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# Sustainability of $CO_2$ technology and the role of control systems

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ATMO EU sphere
Solutions for Europe
natural refrigerants

07th November 2012

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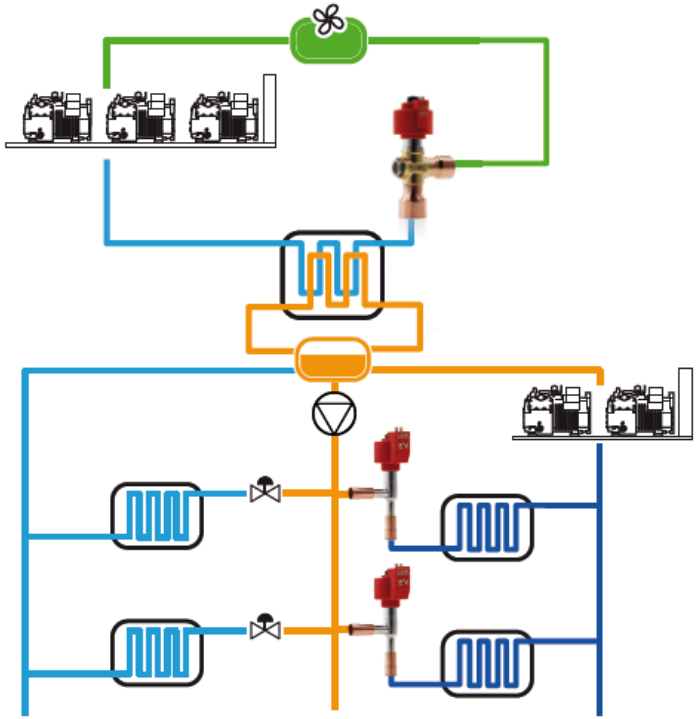
# Agenda

