Principle and Features Of Heat-recovery CO2 Heat Pump

Company Profile

MAYEKAWA

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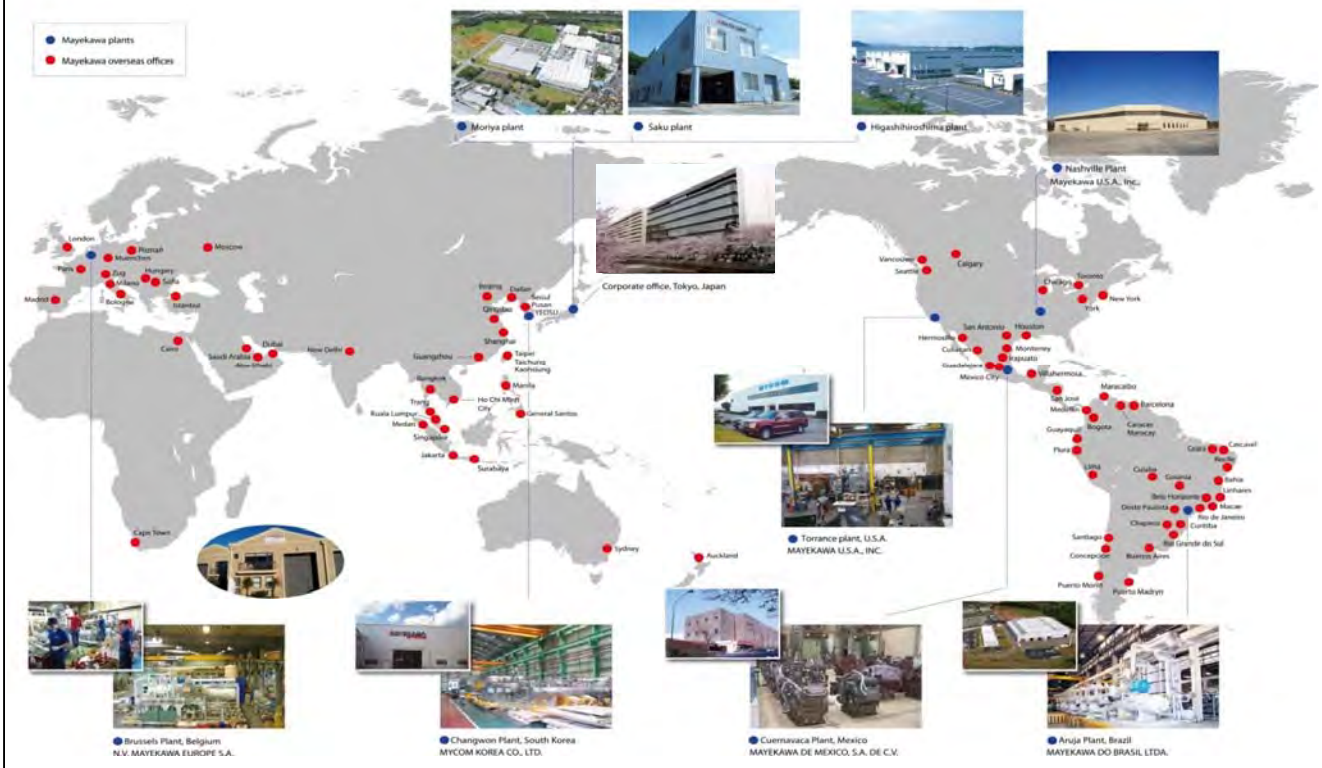
MYCOM

MAYEKAWA MFG. CO., LTD.

Founded:	Since 1924 (in Tokyo, Japan.)
Corporate offices :	3-14-15 Botan, Koto-ku, Tokyo 135-8482,Japan
	Established in 1924
Capital :	1.0 Billion yen (JPY)
Employees:	4,562 (12/2017 including group companies.)
President :	Shin Maekawa

Operating Bases



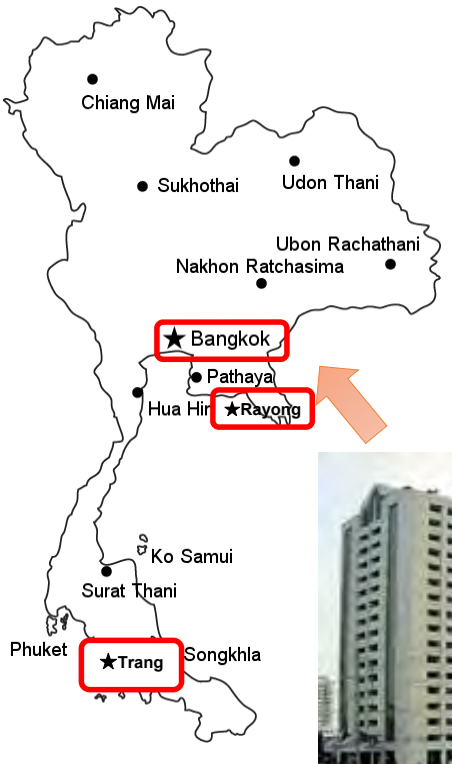
60 Domestic Bases/ **3** Plants **41** Countries / **102** Overseas office/ **7** Plants

Thailand Office

MAYEKAWA (THAILAND) CO., LTD.

Founded : 1988 (2531) ~

- Sales : 1,500 million baht ～
- No. of employees : 140 +@
- 9 Japanese (as of Dec 2016)
- Branch office : Trang



Business Activities

- Sales of MYCOM Compressors and other refrigeration component
- Sales of Food Robots (Deboning machine)
- After-Sales Service (Component)
- After-Sales Service (Refrigeration System)
- Design/installation of refrigeration plant
- Food Process Engineering (Automation)
- Consultation Service
- Design & Manufacture industrial freezers (IQF tunnel / Spiral / Flow / Batch / Blast)
- Support business activities in the region

Contents

- What's a "Heat Pump"?
- Features of CO2 Heat Pump
- Difference in boilers
- Features of Heat-recovery Heat Pump
- Case study of Factory
- Application example in Japan
- Application example in Thailand

What's a "Heat Pump"?

