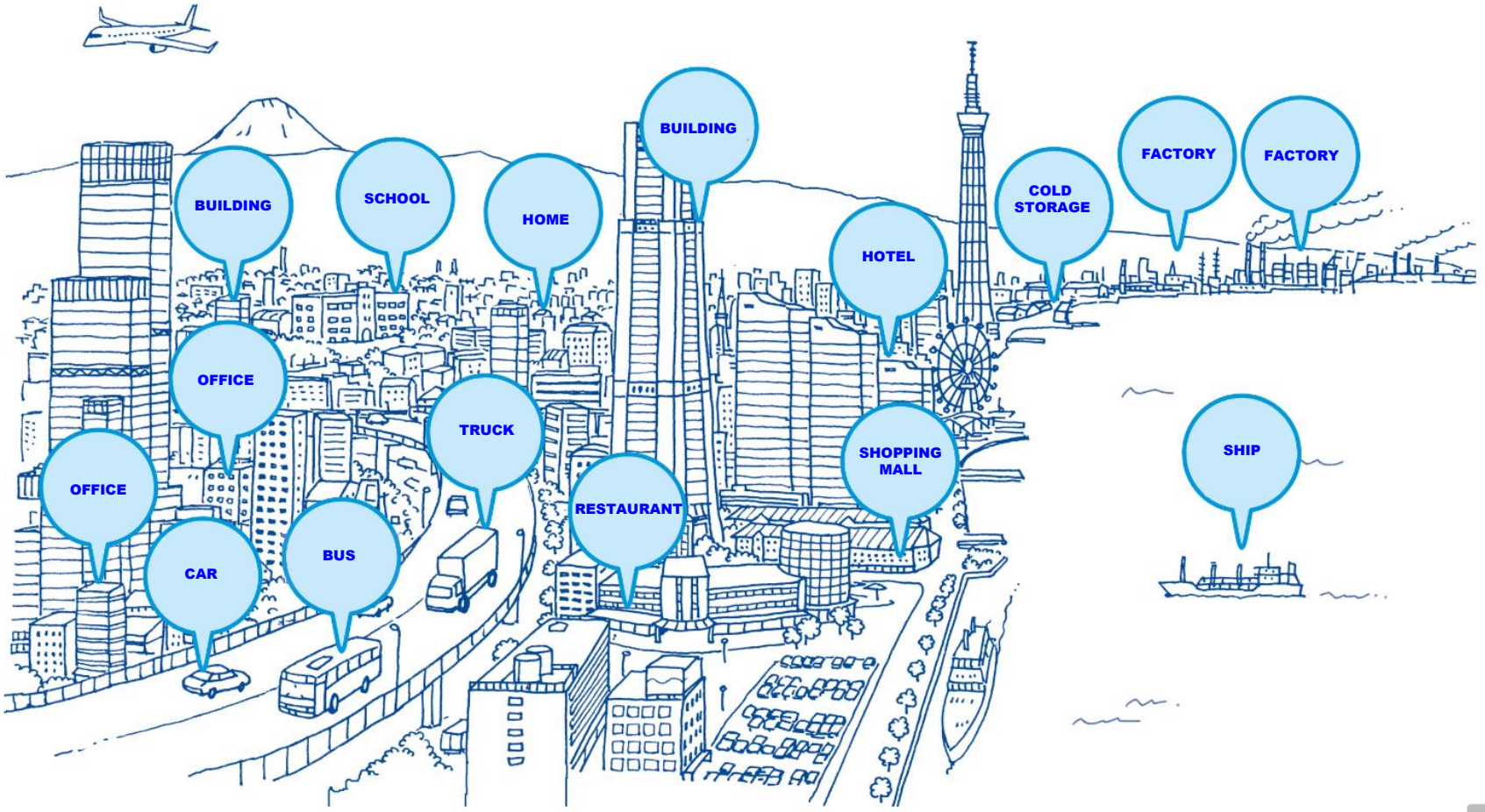
CARBON NEUTRALIZATION
WITH MHI CENTRIFUGAL CHILLER

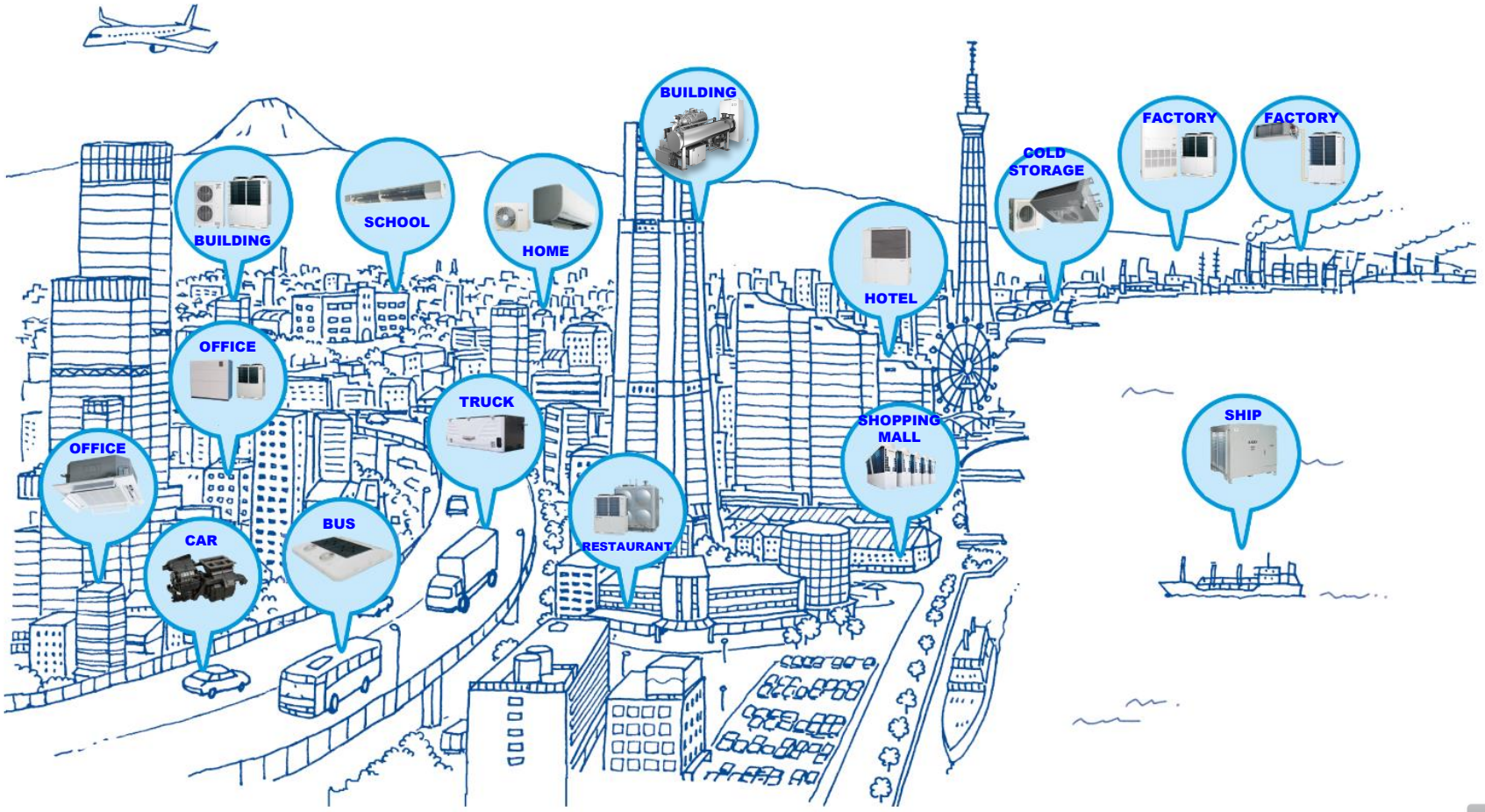
EMS-81646

Sep. 2022

We deliver you comfortable space



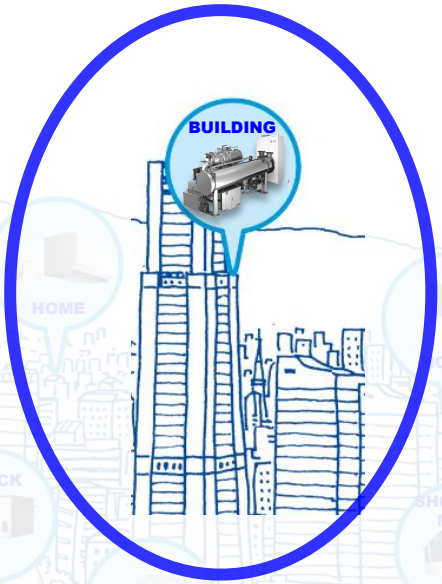
with **high energy efficiency** thermal solutions **friendly to global environment**



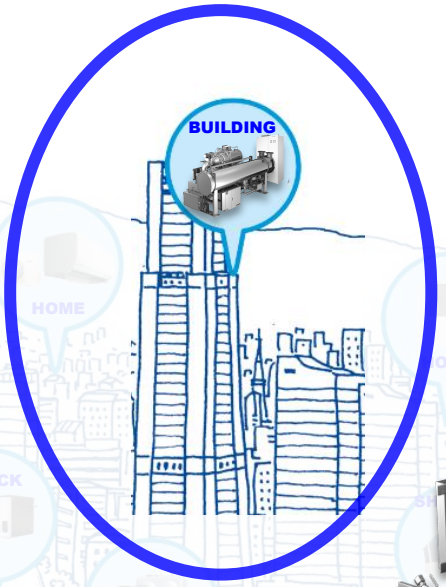
with **high energy efficiency** thermal solutions **friendly to global environment**

Air-conditioners, Heat pump, Centrifugal chiller

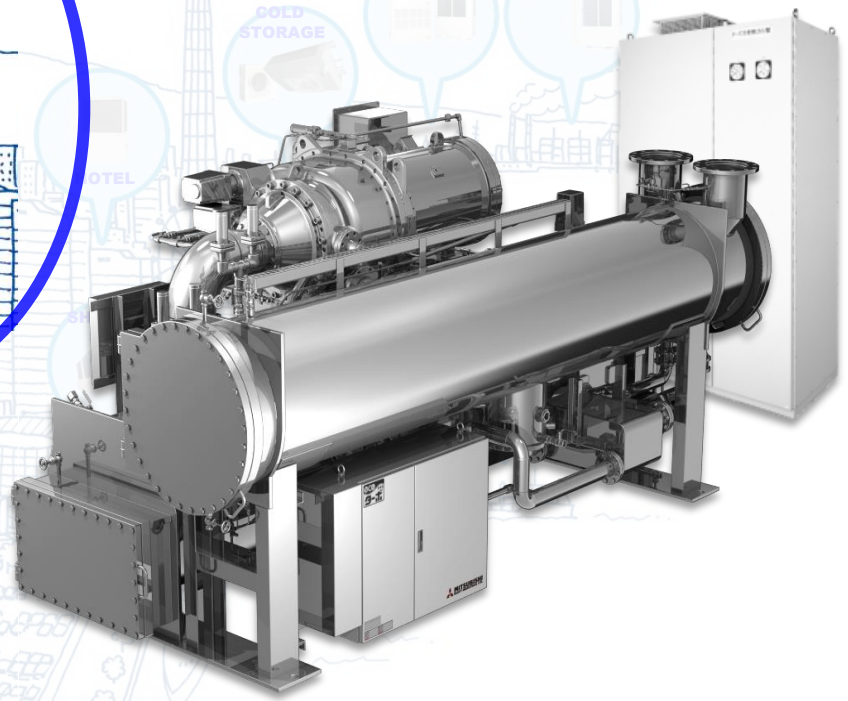
with **high energy efficiency** thermal solutions friendly to **global environment**



Introduction of **Centrifugal chiller**



HIGH ENERGY EFFICIENCY !



