



# The capacity analysis of CO<sub>2</sub> water cooling refrigeration system



Business Case for  
Natural Refrigerants

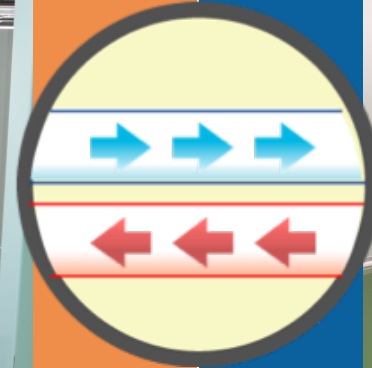
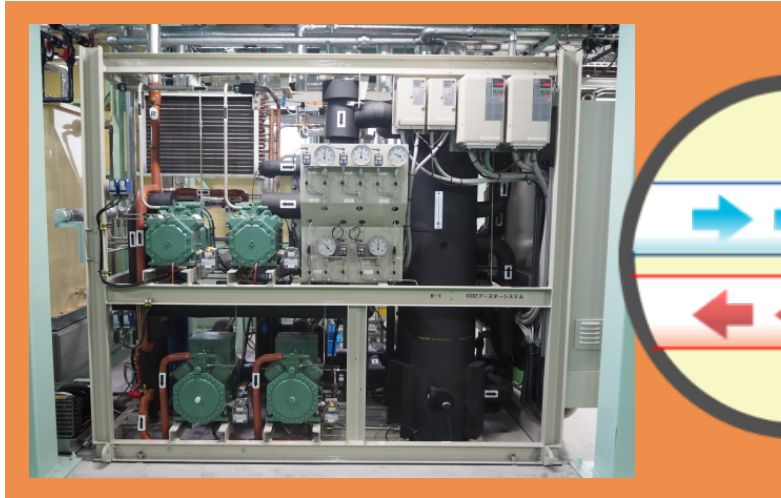
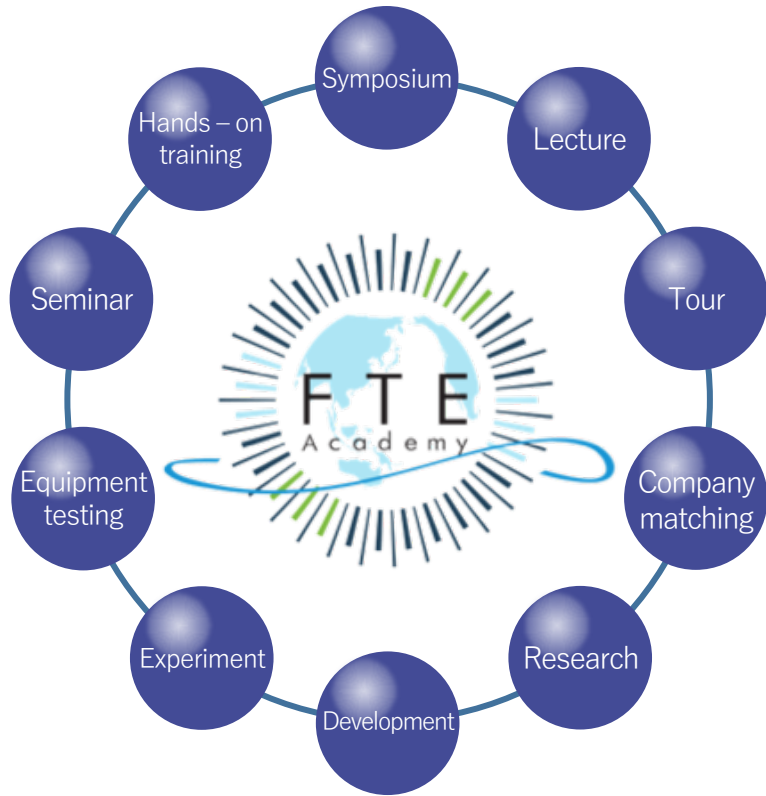


