



Kawasaki centrifugal chiller using water as a refrigerant

MIZTURBO™

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Machinery Division

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1. Introduction of MiZTURBO

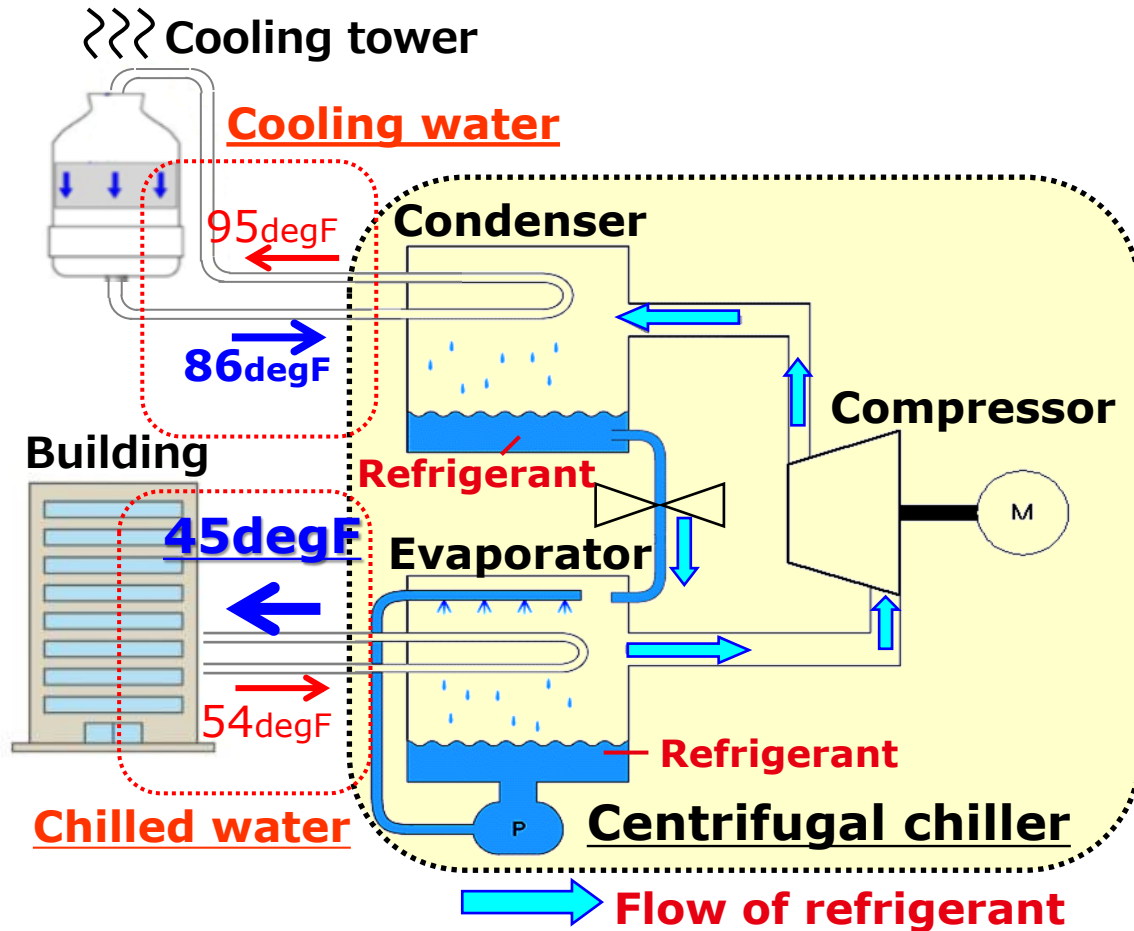
2. Estimated CO₂ emission in San Francisco

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2. Estimated CO₂ emission in San Francisco

Principle of Centrifugal chiller



Evaporator

- ① Refrigerant is heated by returned chilled water and evaporates.
- ② Returned chilled water is chilled by evaporative latent heat of the refrigerant.

