



DESIGNED TO LET
GOODS SHINE

EPTA Technica / HAUSER Packs & Systems Technologies

Packs, FTE, HLS, ETE, Connect water



EPTA Technica product and system technology portfolio

01 ECO₂ packs range

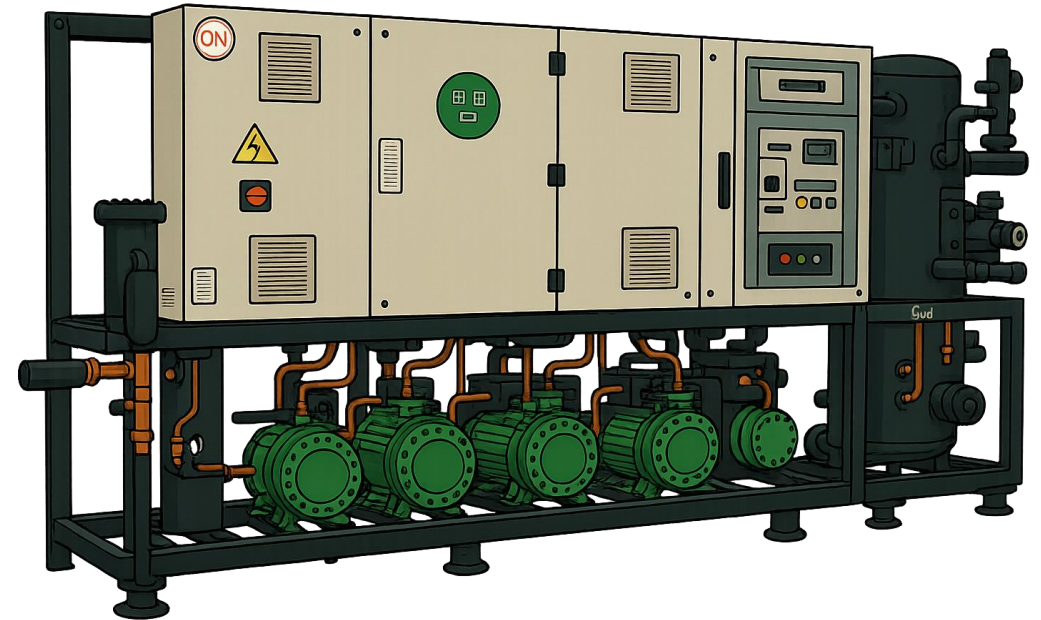
- CO₂ refrigeration packs overview
- From ECO₂Mini to ECO₂Giant

02 CO₂ system technologies

- FTE 3.0 – Full Transcritical Efficiency, from concept to system design
- ETE – Extreme Temperature Efficiency, from concept to system design
- HLS – Hauser Low Superheat, concept and advantages

03 Overview of other technological options

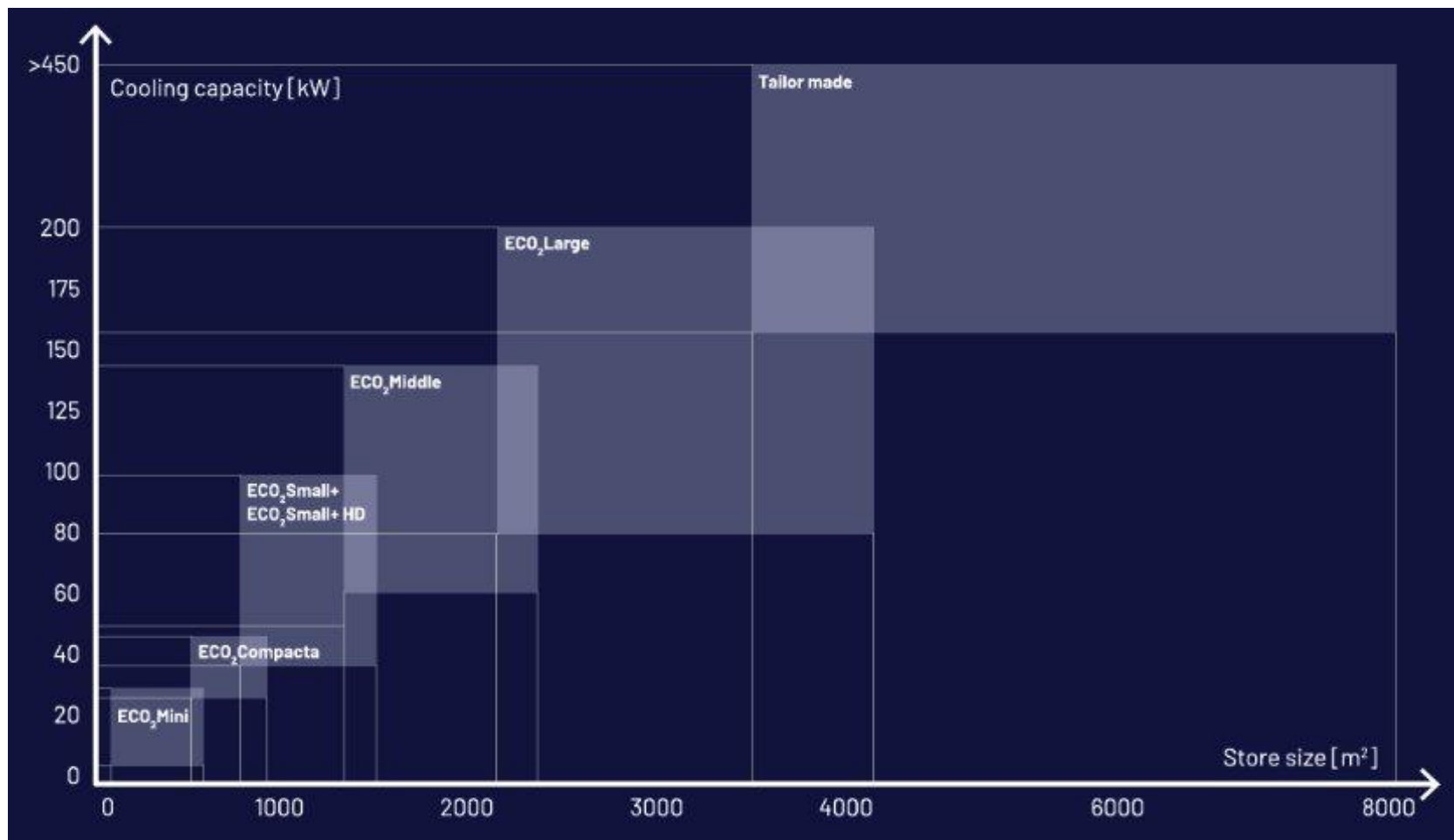
- Parallel compression
- Gas / Liquid ejectors
- Waterloop systems



ECO₂ standard range

Portfolio overview

From proximity to hypermarkets and beyond



EPTA ECO₂ Range

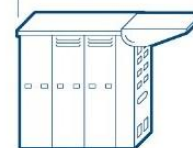
ECO₂ Mini



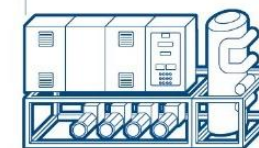
ECO₂ Compacta



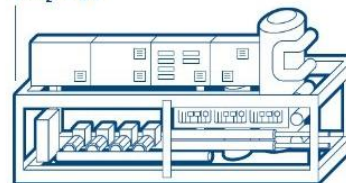
ECO₂ Small+
ECO₂ Small+ HD



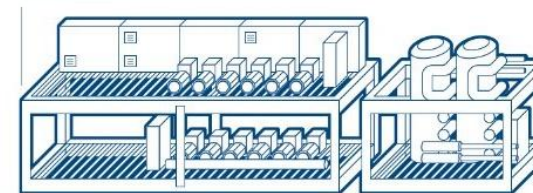
ECO₂ Middle



ECO₂ Large



Tailor made



Hauser range

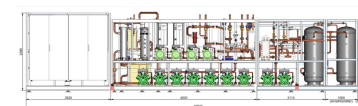
S-rack



M-rack



L/XL-rack



Focus: ECO₂Mini

**Buy&sell
solution**

Proximity, single application and specialized shops

Main features:

- OEM buy and sell (commercialized product)
- rotary hermetic compressors
- Panasonic (cheap) / Rivacold (standard components)
- PS liquid line = 80 bar
- oil system with level check on compressors
- heat recovery as an option

Capacity range @ -30°C / -7°C / 45°C GCO:

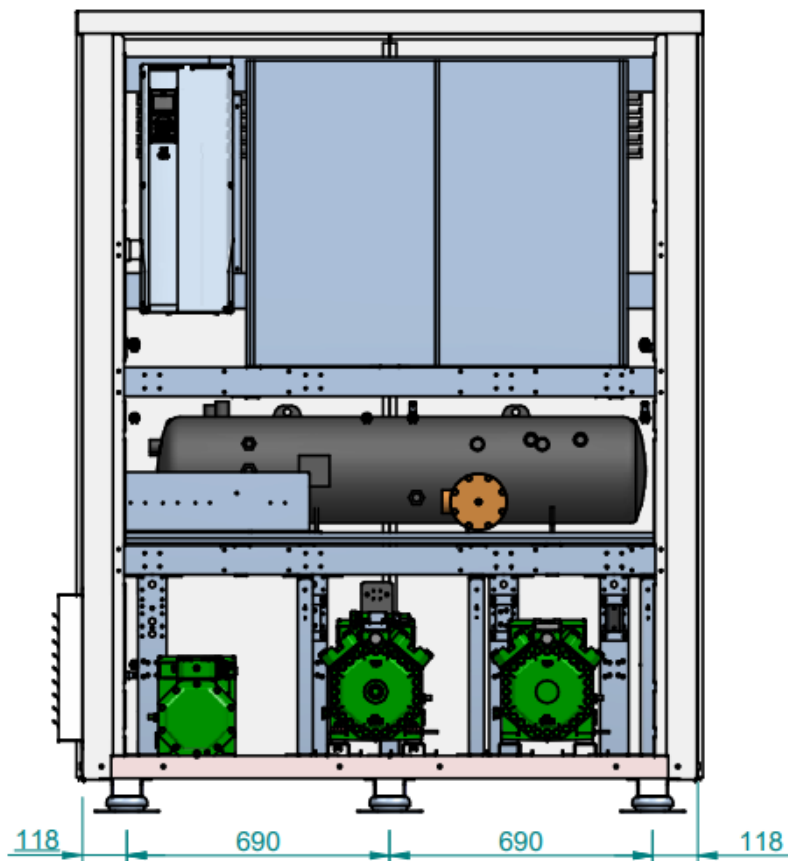
- models:
 - Panasonic (OCU 400 / 1000)
 - Rivacold (UN135 / 145 / 250)
- capacities:
 - LT up to 8 kW
 - MT up to 13 kW



Focus: ECO₂Compacta

**Standard
solution**

Small supermarkets and specialized shops



Main features:

- compact design with front access
- 2+0 / 2+1 / 2+2 compressors configuration with CRII
- horizontal liquid receiver
- housing as an option
- heat recovery as an option

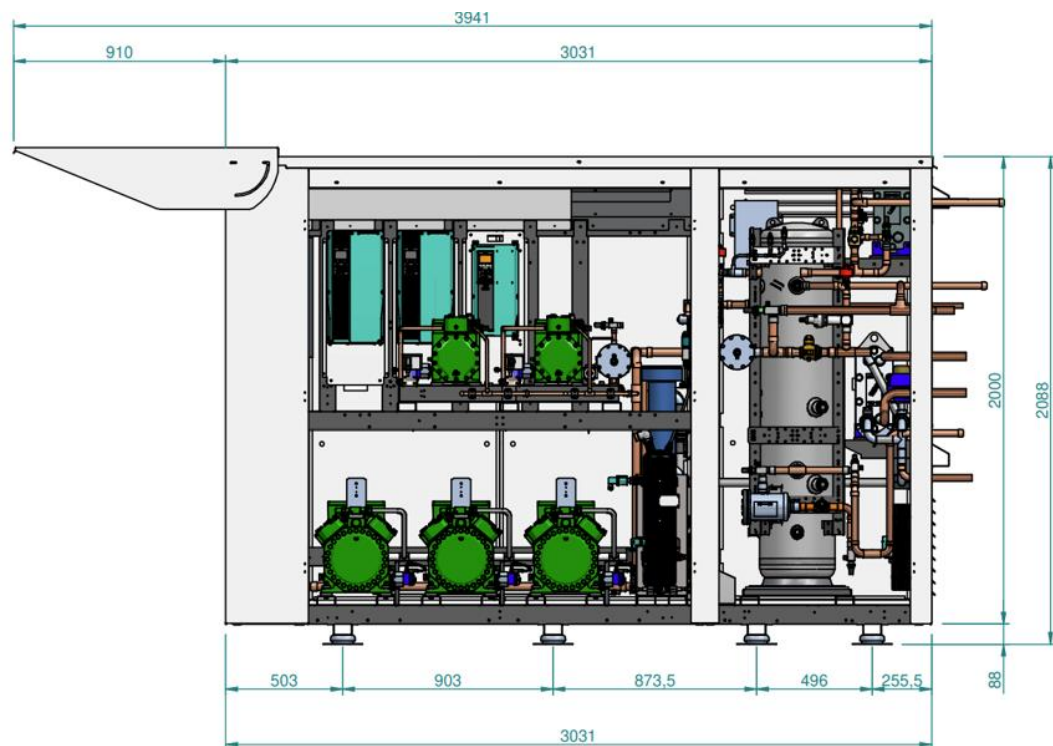
Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - from 2MSL-07K up to 2GSL-3K
 - capacity up to 18 kW
- MT compressors:
 - from 4PTE-7K up to 4HTE-20K
 - capacity up to 38 kW

Focus: ECO₂Small+

**Standard
solution**

Standard supermarkets and hard discount



Main features:

- highly standardized product, everything in one frame
- 3+0 / 3+2 compressors configuration
- third inverter for ETE
- housing as an option
- heat recovery as an option
- FTE / ETE compatible

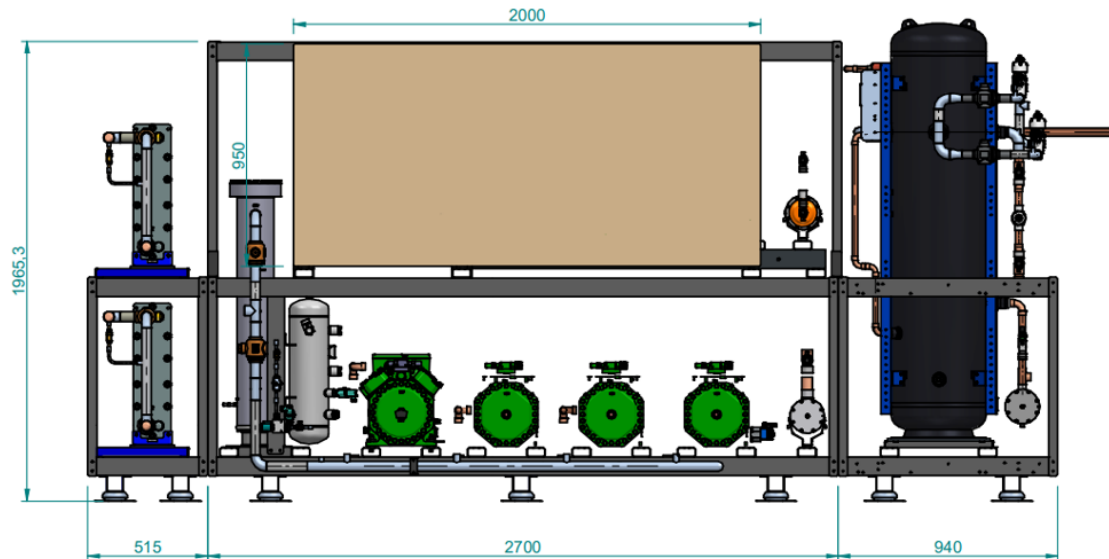
Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - from 2MSL-07K up to 2FSL-4K
 - capacity up to 24 kW
- MT compressors:
 - from 4PTE-7K up to 4HTE-20K
 - capacity up to 100 kW