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Deputy manager

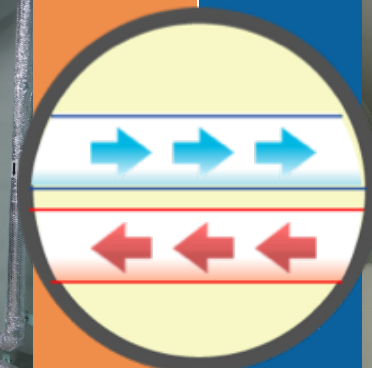
# FTE Academy / FTEアカデミー



**CO2 Transcritical booster unit**  
CO<sub>2</sub> トランスクリティカルブースターユニット



**CO2 Freezer**  
CO<sub>2</sub>対応 フリーザー



**CO2 Refrigeration system**  
CO<sub>2</sub> 冷凍システム



**Chiller**  
冷凍冷蔵庫

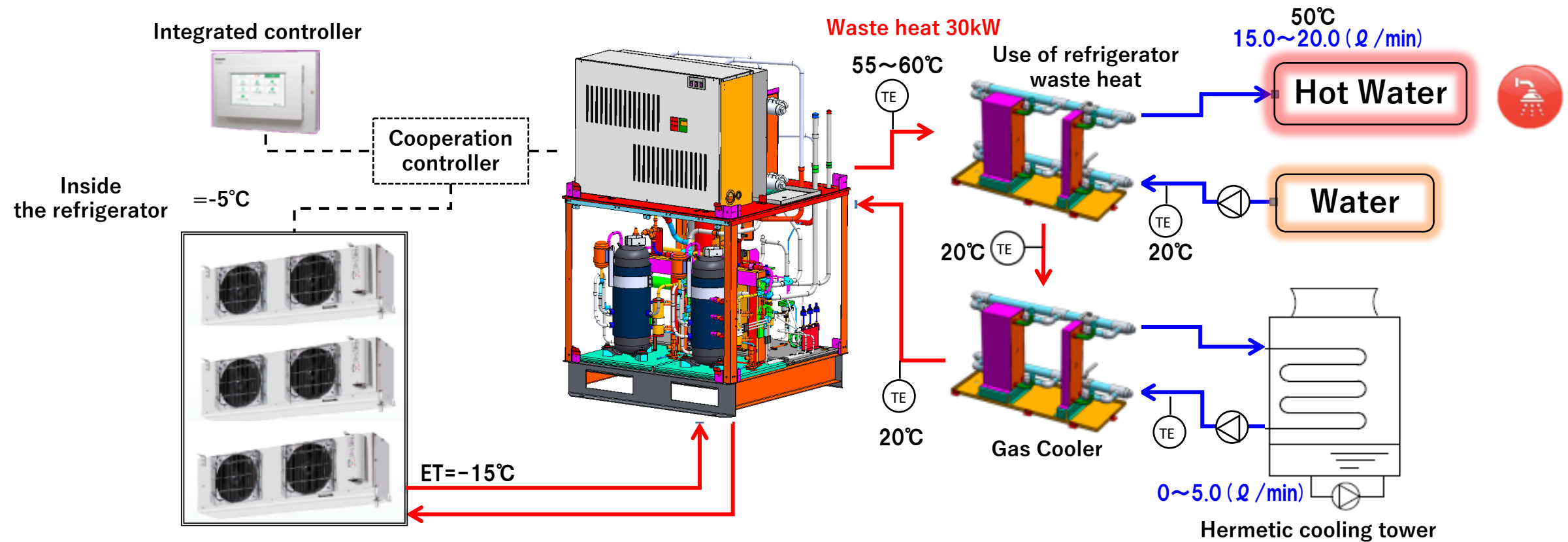
# CO<sub>2</sub> 20HP water cooling refrigeration system

## Objective / 目的

- The water cooling model which is available for a food plant and a frozen cold storage warehouse
- Effective use of refrigerator waste heat as high temperature water improves overall efficiency

## Development elemental technology / 開発要素技術

- Flow rate control of water heat exchanger for high temperature tapping and high efficiency