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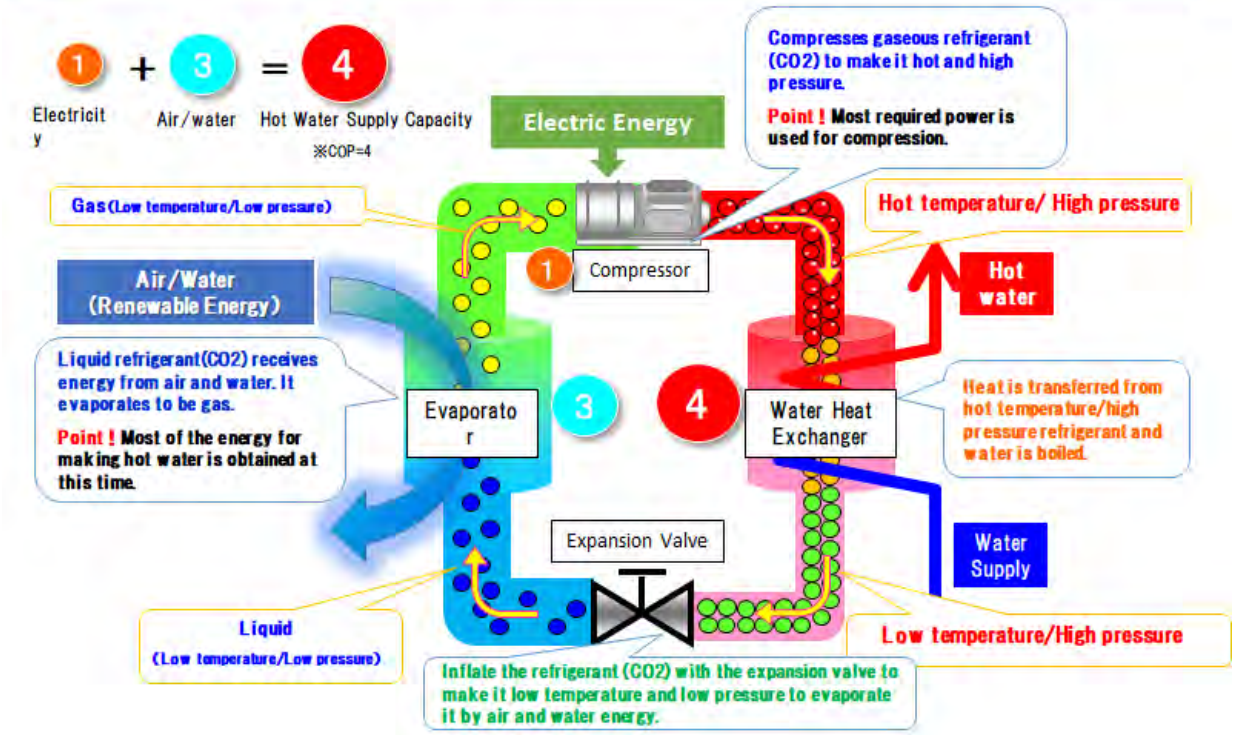
➢Principle of Heat Pump(ECO CUTE)



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Features of CO2 Heat Pump

Heat Pump Technology

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Energy conservation and CO_2 reduction
by "natural refrigerant CO_2"＋"heat pump technology"!!

Air heat source heat pump, Eco Cute	Water heat source heat pump, Eco Cute	CO_2 air heat pump
		
Greatest possible in the industry!	First in the industry!	First in the industry!
Hot water of 65 to 90℃ is supplied (air heat source)	Hot water of 65 to 90℃ ＋Cold water (Water heat source)	Hot air of 80 to 120℃＋ Cold water (Water heat source)
Released from 2006	Released from October 2008	Released from October 2009

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High Temp. Supply

Hot Water at 65～90 deg C in an instant, due to CO_2's High Thermal Capability.

(Supercritical Cycle)

Complement(Supercritical Cycle)

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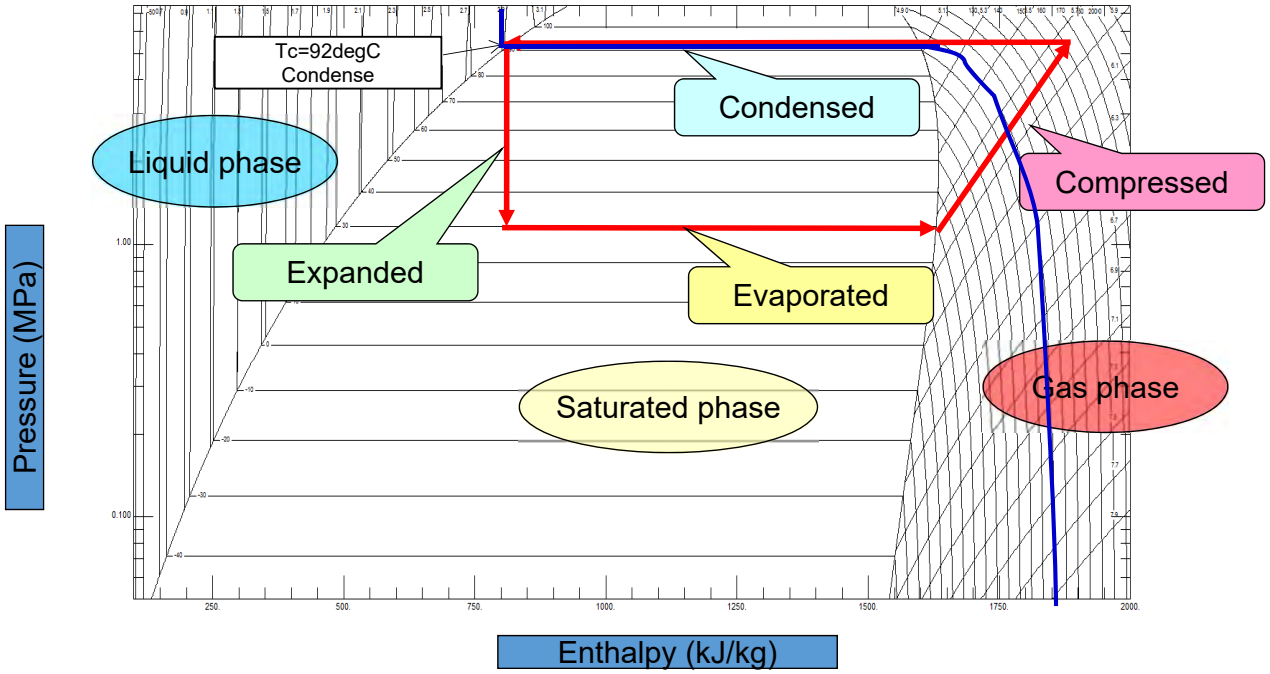
P-h Diagram_NH3



These diagrams are only for image.