Refrigerant : Liquid -> Vapor

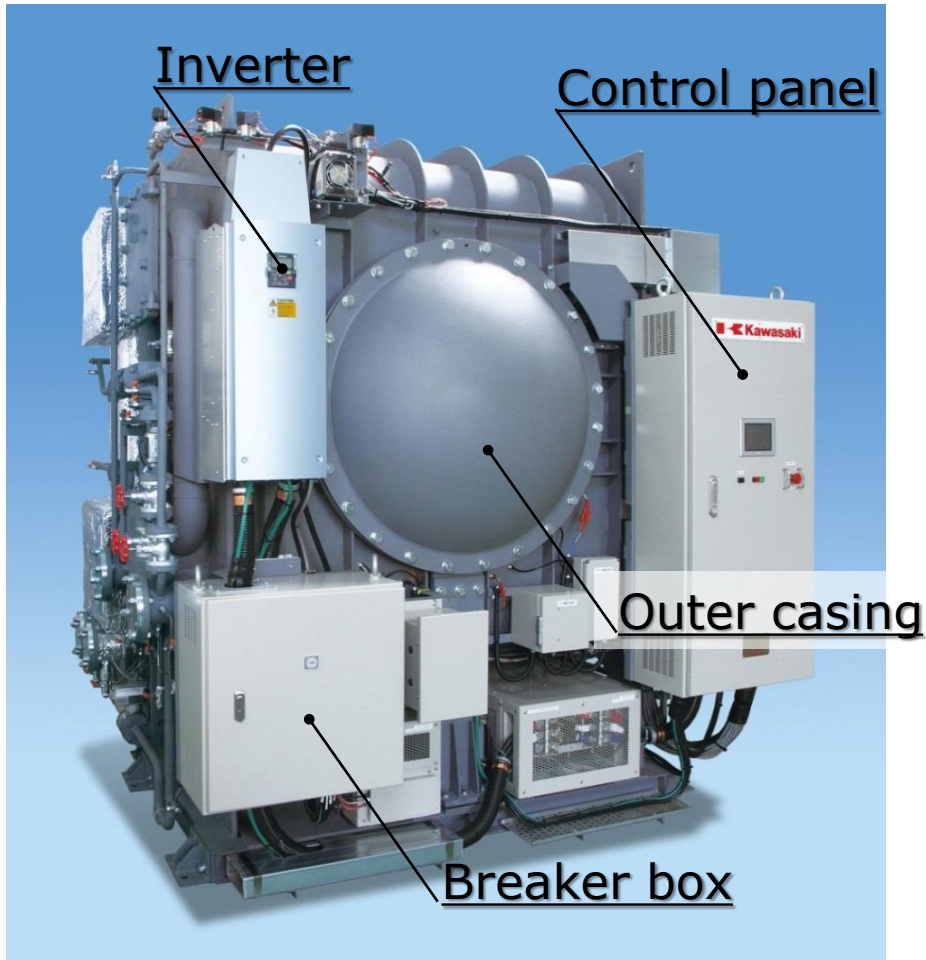
Condenser

- ① Compressed vapor of the refrigerant is cooled by cooling water and condenses.
- ② Cooling water is heated by latent heat of the refrigerant.

Refrigerant : Vapor -> Liquid

	Common chiller	MiZTURBO
Refrigerant	HFC	Water

MiZTURBO™



Cooling capacity		100USRt (352kW)
Power consumption		69kW
Refrigerant		R718(water)
Chilled Water temp.	Inlet	54degF (12degC)
	Outlet	45degF (7degC)
Cooling Water temp.	Inlet	86degF (30degC)
	Outlet	95degF (35degC)
Motor drive		Inverter
Power supply		3Φ, 400/440V (50/60Hz)
Size		2.5m x 2.5m x 2.6m
Weight		8.0 ton
Intended application		Air conditioning

* MiZTURBO can supply the chilled water at higher temperature up to 68degF, and be applied to other applications such as process cooling

Compressor, Motor, Evaporator and Condenser are in the outer casing.