Focus: ECO₂Middle

Medium sized supermarkets

**Standard
solution**



Main features:

- slim design (80cm depths) to fit inside small mechanical rooms and through small doors
- 3+0 / 4+0 / 3+1 / 3+2 / 3+3 / 4+1 / 4+2 / 4+3 compressors configuration
- third inverter for ETE
- housing as an option
- heat recovery as an option
- FTE / ETE compatible

Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - from 2MSL-07K up to 2DSL-5K
 - capacity up to 50 kW
- MT compressors:
 - from 4JTE-10K up to 4DTE-25K / 4CTE-30K
 - capacity up to 150 kW (MT only)

Focus: ECO₂Large

**Standard
solution**

Large sized supermarkets and hypermarkets



Main features:

- 4+3 / 5+3 compressors configuration
- third inverter for ETE
- housing as an option
- heat recovery as an option
- FTE / ETE compatible

Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - from 2JSL-2K up to 2CSL-6K
 - capacity up to 62 kW
- MT compressors:
 - from 4JTE-10K up to 4CTE-30K
 - capacity up to 200 kW

Focus: ECO₂Giant (or tailor made)

Custom
solution

Hypermarkets and light industrial



Main features:

- 6+4 compressors configuration
- third inverter for ETE or parallel compression available
- housing as an option
- heat recovery as an option
- FTE / ETE compatible

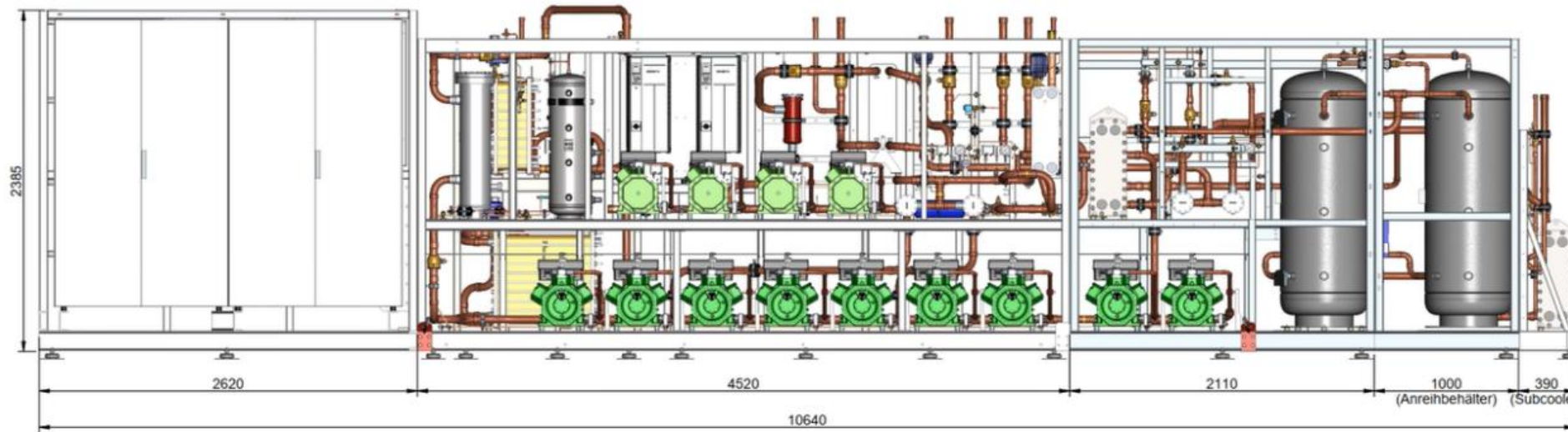
Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - up to 4 x 4DME-10K (PS 60 bar) or 4CSL-12K (PS 30 bar)*
 - capacity up to 160 kW
- MT compressors:
 - up to 6 x 4CTE-30K
 - capacity up to 400 kW

Focus: Hauser XL (or tailor made)

Custom
solution

Industrial



Main features:

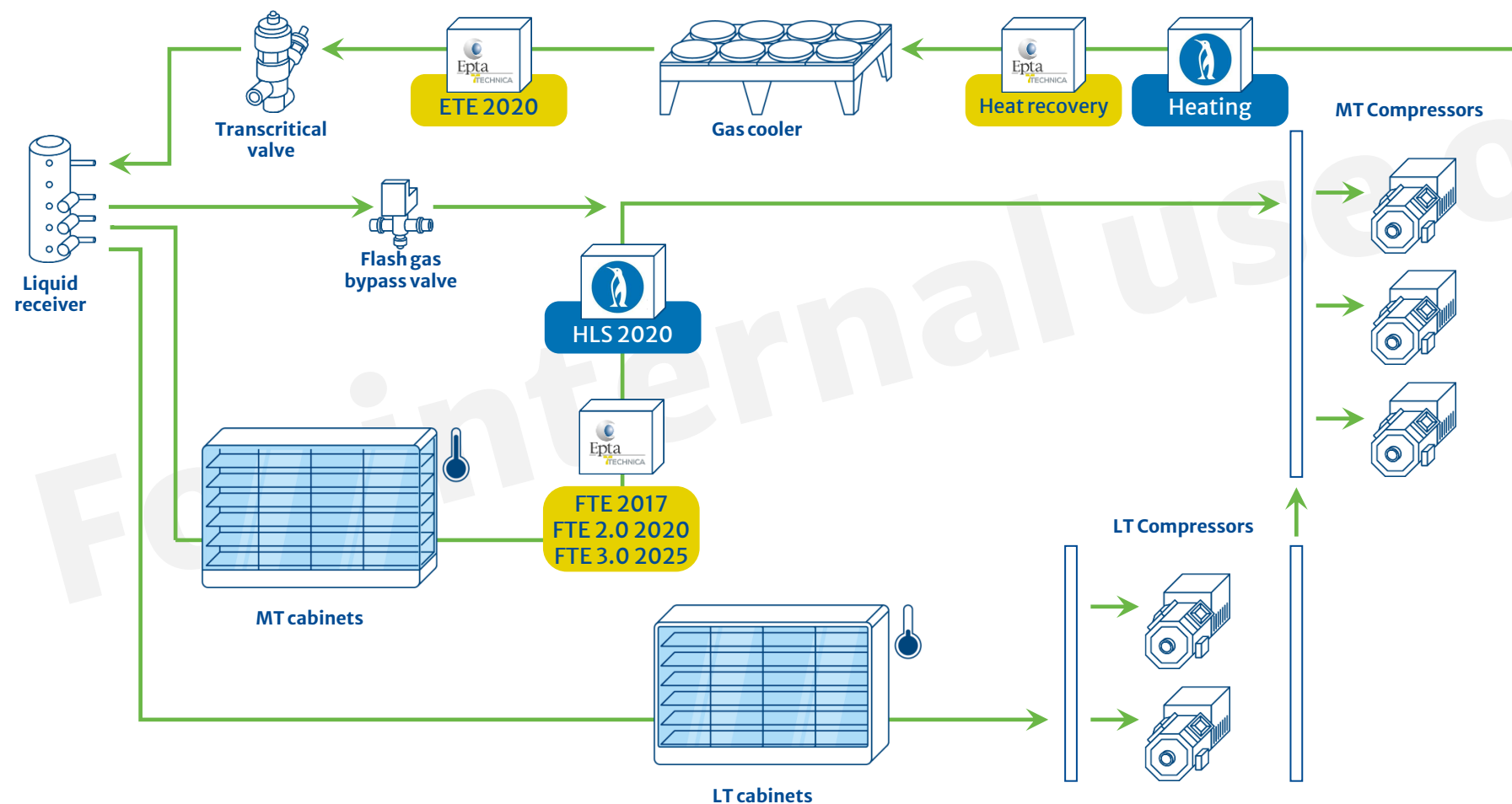
- 7+2+4 compressors configuration
- third inverter for parallel compression available
- housing as an option
- heat recovery as an option
- parallel compression compatible

Capacity range @ -30°C / -7°C / 42°C GCO:

- LT compressors
 - capacity up to 200 kW
- MT compressors:
 - capacity up to 700 kW

CO₂ transcritical systems

CO₂ transcritical system innovation portfolio & cadence



Why FTE, HLS & ETE

We are facing two major problems these days:

1. Energy costs are getting more and more expensive



2. Climate change is real: temperatures are rising!



Why FTE, HLS & ETE

With **FTE, HLS & ETE**, Epta and Hauser have developed technologies to answer these major challenges!

An increased energy saving (compared to state-of-the-art technologies) and a technological solution to run the natural refrigerant CO₂ in all climate conditions – with no limits in ambient temperature!

Market figures (2020–2025):

- **FTE:** 641 units
- **ETE:** 788 units
- **HLS:** 50 units



Transcritical systems

Overfeeding of evaporators MT + LT

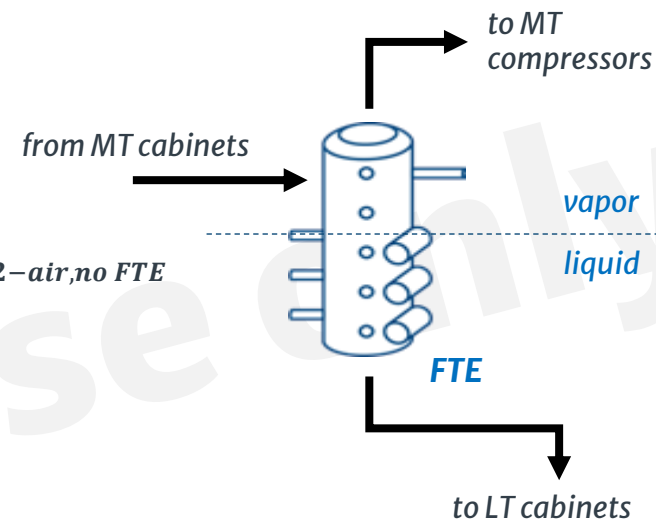
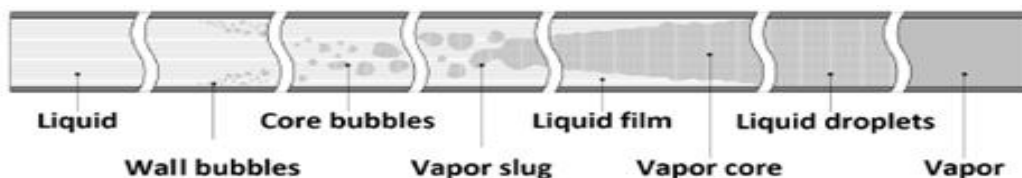
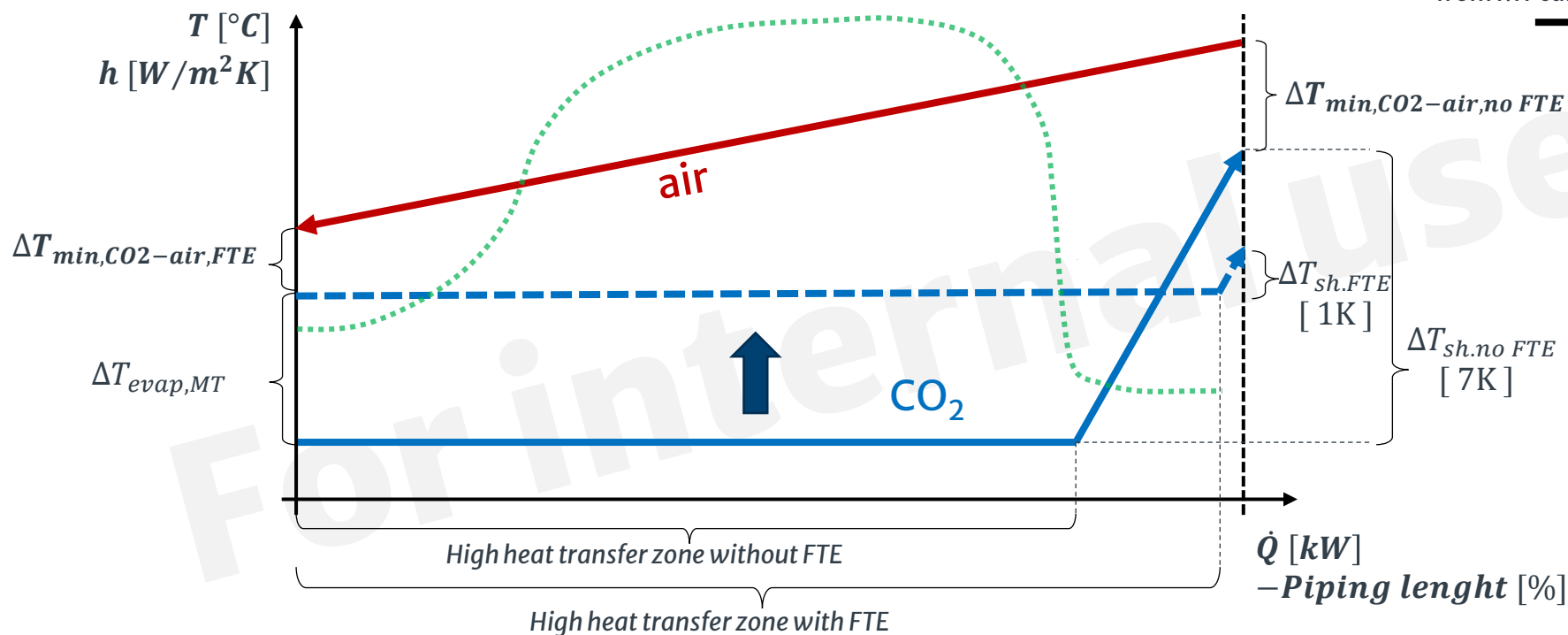


FTE – Full Transcritical Efficiency concept

Key factor: evaporators “overfeeding” → T_{evap} increases both on MT and LT

Boundary condition: air temperatures shall remain constant under all varying conditions.