Complement(Supercritical Cycle)

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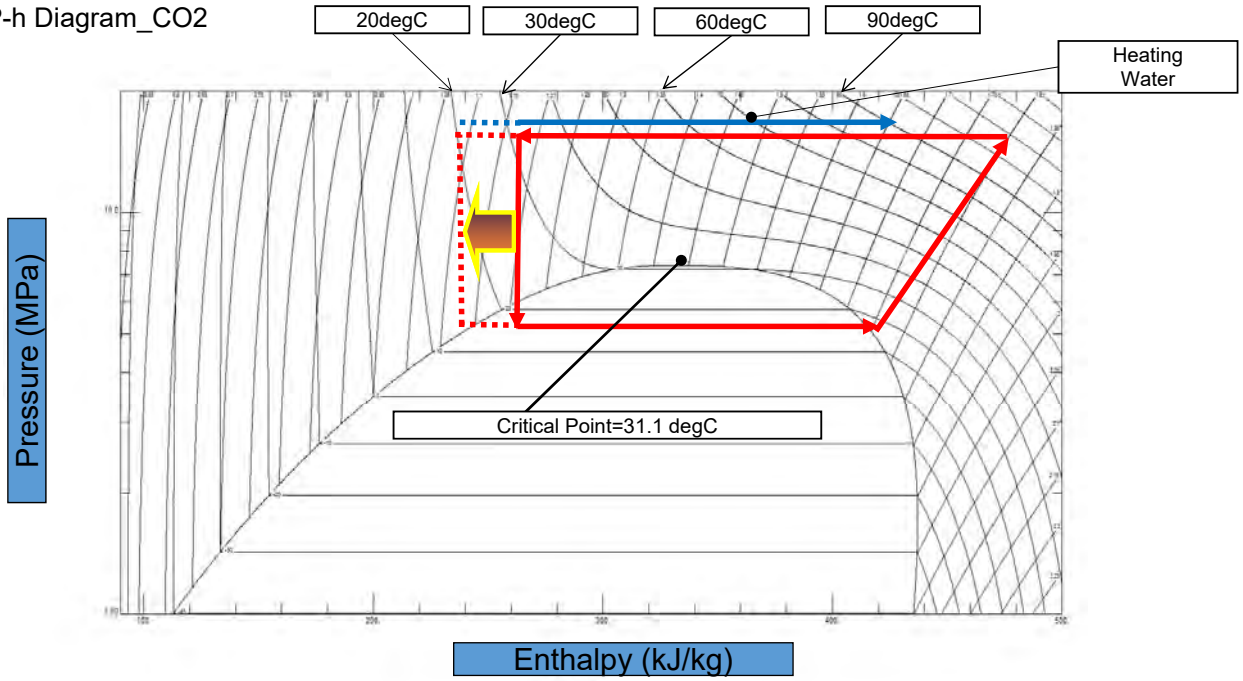
P-h Diagram_CO2



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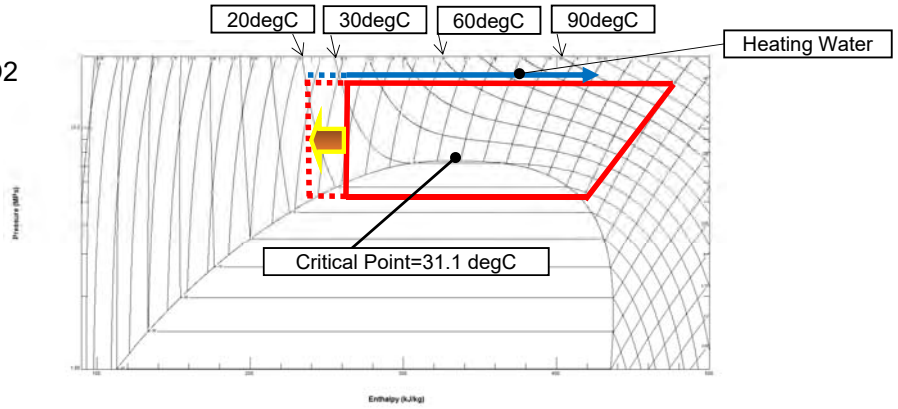
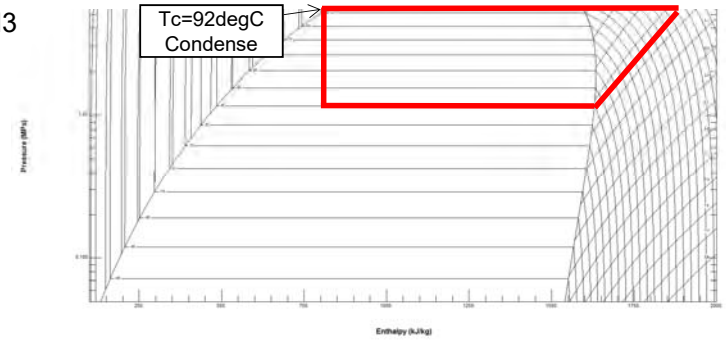
Complement(Supercritical Cycle)

P-h Diagram_CO2



P-h Diagram_NH3



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Properties of matter of various refrigerants

	Refrigerant	ODP	GWP (100Years)	GWP Section	High Pressure MPa	Discharge Temperature
HCFC	R22	0.055	1700	A1	1.53	57.5
HFC	R134a	0	1300	A1	1.02	44.5
	R404A	0	3850	A1/A1	1.83	44.8
	R407C	0	1370	A1/A1	1.64	53.6
	R410A	0	1370	A1/A1	2.41	57.2
	R507A	0	3900	A1	1.88	44.4
Natural Refrigerants	R717 Ammonia	0	<1	B2	1.55	93.3
	R290 Propane	0	3	A3	1.37	44.2
	R600a Isobutene	0	3	A3	0.53	40.0
	R744 CO_2	0	1	A1	9.0	72.0

※Discharge pressure and discharge temperature are Tc＝40℃

※Safety classification is based on ASHRAE Standard 34 Safety Group;