Introduction of Centrifugal Chiller : How it works

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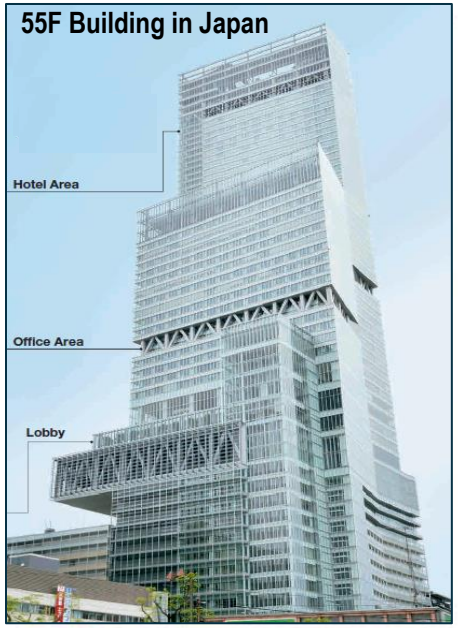

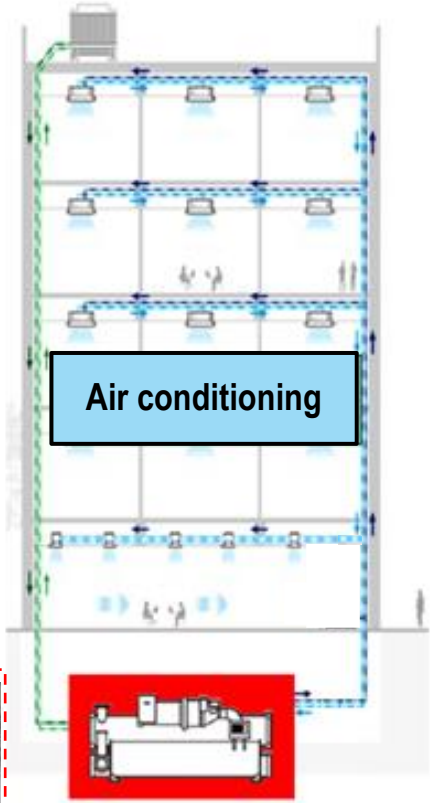

Chiller

Installed at the underground level

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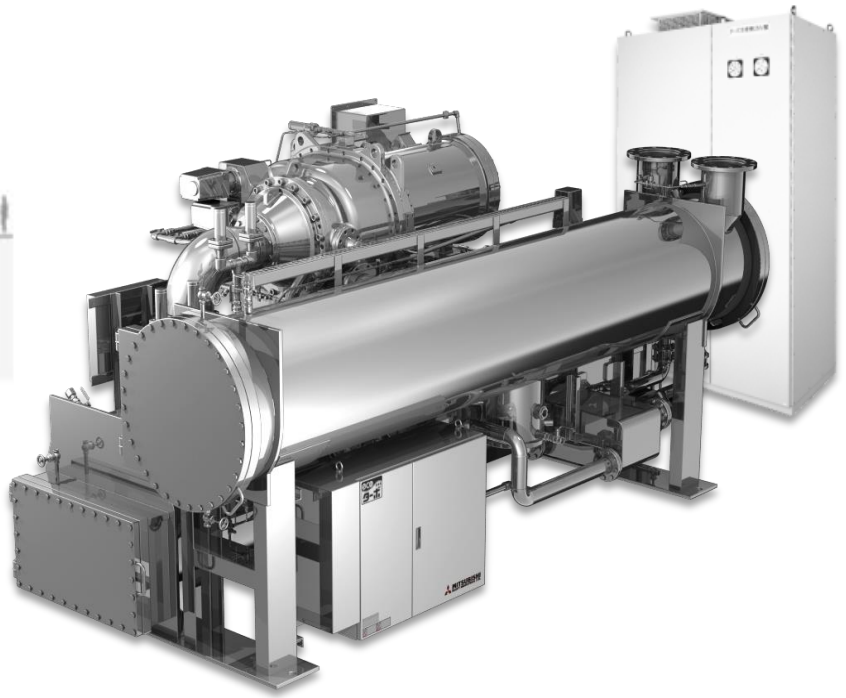
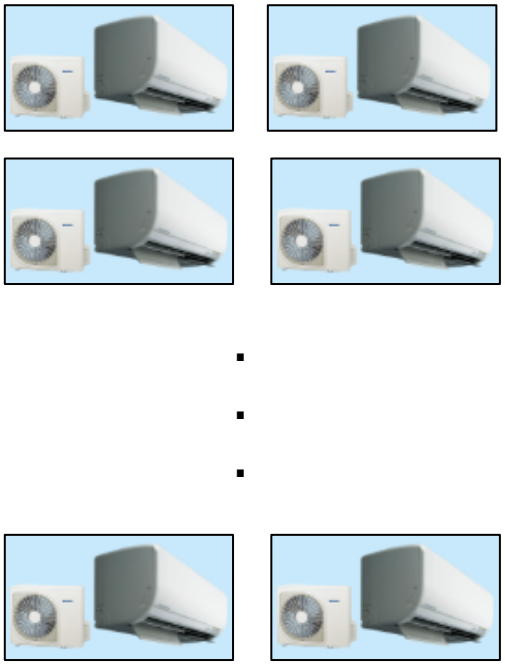
Building
Air conditioning



One Centrifugal chiller can cover about 2000 units Air-Conditioner !

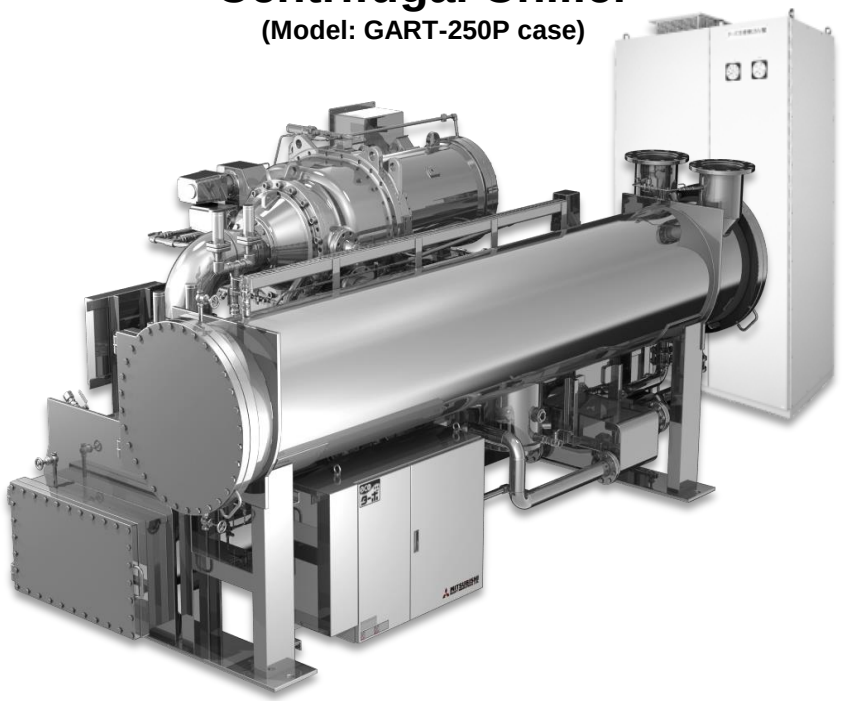
Cooling capacity of 2000 units room Air-Conditioner

(Case of Air-Conditioner cooling capacity is 3.5kW)

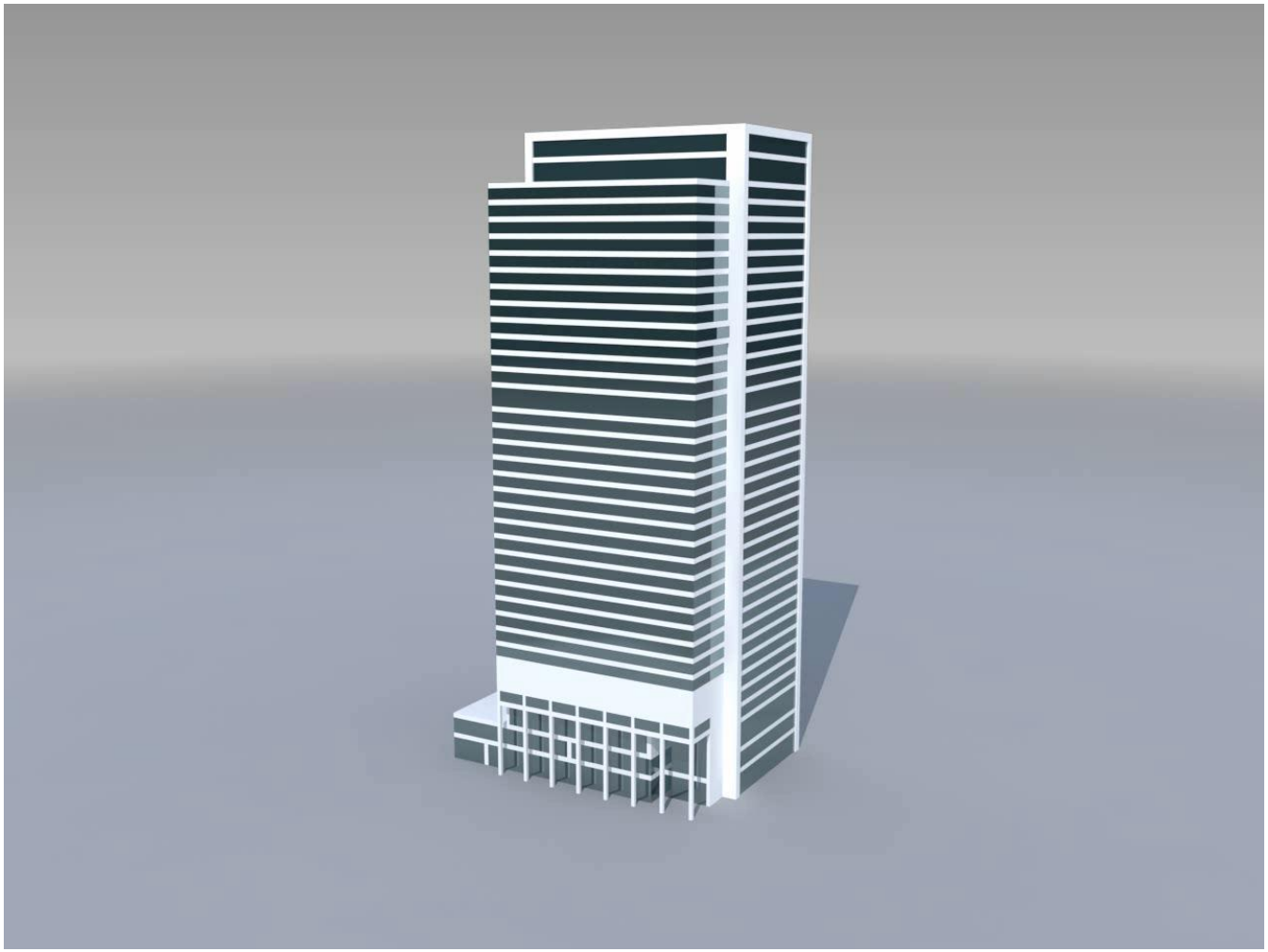


Cooling capacity of one unit Centrifugal Chiller

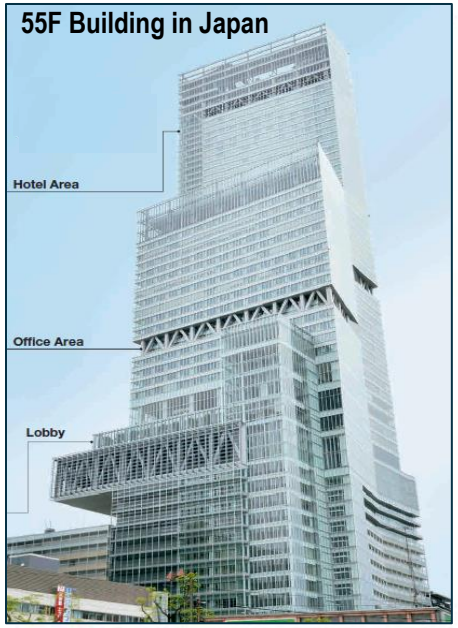
(Model: GART-250P case)

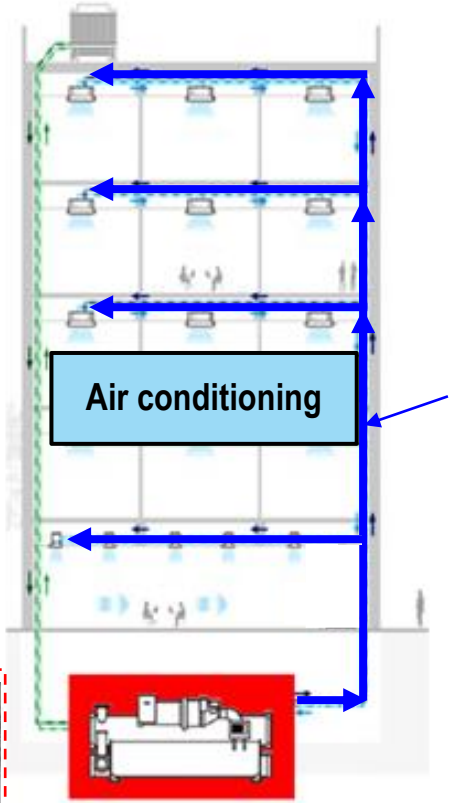


HOW CHILLER WORKS?