1. Background
2. Technology evolution
3. Upcoming innovations & trends

# Background

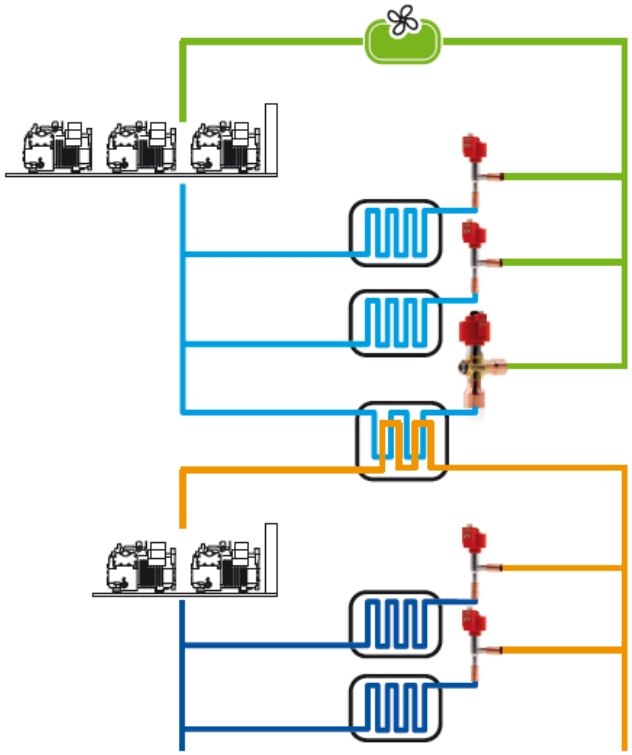


late 90s

The Late 1990s

Developments in the use of brines for both LT & MT Systems in Nordic countries

# Background



The early 2000s

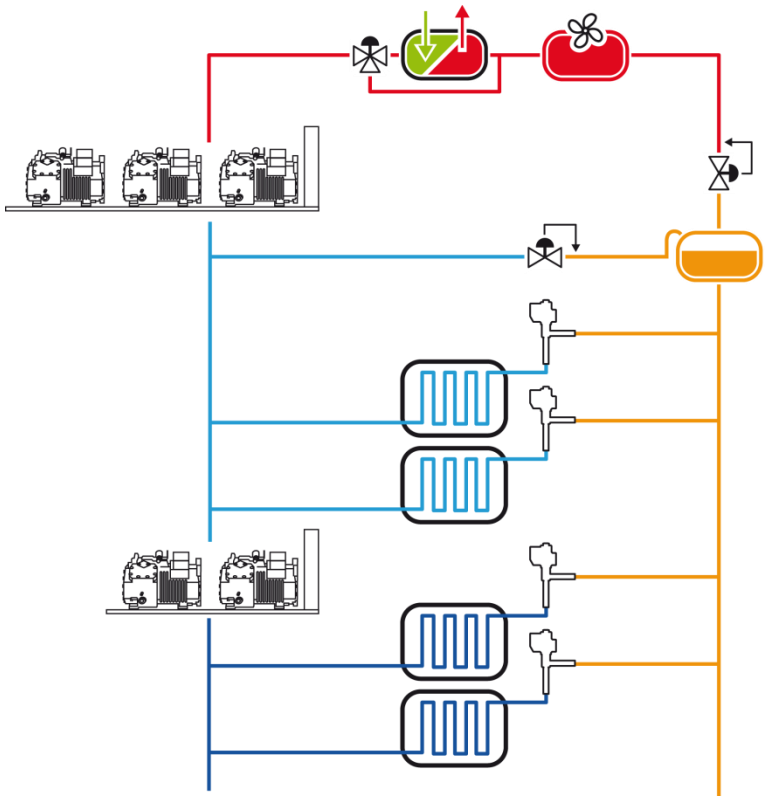
Introductions

of cascade systems

R xxx /LT $CO_2$

late 90s → early 2000s

# Background



Today

The most promising system

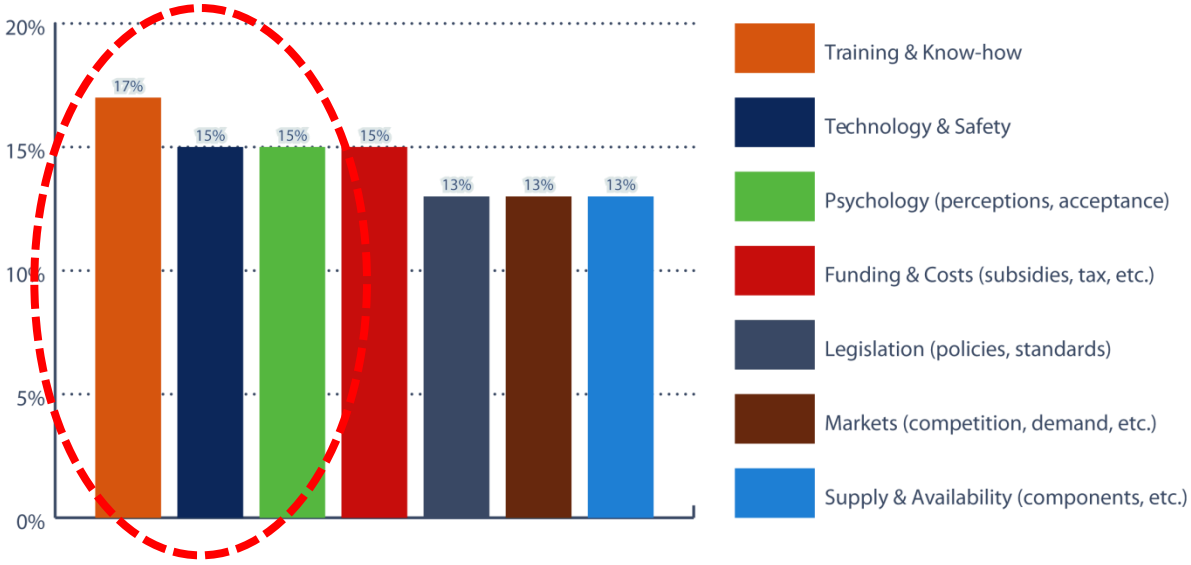
Transcritical Booster DX

One Refrigerant

late 90s → early 2000s → ... → today

# Main barriers

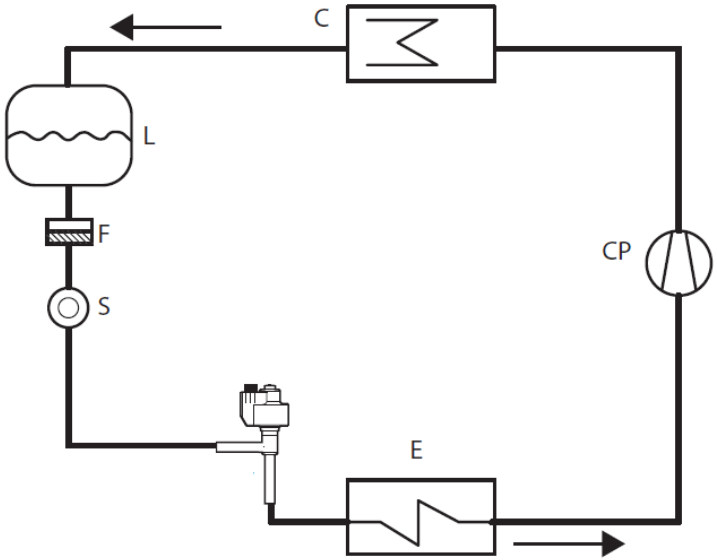