Features

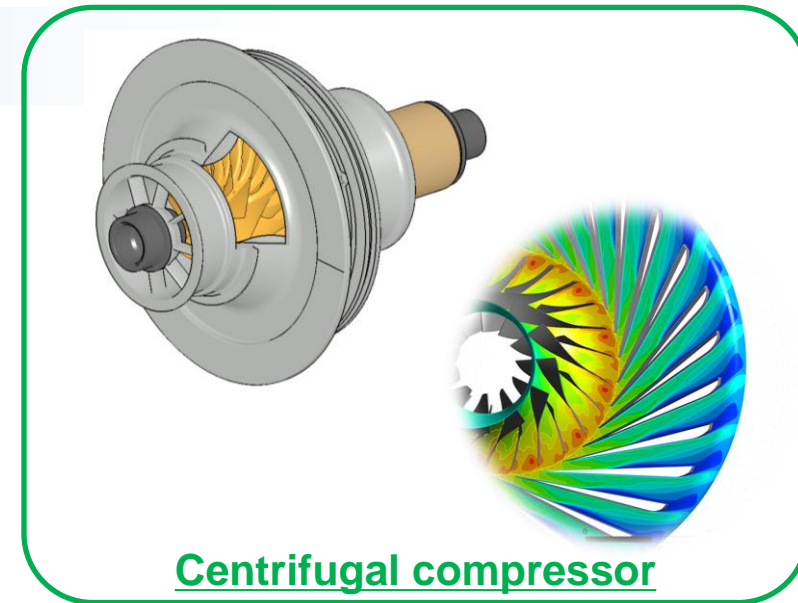
Water refrigerant

→ **Zero emission of HFC**

High efficient performance

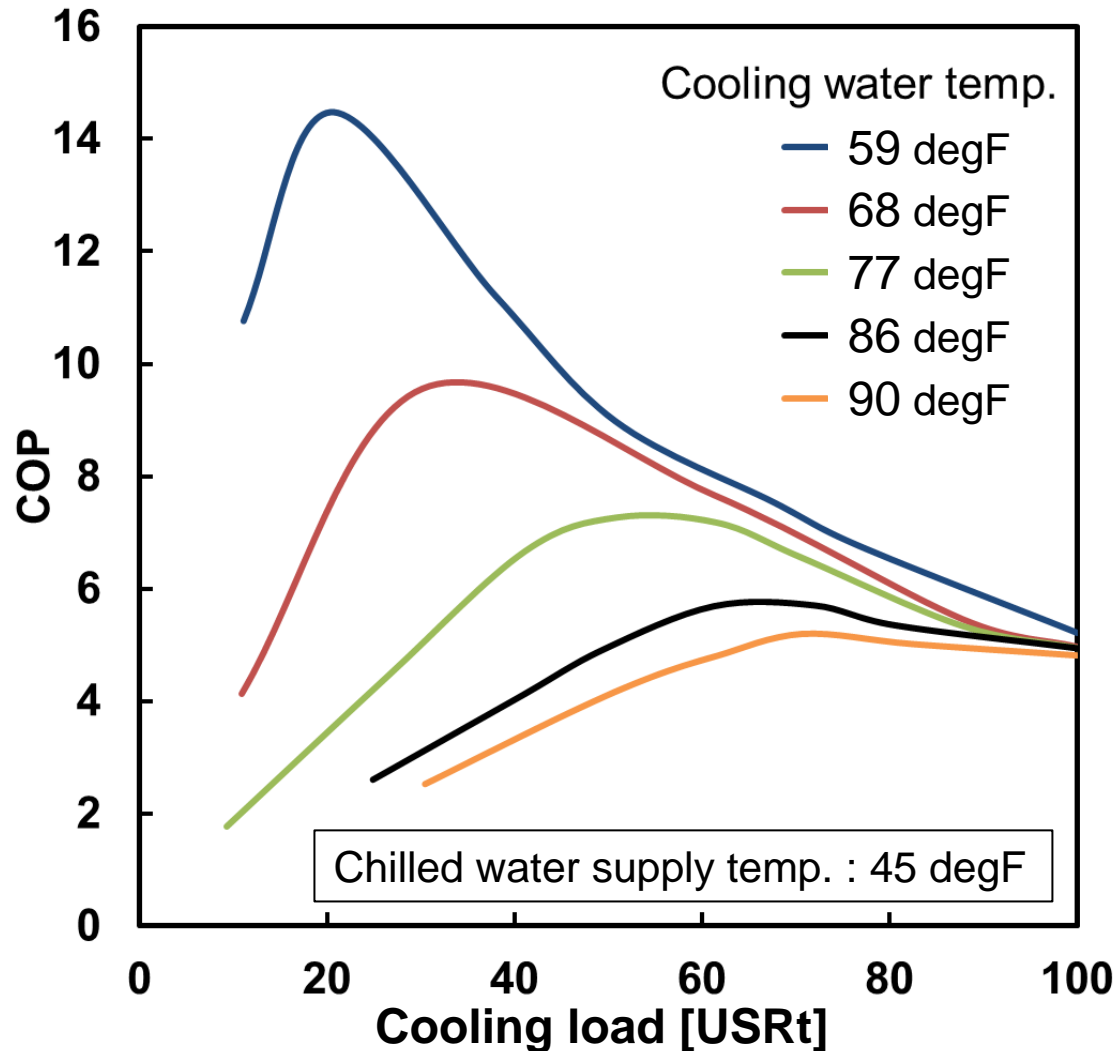
- Development of the high efficient compressor under low pressure and high pressure ratio

→ **Low power consumption**



Centrifugal compressor

Performance - 45degF supply -



■ COP(capacity[kW]/input power[kW])