Introduction of Centrifugal Chiller : How it works



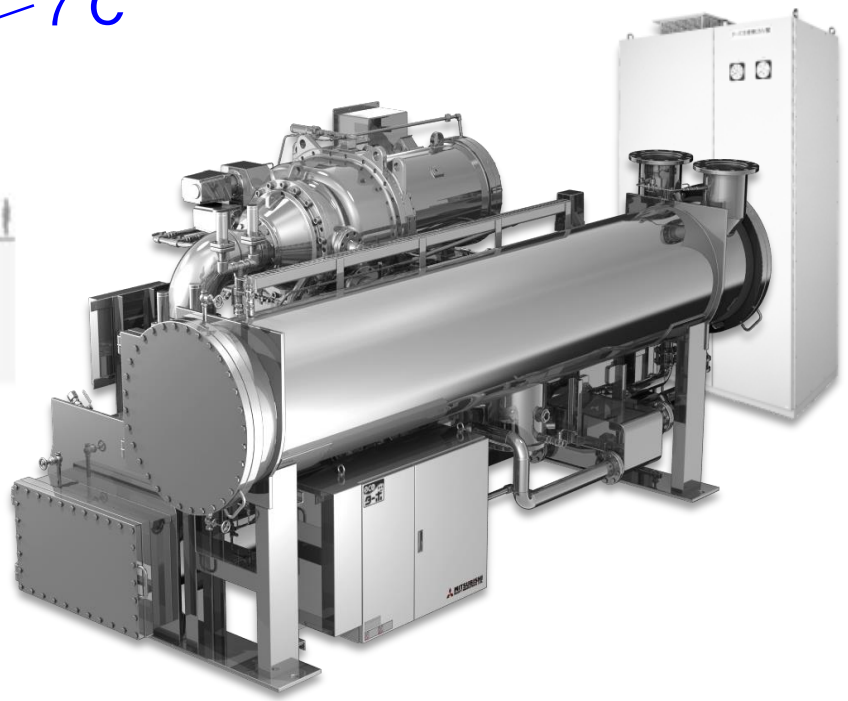


Chiller

Installed at the underground level

For Air conditioning
7℃* Chilled water
is provided by chiller

(*Normally 5 ~ 7℃)



Introduction of Centrifugal Chiller : How it works

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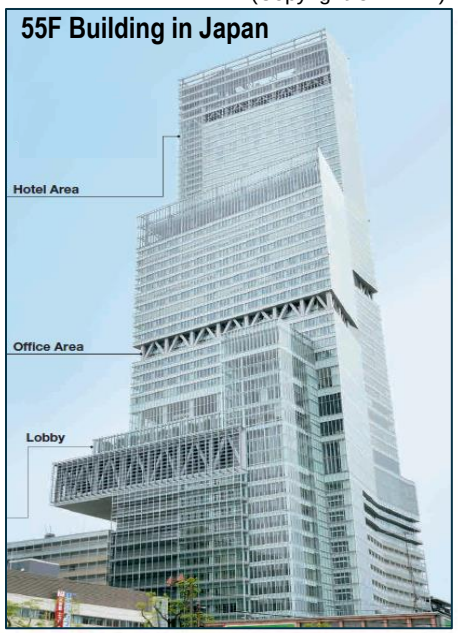
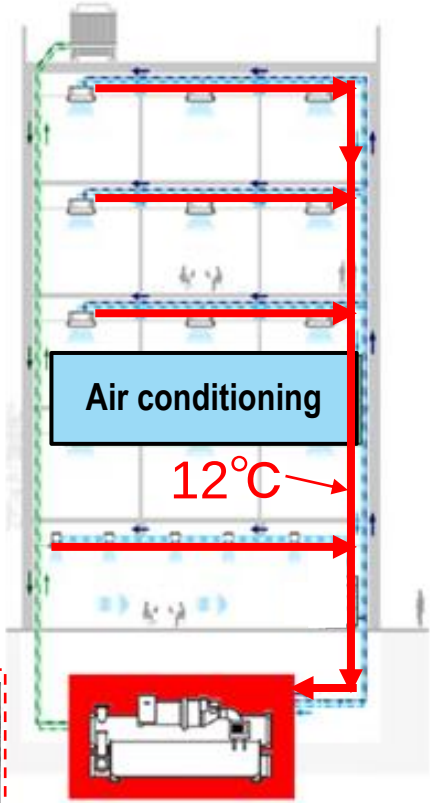




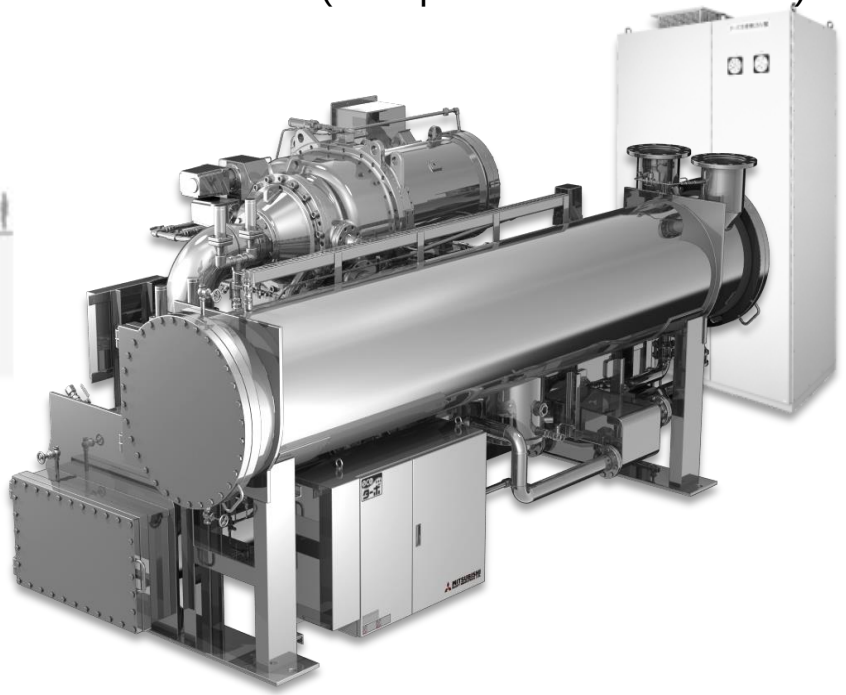
Chiller

Chiller
12℃➡7℃

Installed at the underground level

12℃ water return to chiller, and water is cooled down from 12*℃ to 7*℃ by chiller

(*It depends on the condition)



Introduction of Centrifugal Chiller : How it works

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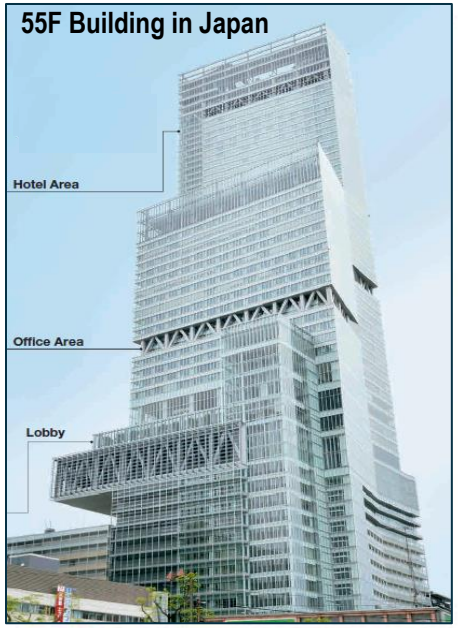
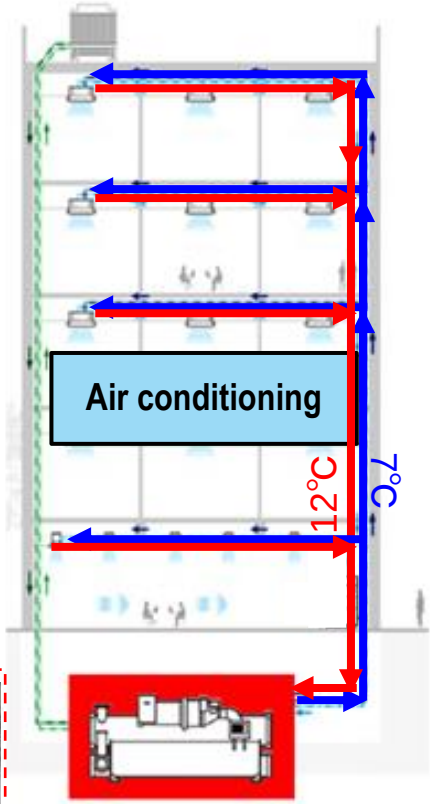




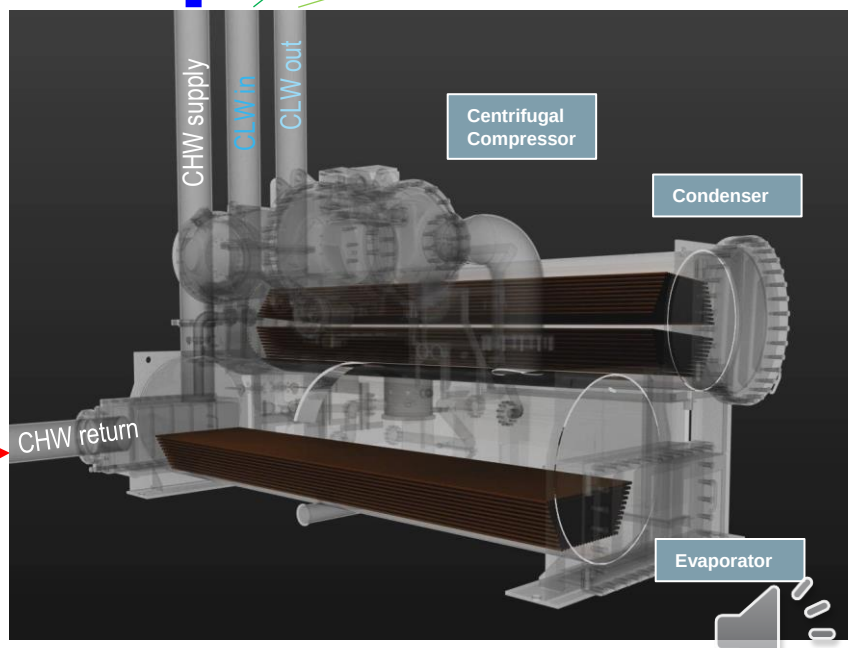
Chiller

Chiller
12℃➡7℃

Installed at the underground level

For Air conditioning 7℃* Chilled water is provided by chiller continuously

(*Normally 5 ~ 7℃)



Introduction of Centrifugal Chiller : How it works

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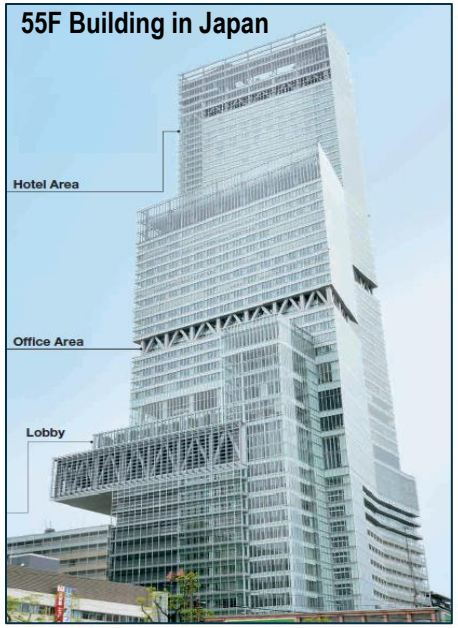
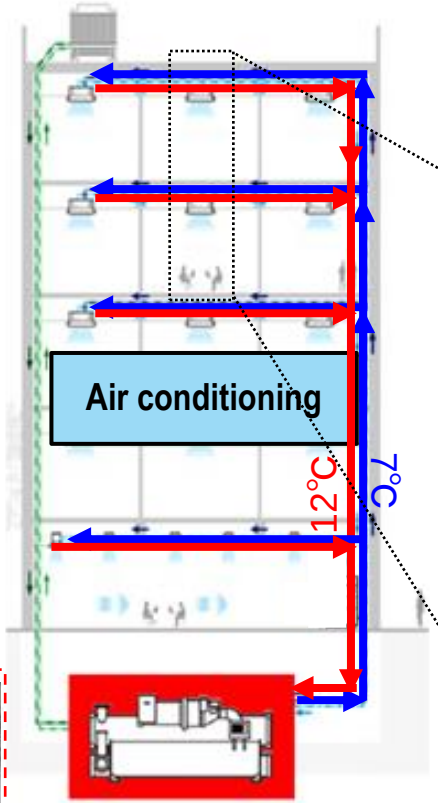
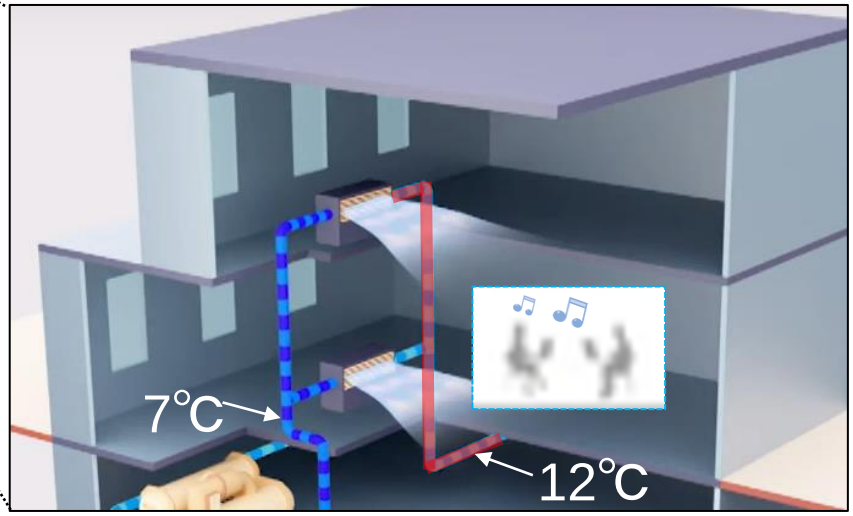






(Source of picture: agency for natural resources and energy)

Chiller

Installed at the underground level

Chiller
12℃➡7℃

Comfortable Space !

Introduction of Centrifugal Chiller : How it works

Marina Bay
New Downtown
Singapore

D.H.C.*

853 RT x 1 unit
2000 RT x 2 units
2844 RT x 11 units
3697 RT x 2 units (Total 15 units)

Total 43,531 RT

* D.H.C. : District heating and cooling

MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS,LTD.