A:Low toxicity, B:High toxicity, 1:Incombustibility, 2:Low flammability, 3:High flammability

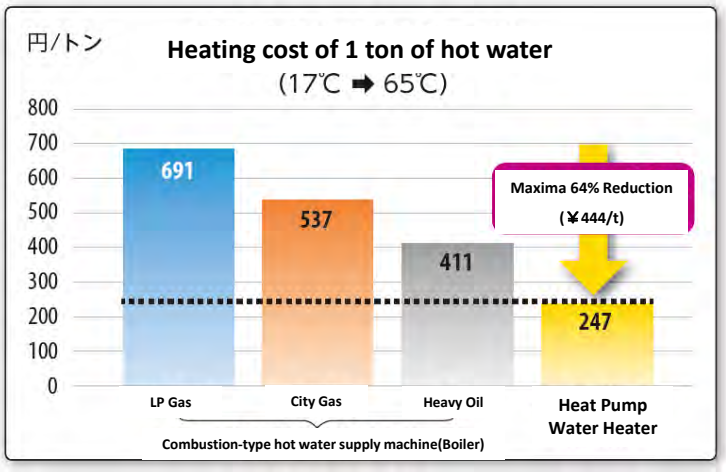
Difference in boilers

General Feature of Various Heating Methods

Items	Boiler	CO2 Water heat source Heat pump	HFC Heat Pump	Other
Instant Heating Capacity	○	△	△	Depend on User
Cooling Capacity	×	○	△	
Environments	×	○	×	CO2 Emission, GWP
Initial Cost	○	×	△	
Running Cost	△	○	○	Depend on Fuel price
Uses above 100℃	○	×	×	
Hot water disinfection	○	○	×	Over 80℃
Prevention measure of Legionella	○	○	×	Over 60℃

※ヒートポンプは当社製品比較

Hot water Supply Cost Comparison



●Test Calculation Condition

Type	Cost
Heavy oil	¥67.6/ℓ
City Gas	¥97.38/ m3
LP Gas	¥280.0/m3
Electricity	¥16.4/kWh

※Cost estimate is an one of example.
It is depending on customer's term.

出展:一般社団法人 日本冷凍空調工業会 業務用ヒートポンプ給湯機連絡会 発行 チラシより

Safety of CO2 Heat Pump

Prevention measure of Legionella

- Over 60℃⇒Required for hot water supply facility

Hot water disinfection

- Over 80℃⇒Required for washing cooking tools and medical tools

All electrification cooking tool

- Required over 83℃ hot water for washing Machines

厚生労働省・(財)日本公衆衛生協会

Features of Heat-recovery Heat Pump

unimoWW

Water Heat Source Heat Pump unimoWW

Eco-friendly

High efficiency

Natural Five

CO2 heat pump unimo WW

☆provides hot water and chilled water at the same time ultilising water as thermal energy.

☆It integrates both functions of boiler and chiller.

☆Space saving design and the ability of using dead areas indoors effectively such as corners of plant room.

CO2 heat pump unimo WW

While providing hot water, chilled water can be utilised for air-conditioning or process cooling.

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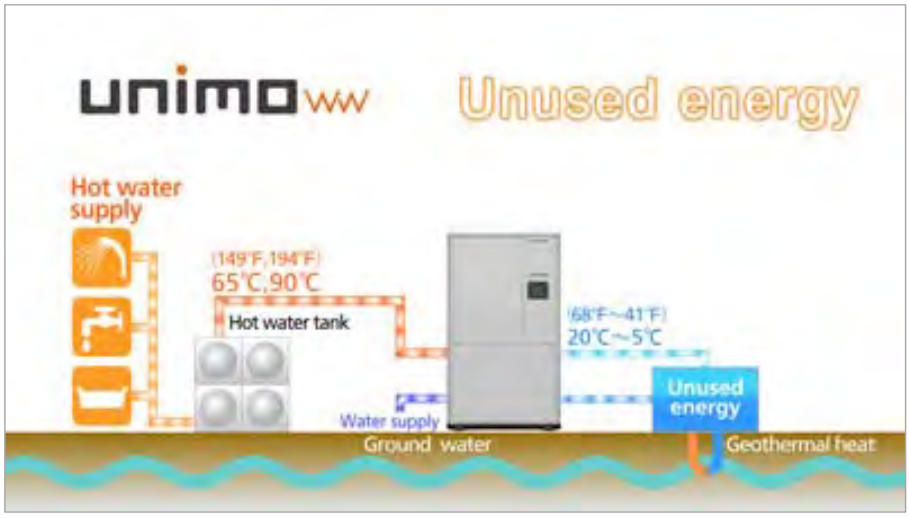
CO2 heat pump unimo WW

Using unused energy including ground source and geothermal energy effectively



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CO2 heat pump unimo WW

Providing heat recovery from cooling water and waste water

Specification

Model		HWW-2HTCR		
Temp. of Cooling Side（Inlet→Outlet）		-5℃→-9℃	12℃→7℃	37℃→32℃
Performance （Hot Water In. 17℃→ Out. 65℃）	Heating Capacity〔kW〕	53.2	85.8	116.8
	Hot Water Amount [L/h]	953	1537	2093
	Cooling Capacity〔kW〕	37.9	64.0	94.8
	Input Power〔kW〕	17.9	21.4	22.1
	Total COP※1	5.1	7.0	9.6
Power source		3φAC380V 50Hz		
Outer Dimensions〔mm〕		W1,100×L1,200×H1,893		
Weight〔kg〕		985		
Compressor	Model	Semi-hermetic 2 cylinder Reciprocating mayekawa 2HT		
	Rated Motor Power〔kW〕	25		
Range of Use	Makeup Water Temp.〔℃〕	5～40℃（@65℃ Hot Water Heating） 5～65℃（@90℃Hot Water Heating）		
	Hot Water Temp.〔℃〕	65 & 90		
	Cooling Side Inlet〔℃〕	-5～40		
	Cooling Side Outlet〔℃〕	-9～35		

※1 Total COP＝（Heating Capacity＋Cooling Capacity ）/ Input Electric Power

Case study of Factory

•Features of Water Heat Source type Heat Pump, Eco Cute ①

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"Possible to supply cold and hot water simultaneously"

Are there cooling loads?
Energy conservation is possible by using cold water effectively from Eco Cute!!