Energy consumption reduction: $\Delta COP \approx +3 \text{ } \%/^{\circ}\text{C}$ on MT, $+1 \text{ } \%/^{\circ}\text{C}$ on LT



$$COP \sim \frac{T_{evap}}{T_{cond} - T_{evap}}$$

$$\dot{Q} \sim h A \Delta T$$

$\uparrow$ $\downarrow$

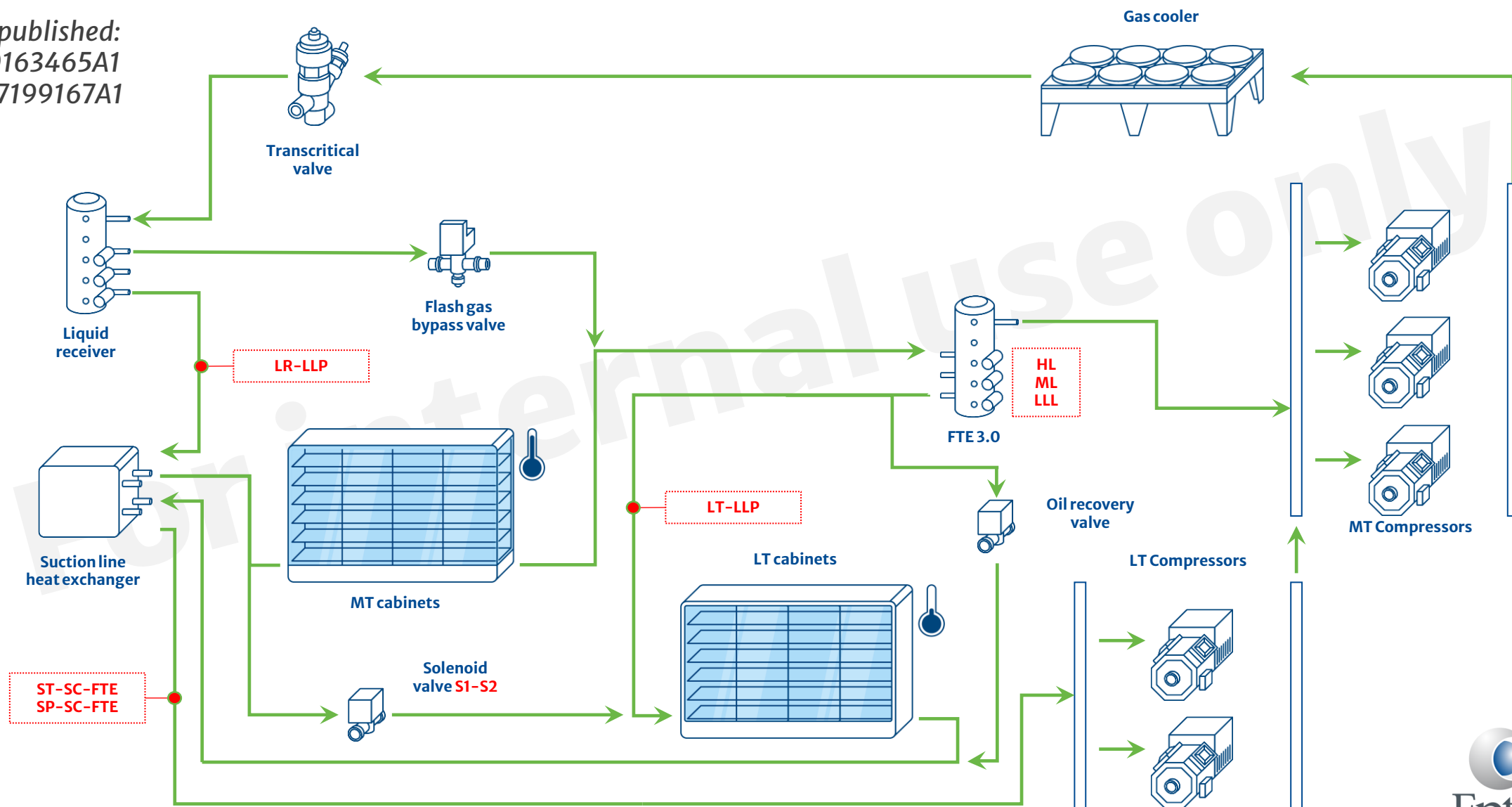
..... Heat transfer coefficient $[W/m^2K]$

— CO_2 temperatures $[^{\circ}\text{C}]$

— Cabinet air temperature $[^{\circ}\text{C}]$

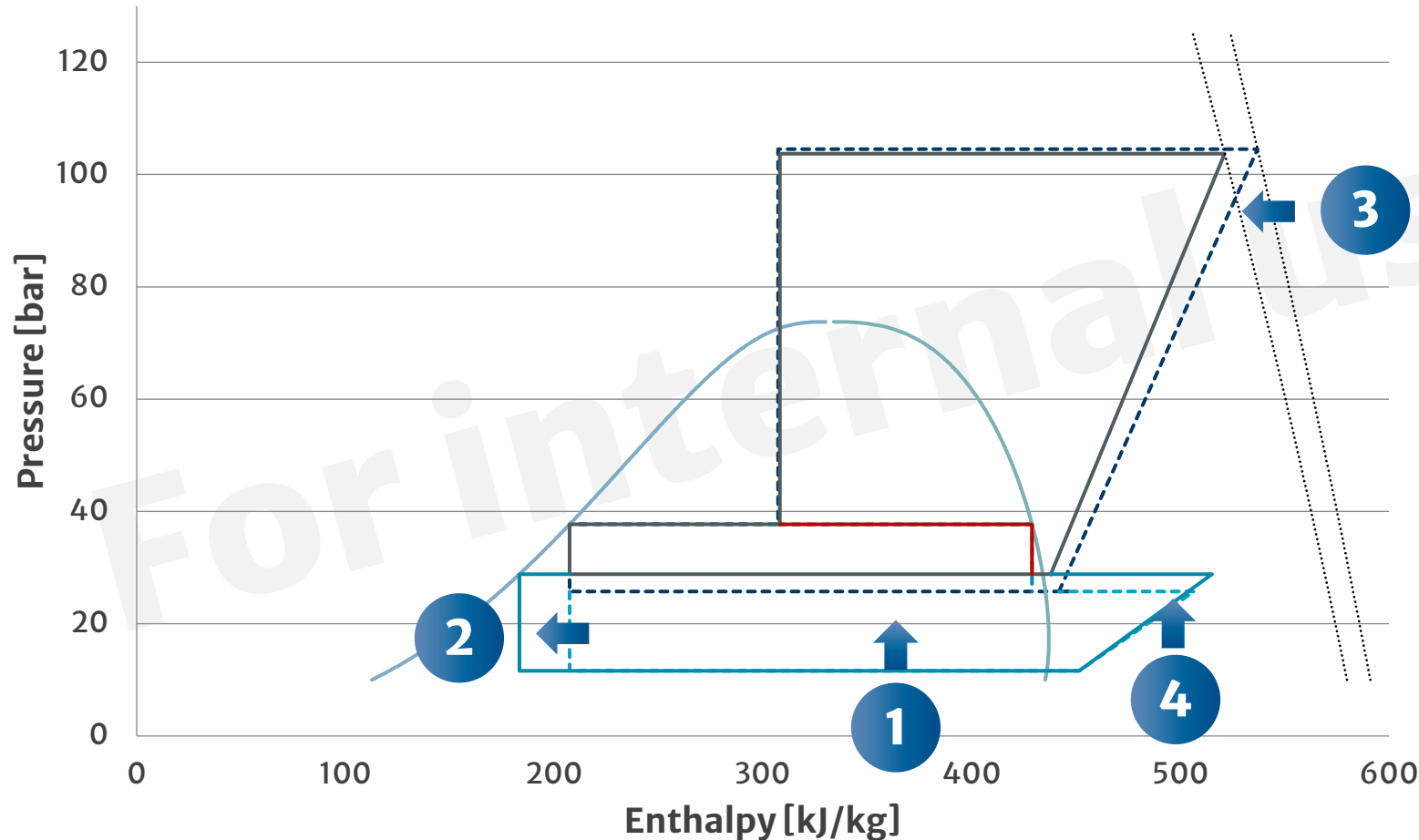
FTE 3.0 – High level system layout

Patent published:
ITUA20163465A1
WO2017199167A1



FTE – Thermodynamic aspects

Focus on MT only system, P-H diagram



Which are the effect of FTE 3.0, from a thermodynamic perspective?

1. MT evaporator temperature rise
2. LT mass flow reduction
3. MT discharge temperature reduction
4. LT discharge pressure rise

N.B: points 2 and 4 compensate each other

Example of P-H diagram at +40°C,
dotted line = standard cycle,
solid line = FTE cycle

FTE 3.0 – Main advantages

Evaporating temperature increased 365day/year

Efficiency gain of +13% minimum



Saving is independent by external temperature

Also, in cold climates



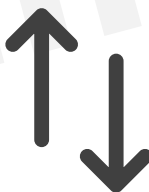
MT compressor discharging temperature decrease

Especially in hot climate conditions



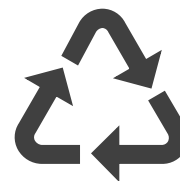
LT loads supplied with cooler liquid
but LT discharge pressure increase

Compensation effect: expansion
device does not change, and LT
compressor consumption remains
the same.



Flash gas is partially reused

Small liquid flow generated through
flash gas expansion goes to LT
cabinets
Increased efficiency and reliability of
the compressors



No oil reclaim issues

Return of the oil to the compressors is
not an issues, thanks to the oil
recovery valve



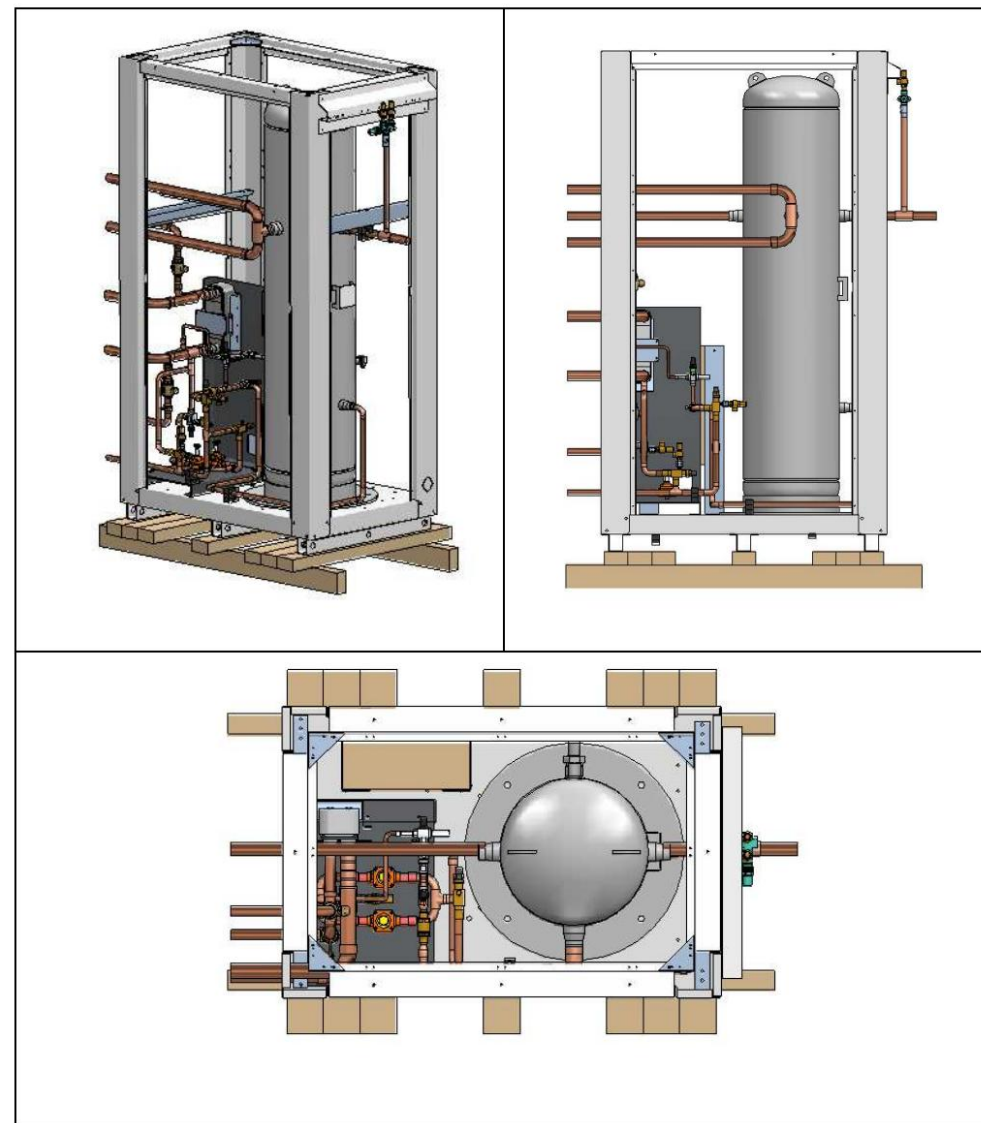
FTE 3.0 – Mechanical design

One receiver size per platform

Platform	FTE 3.0 receiver
ECO ₂ Compacta	Not in scope
ECO ₂ Small+	110 L
ECO ₂ Middle	165 L
ECO ₂ Large	200 L
ECO ₂ Giant	300 L

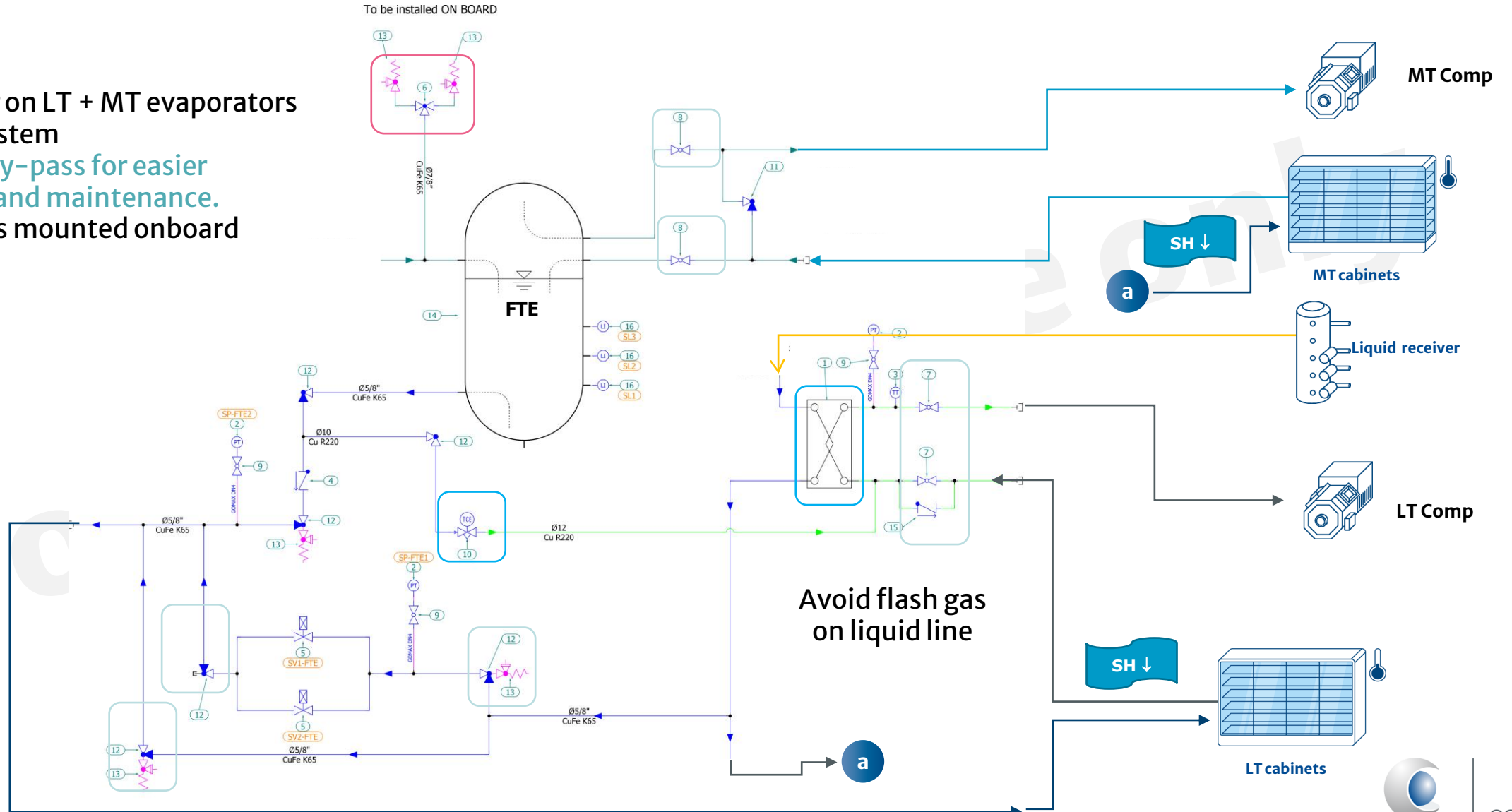
WHY ?