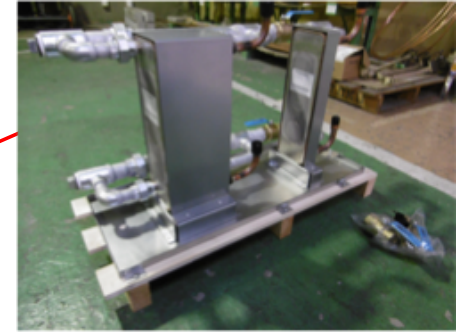
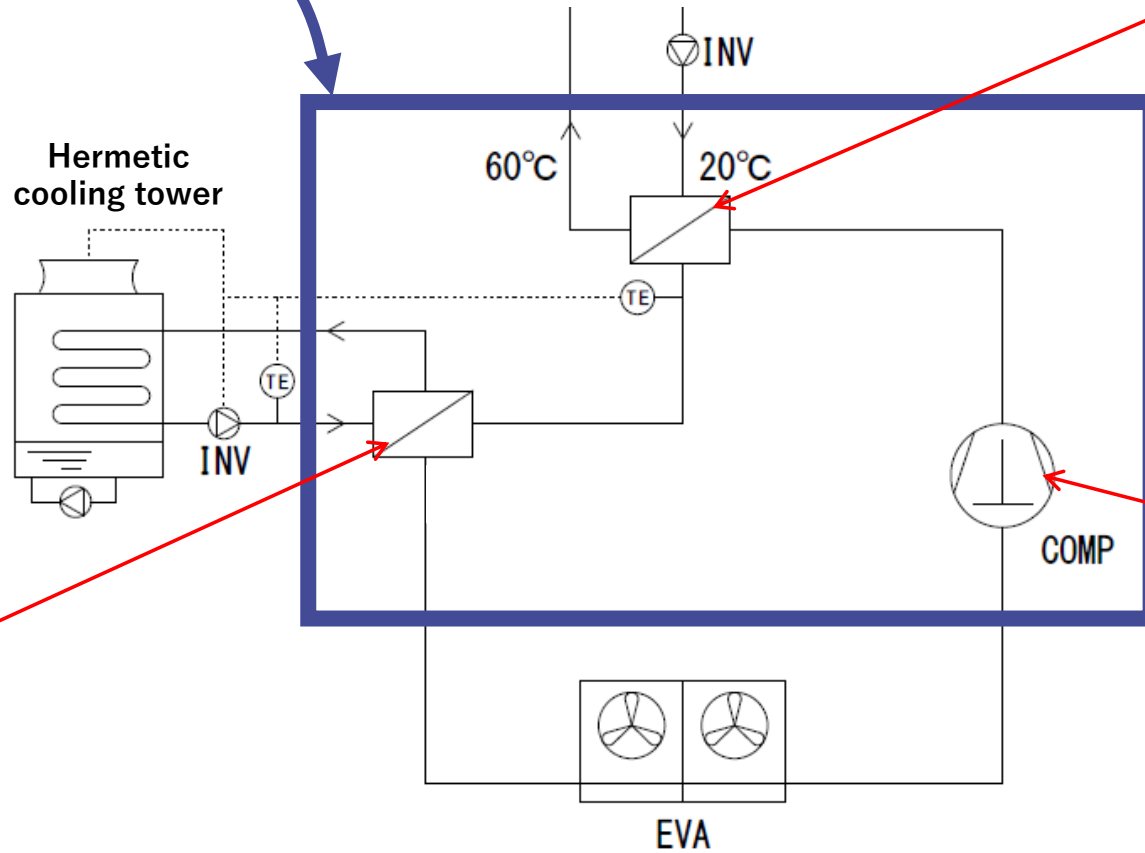




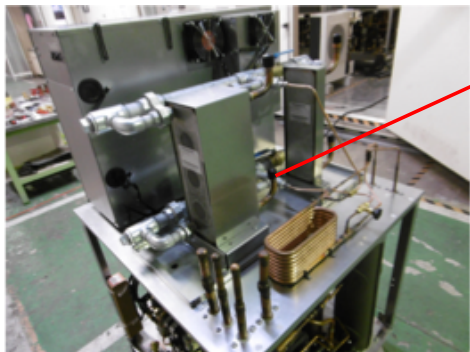
# CO<sub>2</sub> 20HP water cooling refrigeration system



CO<sub>2</sub> 20HP water cooling refrigeration system



Heat recovery gas cooler unit



Gas cooler unit  
(Install in refrigerator)