Example of Proposal

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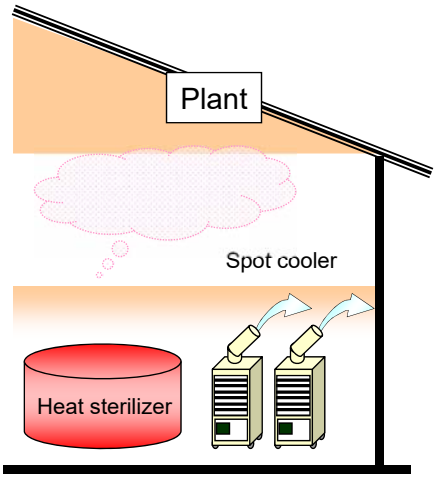
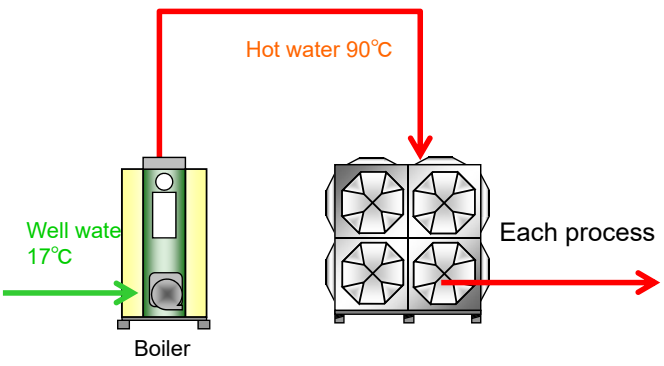
"Used for cooling in plant"

[Present situation]

- Hot water of 90℃ is made by boiler and supplied to each process.
- Heat from heat sterilizer makes the interior of the plant always hot throughout the year.
- Spot coolers are used (resulting in increase of the load for the whole room).

Specifications	
Hot water make-up water:	0.9 tons/h
Annual operation time:	5,600 h/yr
Boiler fuel:	LNG 60 yen





Example of Proposal

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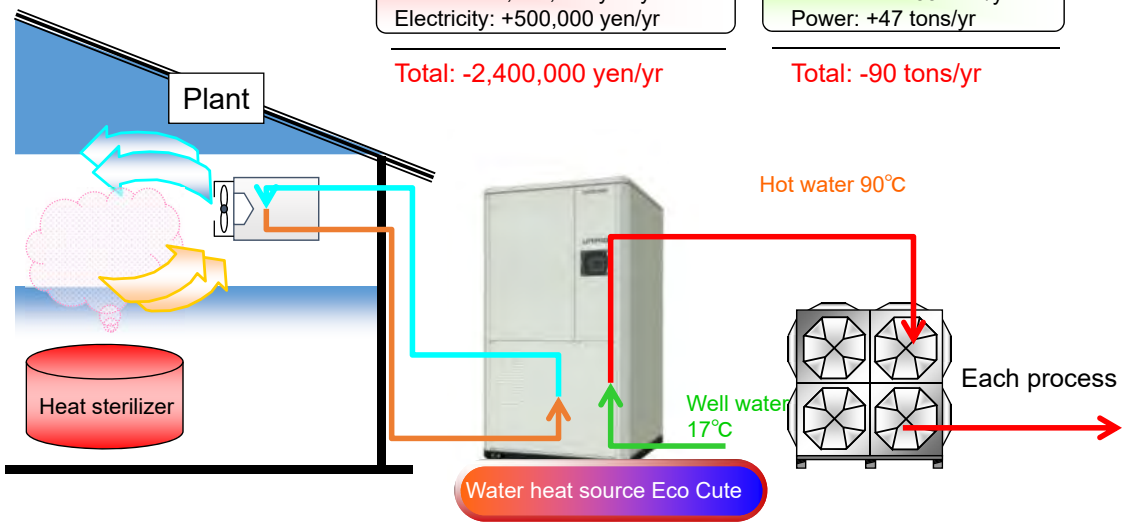
[Proposal]

- Hot water of Eco Cute is supplied to each process.
- Using cold water cools the interior of the plant (Improvement of working environment)

[Effect]

1 Eco Cute introduced		CO2 reduction	
Fuel:	-2,900,000 yen/yr	Fuel oil A:	-133 tons/yr
Electricity:	+500,000 yen/yr	Power:	+47 tons/yr
Total:	-2,400,000 yen/yr	Total:	-90 tons/yr



•Features of Water Heat Source type Heat Pump, Eco Cute②

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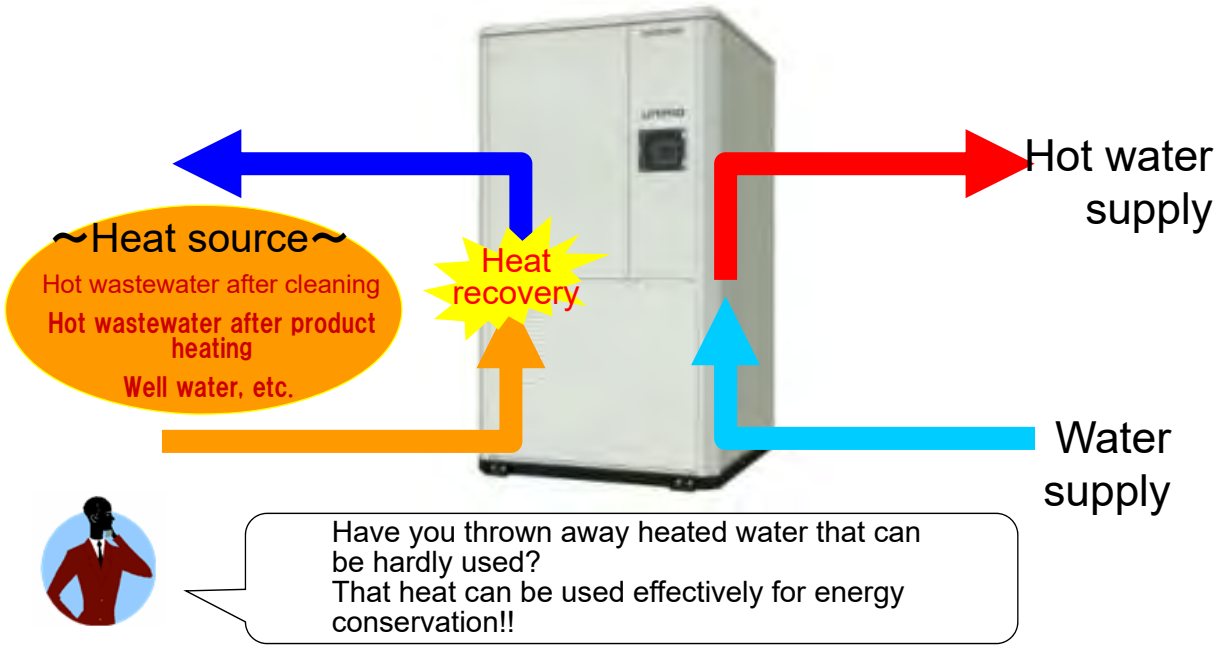
"High-efficiency operation possible by heat recovery"



