Market trends & developments for CO_2 in Commercial Refrigeration in Europe

ATMOsphere Europe 2012 Conference, Brussels

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United Technologies
Climate | Controls | Security

ATMO EU sphere
Solutions for Europe
natural refrigerants

AGENDA

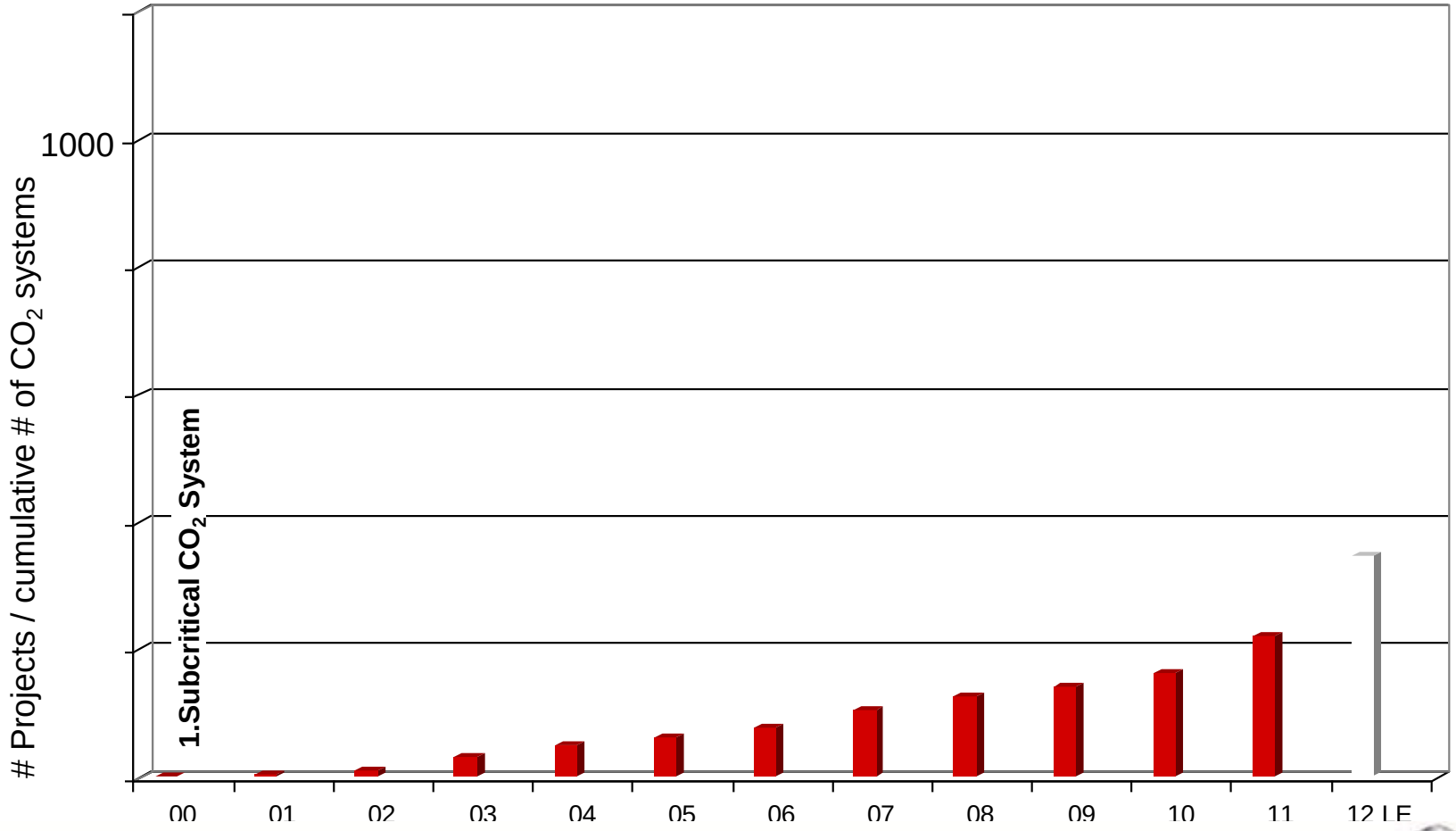
CO_2 projects & systems evolution at Carrier Commercial Refrigeration

