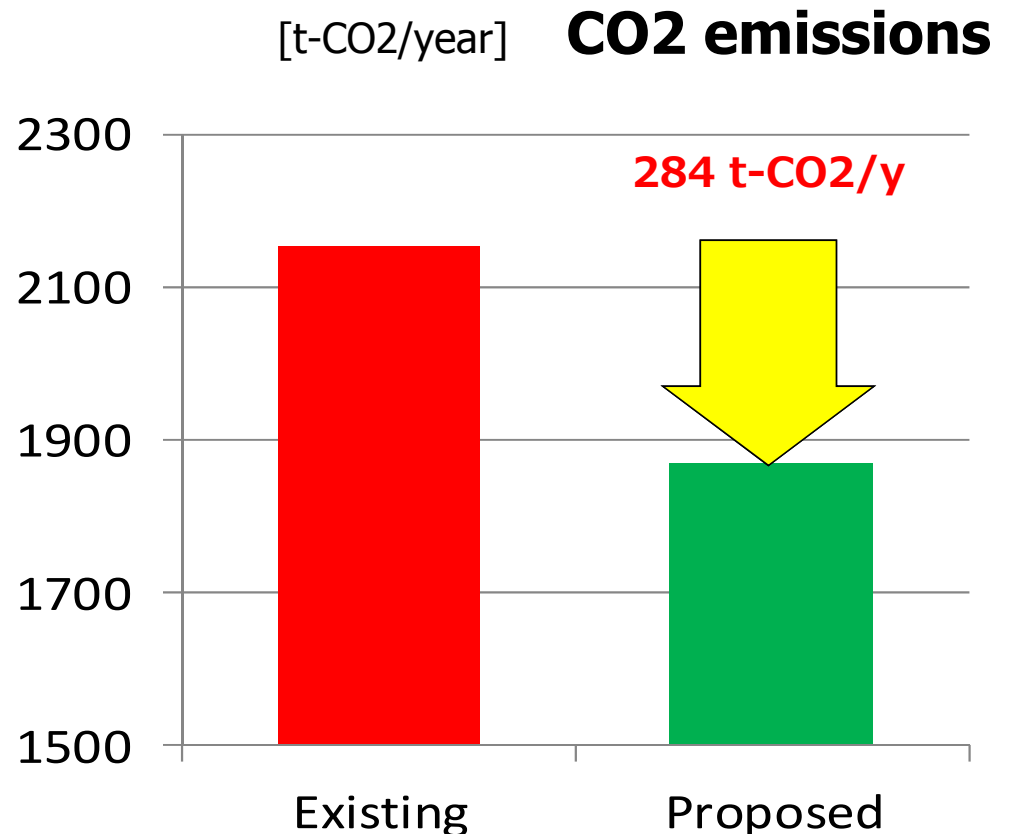
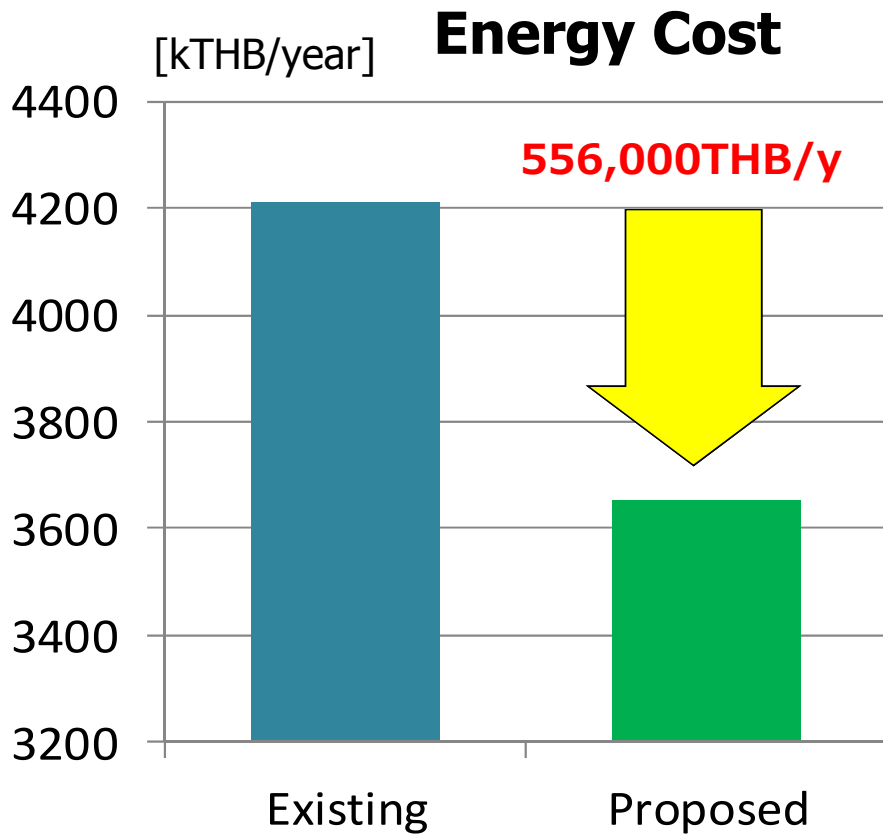
Actual case study in Thailand