Example of Proposal

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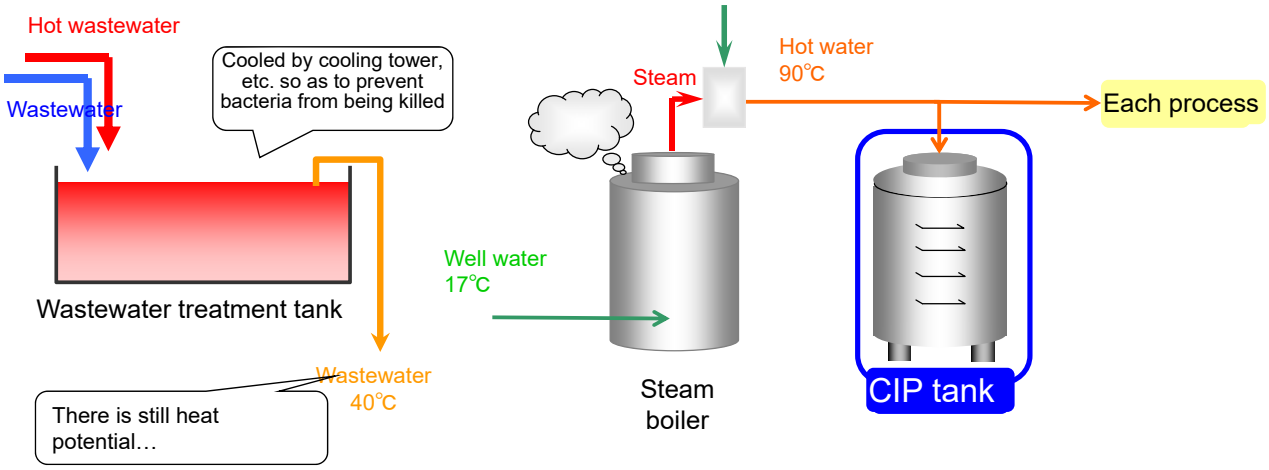
"Hot wastewater heat source"

[Present situation]

- Hot water for cleaning in each process is produced by using "steam + well water".
- Hot wastewater exceeding 40℃ and flowing to the wastewater treatment tank is thrown away.

Specifications	
Cold water:	14 tons/h
Hot makeup water:	1.2 tons/h
Operation time:	8,760 h/year
Boiler fuel:	Fuel oil A 60 yen/L



Example of Proposal

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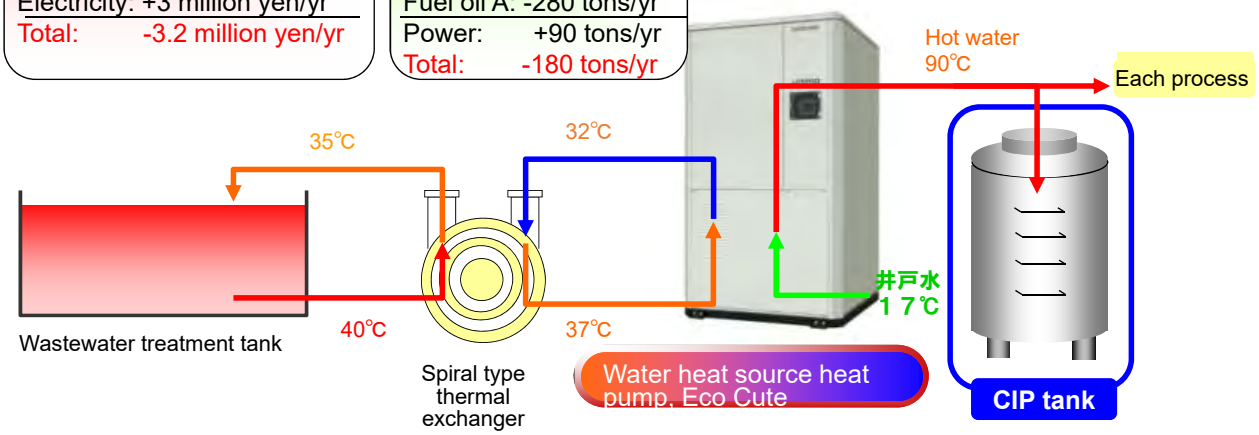
Proposal

- High-efficiency operation of Eco Cute with hot wastewater from treatment tank as heat source
- Problem of water quality has been solved through special heat exchanger.

Expected benefit

Introducing 1 Eco Cute	
Fuel:	-6.2 million yen/yr
Electricity:	+3 million yen/yr
Total:	-3.2 million yen/yr

Reduction of CO2 emission	
Fuel oil A:	-280 tons/yr
Power:	+90 tons/yr
Total:	-180 tons/yr



Application example in Japan

unimo WW

35% operating cost reduced by adopting
CO_2 heat pump unimoWW
waste heat recovery at winery.