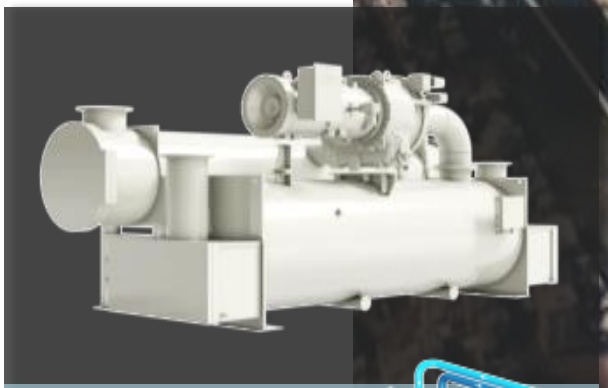
Introduction of Centrifugal Chiller : How it works

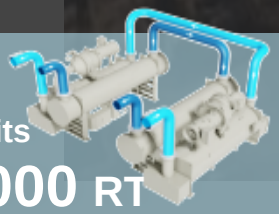
MITSUBISHI HEAVY INDUSTRIES

Madinah Urban Development Project

Saudi Arabia

D.H.C.*





Variable speed
2500 RT x 80 units

Total **200,000** RT

MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS,LTD.

Kansai International Airport

D.H.C.*

Japan

1100 RT x 1 unit
1200 RT x 1 unit
2000 RT x 2 units (Total 4 units)

Total 6,300 RT

Heat supply plant | Passenger terminal | Hotel | Office

Chilled water/steam

* D.H.C.: District heating and cooling

Introduction of Centrifugal Chiller : How it works

Shirakawa Data Center

Japan

450 RT x 9 units

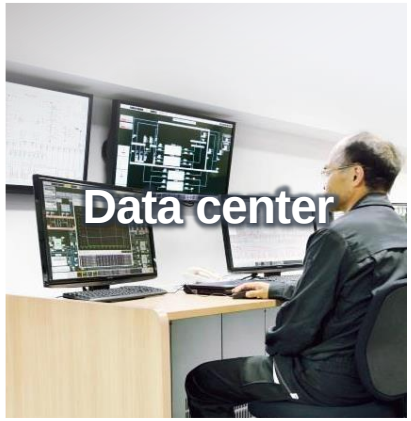
400 RT x 2 units

Amari Hotel Bangkok

Thailand

MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS,LTD.

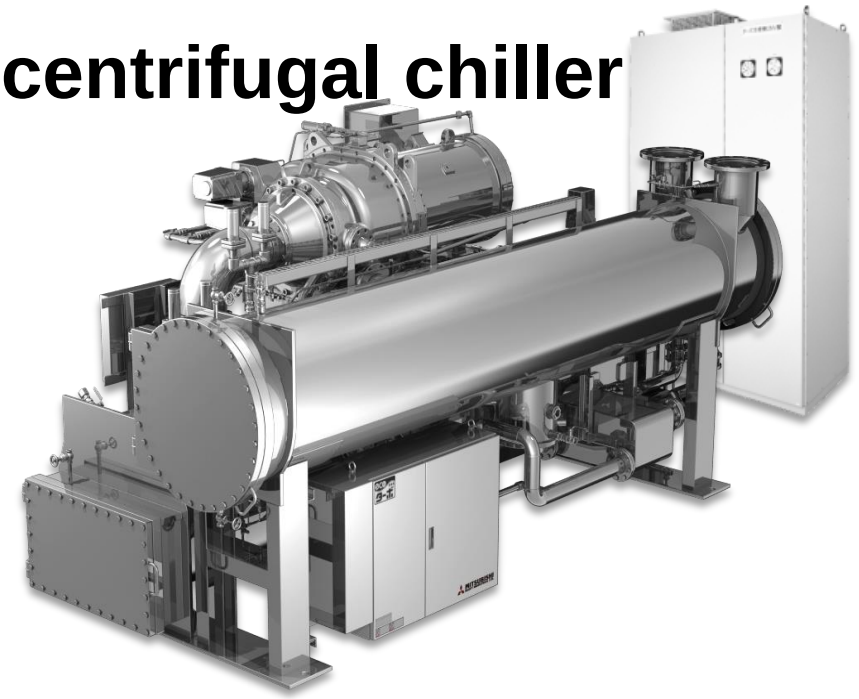
Introduction of Centrifugal Chiller : Application



MHI Centrifugal chiller is,

1) High efficiency cooling system

2) Low GWP* refrigerant centrifugal chiller



(*GWP: Global Warming Potential)

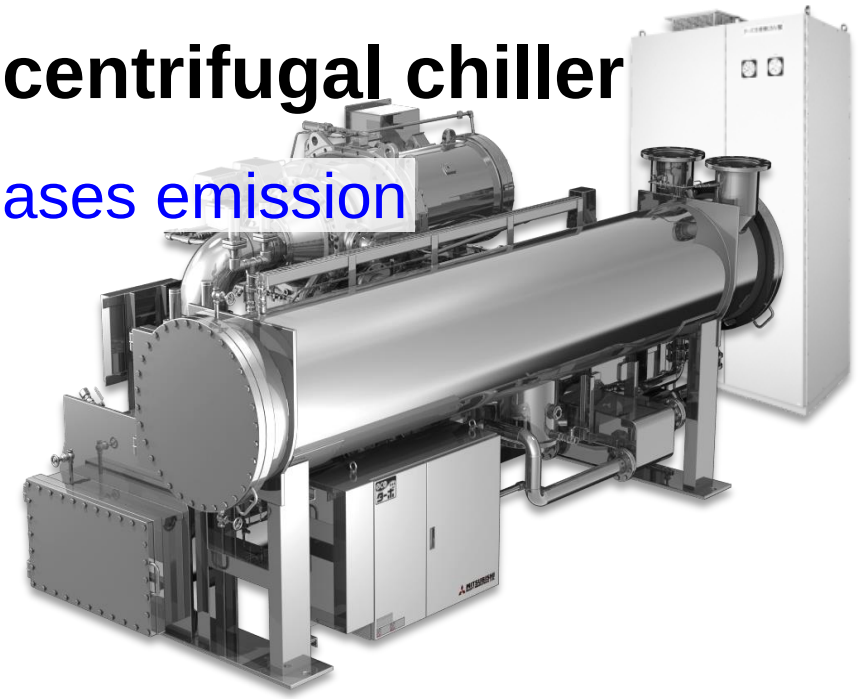
MHI Centrifugal chiller is,

1) High efficiency cooling system

➡Less energy, Reduction of CO2 emission

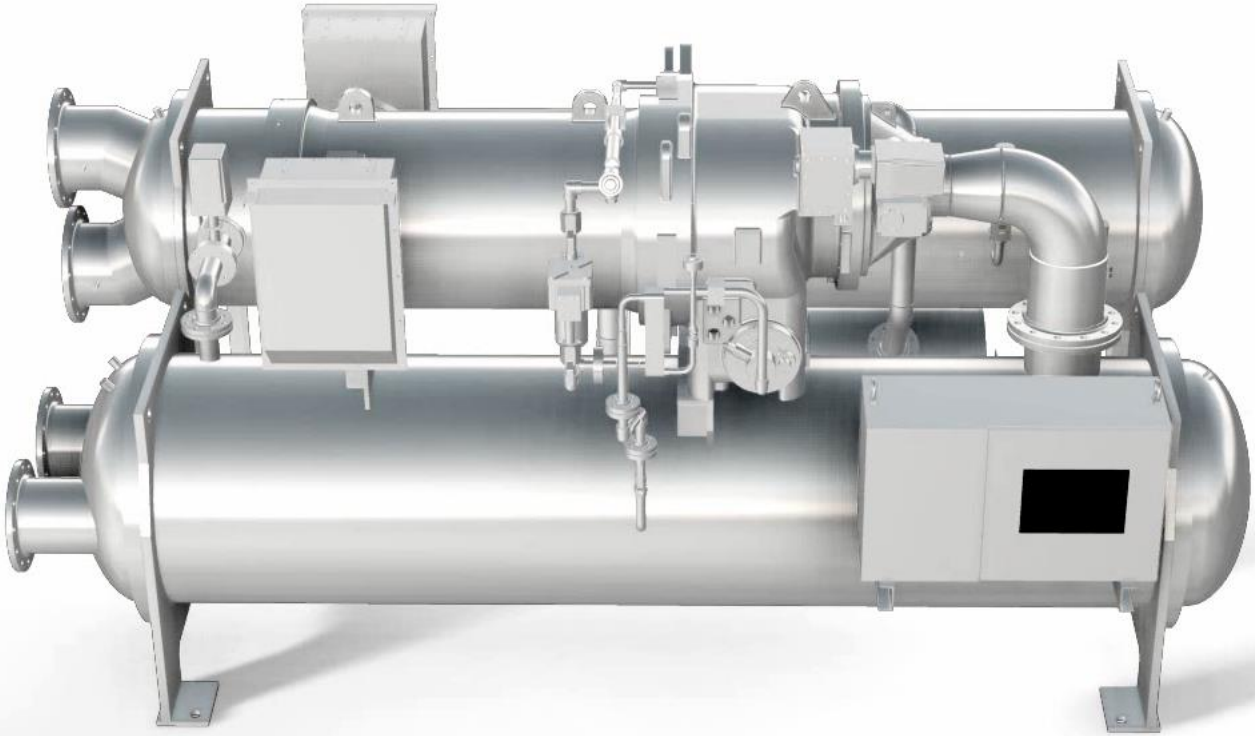
2) Low GWP* refrigerant centrifugal chiller

➡Reduction of Greenhouse gases emission



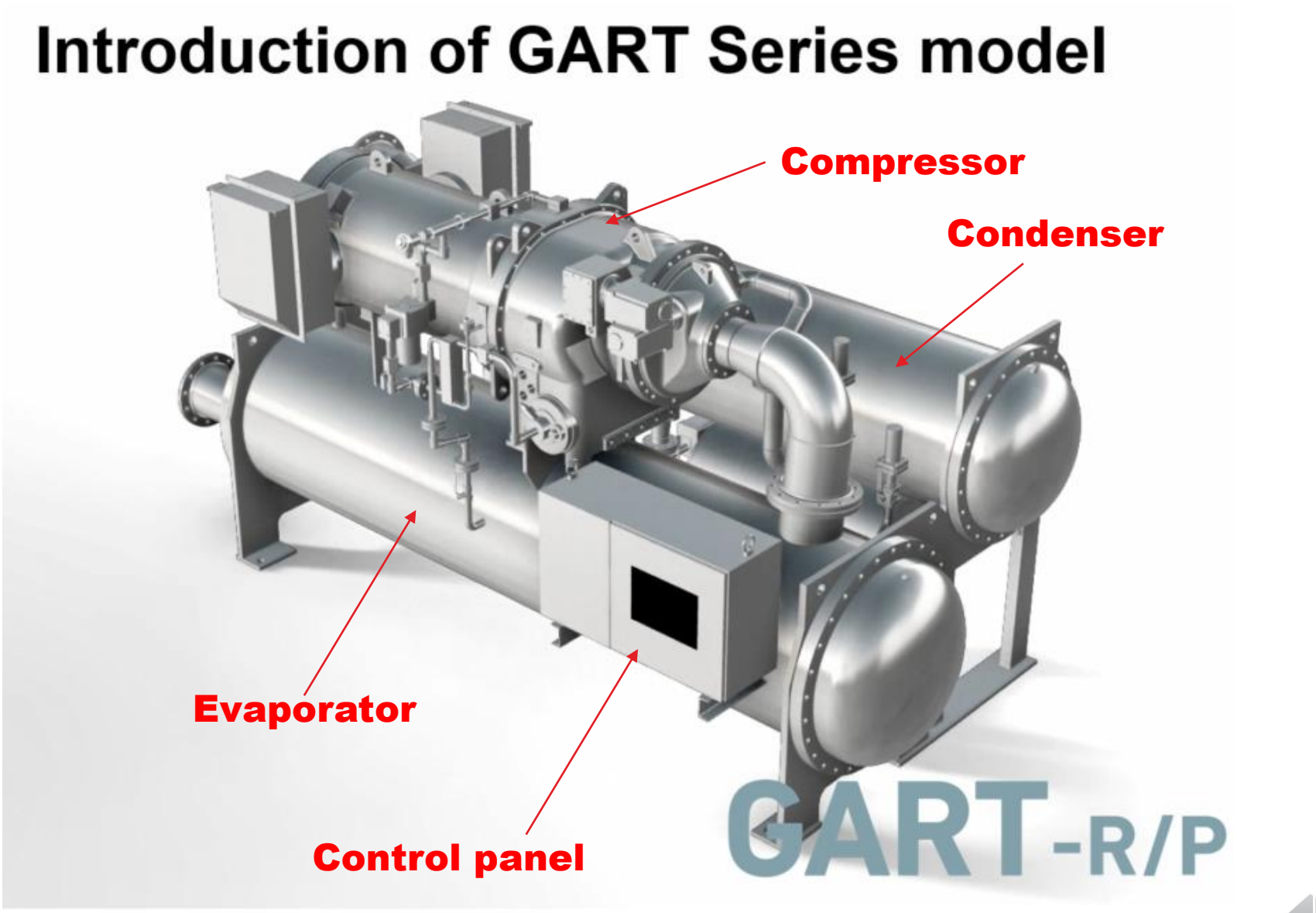
(*GWP: Global Warming Potential)