10HP Compressor ☒ 2

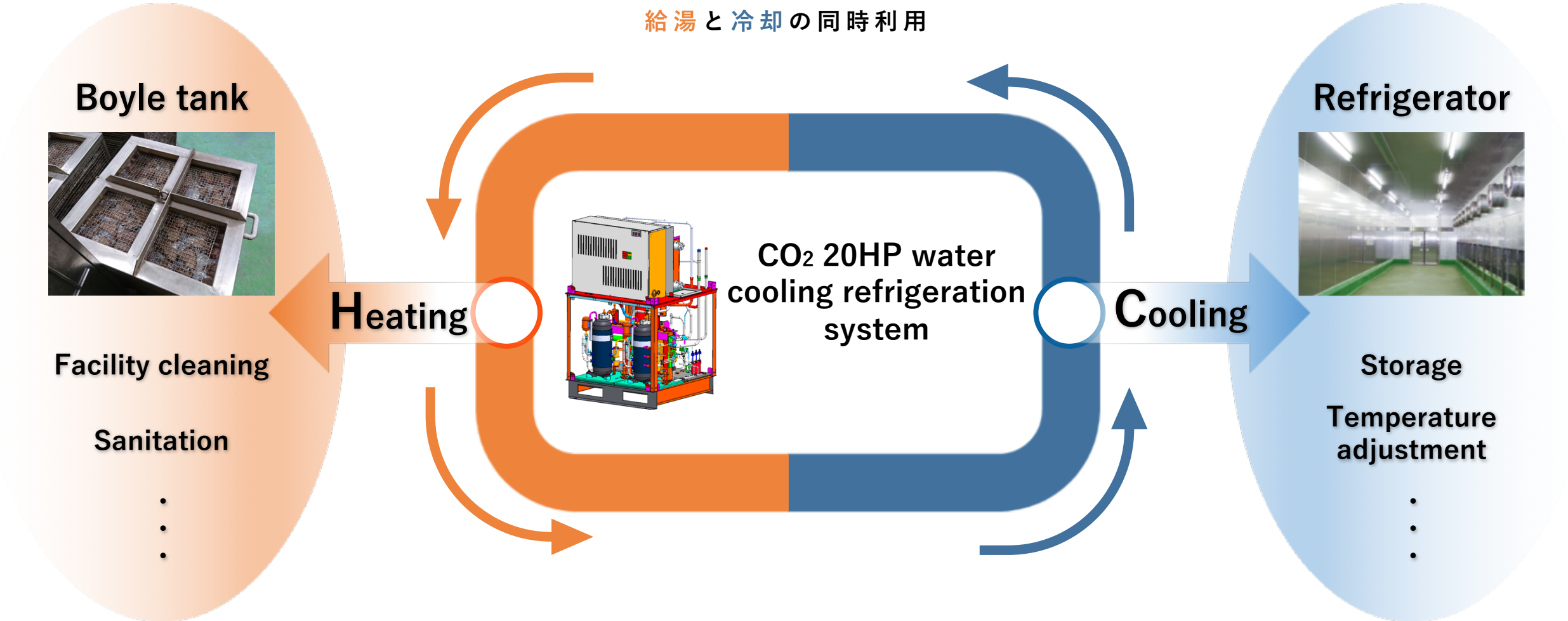


# Case of Location / (想定した) 現場事例



## Hot water supply and Cooling at the same time

給湯と冷却の同時利用



# Case of Location / (假想した) 現場事例

## ● Roast beef



## ● Appearance of Food processing plant



※ Specific heated processed meat products made by Vacuum cooking method  
真空調理法を用いた特定加熱食品製品



# Specific heated processed meat products / 特定加熱食肉製品



Sterilized by heating the center part at **63** degrees centigrade for **30** minutes or by any other equivalent or more effective methods

中心部の温度を**63**°Cで**30**分間加熱する方法又はこれと同等以上の効力を有する方法以外の方法による加熱殺菌を行った食肉製品。



Other than the above method

上記の方法以外

## Heating

(°C)	<b>63</b>	<b>62</b>	<b>61</b>	<b>60</b>	<b>59</b>	<b>58</b>	<b>57</b>	<b>56</b>	<b>55</b>
(Min)	sec	6	9	12	19	28	43	64	97

OR



**35**°C ~ **52**°C

35°C以上52°C未満

AND



Within  
**170** Minutes

170分以内

+

## Cooling



**25**°C ~ **55**°C

25°C以上55°C未満

AND



Within  
**200** Minutes

200分以内



# Vacuum cooking method / 真空調理法

✓ Vacuum-packing foodstuffs together with seasonings and cooking at low temperature with hot water or steam.