- **5.10** at 100%
- Higher at a partial load

■ Operatinal range

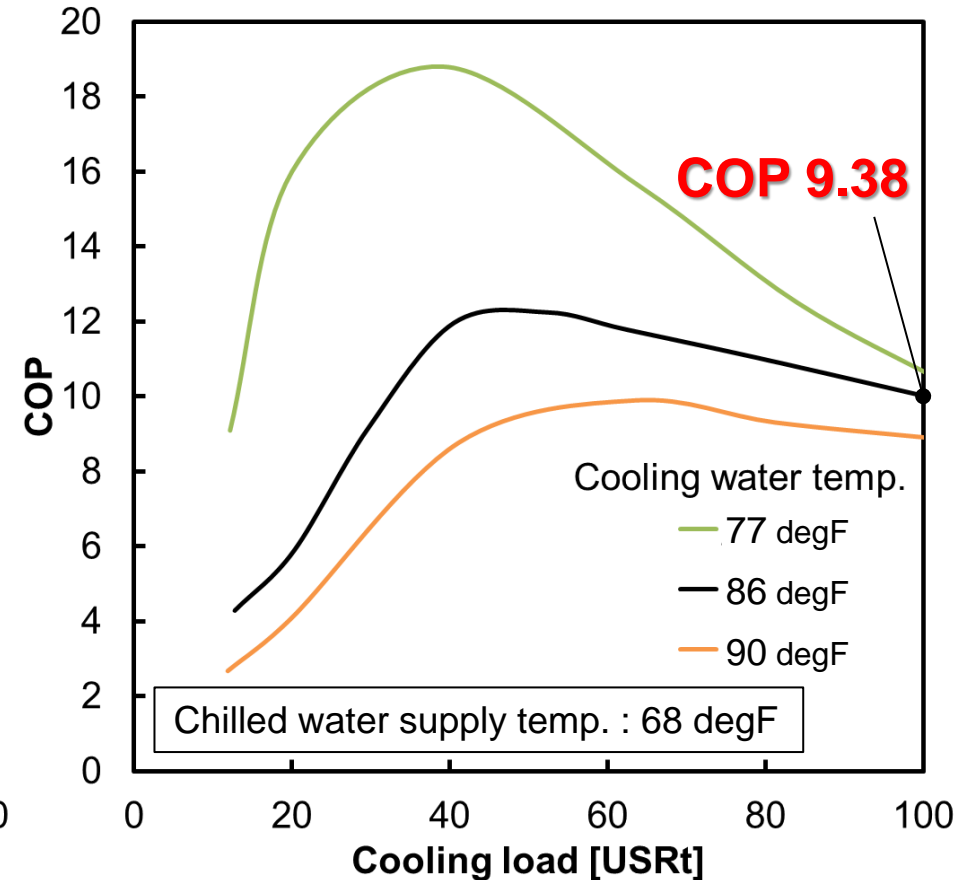
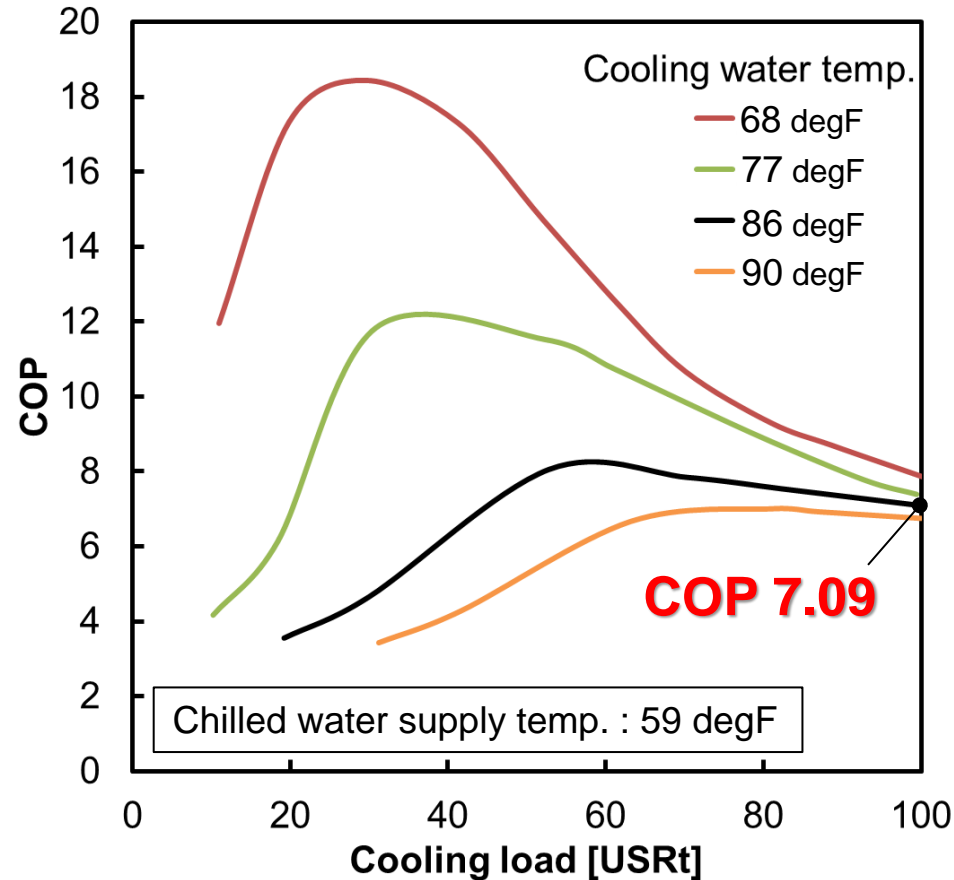
- 10%~100% at less than 77degF of cooling water temperature

■ IPLV(Integrated Part Load Value)

- **8.0** (AHRI 551/591)
- **7.4** (JIS B 8621)

Comparable performance to the other centrifugal chillers

Performance - 59degF & 68degF supply -



- **MiZTURBO shows higher COP for 59-68 degF supply.**
Possible application : Air conditioning for data center
Air conditioning system combined with desiccant
Process cooling etc.