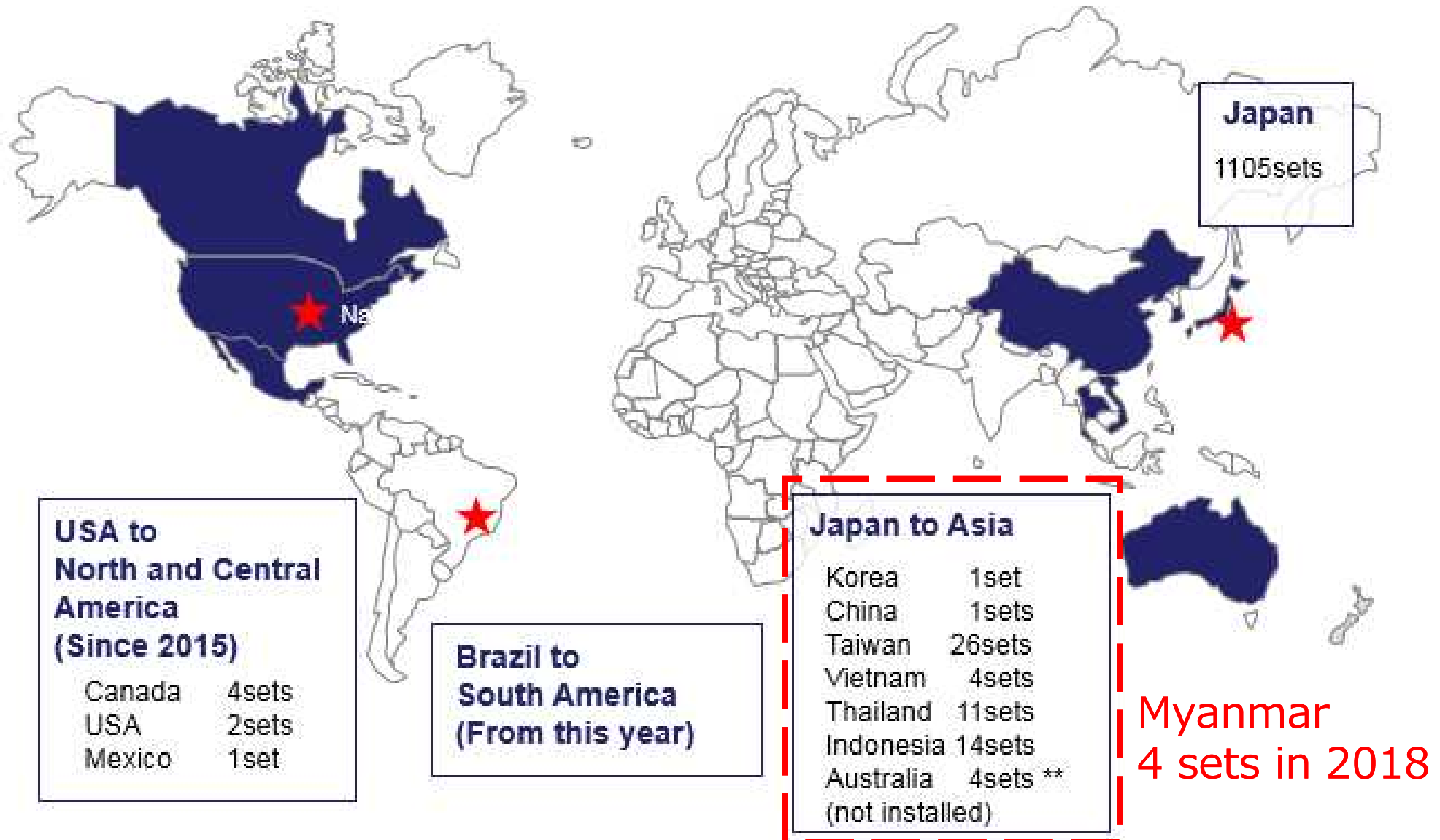
Country : Thailand

Comparison with

Before : Conventional NH3 Liquid pump system

After : NH3/CO2 circulation system







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Thank you very much!