CO_2 high-efficiency solutions for warmer climates

Integrated systems, managing thermal energy flows of buildings

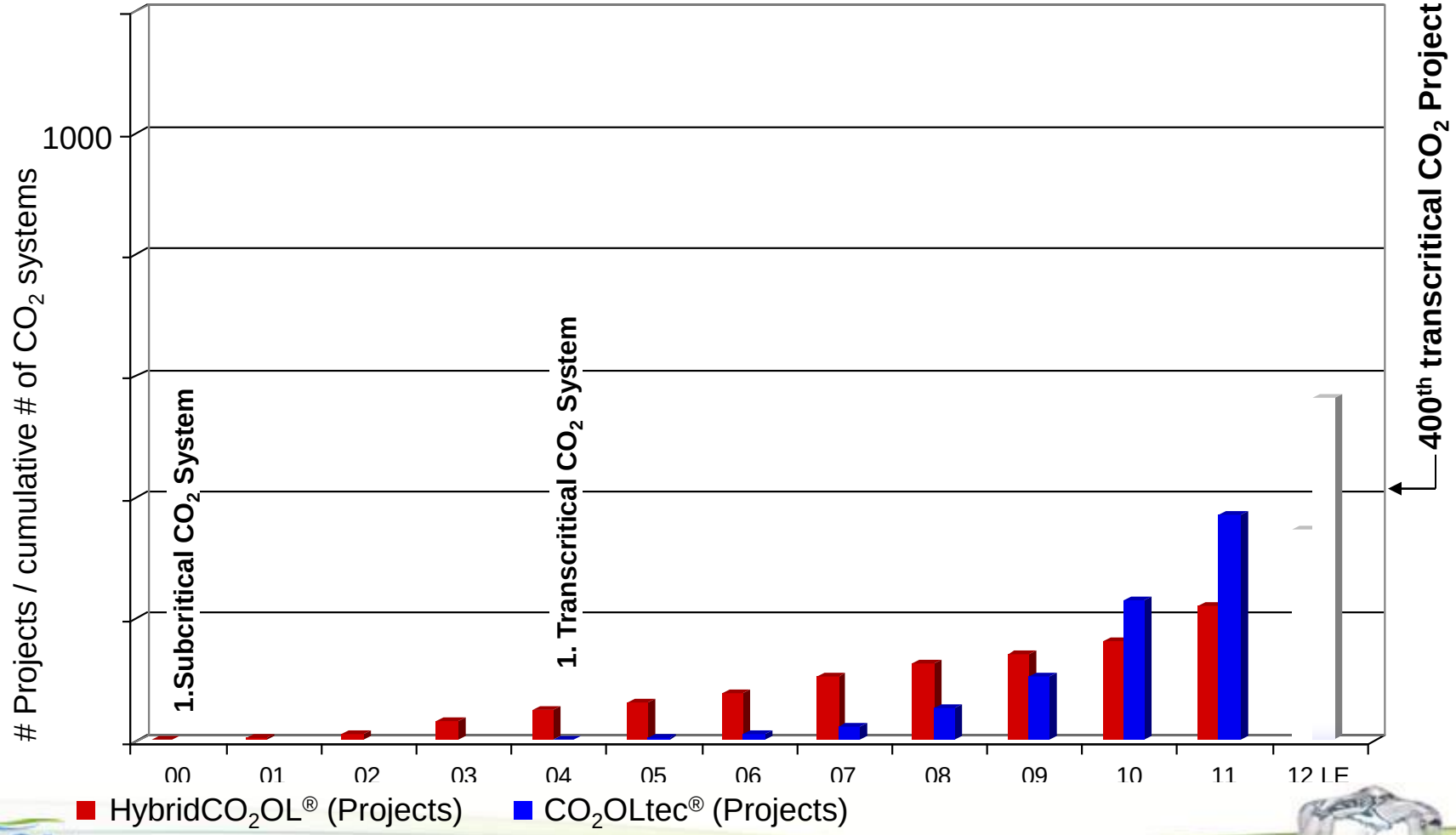
CO_2 IN COMMERCIAL REFRIGERATION

Project & systems evolution at Carrier



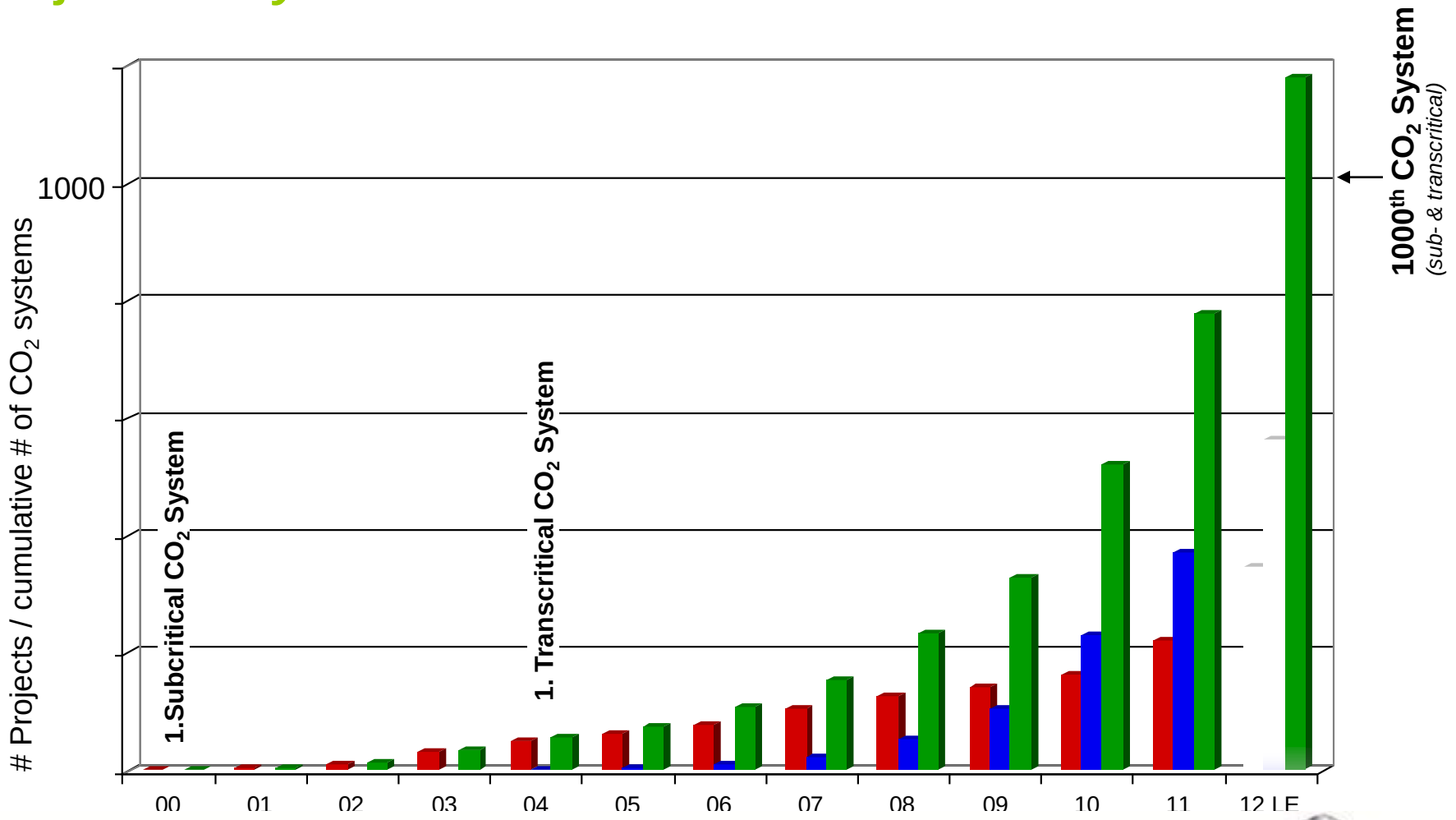
CO_2 IN COMMERCIAL REFRIGERATION

Project & systems evolution at Carrier



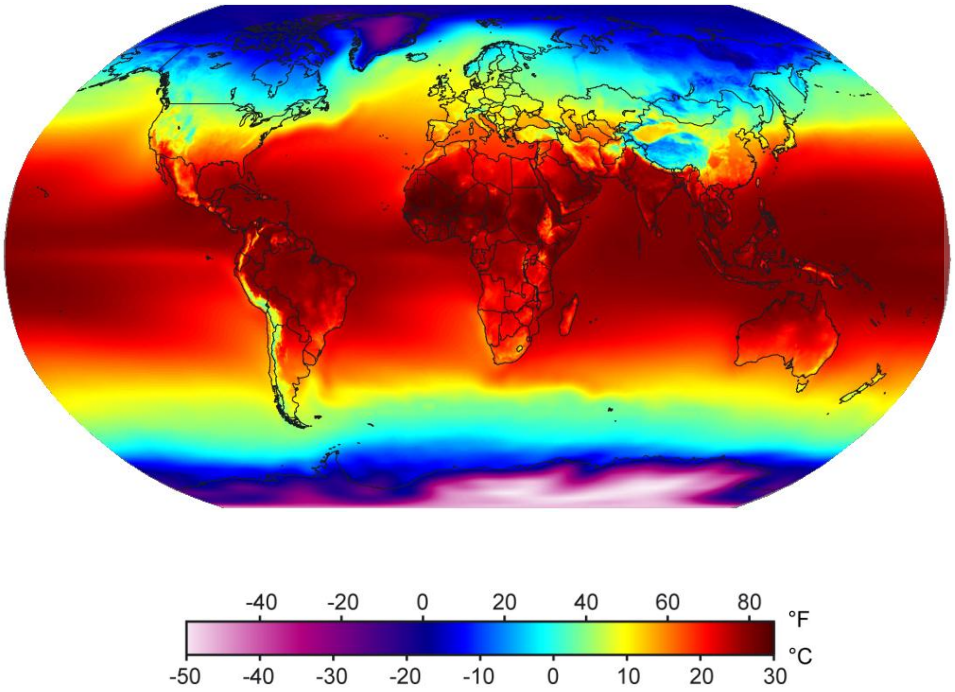
CO_2 IN COMMERCIAL REFRIGERATION