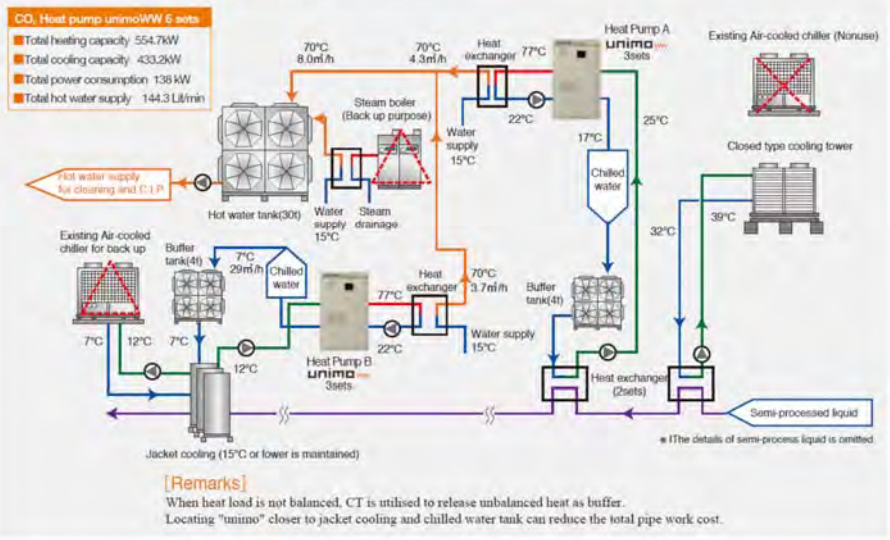
Why "unimo"

The development of 90°C heat pump
Better energy efficiency
The use of natural refrigerant

Winery
Mercian Corp. Fujisawa plant

Conceptual Diagram

Recovering waste heat from semi-process liquid of removal process of yeast after fermentation, heat pump "unimo" produces hot water to cleaning process and C.I.P.



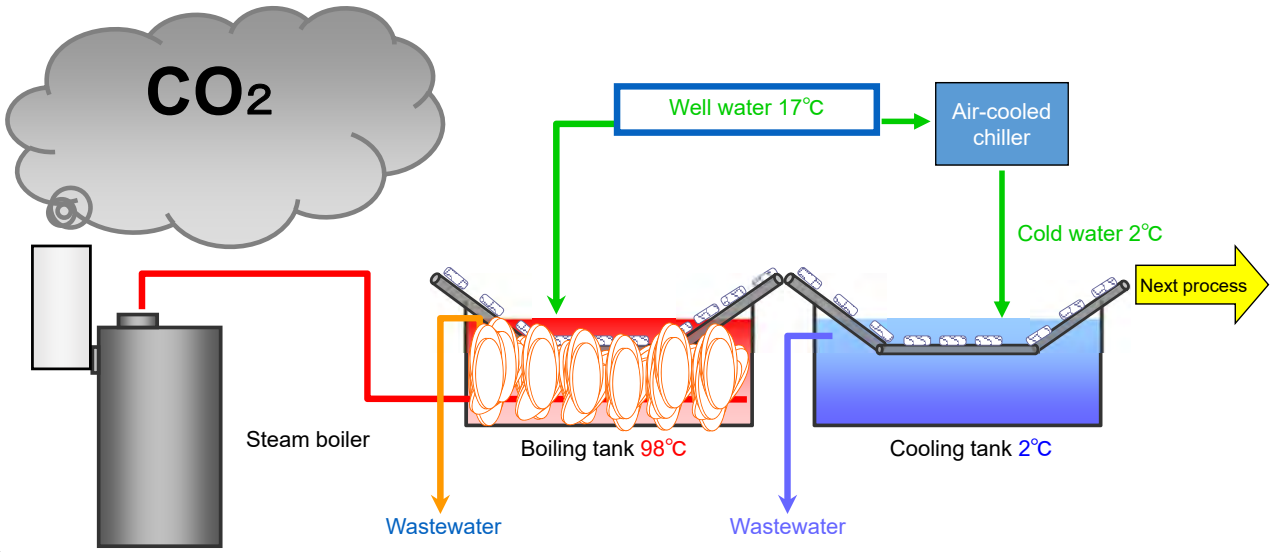
[Remarks]
When heat load is not balanced, CT is utilised to release unbalanced heat as buffer.
Locating "unimo" closer to jacket cooling and chilled water tank can reduce the total pipe work cost.

Solutions of unimo WW

Application example in Japan/Food processing

◆Simultaneous operation with hot water and colder water by installing separated equipment

Energy load and environmental load are excessively large.



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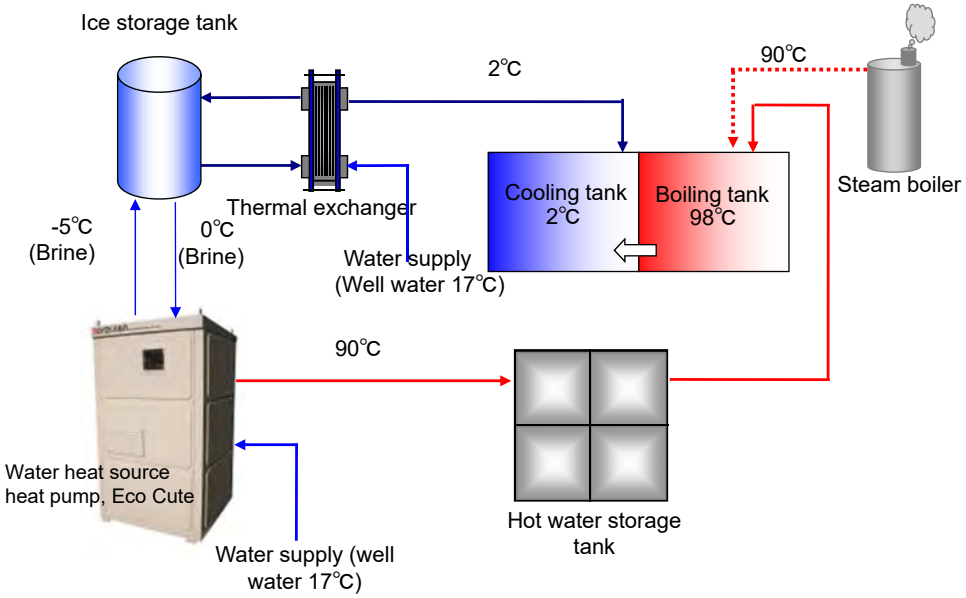
Application example in Japan/Food processing

◆Hot water and cold water are supplied by “one equipment”.

Improvement of energy and environmental loads



Boiling tank

◆ Noodle is boiled for a short time (8 to 10 minutes) with a bucket having twice surface area that of conventional one, achieving a higher yield and making the noodle with sharp edges.