Features

Water refrigerant

➔ **Zero emission of HFC**

High efficient performance

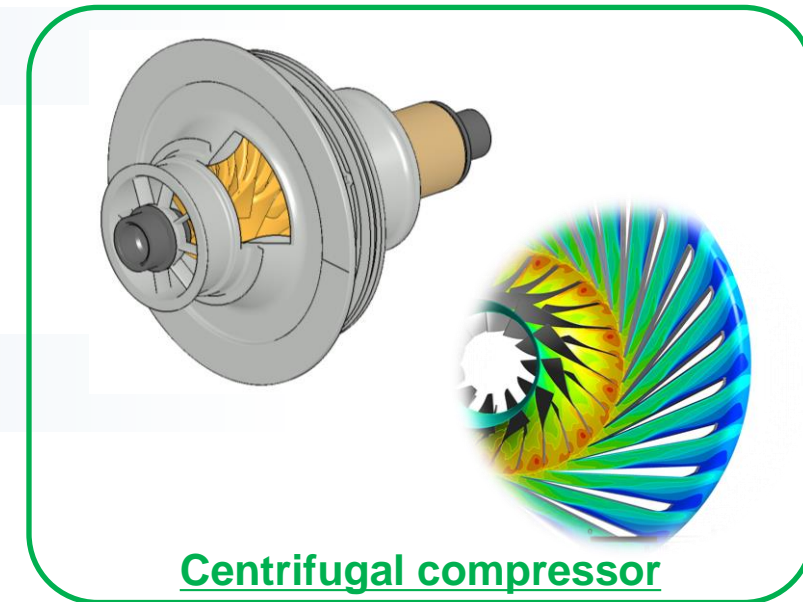
- Development of the high efficient compressor under low pressure and high pressure ratio

➔ **Low power consumption**

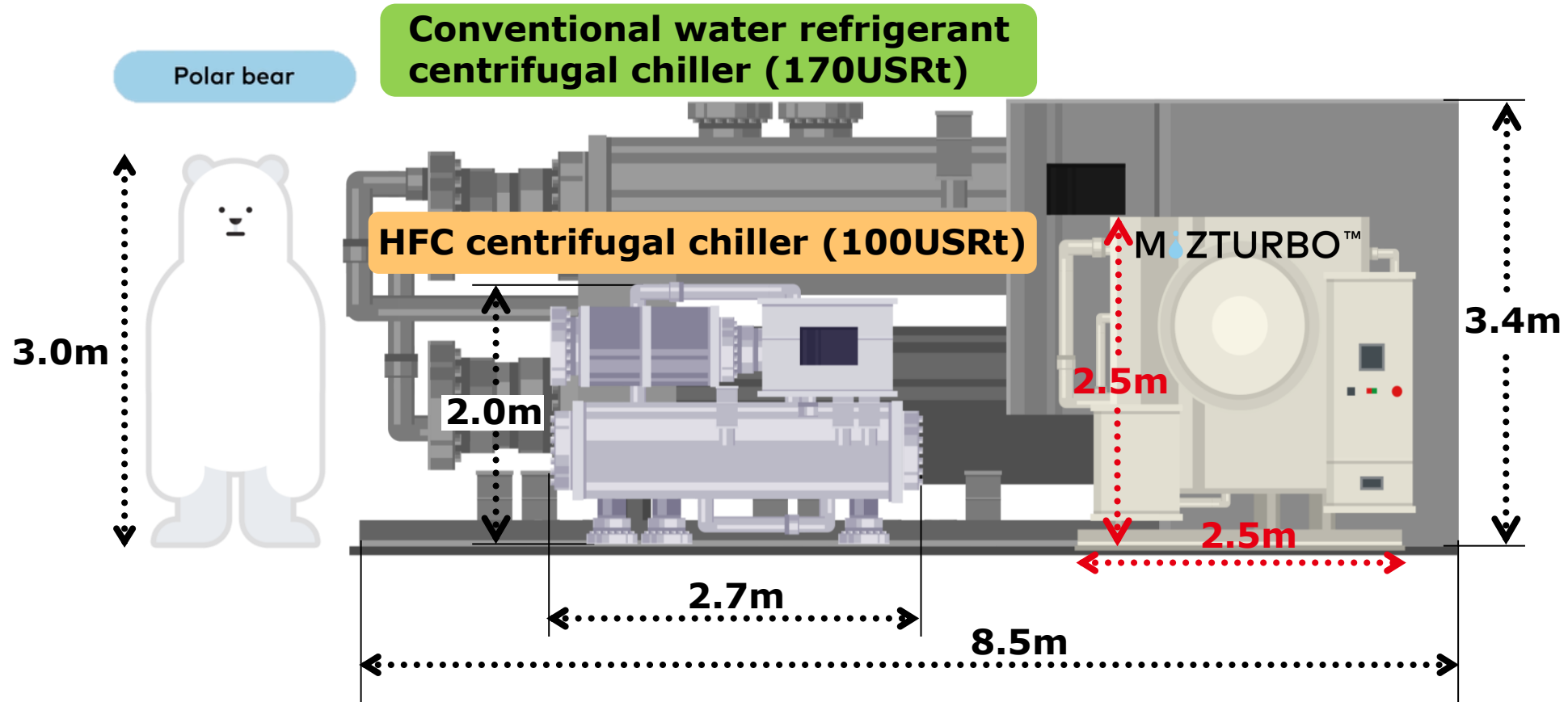
Compact

- Development of the core components
- Optimization of their layout

➔ **Alternative to existing chillers**



Compact



- Conventional water refrigerant centrifugal chiller is extremely large because of high specific volume.
- MiZTURBO is as compact as the existing chillers by optimum arrangement of components.