Project & systems evolution at Carrier



CO_2 HIGH EFFICIENCY

Viable solutions of increasing transcritical CO_2 system efficiencies in warmer climates



Source: http://en.wikipedia.org/wiki/File:Annual_Average_Temperature_Map.jpg#filelinks

Demonstrable market acceptance of CO_2 DX systems:

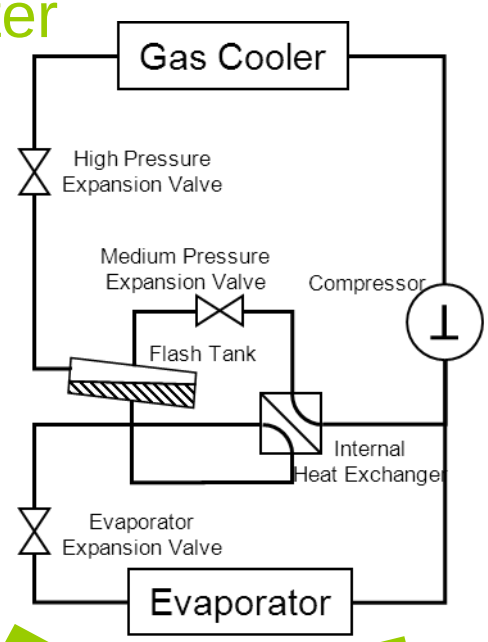
Attractive energy performance at average annual temperatures up to +15 °C in line with EPEE statement and energy data recording