Valves and by-pass are designed specifically according to P&ID of each platform for simplified installation.



FTE 3.0 – P&I of the 110L version

- Overfeeding on LT + MT evaporators
- Oil return system
- Valves and by-pass for easier installation and maintenance.
- Safety valves mounted onboard



FTE 3.0 – Advantages

For the end user:

- significant energy savings observed and quantified → **13% minimum for combined LT + MT overfeeding**
- system using natural refrigerant
- stability and reliability over time of operation and components
- simplified maintenance compared to other energy-saving systems.

For contractors:

- possibility of offering an energy saving option with a real return on investment to its customer
- everything is sized as for a classic transcritical installation (evaporators, expansion valves, pipes, regulators, gas coolers, compressors, etc.)
- there is only the need to separate the liquid lines between the positive and negative cabinets and evaporators.

For the maintenance company / technician:

- simple and reassuring system
- no fancy adjustments or complications on the machine
- a safety device (the anti-liquid bottle) is used as a generator of savings thanks to the principle of overfeeding positive and negative evaporators
- minimal training of technicians to acquire the basics of the system

FTE 3.0 – System design rules

Layout:

- everything is standard: expansion valve, controllers, velocity in pipes, siphons.
- **LT cooling load must be >15% of MT cooling load** and there must be minimum 5 expansion valves on LT
- standard layout: link between P&ID of pack and P&ID of the related FTE receiver.
- separate liquid line LT and MT from the receiver room

Cooling balance:

- cabinets mix:
 - mainly open MT cabinets: daily design cooling need similar to real needs → no actions
 - mainly closed MT cabinets: normally oversized compared to real needs → do not apply to much margin on system design
 - LT cabinets → normally undersized compared to real needs → the pressure on outlet will increase when FTE is active, no actions
- coefficients on cooling load → find balance between security and good working conditions in winter



if MT cabinets closed + safe margin + standard evaporating temperature → oversized capacity, could lead to system stability issue in winter

Electronics:

- connection of EVCO controller to supervisor via Modbus straight to Boss platform (CAREL) or via X-Gate to System Manager platform (Danfoss)
- EVCO has a WIFI access with mobile phones for setting and reading parameters with free App « EVCONNECT »

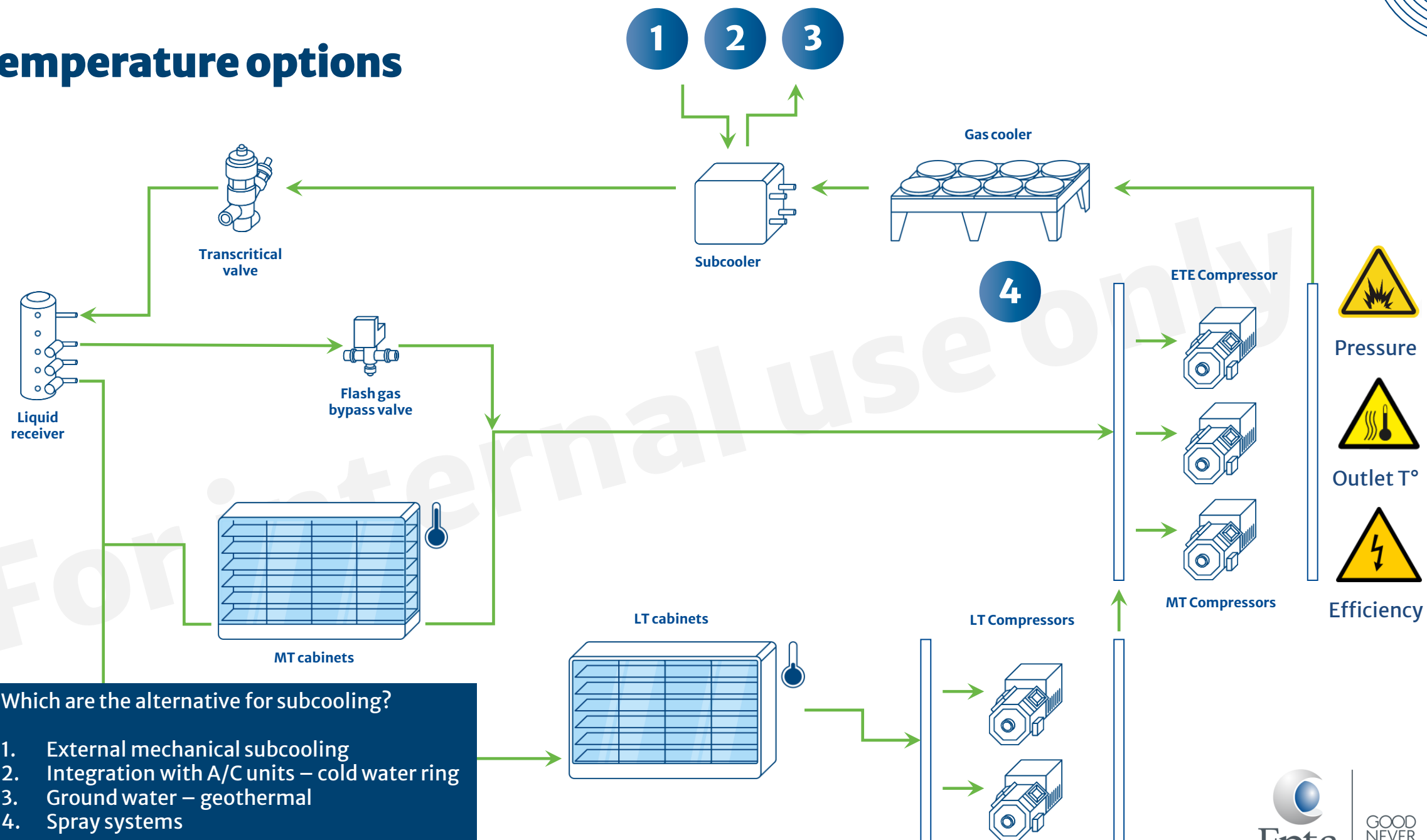
Transcritical systems

Internal mechanical subcooler CO₂



ETC

High temperature options

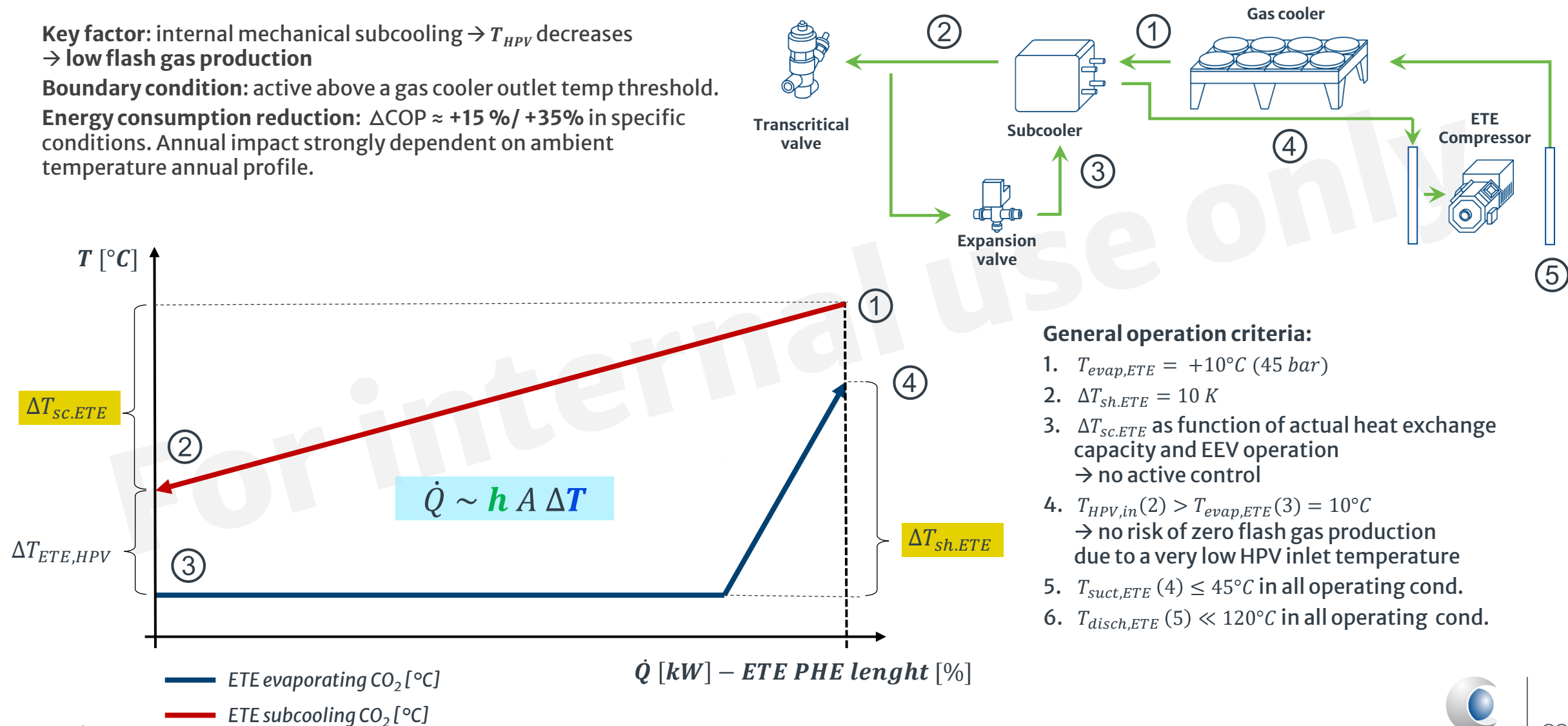


ETE – Extreme Temperature Efficiency concept

Key factor: internal mechanical subcooling $\rightarrow T_{HPV}$ decreases
 $\rightarrow$ low flash gas production

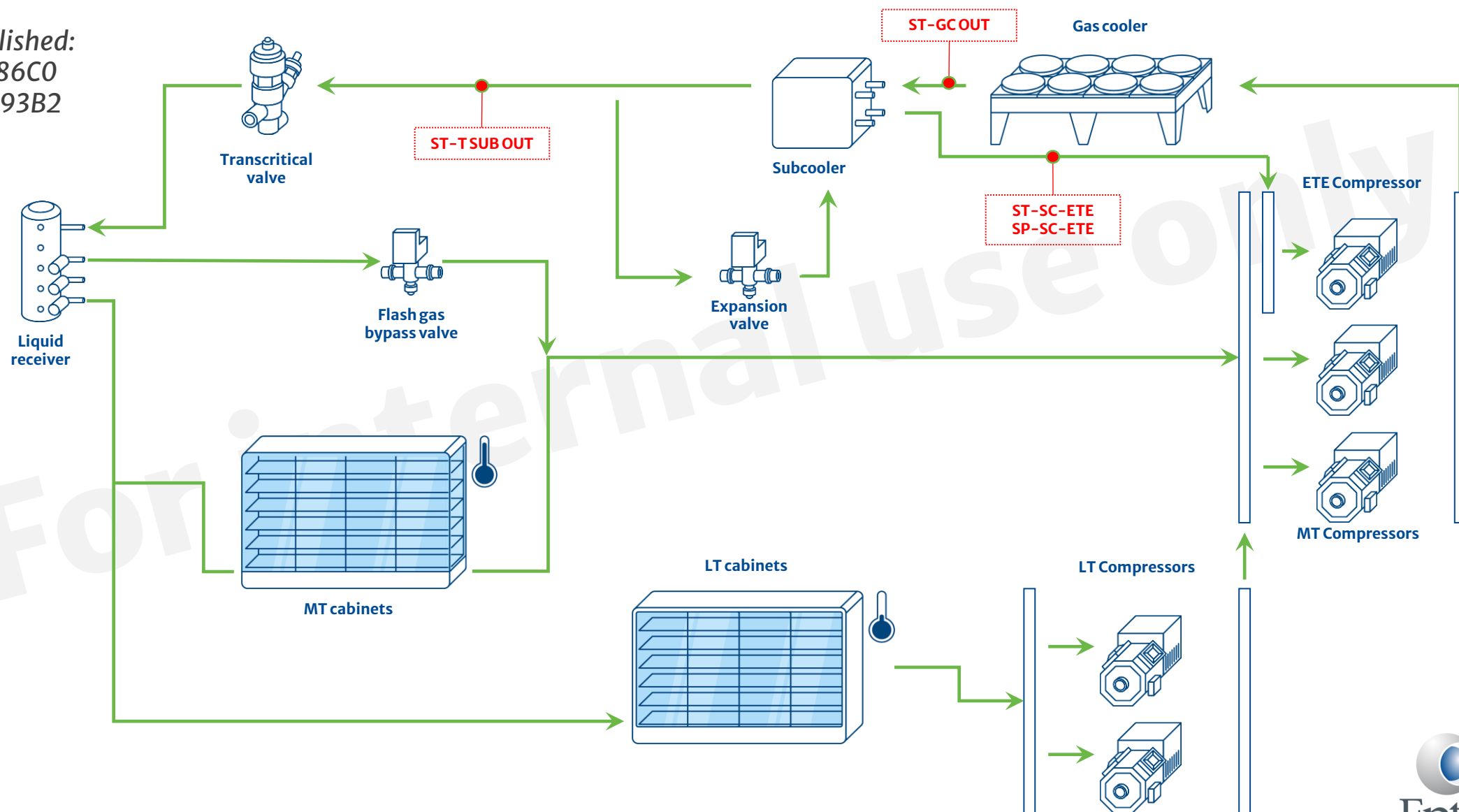
Boundary condition: active above a gas cooler outlet temp threshold.

Energy consumption reduction: $\Delta\text{COP} \approx +15\% / +35\%$ in specific conditions. Annual impact strongly dependent on ambient temperature annual profile.