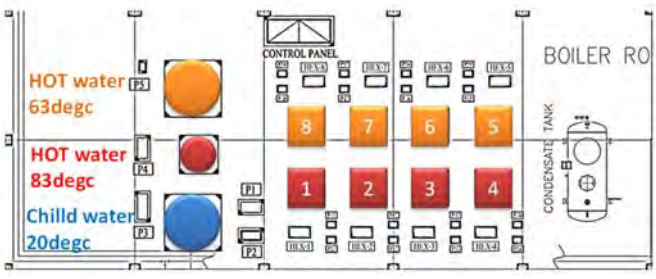
Application example in Thailand

JCM Model project 2015-2017

Water tanks

Control panel

Heat recovery heat pumps



Boiler room

JCM Model project 2015-2017

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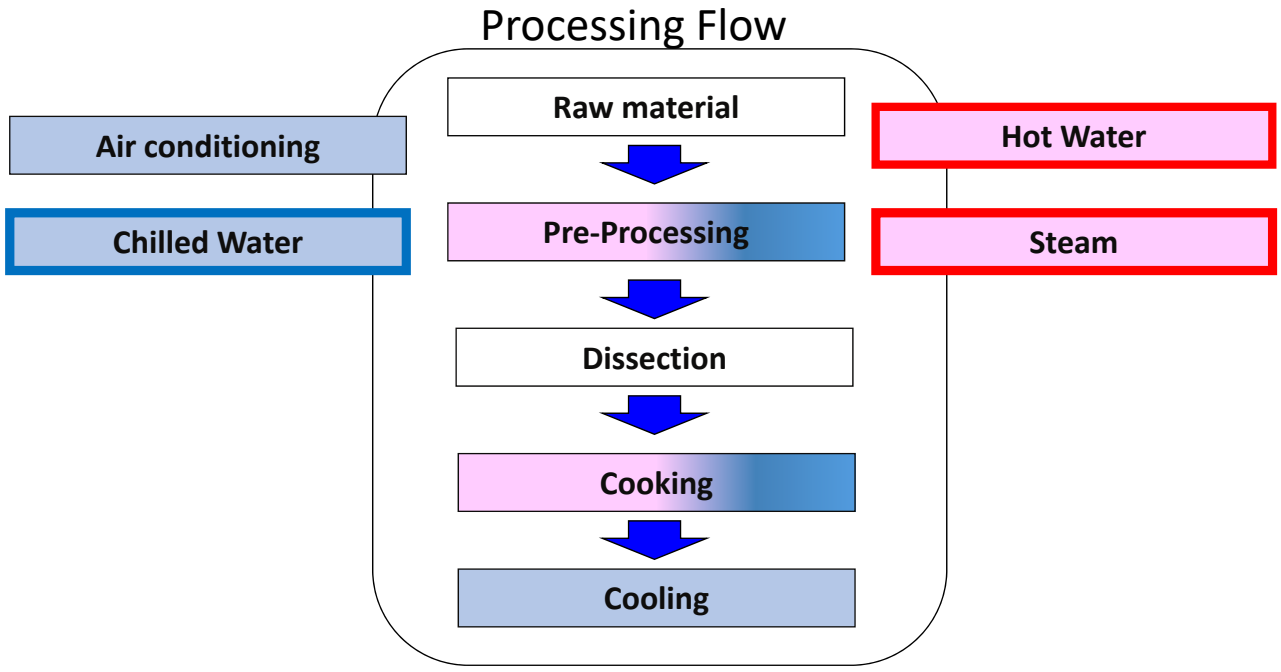
Target Of JCM Model project



JCM Model project 2015-2017

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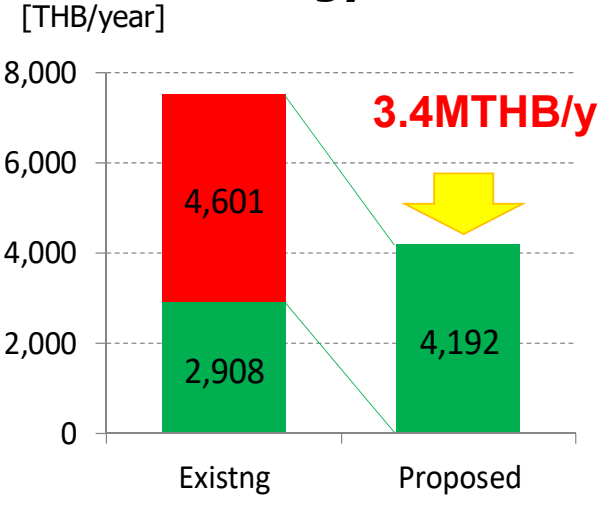
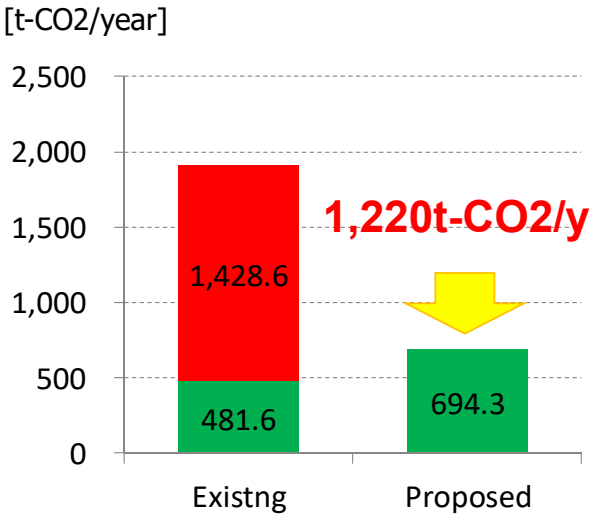
Energy Cost



CO2 emissions



Heavy Oil
Electric

Payback year 3.7 years

Energy Cost Rate : Electricity 3.42THB/kWh], Heavy Oil 9.67 [THB/L]
Calorific Value : Heavy Oil 0.03977 [GJ/L]
CO2 Emission Rate : Electricity 0.56643 [t-CO2/MWh], Heavy Oil 0.0755t-CO2/GJ
Boiler efficialcy 80%, Chiller COP3.48

Fuel of Boiler	Heavy Oil
Heat Pump Q'ty	8
Running Hours	6000[h/year]

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Thank you

for your attention