CO_2 DX systems next generation:

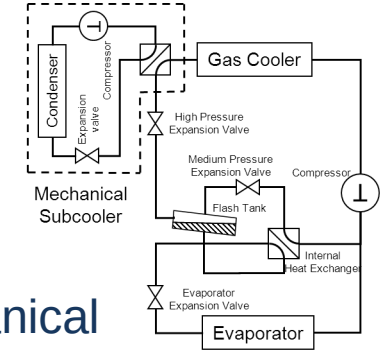
Different technology options showing the path to achieve attractive energy performance across whole Europe

POTENTIAL SOLUTIONS

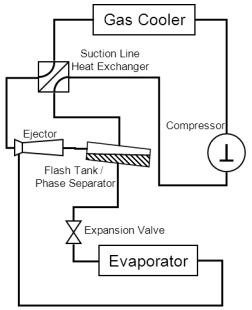
Standard CO_2 booster *(MT part of system)*



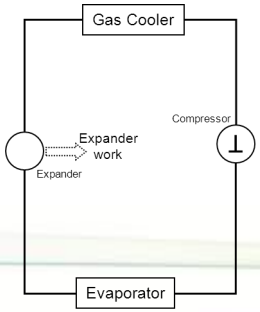
Mechanical Subcooler



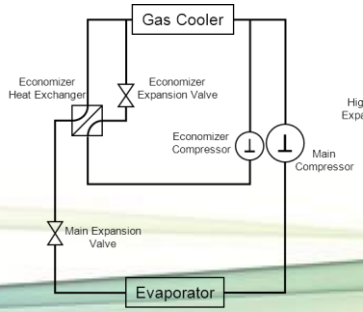
Ejector

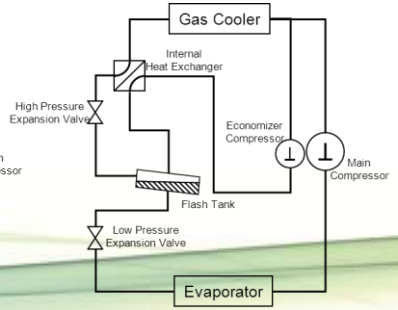


Expander



Economizer





FACTORS FOR EVALUATION

Efficiency

Potential of efficiency improvement

Safety & reliability

Reliable and safe operation are mandatory

Environmental impact

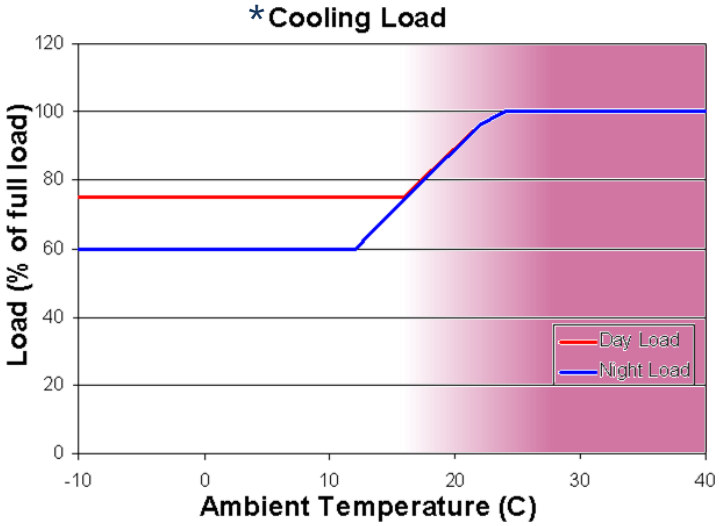
Low GWP of refrigerant used combined with high efficiency ensures best TEWI