Features

Water refrigerant

➔ **Zero emission of HFC**

High efficient performance

- Development of the high efficient compressor under low pressure and high pressure ratio

➔ **Low power consumption**

Compact

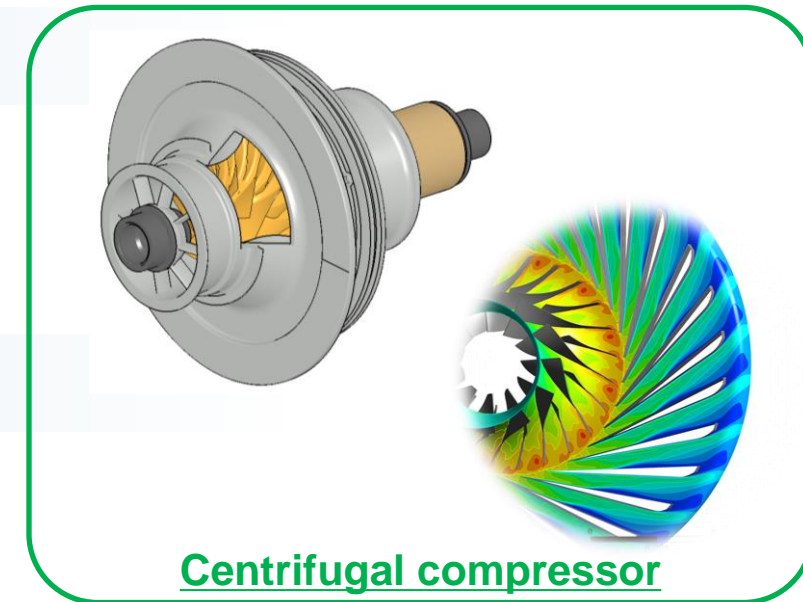
- Development of the core components
- Optimization of their layout

➔ **Alternative to existing chillers**

Oil-free

- The compressor is driven by the high speed motor

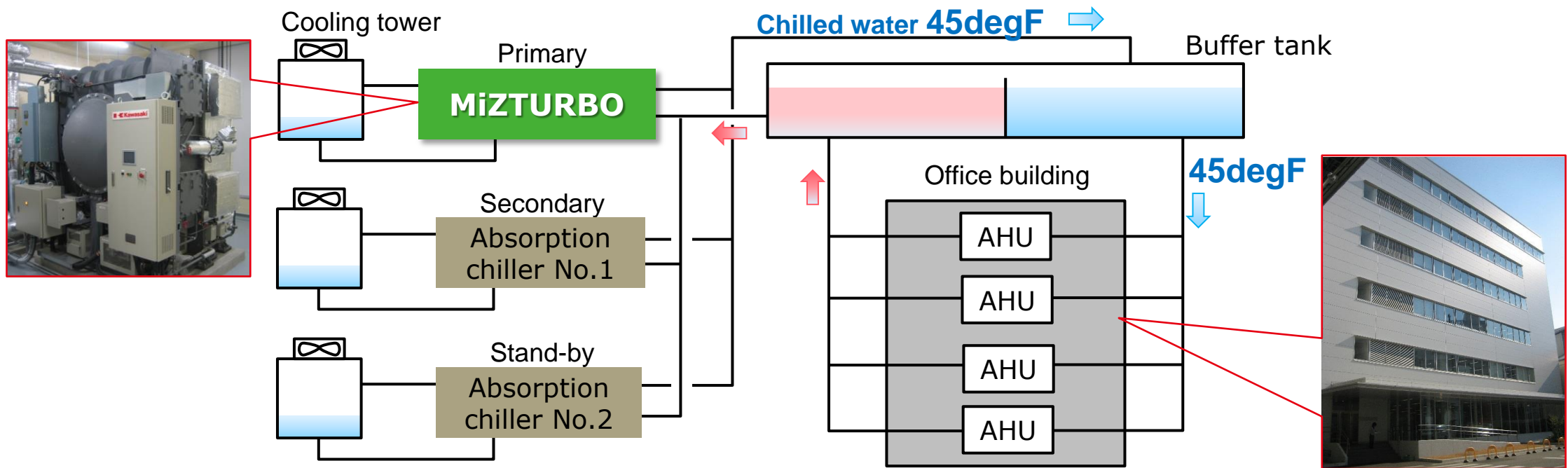
➔ **Auxiliary system for oil is not necessary**



Actual operation in Japan

MiZTURBO has been used for an air conditioning in Kawasaki's Kobe works in Japan since 2013

- Floor Area : 5,000m²
- Primary chiller : MiZTURBO 100USRt 1unit
- Secondary chiller : Absorption chiller 120USRt 1unit



Total operation time is 4,260 hours.