Ref. 2012 Shecco Natural refrigerant guide


1. Training & Know how
2. Technology & Safeties
3. Psychology (perceptions, acceptance)

Control systems must **MAKE IT EASIER**, it's our role.

# Technology evolution




**In the past:**

**Standard HFC systems**

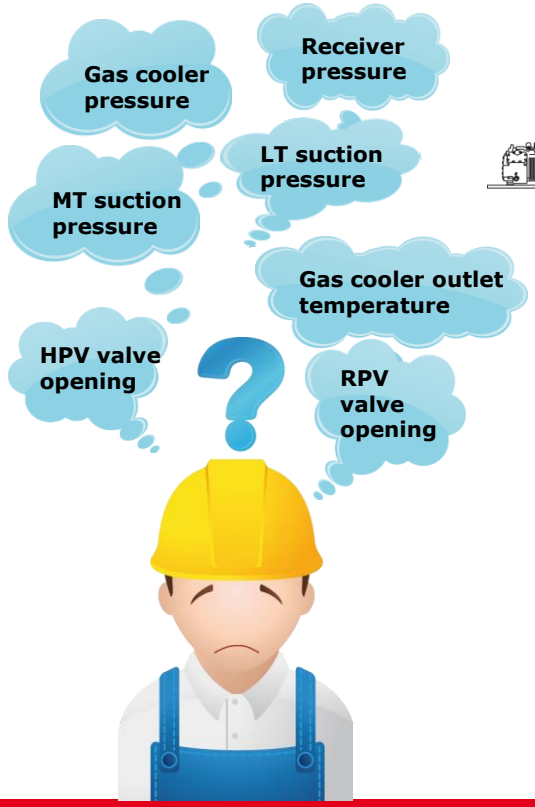
- Consolidated knowledge
- Simple and well known technology
- Simple tools and maintenance procedures
- Electromechanical backup
- Manual management in case of problems

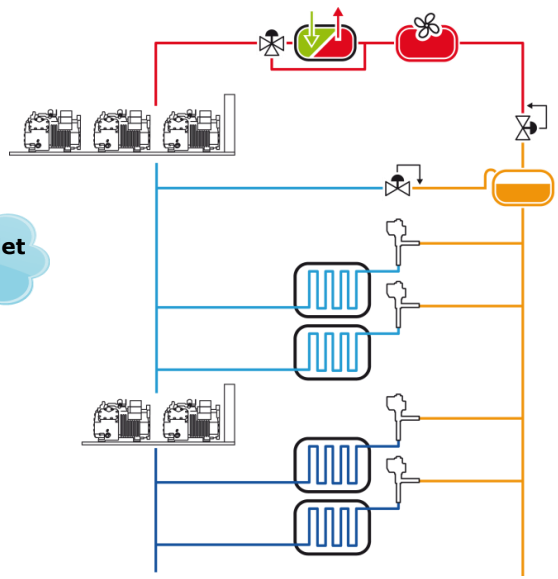
**MAIN TARGET:**
**FOOD TEMPERATURE even with no efficiency**