Introduction of GART Series model

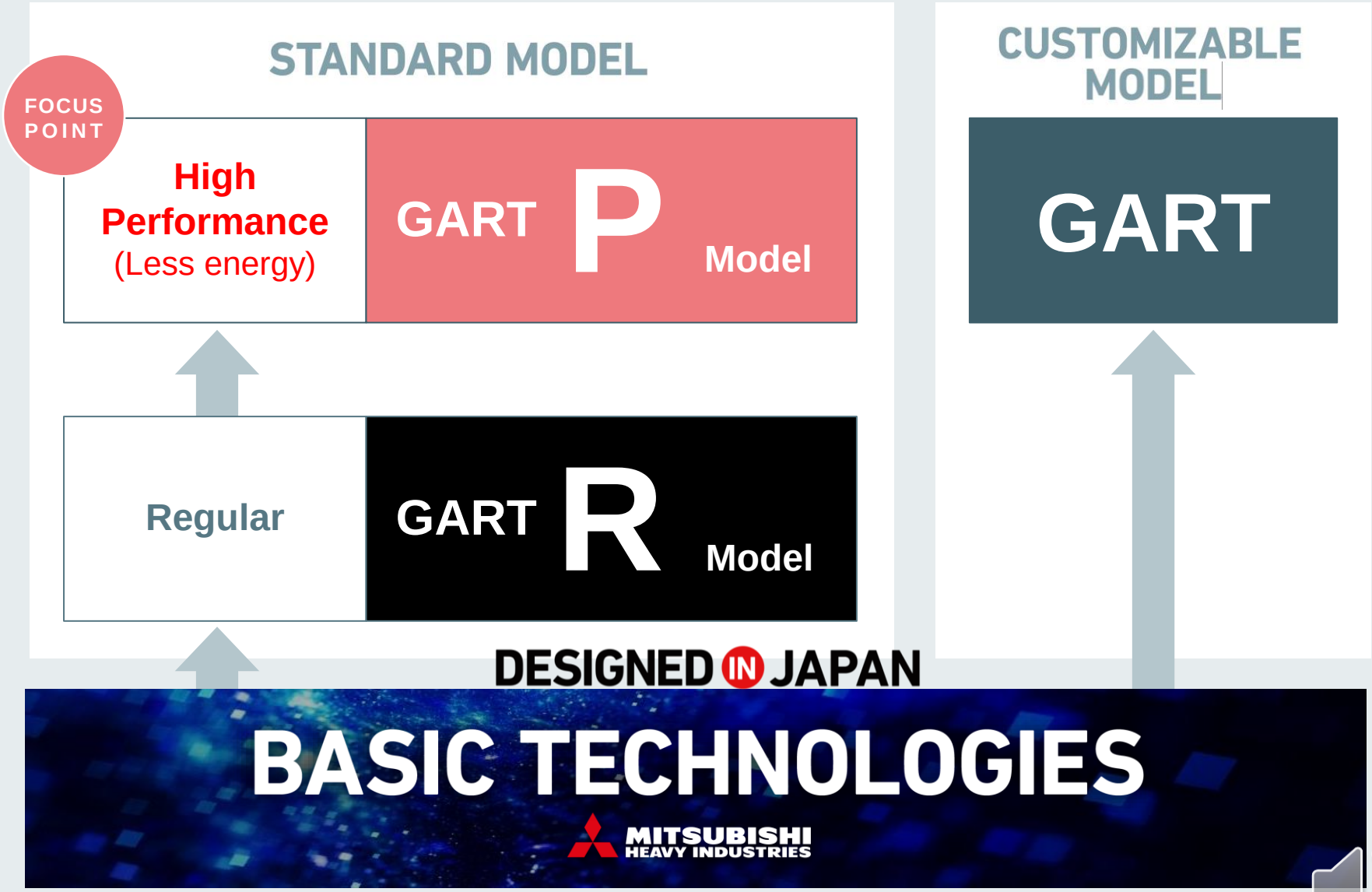


GART-R/P

Introduction of GART Series model



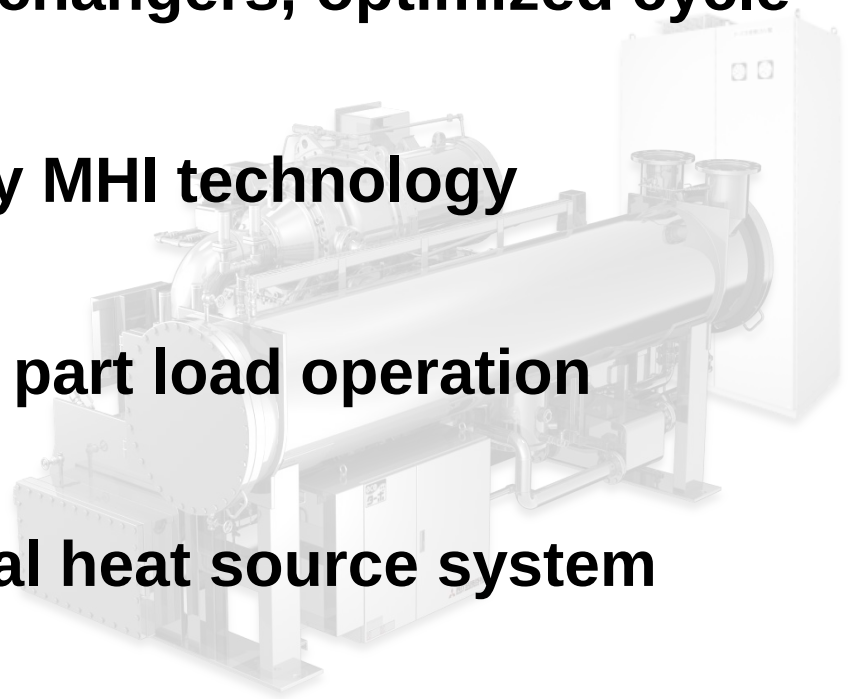
MHI Centrifugal Chiller: GART Series



MHI Centrifugal chiller is,

1) High efficiency cooling system

- High performance heat exchangers, optimized cycle
- Centrifugal compressor by MHI technology
- Variable speed control for part load operation
- Ene-Conductor for the total heat source system



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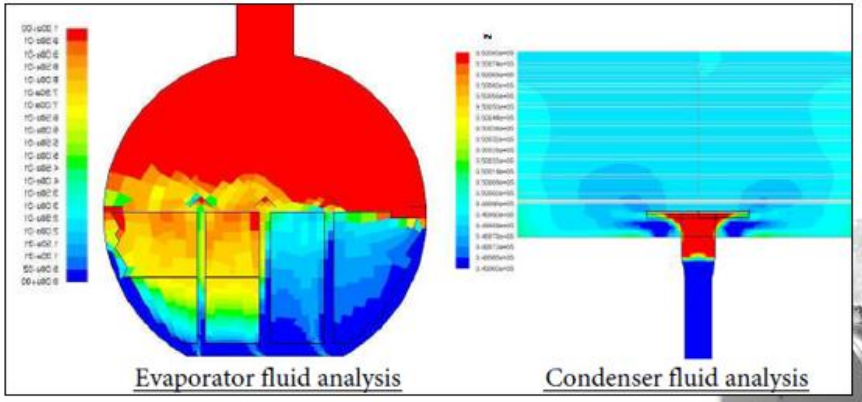

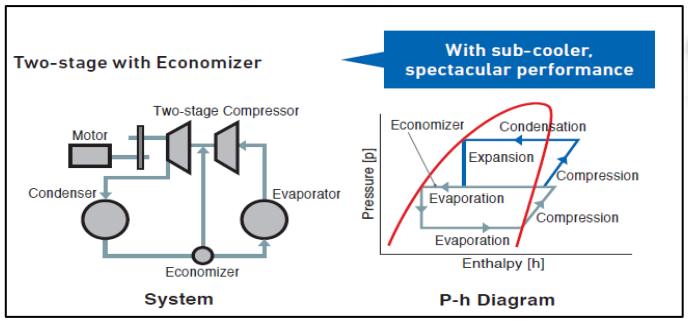

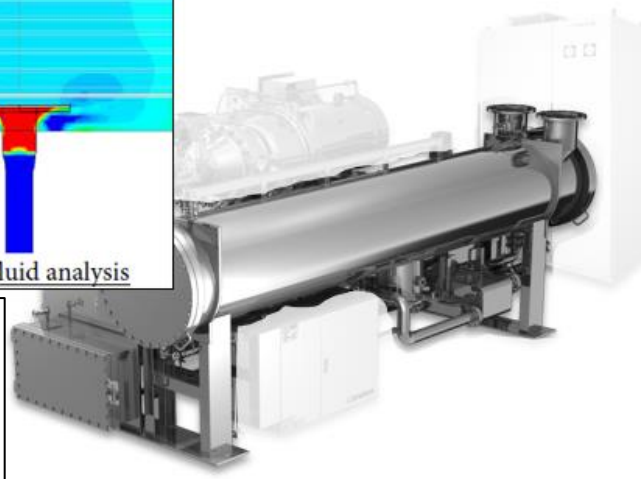

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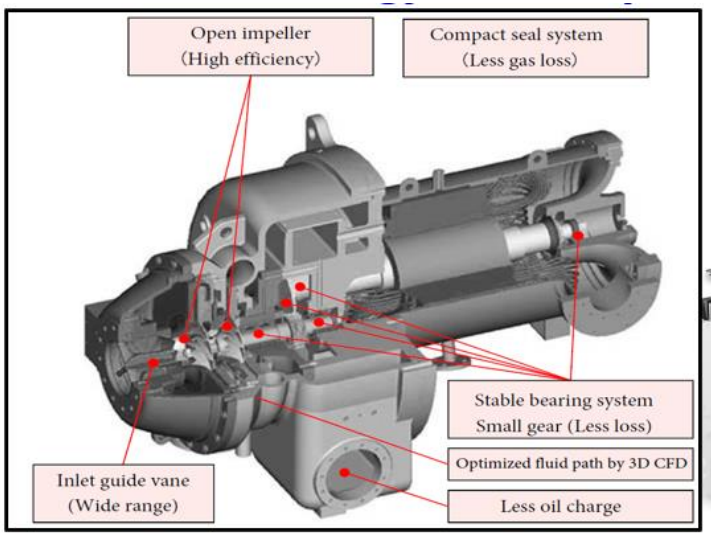

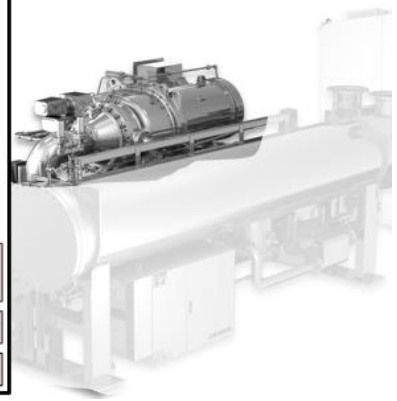

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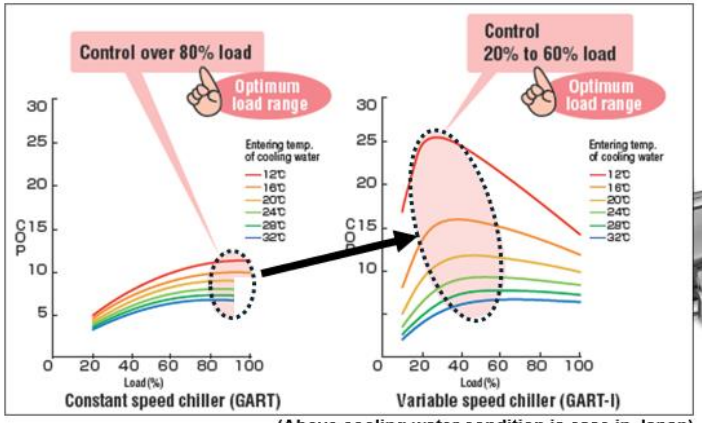
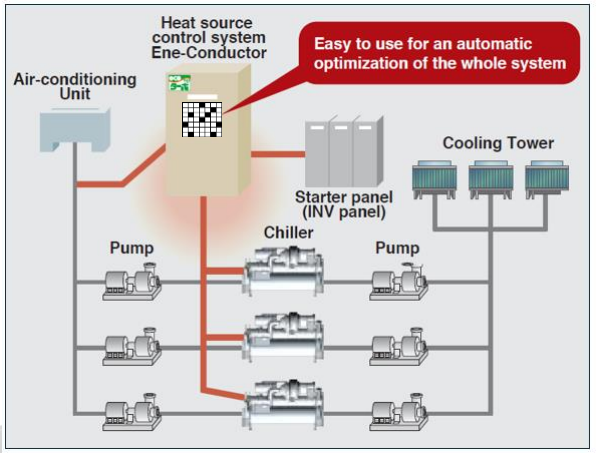


(Above cooling water condition is case in Japan)