調味料と一緒に食品を真空包装し、低温のお湯または蒸気で調理する方法。

✓ Necessary condition  
必要条件

## Heating



63°C ~ 100°C

63°C以上100°C未満

+

## Cooling



AND

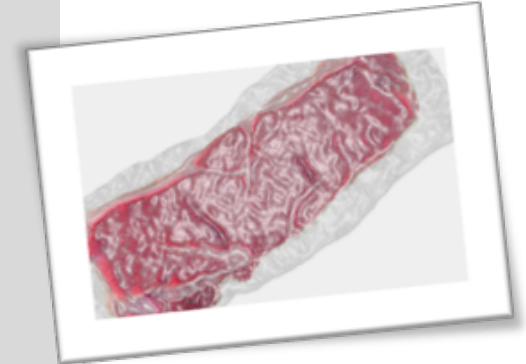


10°C or less

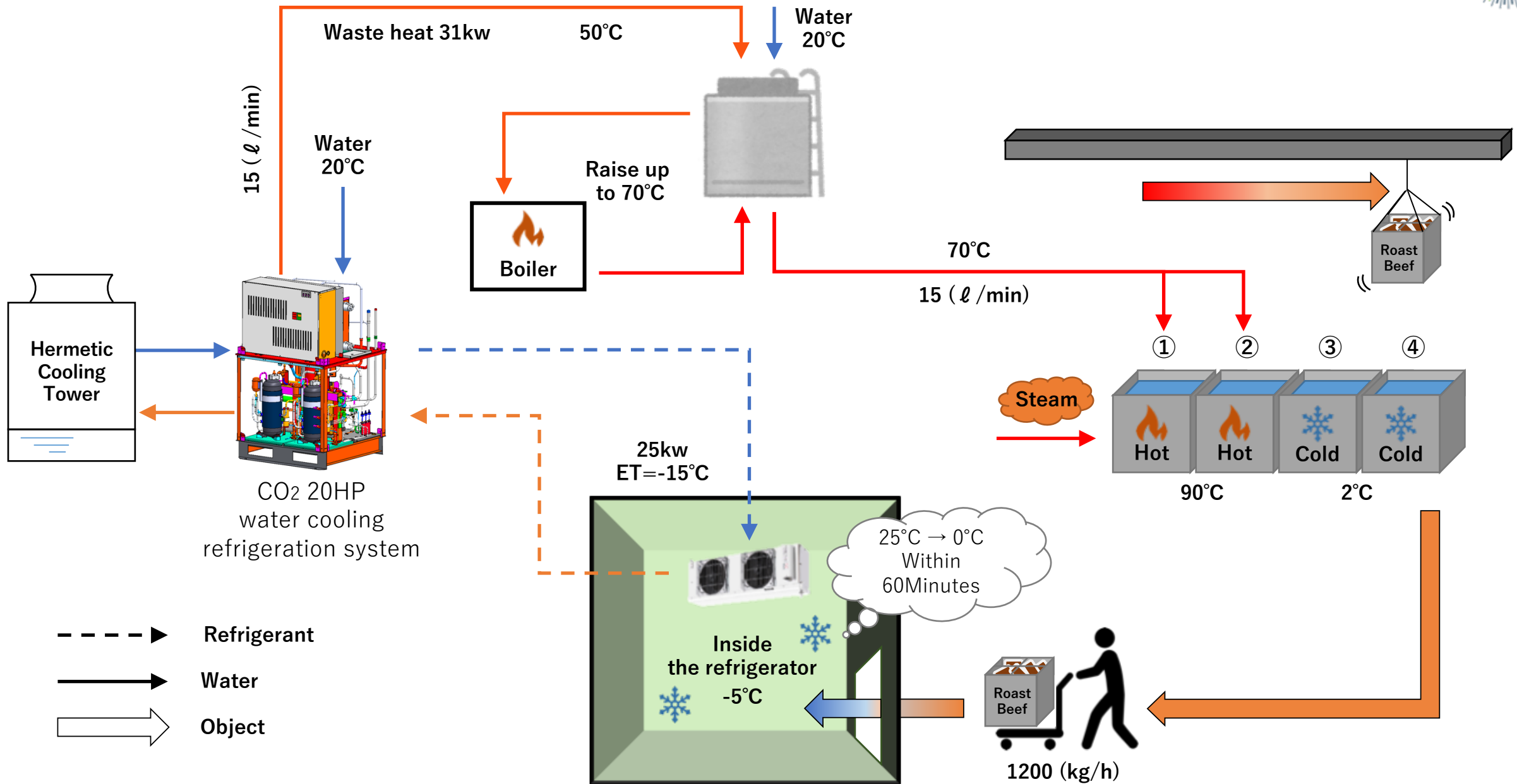