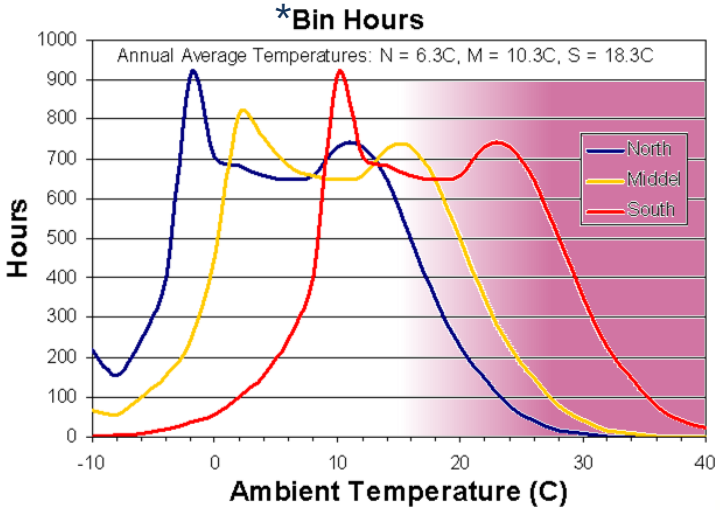
Modularity

Easy integration into existing design

Total life cycle cost

Initial investment, energy & service costs



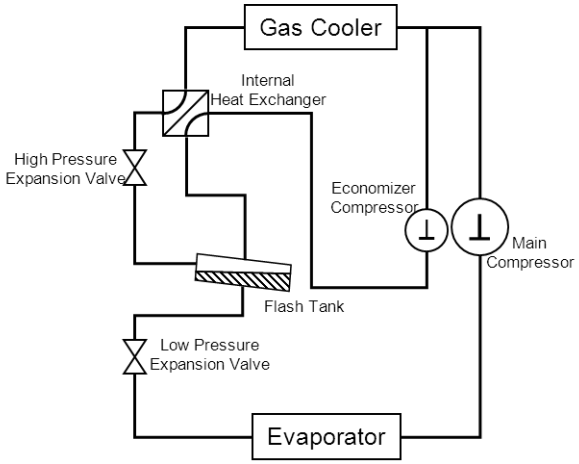


COOLtec

** Analysis conducted by Carrier*

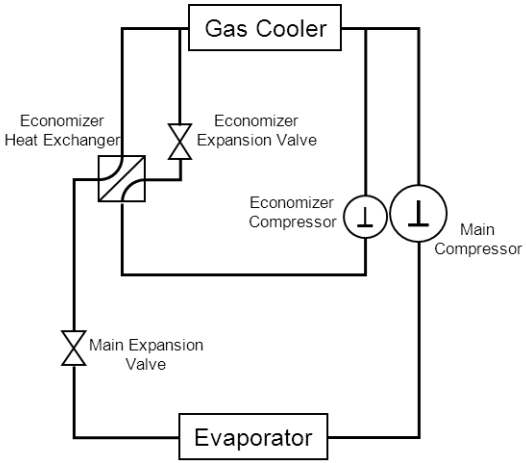
ECONOMIZER (PARALLEL COMPRESSION)

Conventional 2-stage cycle,
various implementations exist



Advantages:

- Known technology
- No new components
- No fundamental change of CO_2 booster concept



Disadvantages:

- Part load operation
- Oil return
- Efficiency potential lower than other solutions

EXPANDER

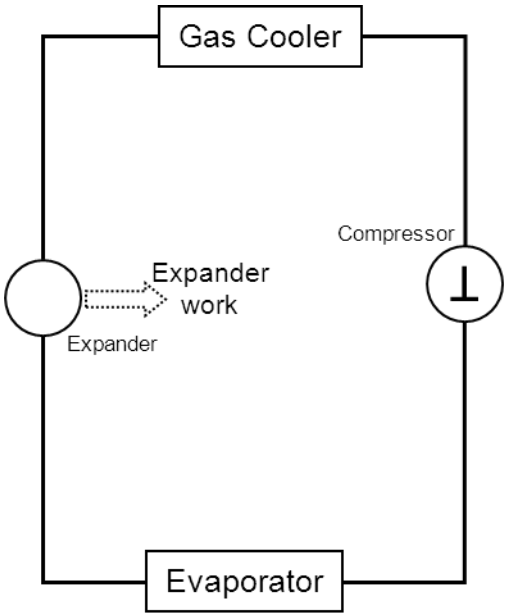
Mechanical work extraction from expansion process

Advantages:

- Theoretically high efficiency potential

Disadvantages:

- New technical territory
- Part load operation
- Oil return
- Expander work demand/supply management
- Reliability (moving parts, design)

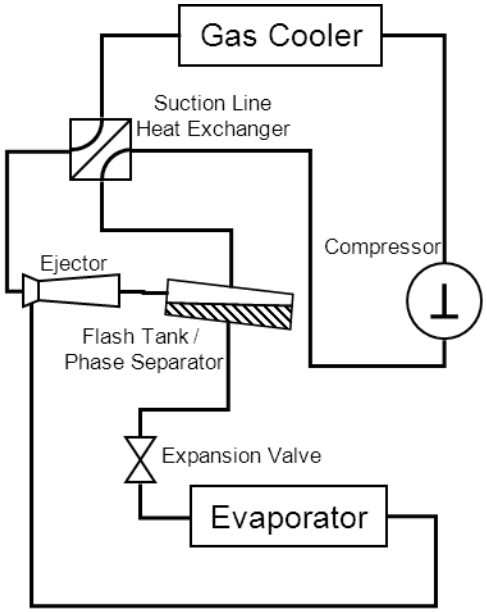


EJECTOR

“Fluid-dynamic” work extraction from expansion process

Advantages:

- High efficiency potential
- Few new moving parts
- Few additional parts in system
- Ejector (theoretically) similar to expansion valve

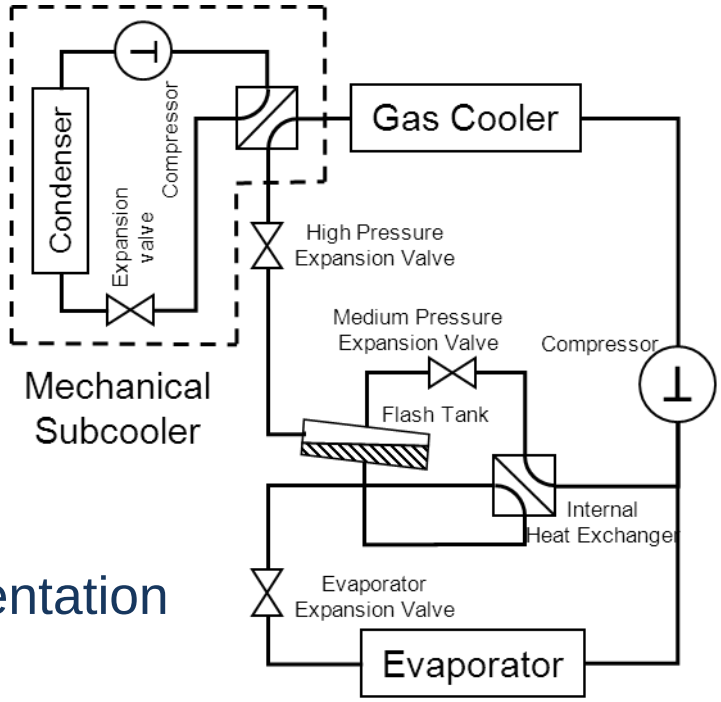


Disadvantages:

- New technical territory
- Part load operation
- Oil return
- Reliability (compressor may run outside operating envelope)

MECHANICAL SUBCOOLER

External chiller / CDU cools CO_2 after gas cooler below ambient temperature



Advantages:

- Option to use hydrocarbon refrigerant for "all natural" solution
- Known technology
- No new components
- High efficiency potential
- Potential of space heating & cooling implementation

Disadvantages:

- Additional space required for installation
- Individual customers may not accept hydrocarbon refrigerant

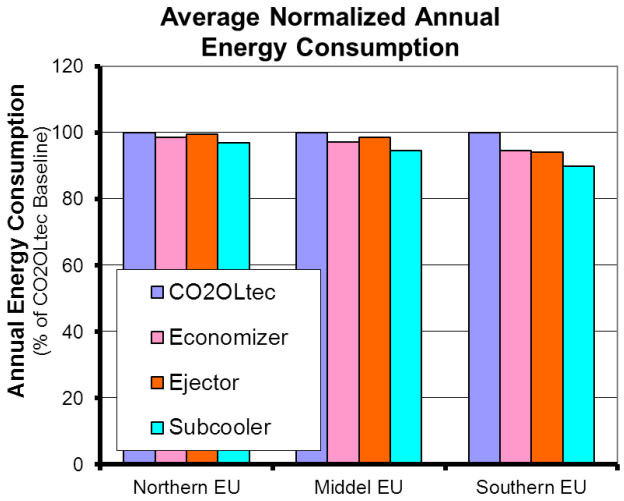
PERFORMANCE COMPARISON

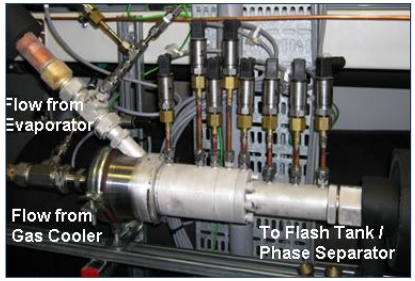
Performance comparison

Simulations and tests conducted at Carrier laboratories to assess efficiency

Current status

Mechanical subcooler offers the greatest potential, based on components available today





Ongoing research at Carrier

Aim to improve all solutions to fulfill expectations for highest quality standards and superior performance

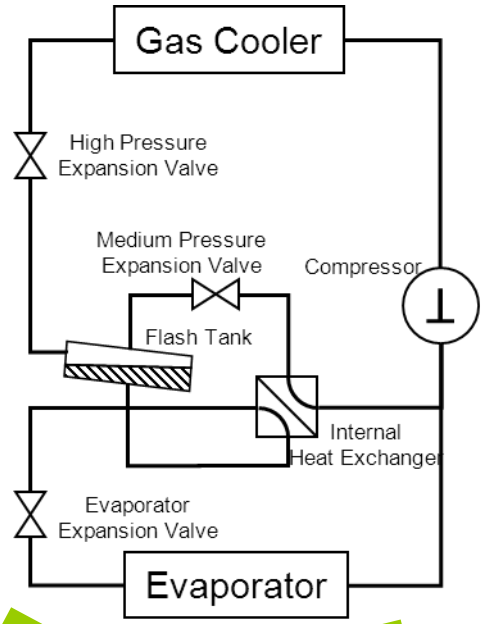
VIABLE SOLUTIONS – WHAT TO CHOOSE?

One solution might not fit all

Further to laboratory tests and simulations. Carrier conducts field tests on selected solutions

Outlook

To develop a set of standard solutions based on customer input, field experience and upcoming EU regulations



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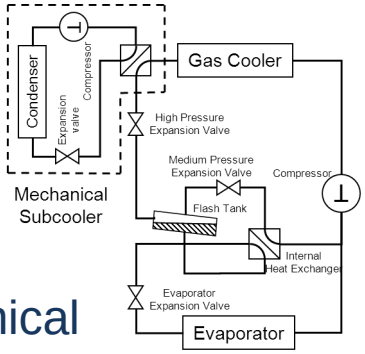

Mechanical Subcooler

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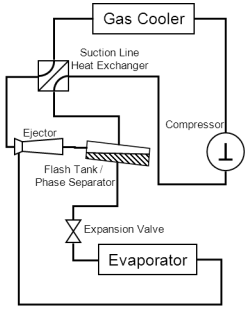

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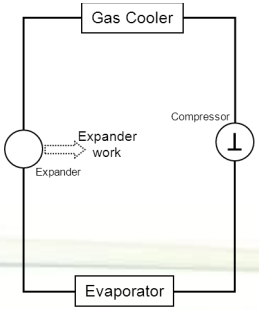