- Variable speed control for part load operation

- Ene-Conductor for the total heat source system

MHI Centrifugal chiller is,

1) High efficiency cooling system technology

- High performance heat exchangers, optimized cycle
- Centrifugal compressor by MHI technology
- Variable speed control for part load operation
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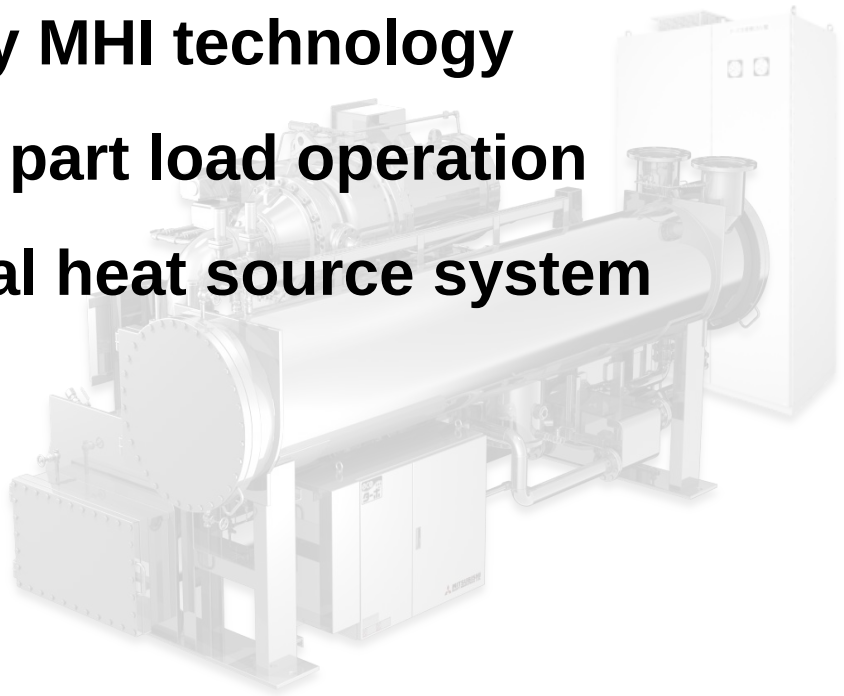

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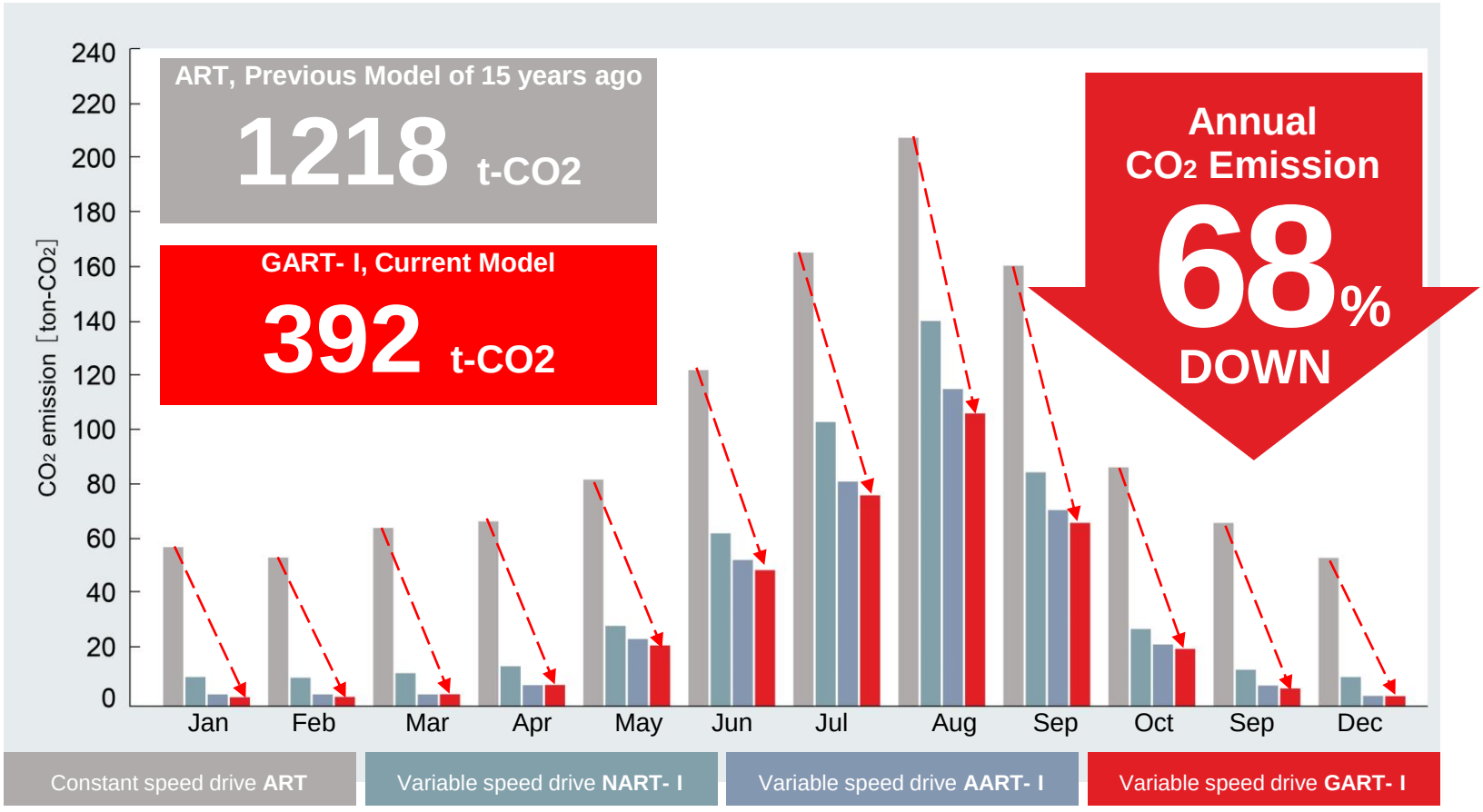
ENERGY SAVING IS ACHIEVED !

➡ REDUCTION OF CO2 EMMISION

Reduction of CO2 emission with MHI Centrifugal chiller

Case introduction : CO2 emission reduced case study



Simulation condition:

Load pattern	: Air conditioning	Chiller capacity	: 1300 USRt
Annual total load	: 8406 MWh/year	Unit No.	: 2 units
Max. load	: 2000 USRt	CO_2 coefficient	: 0.525 kg-CO_2/kWh

(Above is case in Japan)

Reduction of CO2 emission with MHI Centrifugal chiller

Case introduction : CO2 emission reduced

Before

Variable Speed Drive
MHI Centrifugal Chiller
(Previous Model NART-I Series)

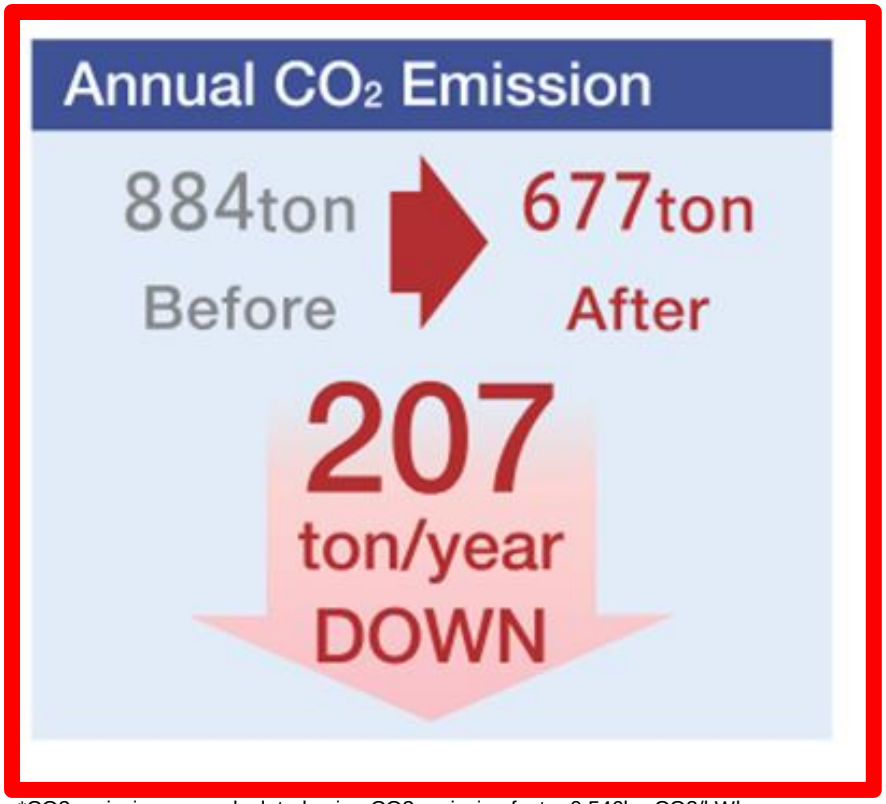
After

Variable Speed Drive
MHI Centrifugal Chiller
(Existing Model ETI Series)

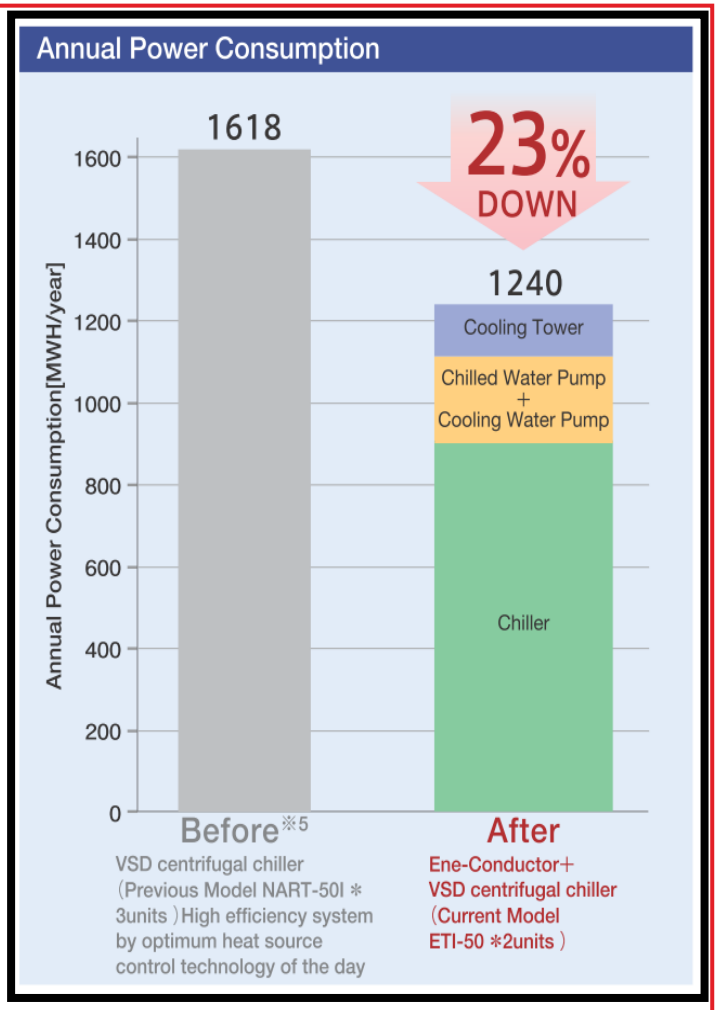
+ Ene-Conductor

Reduction of CO2 emission with MHI Centrifugal chiller

Case introduction : CO2 emission reduced



*CO2 emission was calculated using CO2 emission factor 0.546kg-CO2/kWh
(FY2011 actual record by Tohoku Electric Power Co., Inc.)



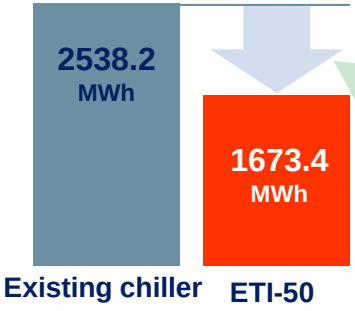
*Power consumption (Before) is calculated based on 2012 data divided by 2004 System COP 5.9

(Above is case in Japan)

Case introduction : CO2 emission reduced

Energy Saving & Cost Reduction Effect
(comparison with the other brand's existing chiller)

■ **Annual Electric Power Consumption (Result)**



864.8MWh

About 35% Reduction

Variable speed drive centrifugal chiller

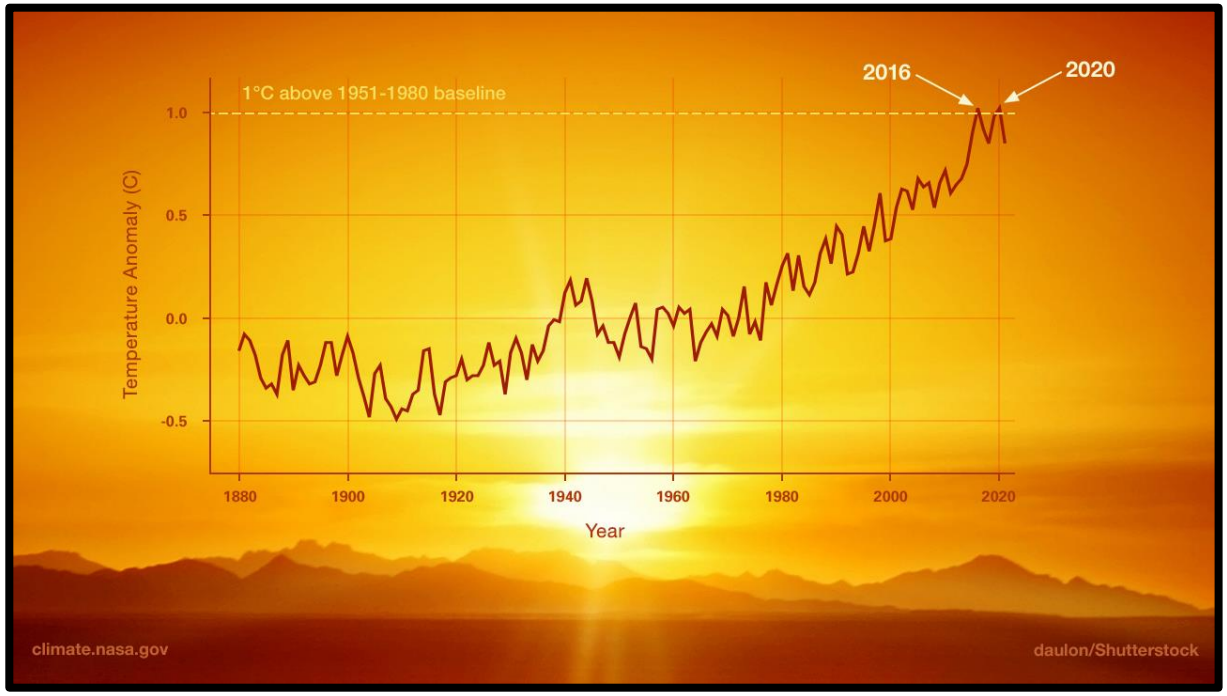
500 RT x 1 unit (ETI-50)