10°C未満

Within  
120 Minutes

120分以内



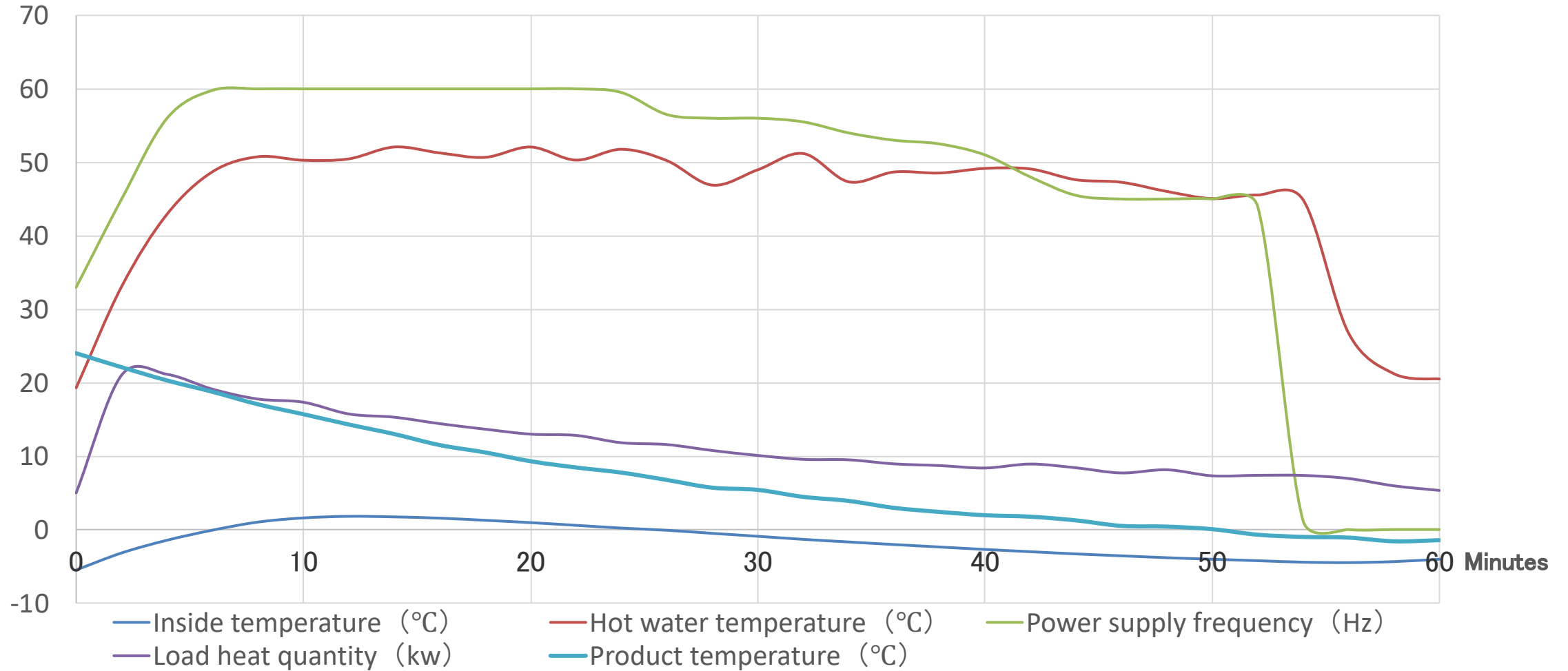
# Manufacturing process flow / 製造工程フロー



# Trend of temperature / 温度トレンド



Variable load (antifreeze : 25°C→0°C) / 変動負荷 (ブライン)