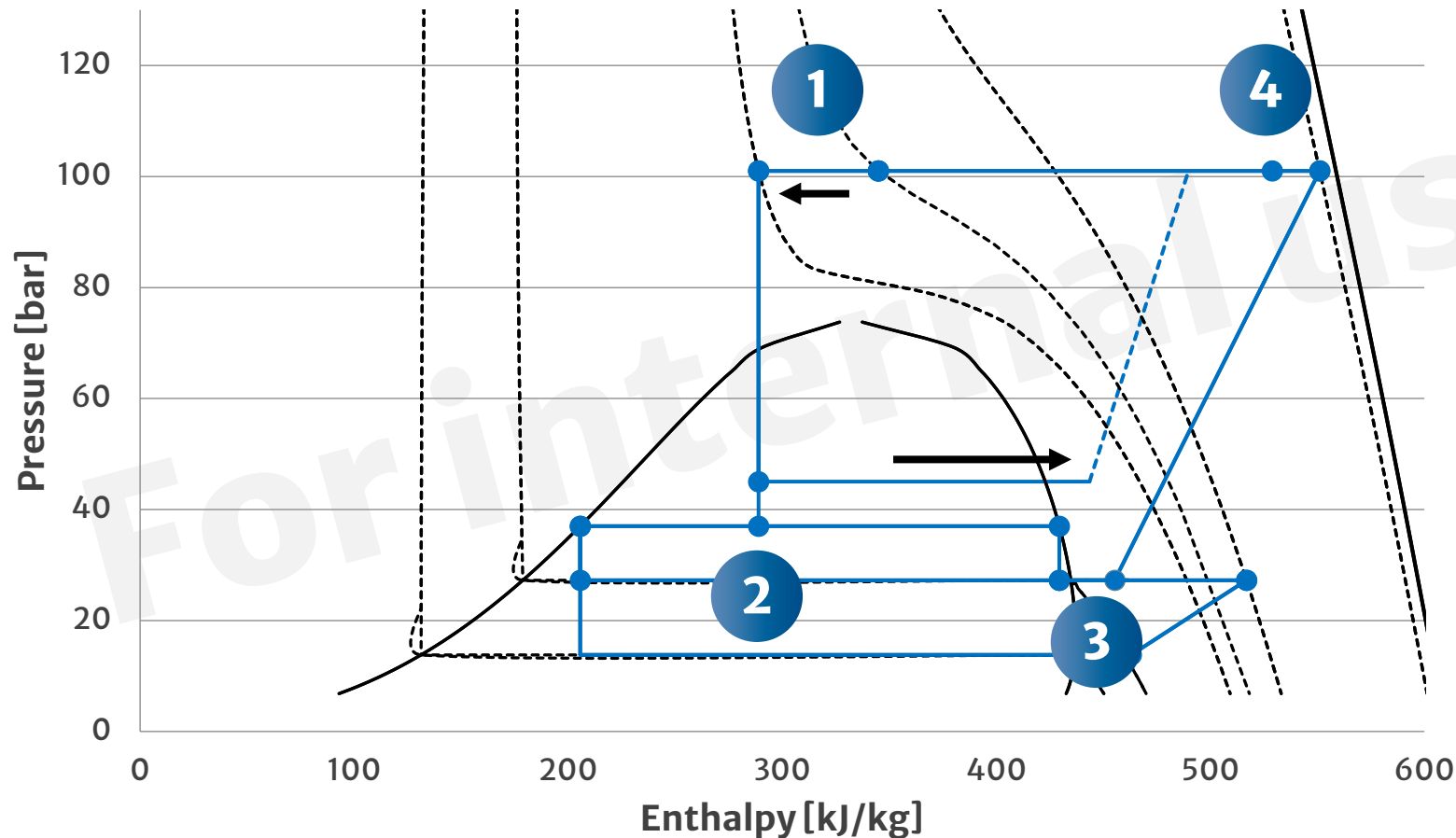
ETE – High level system layout

Patent published:
EP3865786C0
US11852393B2



ETE – Thermodynamic aspects

Focus on MT+LT system, P-H diagram



Which are the effect of ETE, from a thermodynamic perspective?

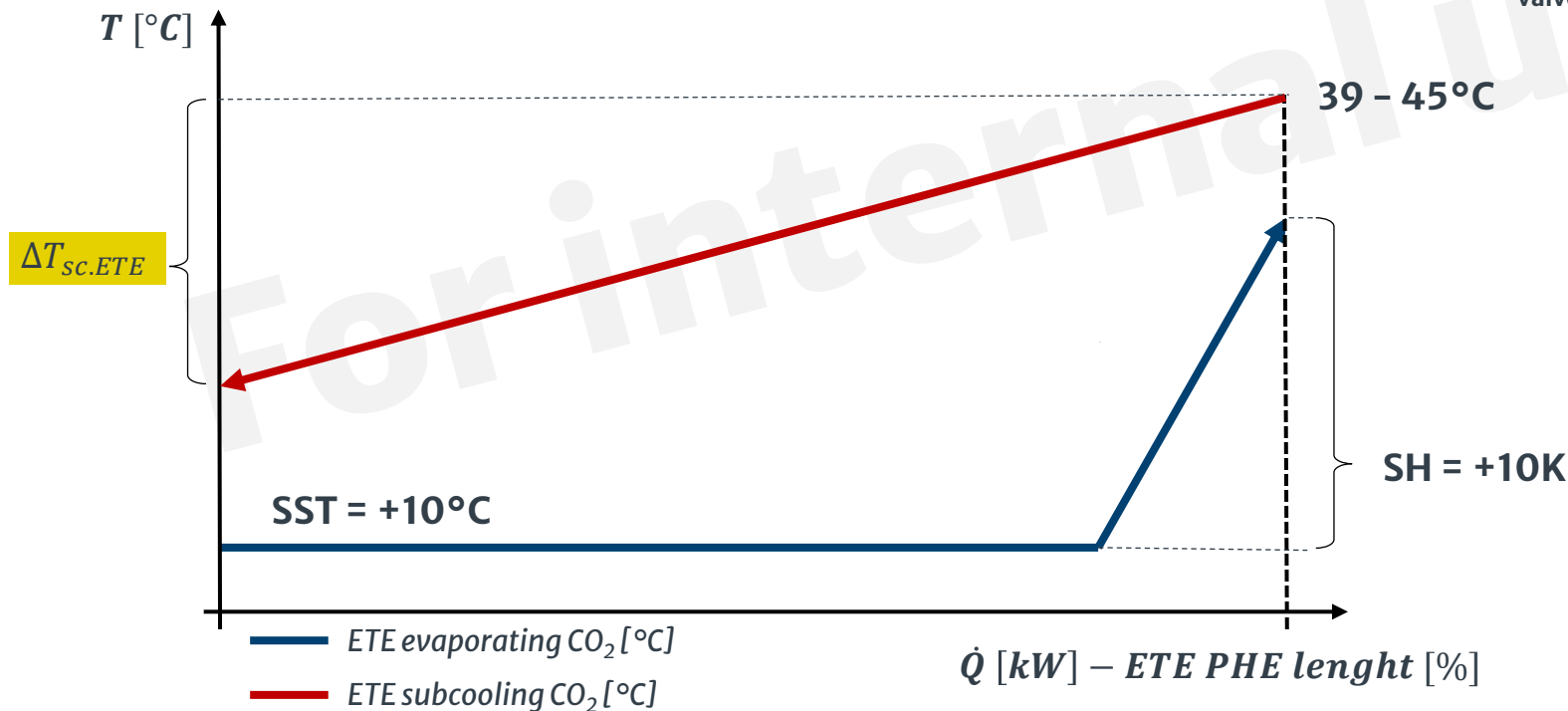
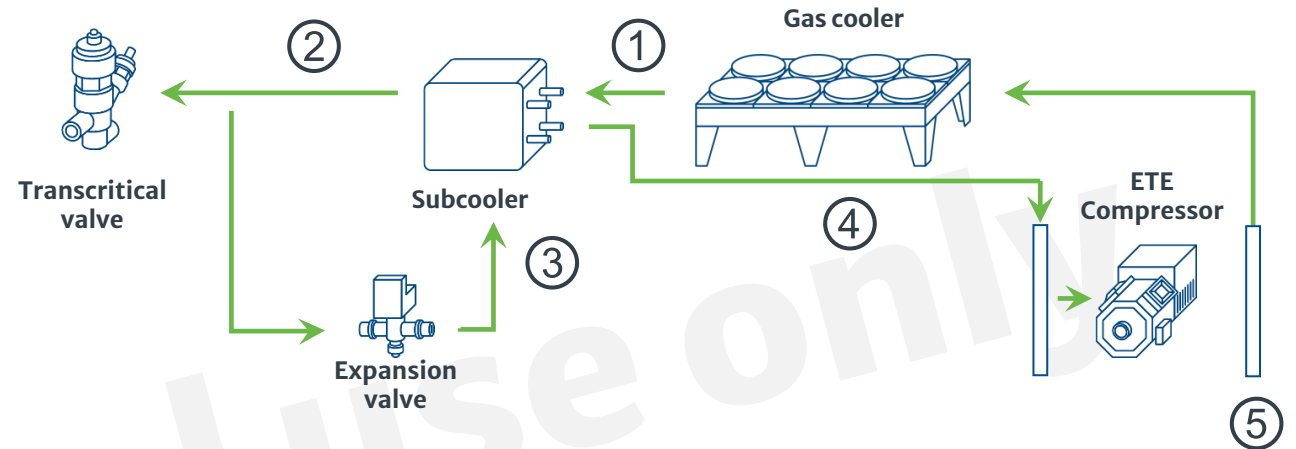
1. HPV inlet temperature decreases
2. lower production of flash gas
3. MT mass flow reduction
4. MT discharge temperature reduction at oil separator inlet

Example of P-H diagram at +40°C,
dotted line = ETE compressor cycle,
solid line = standard cycle parts

ETE – Extreme Temperature Efficiency at design point

EEV and compressor have two separated control logic:
the balance between the two components should be guaranteed by
the proper design $\Delta T_{sc,ETE}$

- design subcooling too low (<4K) = downsized compressor
→ risk of reliability at high temperature
- design subcooling too high (>10K) = oversized compressor
→ limited operation at part load



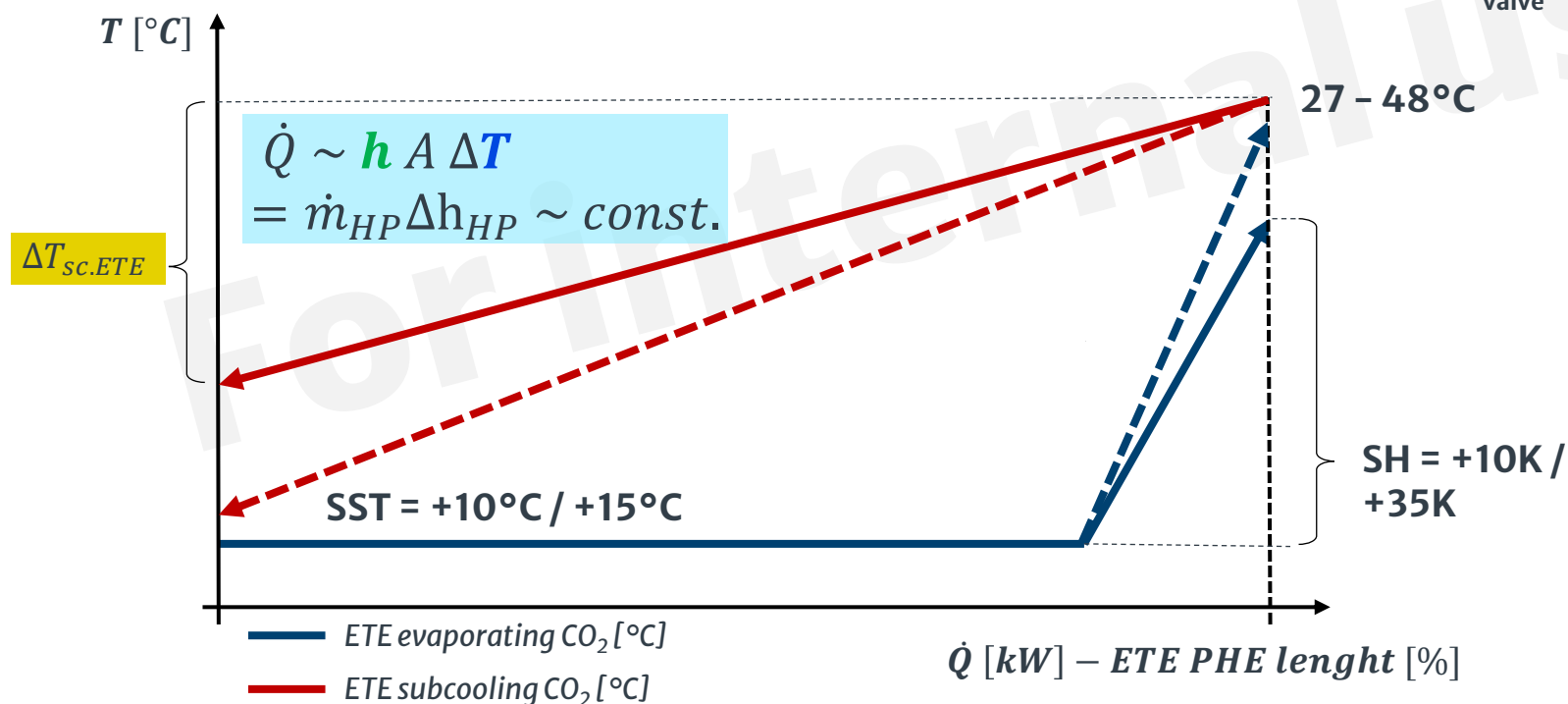
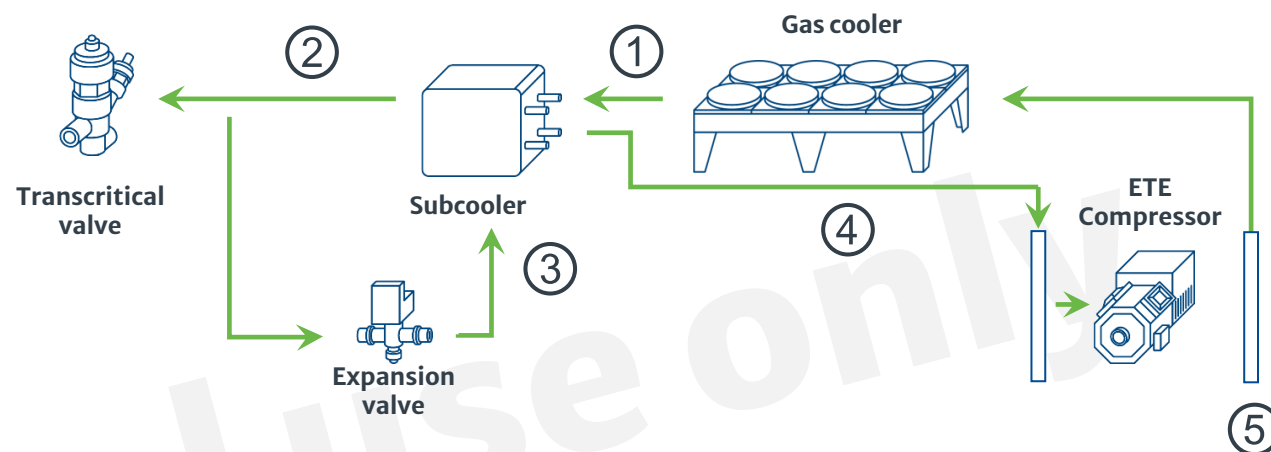
General design criteria:

Target subcooling at design condition
 $\Delta T_{sc,ETE}$ ranging from 4–5K to 10K

ETE – Extreme Temperature Efficiency at part load

The actual ETE subcooling effect is given by the thermal balance on the PHE. In reality:

- Case 1: ETE capacity big or low MT+LT cooling demand or low gas cooler outlet temperature $\rightarrow$ low $\dot{m}_{HP}$ $\rightarrow$ high $\Delta T_{sc,ETE}$ $\rightarrow$ unstable ETE compressor $\rightarrow$ fine tune / increase $T_{act,ETE}$
- Case 2: ETE capacity low or high MT+LT cooling demand or high ambient conditions higher $\dot{m}_{HP}$ $\rightarrow$ low $\Delta T_{sc,ETE}$ $\rightarrow$ MOP intervention $\rightarrow$ fine tune MOP settings to control SST



$\Delta T_{sc,ETE}$ ranging from 5K to 30K according to real operating conditions

- $\rightarrow$ minimum HPV inlet temperature guaranteed by ETE evaporating temperature
- $\rightarrow$ maximum superheat limited by gas cooler temperature
- $\rightarrow$ maximum suction pressure guaranteed by MOP functions

ETE – Main advantages

No more limits on external temperature

Allow the use of CO₂ transcritical systems in extreme climates up to 48°C ambient (*), with a significant energy saving up to 30%



100% natural and non-flammable refrigerant

Only CO₂ used, no other systems



No waste of water

No use of spray systems or adiabatic gas cooler



Simple and reliable system

Simple and easy to understand, pre-installed on the pack with standard parametric controllers



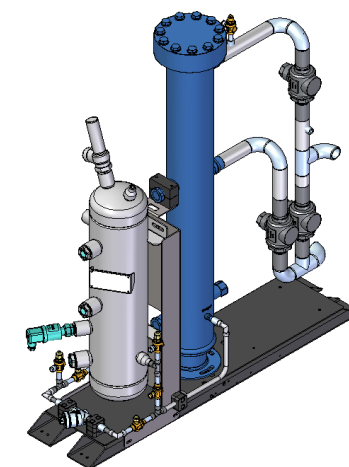
Oil management optimization

Special oil system developed for ETE application, to manage suction pressure up to 50 bar. Now the standard on all platforms.