MHI Centrifugal chiller is,

2) Low GWP* refrigerant centrifugal chiller

➡Reduction of **Greenhouse gases** emission

(*GWP: Global Warming Potential)



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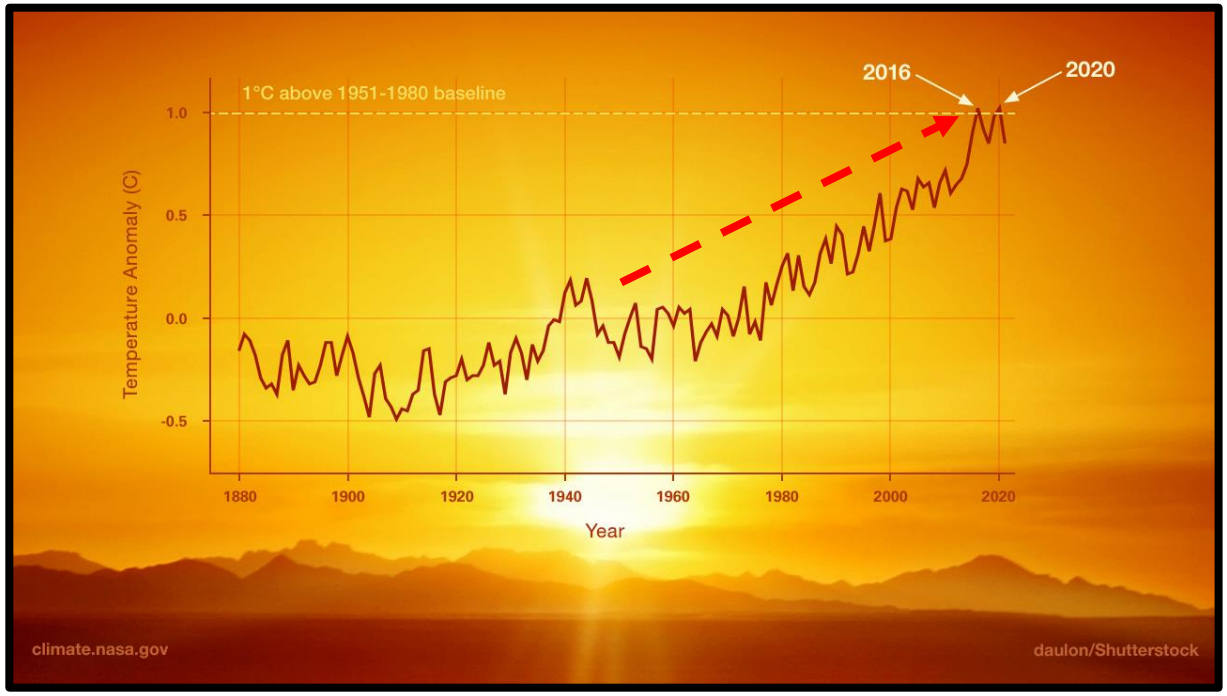

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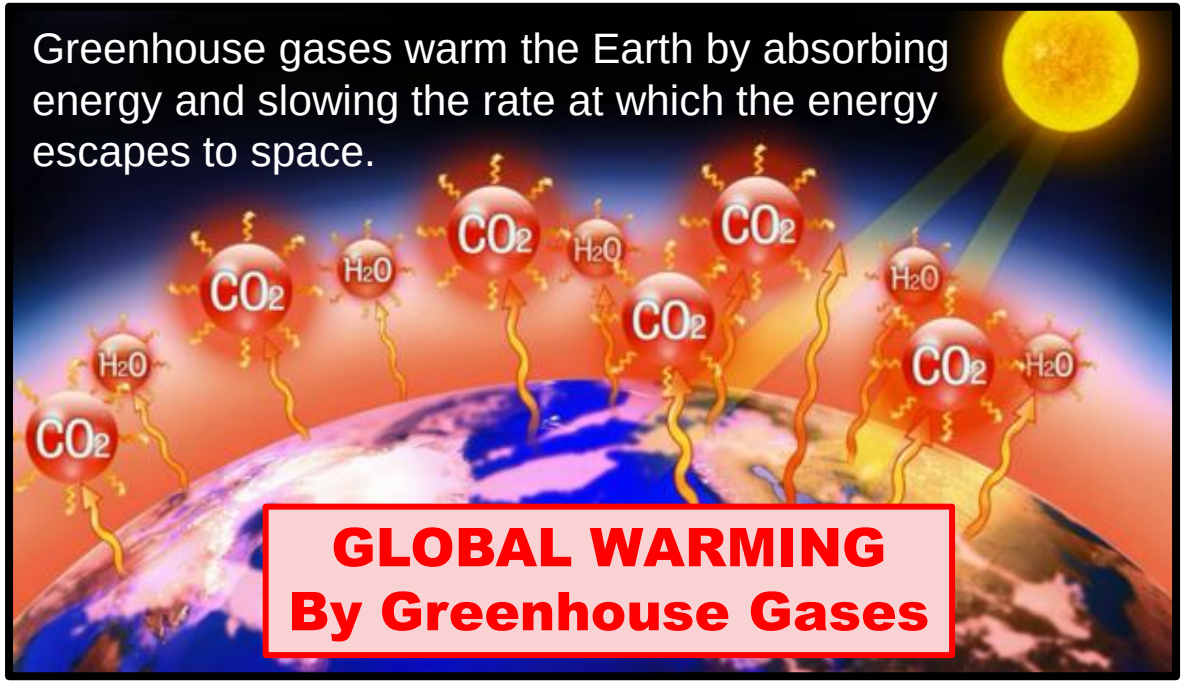
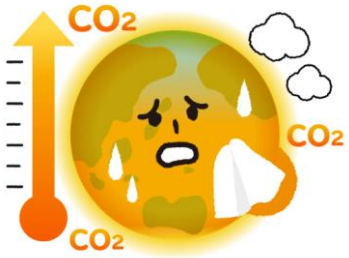


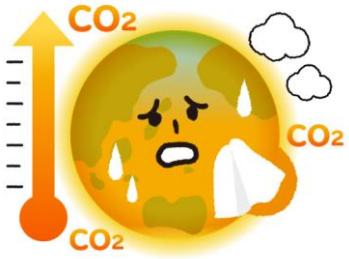
(Source of picture: https://www.pref.toyama.jp/1705/kurashi/kankyoushizen/kankyou)

Montreal Protocol "Kigali Amendment" (2016)



HFCs(Hydrofluorocarbons) are added as substances requires gradual phasedown, because HFCs are **Greenhouse Gases** many times more potent than CO2.

Montreal Protocol "Kigali Amendment" (2016)



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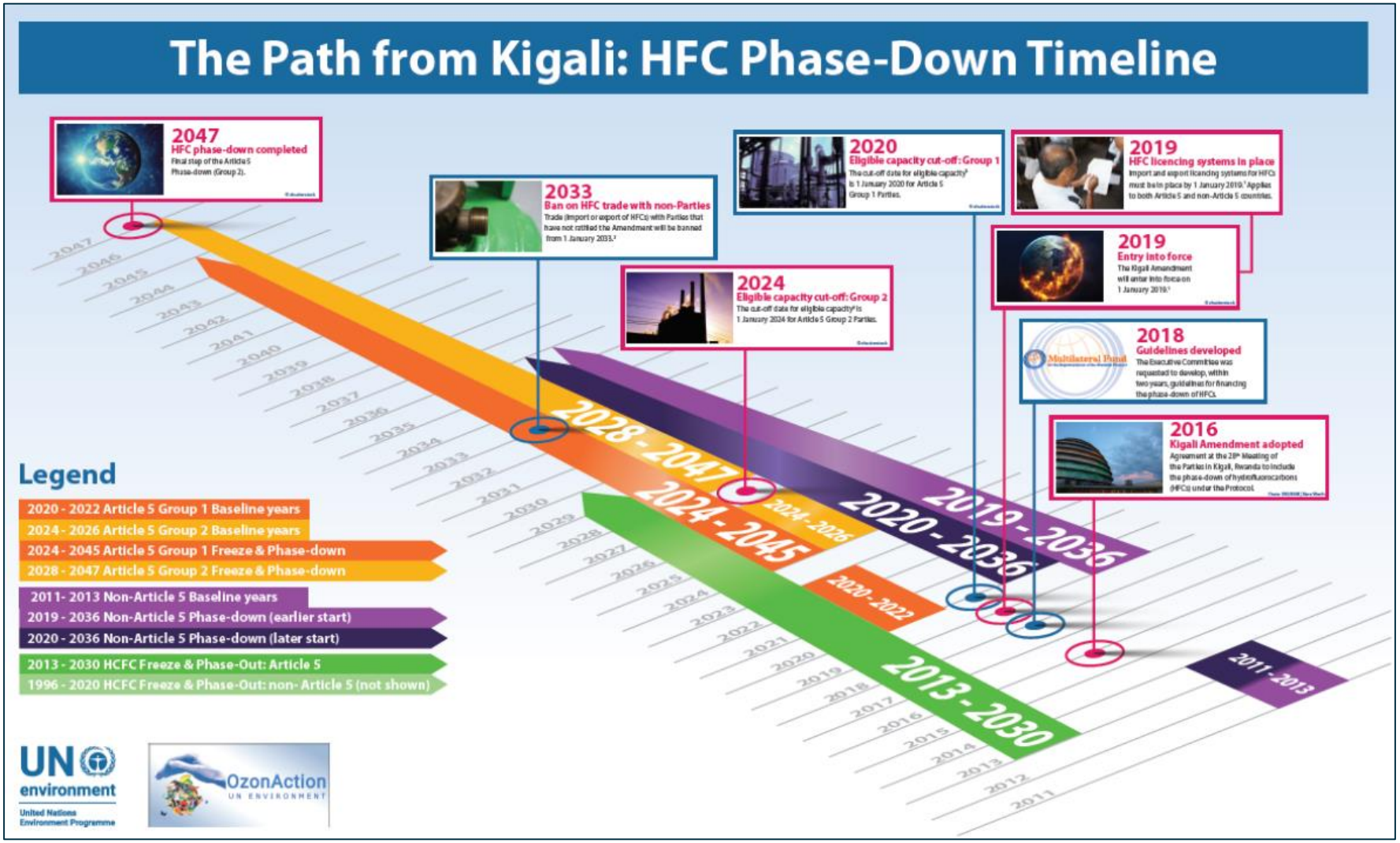
Refrigerant	CFC (Chlorofluorocarbons)		HCFC (Hydrochlorofluorocarbon)		HFC (Hydrofluorcarbons)		HFO (Hydrofluoroolefin)		
	R11	R12	R22	R123	R245fa	R134a	R1234yf	R1234ze(E)	R1233zd(E)
GWP *2 (Global Warming Potential)	4660	10200	1760	79	858	1300	< 1	< 1	1
ODP *3 (Ozone Depletion Potential)	1	1	0.055	0.02	0	0	0	0	≒ 0

*1. Greenhouse gases warm the Earth by absorbing energy and slowing the rate at which the energy escapes to space.

*2. GWP is the heat absorbed by any greenhouse gas in the atmosphere, as a multiple of the heat that would be absorbed by the same mass of carbon dioxide (CO2). GWP is 1 for CO2. GWPs listed are IPCC 5th report (2013), 100-year GWPs.

*3. ODPs is the relative amount of degradation to the ozone layer it can cause.