Cooling capacity (ET=-15°C) 25kw

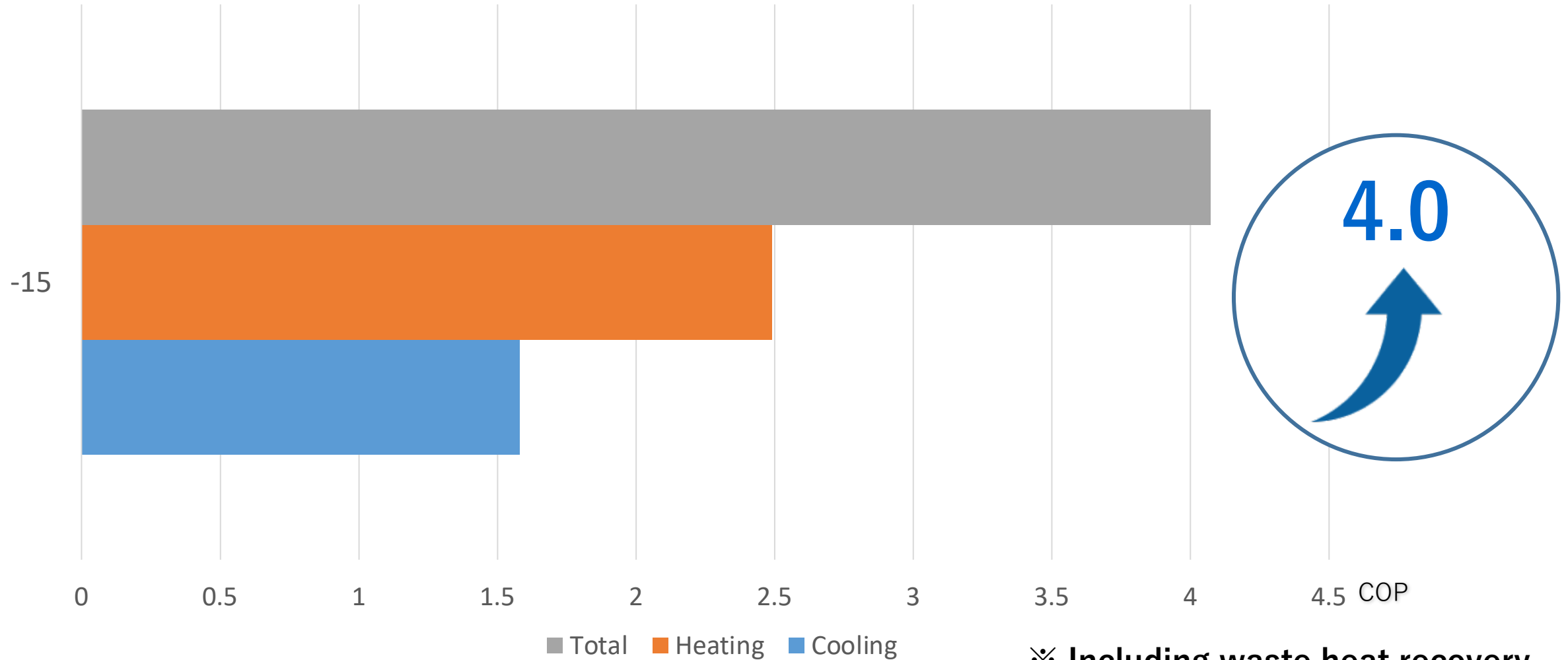
Heating capacity 31kw

Hot water supply 15(ℓ/min)