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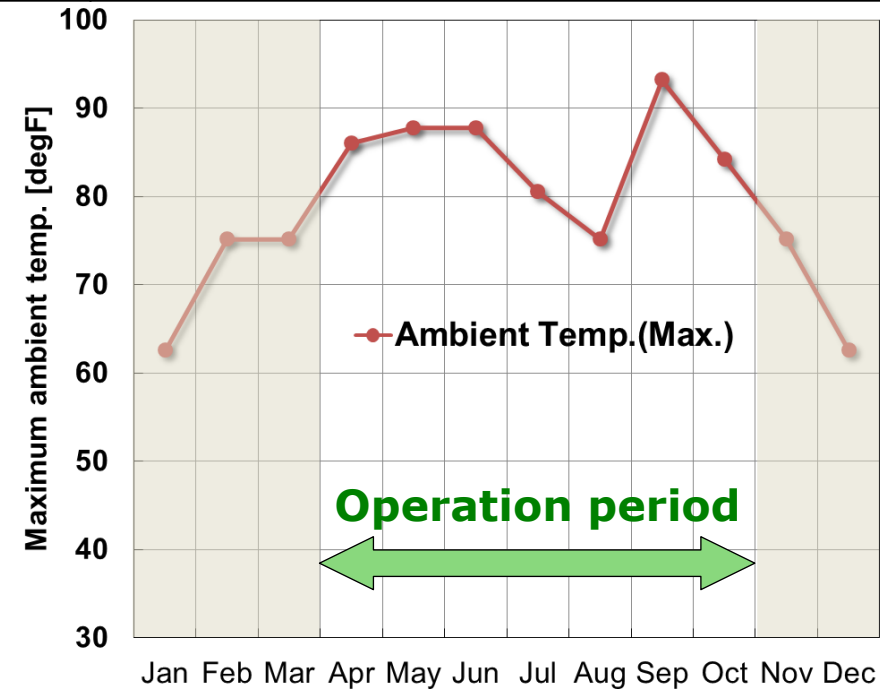
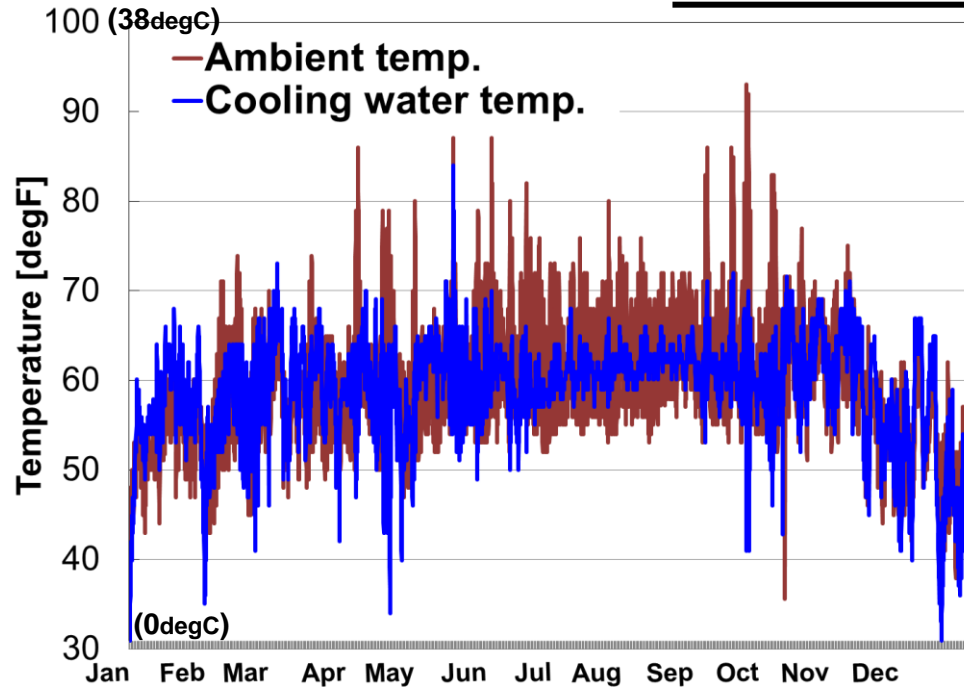
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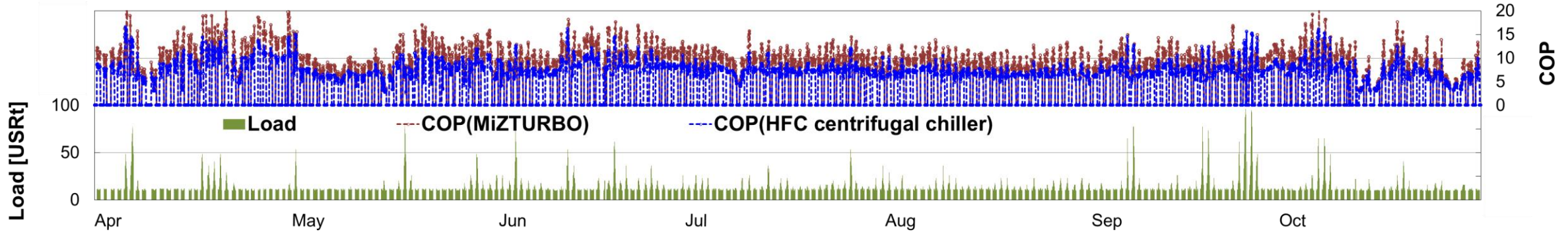
Calculation conditions