2) Low GWP refrigerant centrifugal chiller



From website「https://www.unep.org/ozonaction/who-we-are/about-montreal-protocol」

2) Low GWP refrigerant centrifugal chiller

MHI provide

Low GWP HFO refrigerant Centrifugal chiller

Refrigerant	CFC (Chlorofluorocarbons)		HCFC (Hydrochlorofluorocarbon)		HFC (Hydrofluorcarbons)		HFO (Hydrofluoroolefin)		
	R11	R12	R22	R123	R245fa	R134a	R1234yf	R1234ze(E)	R1233zd(E)
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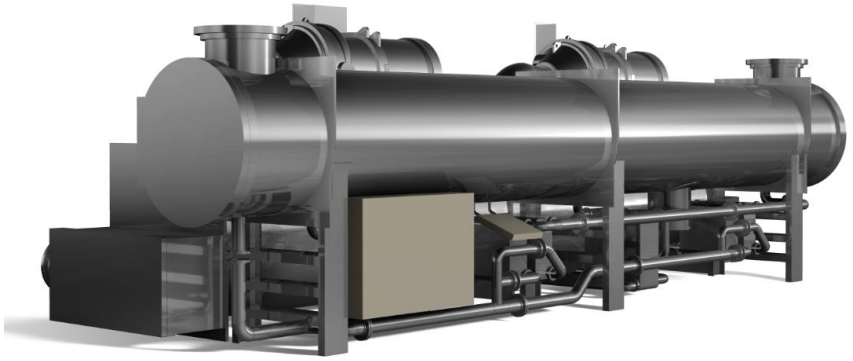
2) Low GWP refrigerant centrifugal chiller

GART-ZE, ZEI series

HFO-1234ze(E) is applied.

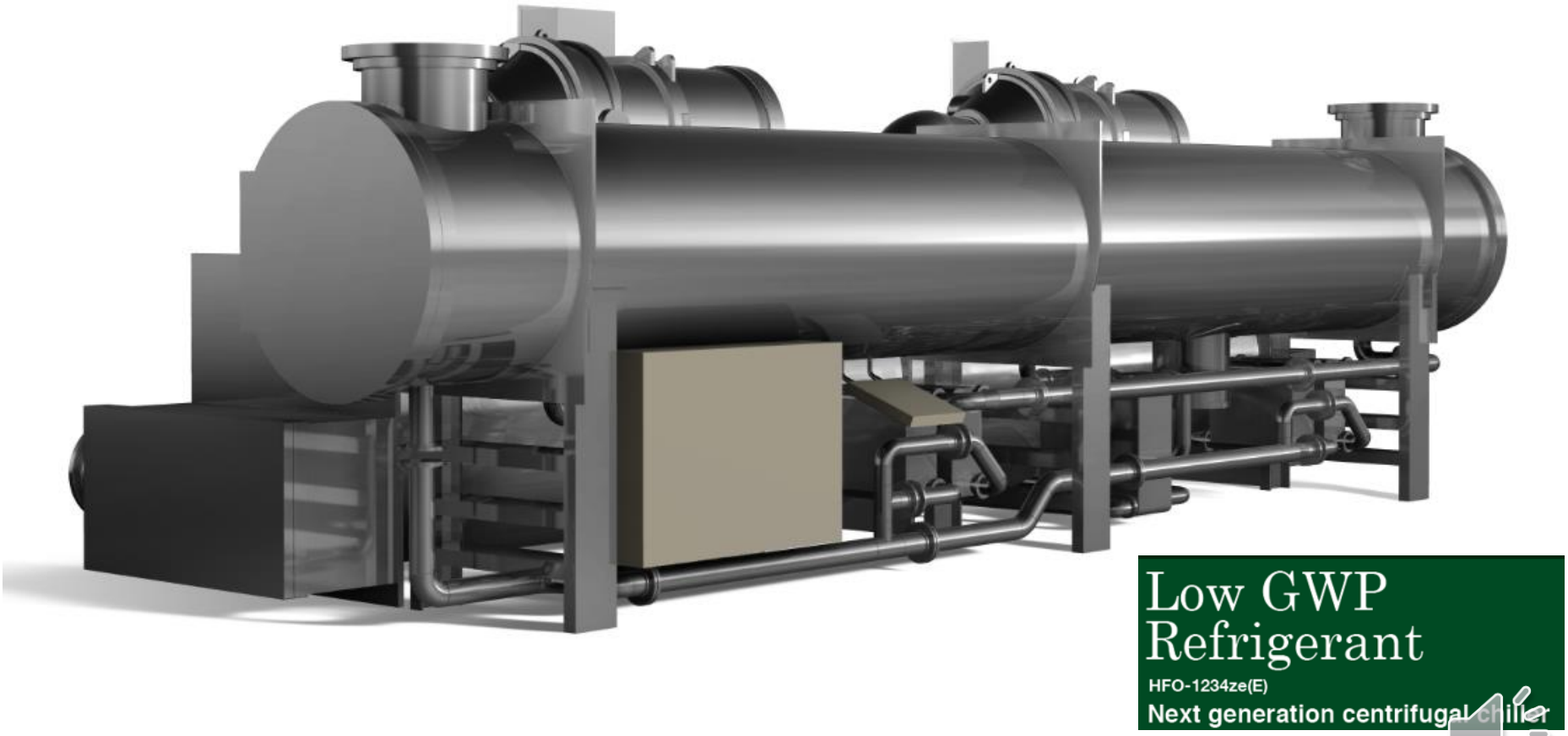


ETI-Z series

HFO-1233zd(E) is applied.

GART-ZE, ZEI series

Up to 5000USRt can be applied by GART-ZE.PL (Dual compressor)



2) Low GWP refrigerant centrifugal chiller

ENERGY CONSERVATION GRAND PRIZE is awarded in 2018, Japan.

ENERGY CONSERVATION GRAND PRIZE

FY2018

Grand Prize for Excellence in Energy Efficiency and Conservation

(Product Category & Business Model Category)

Sponsor : The Energy Conservation Center, Japan

Minister's Prize, The Ministry of Economy, Trade and Industry

ETI-Z series

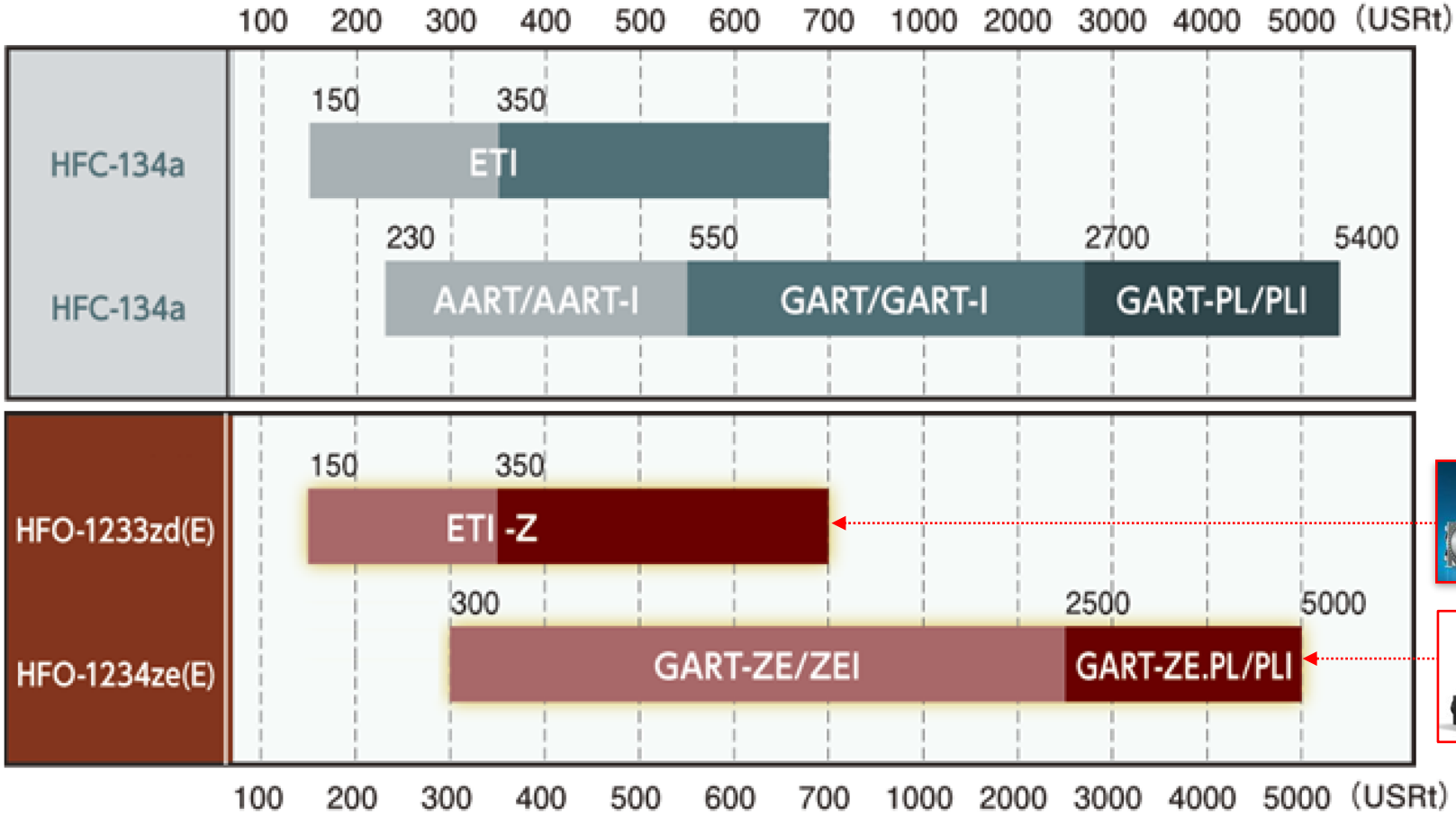
Low GWP Refrigerant

HFO-1233zd(E)

Next generation centrifugal chiller

MHI Centrifugal chiller

for HFC-134a and HFO-1234ze(E), 1233zd(E)



MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS,LTD.

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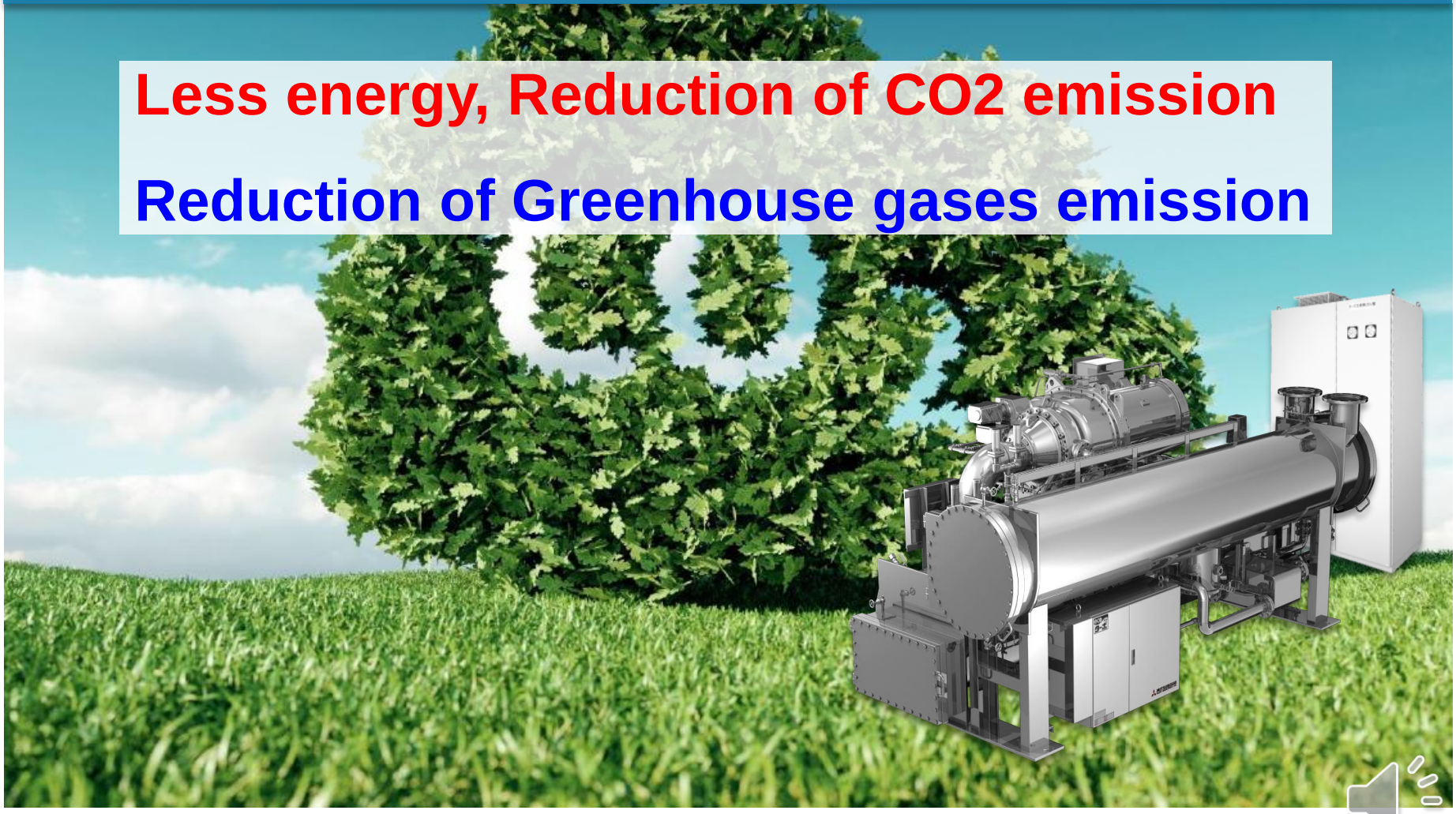
CARBON NEUTRALIZATION
WITH MHI CENTRIFUGAL CHILLER

Less energy, Reduction of CO2 emission

Reduction of Greenhouse gases emission



CARBON NEUTRALIZATION
WITH MHI CENTRIFUGAL CHILLER

THANK YOU

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