# COP / 成績係数

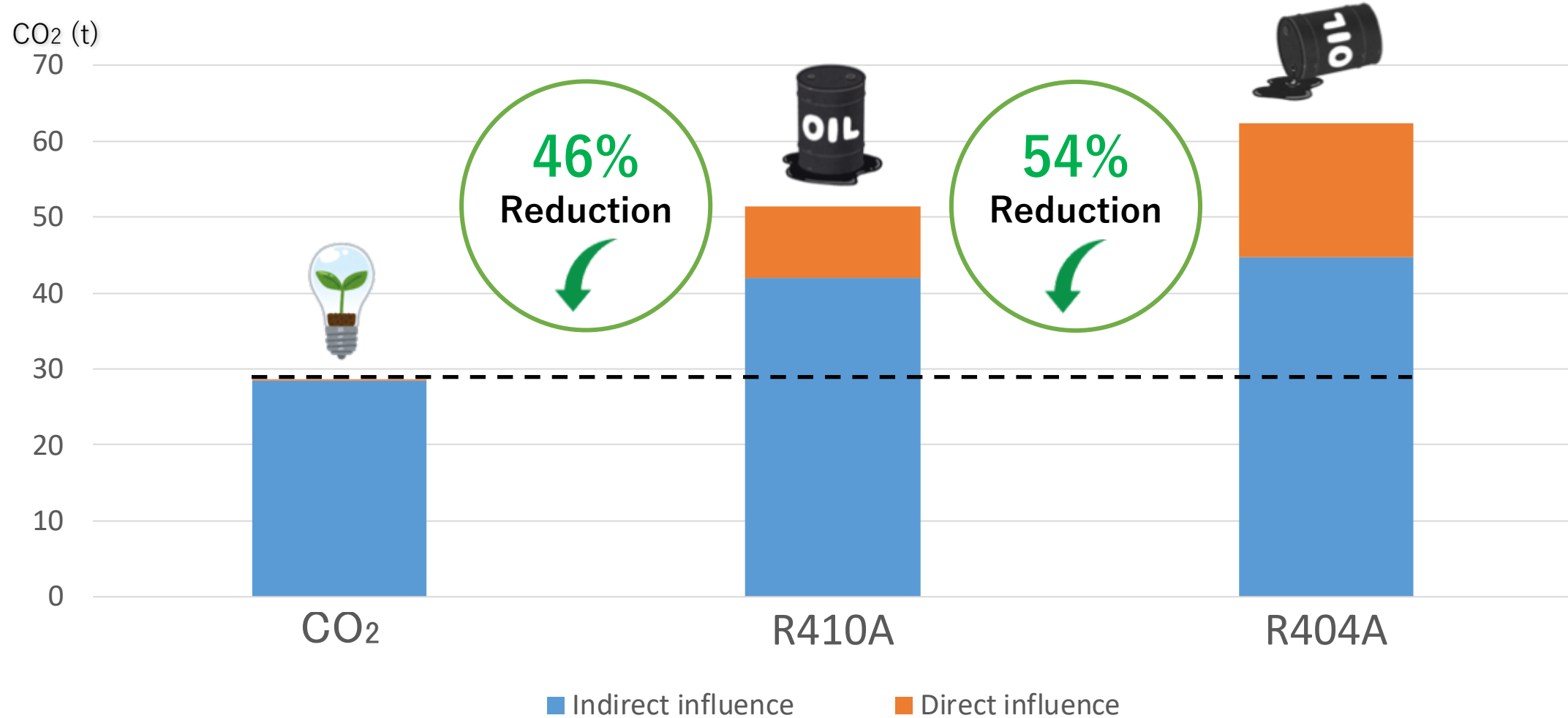
Refrigeration evaporating temperature / 蒸発温度



※ Including waste heat recovery  
廃熱回収を含む

# CO<sub>2</sub> emissions / CO<sub>2</sub> 排出量

## Comparison with HFCs / フロンとの比較



Emission factors	Fuel oil	2.7 (kg-CO <sub>2</sub> /ℓ)	Leak ratio	15 (%/year)
	Electric power	0.5 (kg-CO <sub>2</sub> /ℓ)	Working ratio	8 (h/day), 22 (day/mon)

HFCs COP	R410A	2.2
(ET = -15°C)	R404A	1.8





ATMO  
sphere

Thank you very much!