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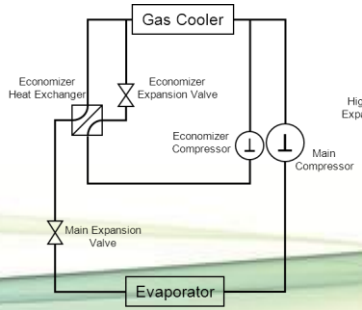
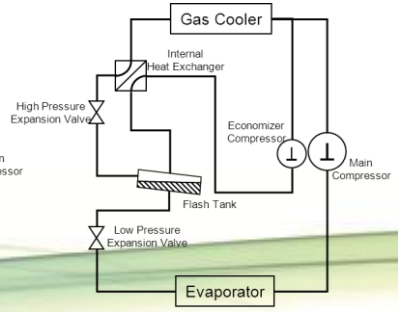




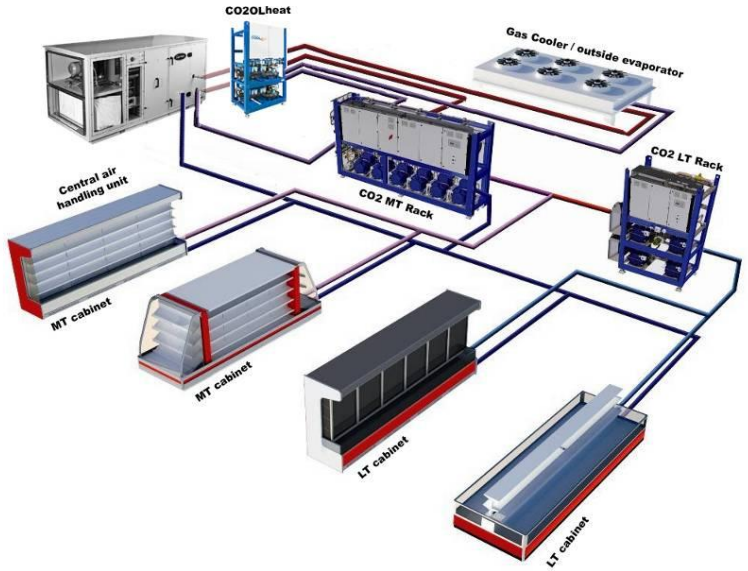
COOLtec

INTEGRATED SYSTEMS

Managing thermal energy flows of buildings

Total thermal supply from one system **avoiding use of fossil fuels**

Range of modular system components & dynamic controls architecture constitute key elements



Summer operation	Winter operation
space cooling	**space heating**
refrigeration	
domestic hot water	
comfort “cold aisle” heating	