Standard 120 bar oil system management:

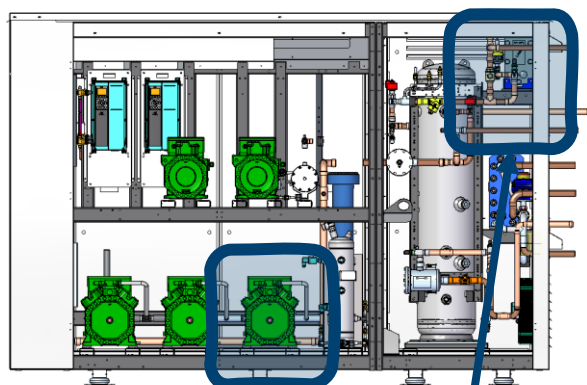
- Oil separator and oil receiver are in parallel and connected.
- Standardization of the oil module:
- Optional by-pass of separator



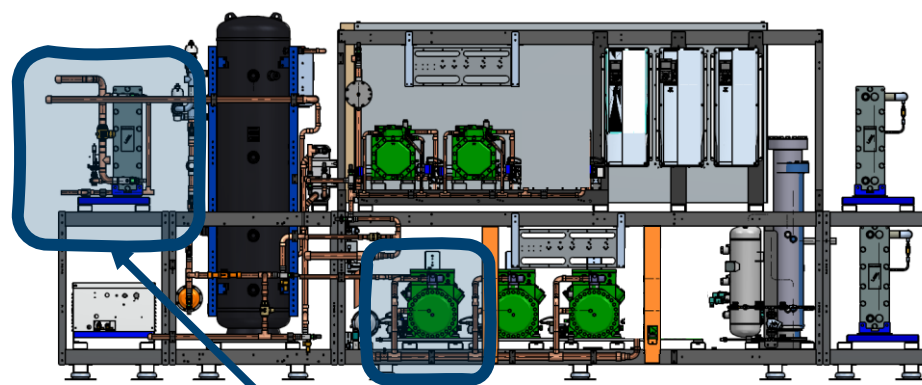
ETE – Mechanical design

Standardized mechanical design and components selection on board of all platforms

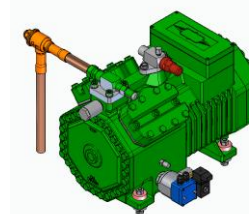
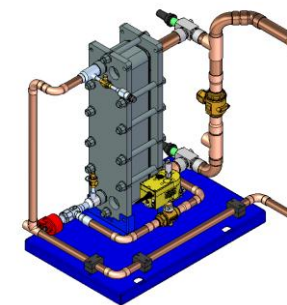
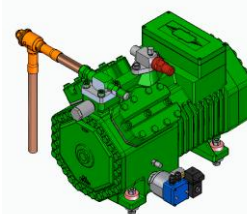
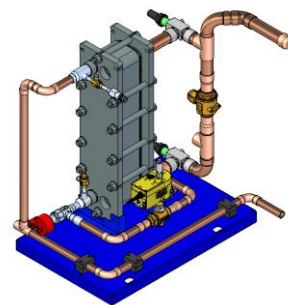
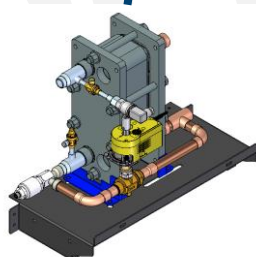
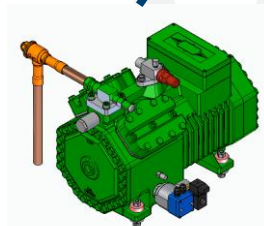
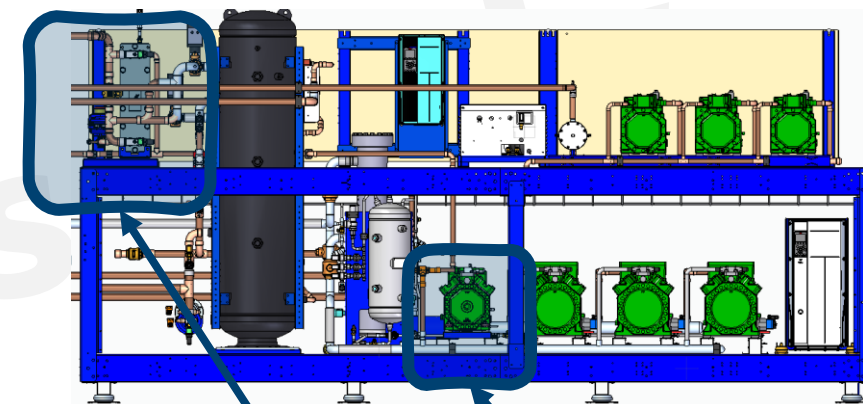
ECO₂Small+



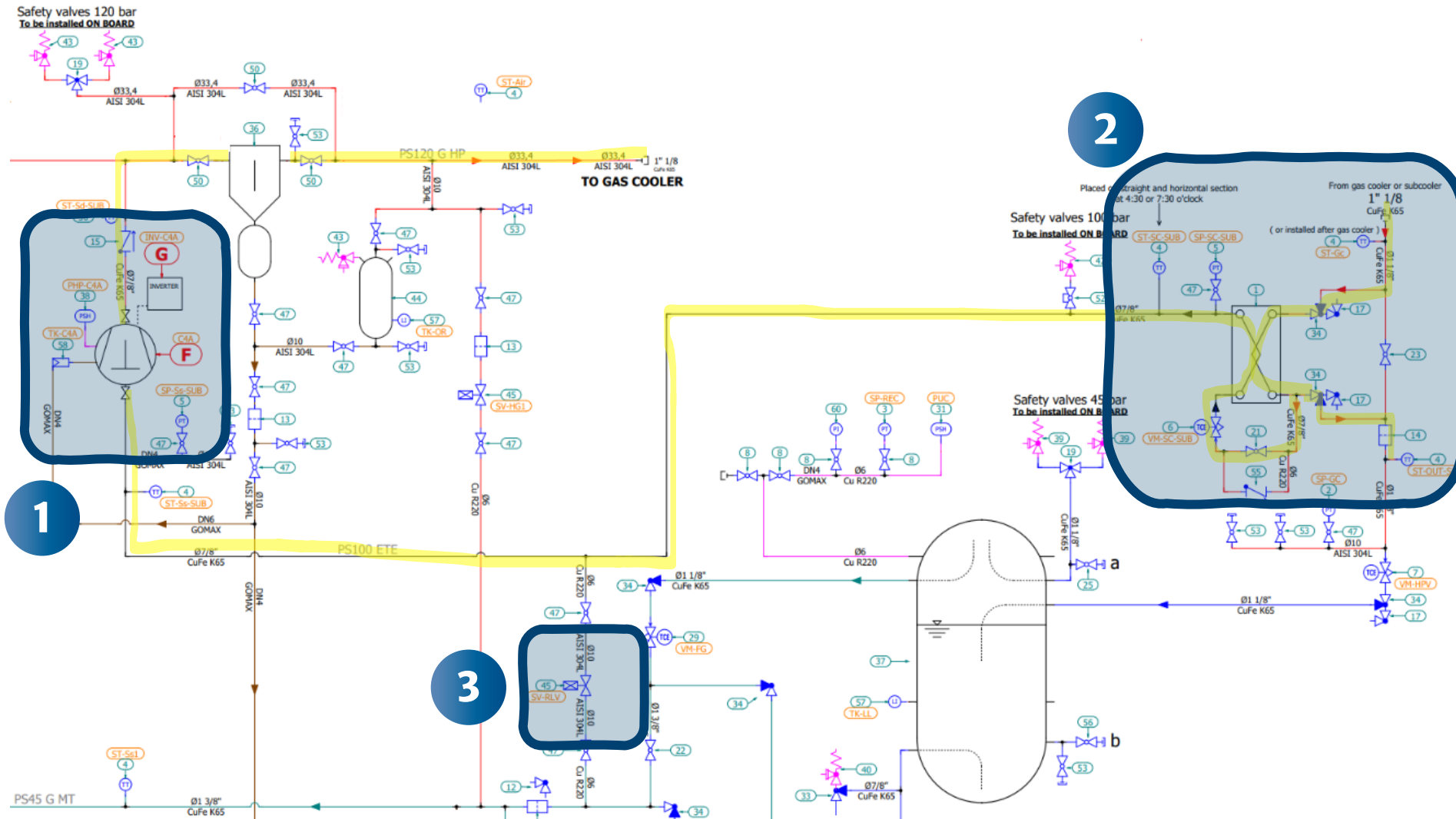
ECO₂Middle



ECO₂Large / Giant



ETE – P&I of the standard solution



1. ETE compressor module:

- Inverter / CRII driver
- Check valve on discharge
- PS suction = 100 bar

2. ETE PHE module:

- standard EEV
- predisposition for upstream motorized ball valve

3. safety valve module:

- Overpressure discharge to MT suction when ETE is off
- preset cut in/out @ 40–36 bar

ETE – Advantages

For the end user:

- lower amount of flash gas in the system by design
- suction pressure of ETE compressor up to 50 bar → better efficiency compared to parallel compression
- no issues in transitional regime across critical point nor in part load operations
- significant energy savings observed and quantified → from +15% up to 35% for ambient temperatures higher than 25°C

For contractors:

- stability and reliability over time of operation and components
- simplified maintenance compared to other energy-saving systems
- possibility of offering an energy saving option with a real return on investment to its customer

For the maintenance company / technician:

- simple system, with significant advantages compared to similar technologies
- no fancy adjustments or complications on the machine
- minimal training of technicians to acquire the basics of the system

Transcritical systems

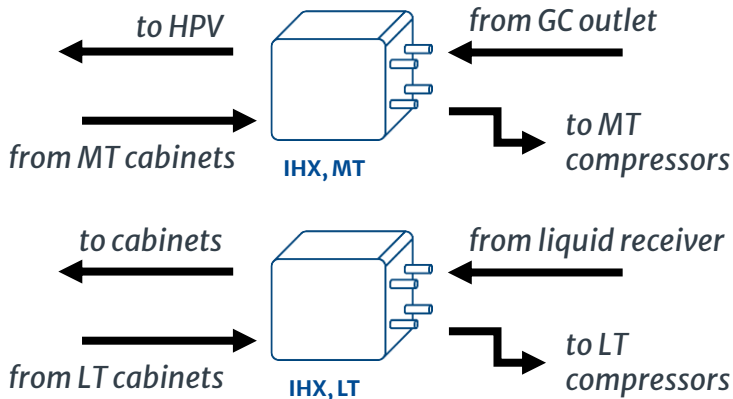
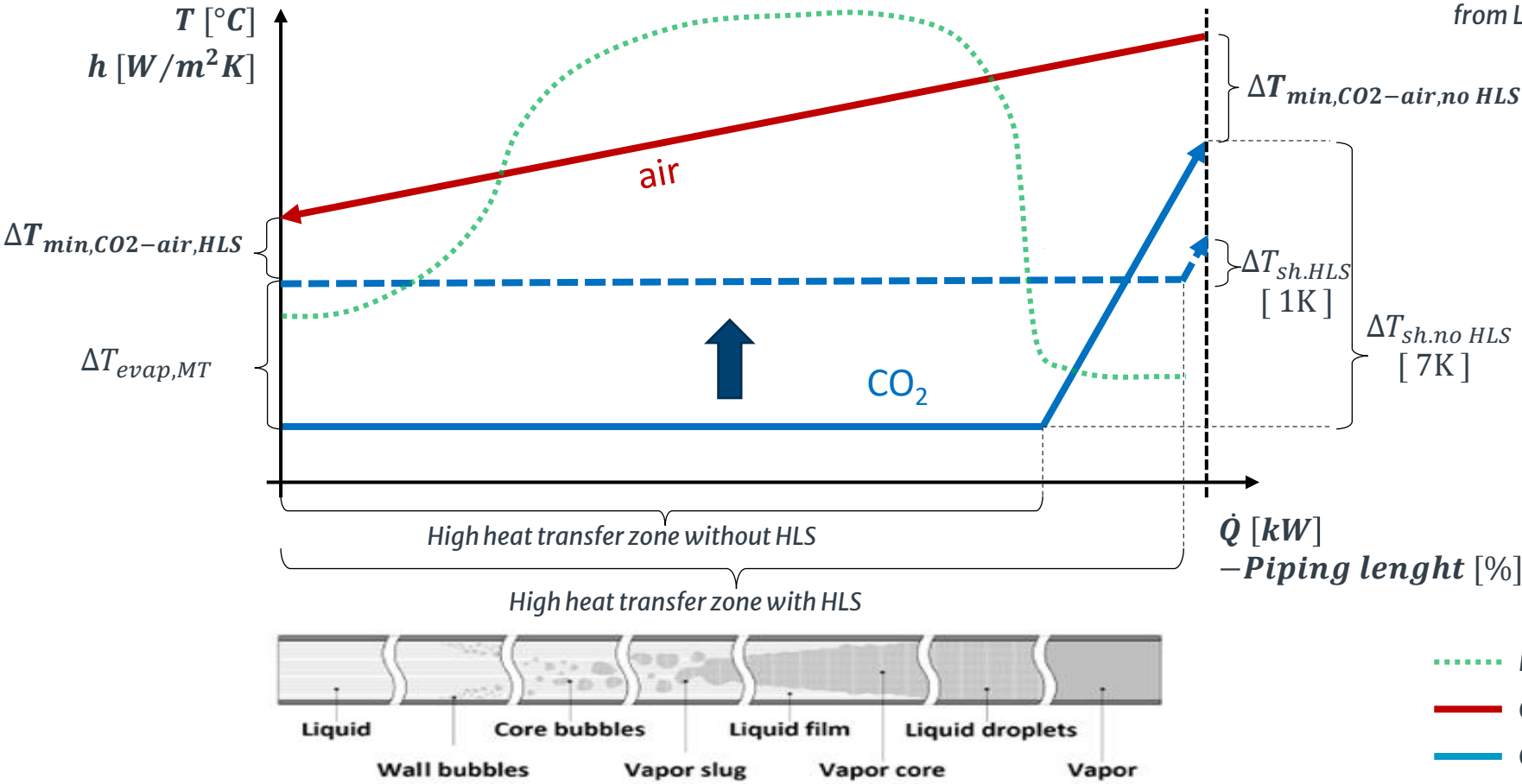
Overfeeding of evaporators MT + LT