Location	San Francisco
Weather history	Jan 1 st 2016 – Dec 31 st 2016
Collected data from weather history (every 1 hour)	Ambient temperature Dew point temperature (Cooling water temp. = Dew point + 9degF(5degC))
Operation period	The month when maximum ambient temperature > 77degF(25degC)
operation time	6:00AM – 9:00PM
Operation year	15 years

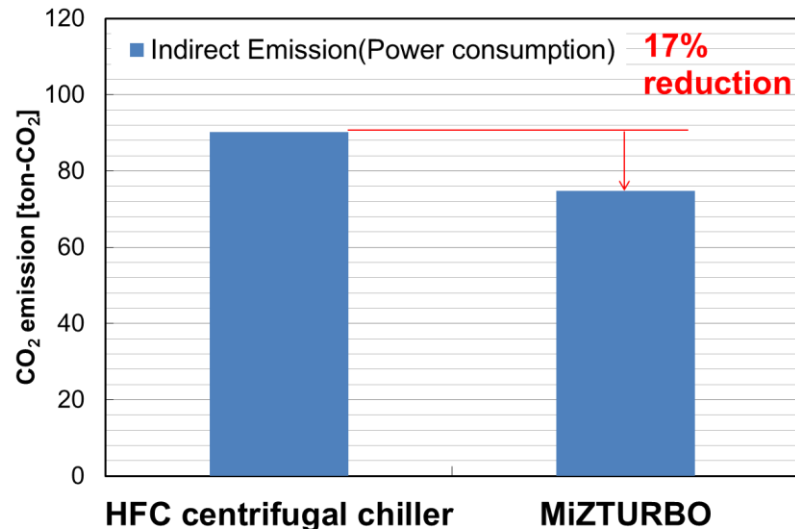


Result - Comparison of CO₂ emission -



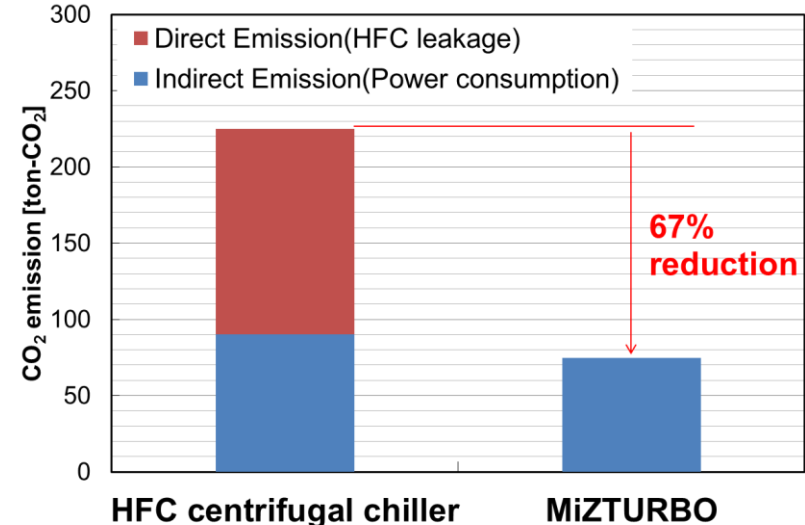
■ Calculation conditions of indirect emission

- Carbon intensity : 0.300 kg-CO₂/kWh
(Reference : California Greenhouse Gas Emission Inventory for 2000 to 2014, 2016 Edition, CARB)



■ Calculation conditions of direct emission

- Leakage rate during operation : 1.4%/year
- Leakage rate on disposal : 20%
(Reference : California's High Global warming Potential Gases Emission Inventory, 2015 Edition, CARB)



CO₂ emission would be reduced by MiZTURBO

Summary

■ Introduction of MiZTURBO

- Features : water(R718) refrigerant, High efficient, compact and oil-free
- 4,260 hours operation in Japan

■ CO₂ emission in America

CO₂ emission would be reduced in San Francisco by MiZTURBO

■ Availability in America

The followings are the items to be solved.

- Compliant with the standards, regulations, UL certification etc.
 - Investigation of UL certification is going to be completed by the end of 2017
- Cooperation with customers and governments to create a path of introduction
 - Pilot plant, subsidy etc. to increase the acknowledge and accelerate the uptake of MiZTURBO



ATMO
sphere

Thank you very much!