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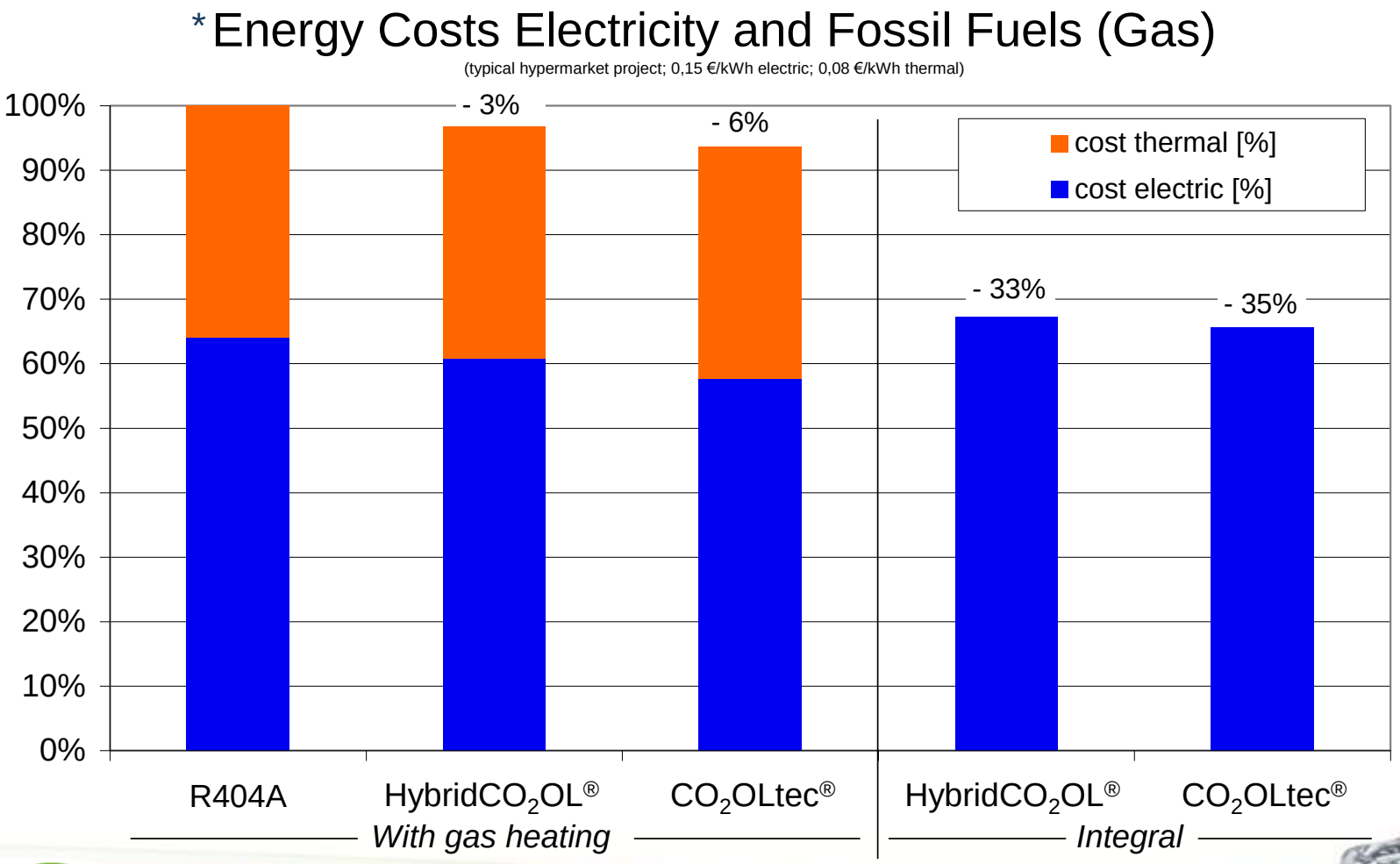
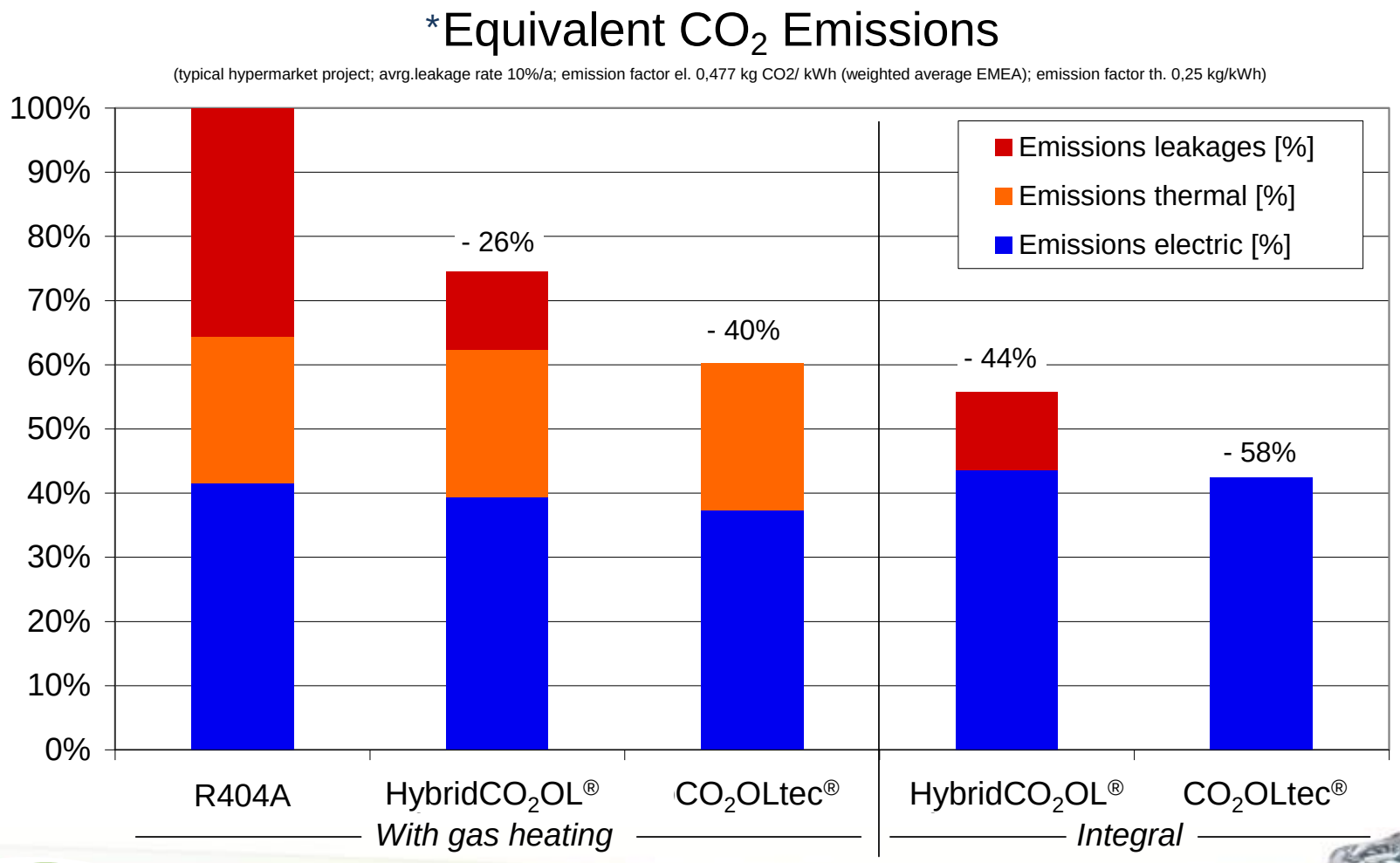
Managing thermal energy flows of buildings



* *Analysis conducted by Carrier*

INTEGRATED SYSTEMS

Managing thermal energy flows of buildings



COOLtec integral

** Analysis conducted by Carrier*

ATMO sphere
Solutions for Europe
natural refrigerants

Carrier has the right refrigerant for every application, but every application will not have the same refrigerant solution.