HLS

HLS – Hauser Low Superheat concept

Key factor: evaporators “overfeeding” → T_{evap} increases both on MT and LT
 Boundary condition: air temperatures shall remain constant under all varying conditions.
 Energy consumption reduction: $\Delta COP \approx +3 \text{ } \%/^{\circ}\text{C}$ on MT, $+1 \text{ } \%/^{\circ}\text{C}$ on LT



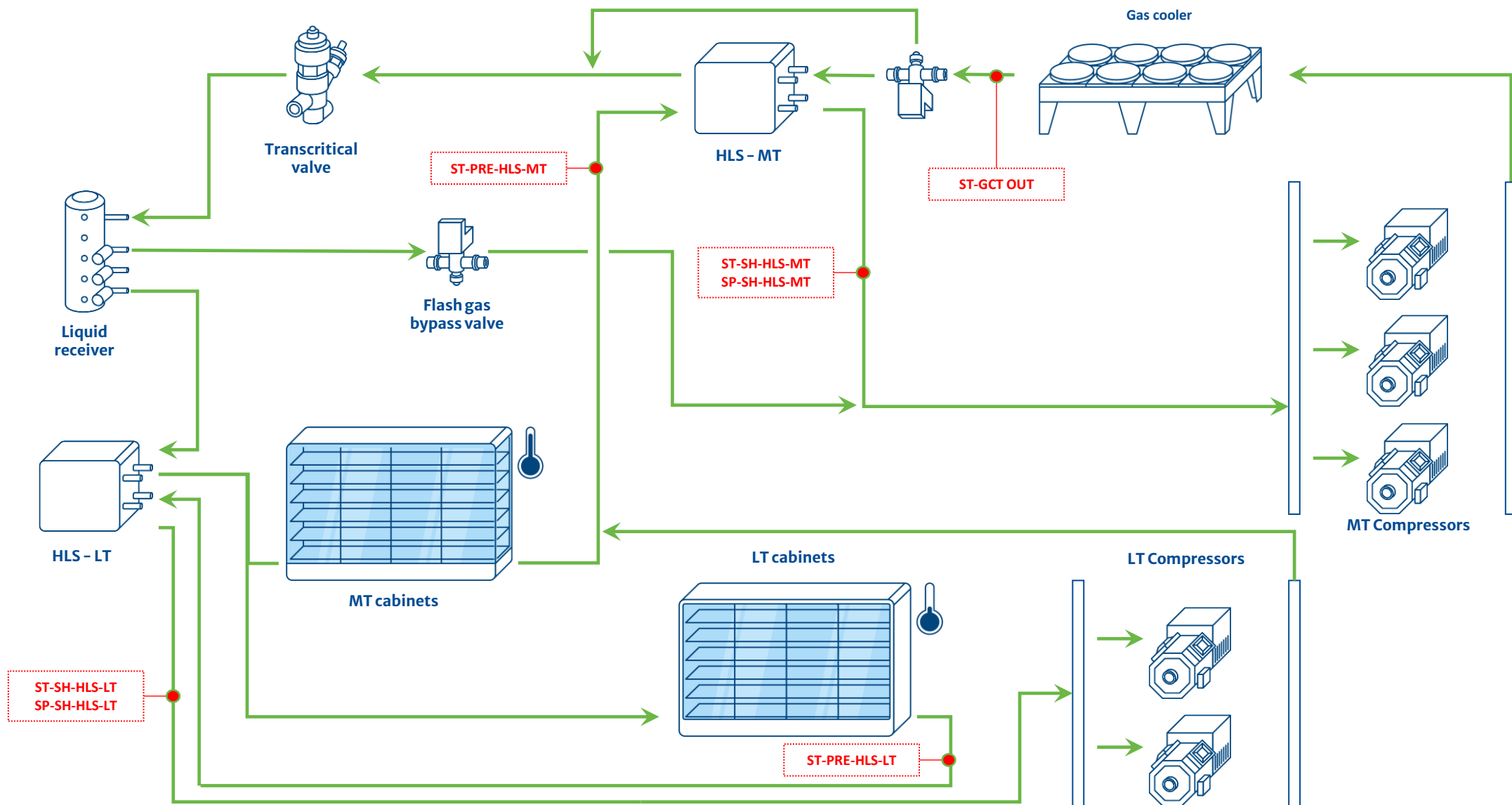
$$COP \sim \frac{T_{evap}}{T_{cond} - T_{evap}}$$

$$\dot{Q} \sim h A \Delta T$$

↑ ↓

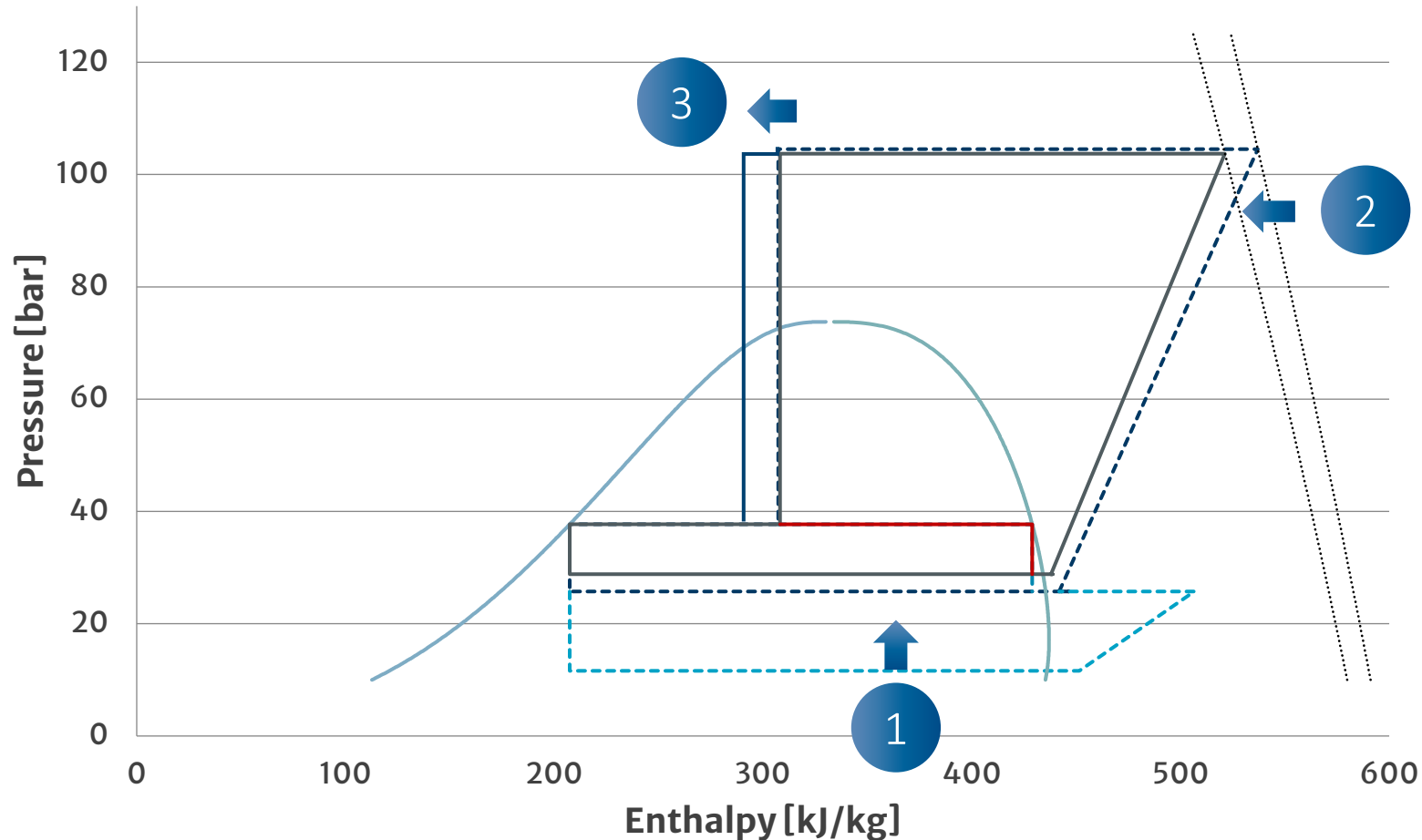
- Heat transfer coefficient [$\text{W}/\text{m}^2\text{K}$]
- CO_2 temperatures [°C]
- Cabinet air temperature [°C]

HLS – High level system layout



HLS – Thermodynamic aspects

Focus on MT only system, P-H diagram



Which are the effect of HLS,
from a thermodynamic perspective?

1. MT evaporator temperature rise
2. MT discharge temperature reduction
3. HPV inlet temperature reduction
= lower flash gas production

*Example of P-H diagram at +40°C,
dotted line = standard cycle,
solid line = HLS cycle*

HLS – Main advantages

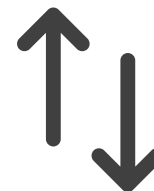
Evaporating temperature increased 365day/year

Efficiency gain of +13% minimum



Saving is independent by external temperature

Also, in cold climates



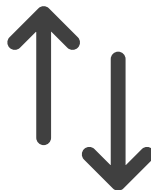
MT compressor discharging temperature decrease

Especially in hot climate conditions



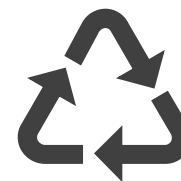
Active MT suction temperature control

MT suction temperature before HLS – MT plate heat exchanger, to keep suction superheat within a predefined optimal range



MT or MT+LT version

The HLS can be applied independently on MT and LT suctions, giving flexibility to the solution



No oil reclaim issues

Return of the oil to the compressors is not an issues, due to the absence of suction line bottles



HLS – System design rules

Layout:

- everything is standard: expansion valve, controllers, velocity in pipes, siphons.
- can be applied both to MT and/or LT
- security functions / compressors protection:
 - oil return bypass on PHE
 - LT desuperheater
 - hot gas injection
 - gas cooler bypass (seldom used)

Cooling balance:



if MT cabinets closed + safe margin + standard evaporating temperature → oversized capacity, could lead to system stability issue in winter

Electronics (WURM only):

- need of a specific case controller
- floating setpoint algorithm on cases superheat and pack suction pressures

HLS – Advantages

For the end user:

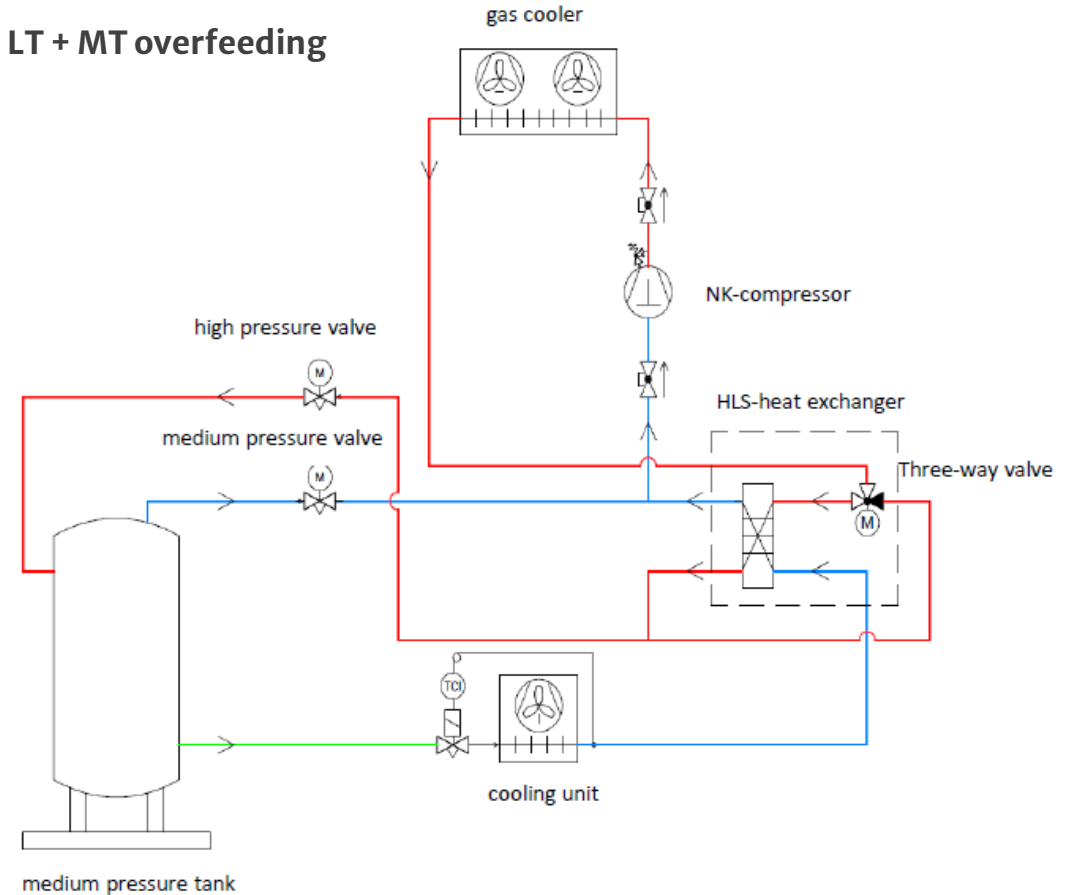
- significant energy savings observed and quantified → **6–8% minimum for combined LT + MT overfeeding**
- system using natural refrigerant
- stable superheat value on compressors suction for higher lifetime
- simplified maintenance compared to other energy-saving systems
- small footprint → no additional modules but everything integrated on the machine

For contractors:

- possibility of offering an energy saving option with a real return on investment to its customer
- everything is sized as for a classic transcritical installation (evaporators, expansion valves, pipes, regulators, gas coolers, compressors, etc.)

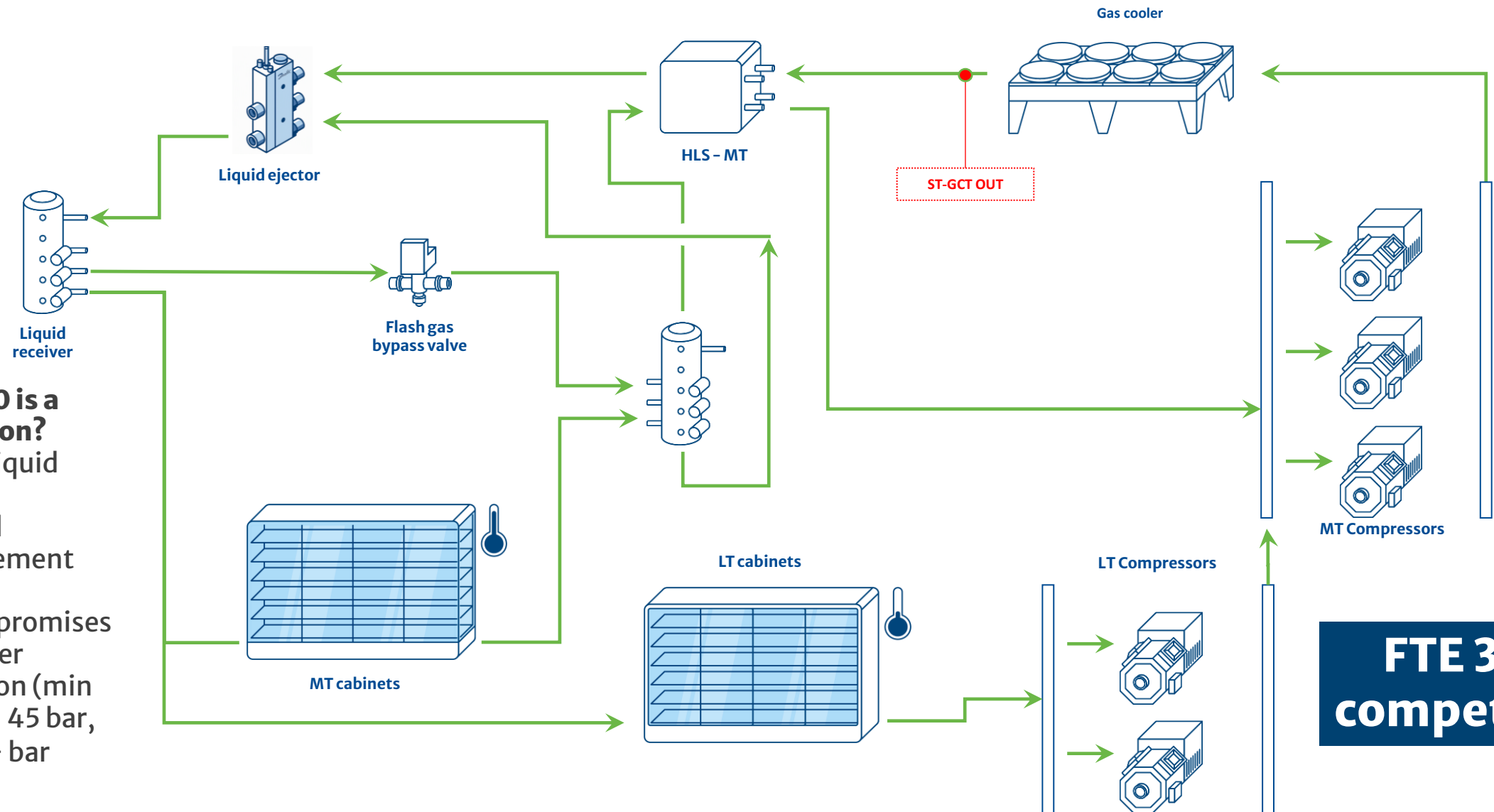
For the maintenance company / technician:

- simple and reassuring system without complex components
- no fancy adjustments or complications on the machine
- minimal training of technicians to acquire the basics of the system



Comparison with other technology solutions

Liquid ejector + evaporators overfeeding– High level system layout



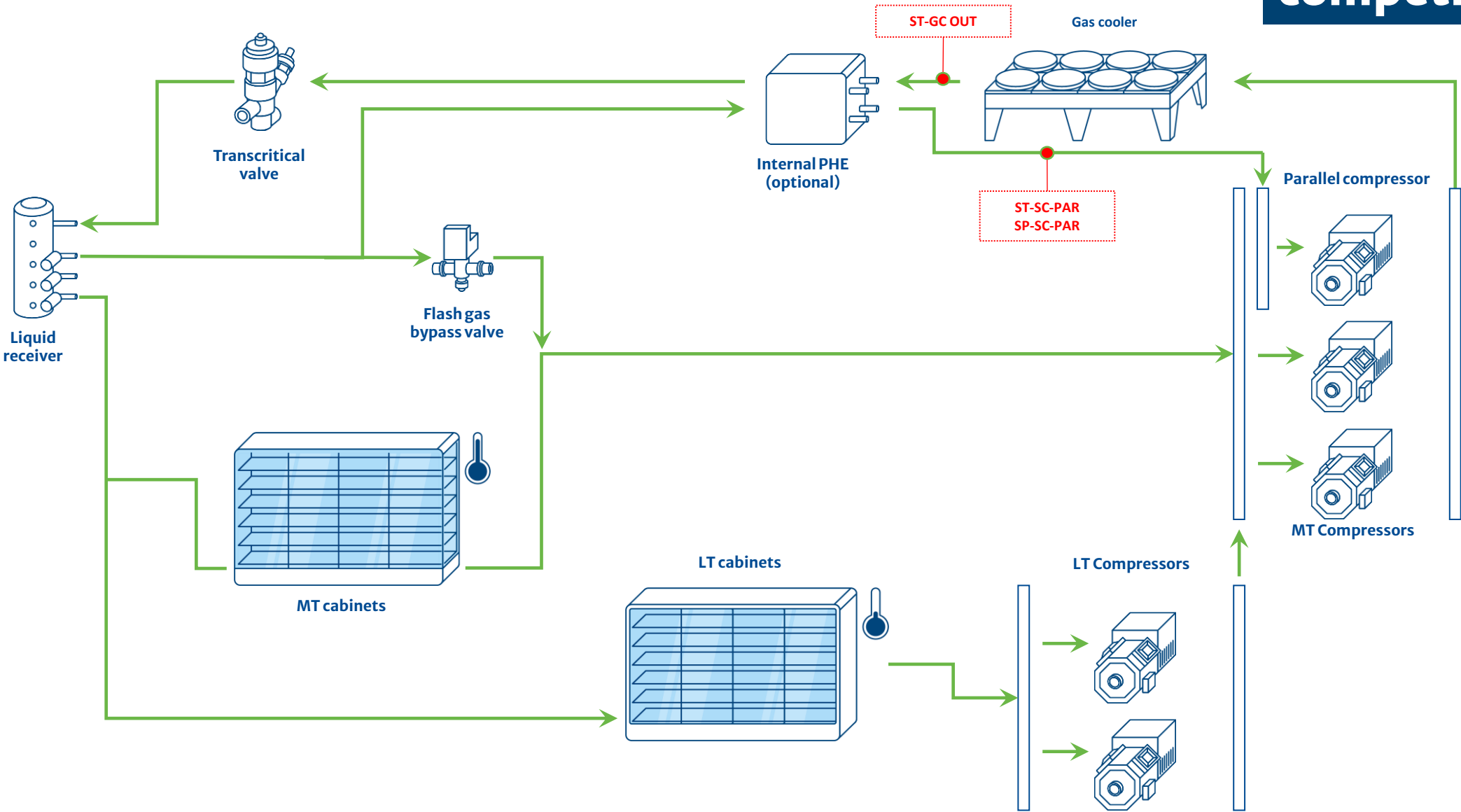
Why FTE 3.0 is a better option?

1. better liquid usage
2. safer oil management system
3. no compromises on winter operation (min $p_{gc,out} = 45$ bar, not 50+ bar)

**FTE 3.0
competitor**

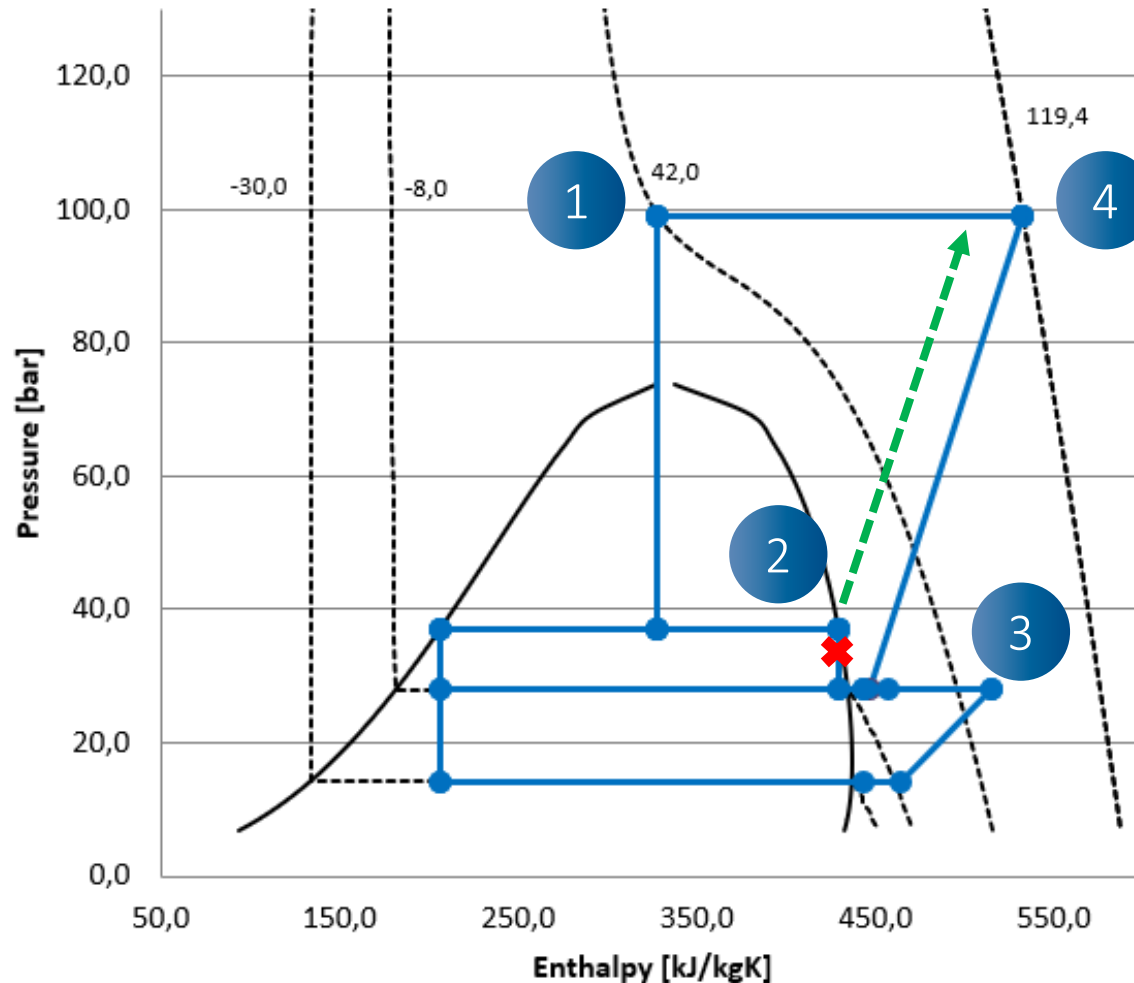
Parallel compression – High level system layout

**ETE
competitor**



Parallel compression – Thermodynamic aspects

Focus on MT+LT system, P-H diagram



Which are the effect of parallel, from a thermodynamic perspective?

1. same HPV inlet temperature
2. same production of flash gas
3. MT mass flow reduction
4. MT discharge temperature reduction at oil separator inlet

Why ETE is a better option?

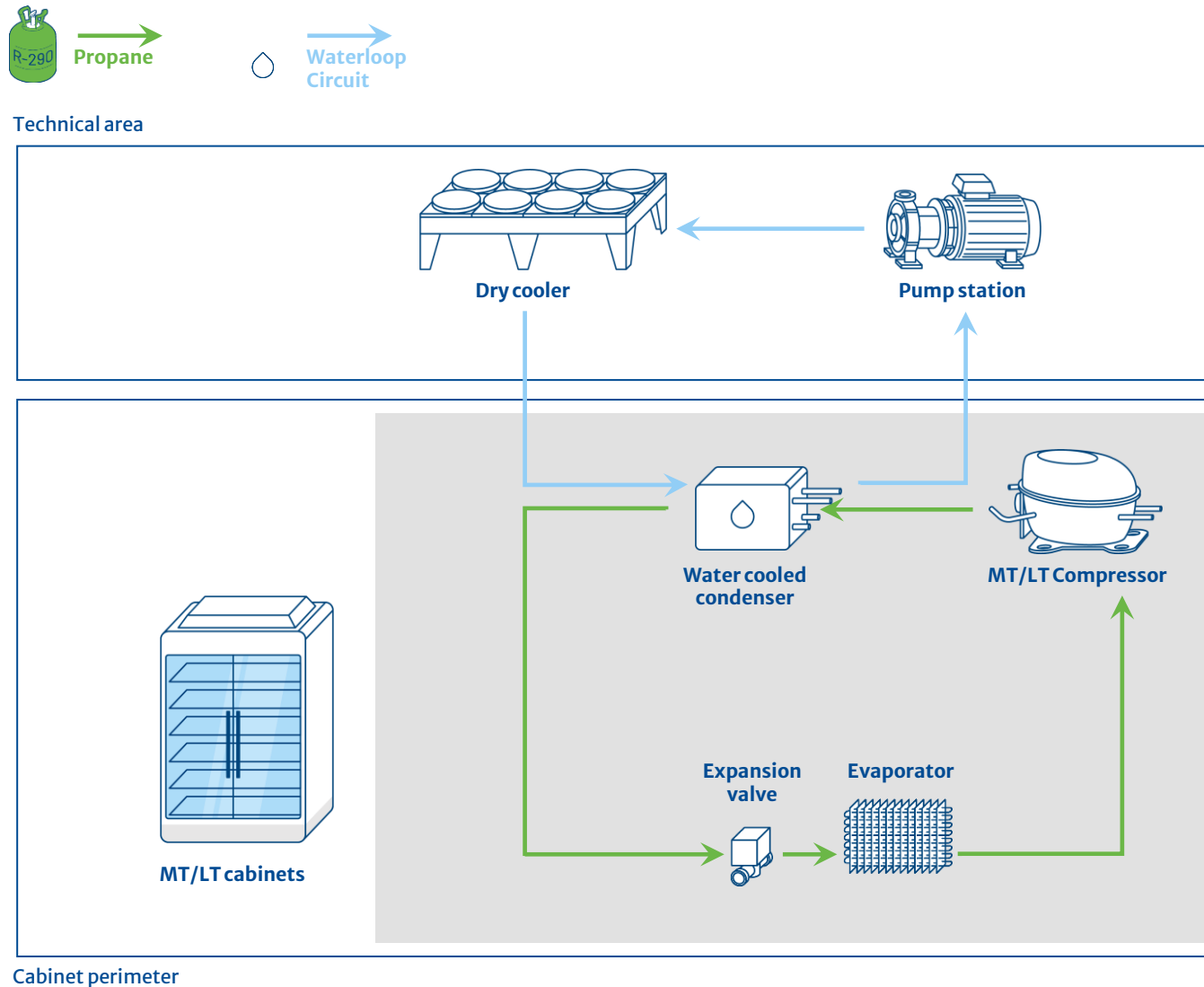
1. same design constraints but better efficiency
2. safer oil management system

*Example of P-H diagram at +40°C,
dotted line = parallel compressor cycle,
solid line = standard cycle parts*

Waterloop systems

Connect water

Connect water – High level system layout



Key features:

Bonus:

- lower amount of refrigerant (R290)
- suitable for ambient temperature up to +43°C
- excess heat removed from vending area → higher comfort in the cabinets area
- standardized pumping stations
- slightly shorter installation time compared to remote CO₂ → optimal for standardized shop

Malus:

- available on specific set of cabinets:
 - *EPTA*: Zenith VP water, Granvista/Skyview, Granbering/Skylight
 - *Hauser*: Rebas, Regius, Remeta (standardized for **large-scale customer**)
- coldrooms integrated with Rivacold units
- non optimal for heat recovery integration solutions



Thank you

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