# Technology evolution

**CO2 booster DX transcritical systems: service/maintenance break trough**

- More relevant information to consider
- Electronic controls are the brain of the system
- Service and maintenance tools need to reflect latest technological improvements



Industries have to consider

- Easy access to all relevant information
- Easy understanding of working conditions
- Guided and flexible procedures
- Built in safeties
- Predictive alarms
- System integration

**MAIN TARGET:**
**SYSTEM EFFICIENCY**
**preserving food quality**

# Human Machine Interfaces

Fast growing and technological improvements in consumer applications

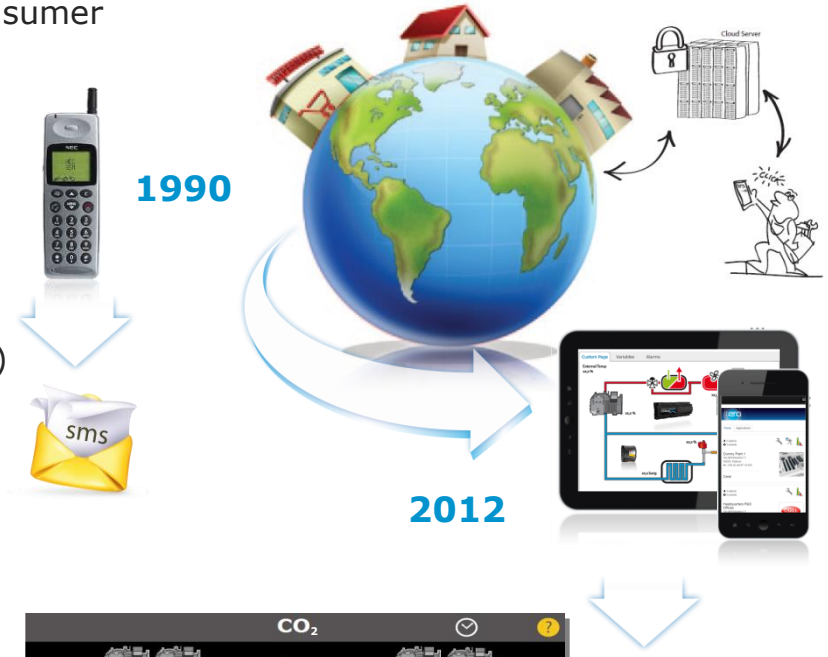
Large scale availablity of:

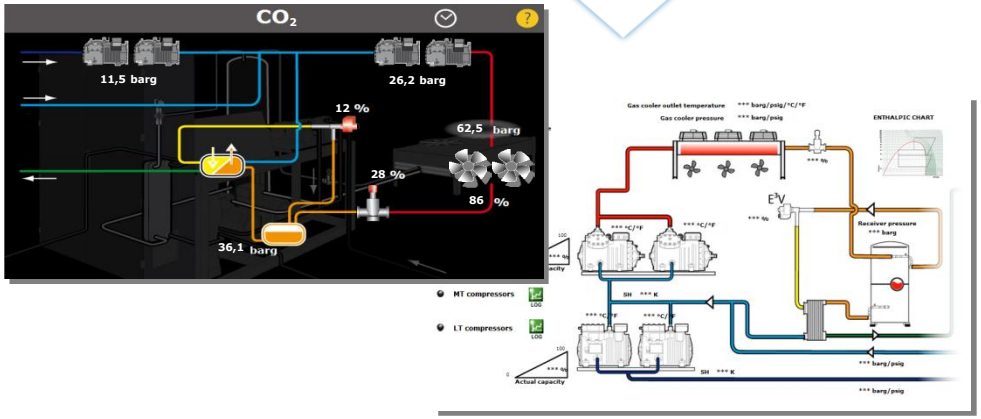
- Widespread broadband connectivity
- Cloud computing
- High level user terminals (smarthpones, tablet, …)

**Conceal complexity behind**

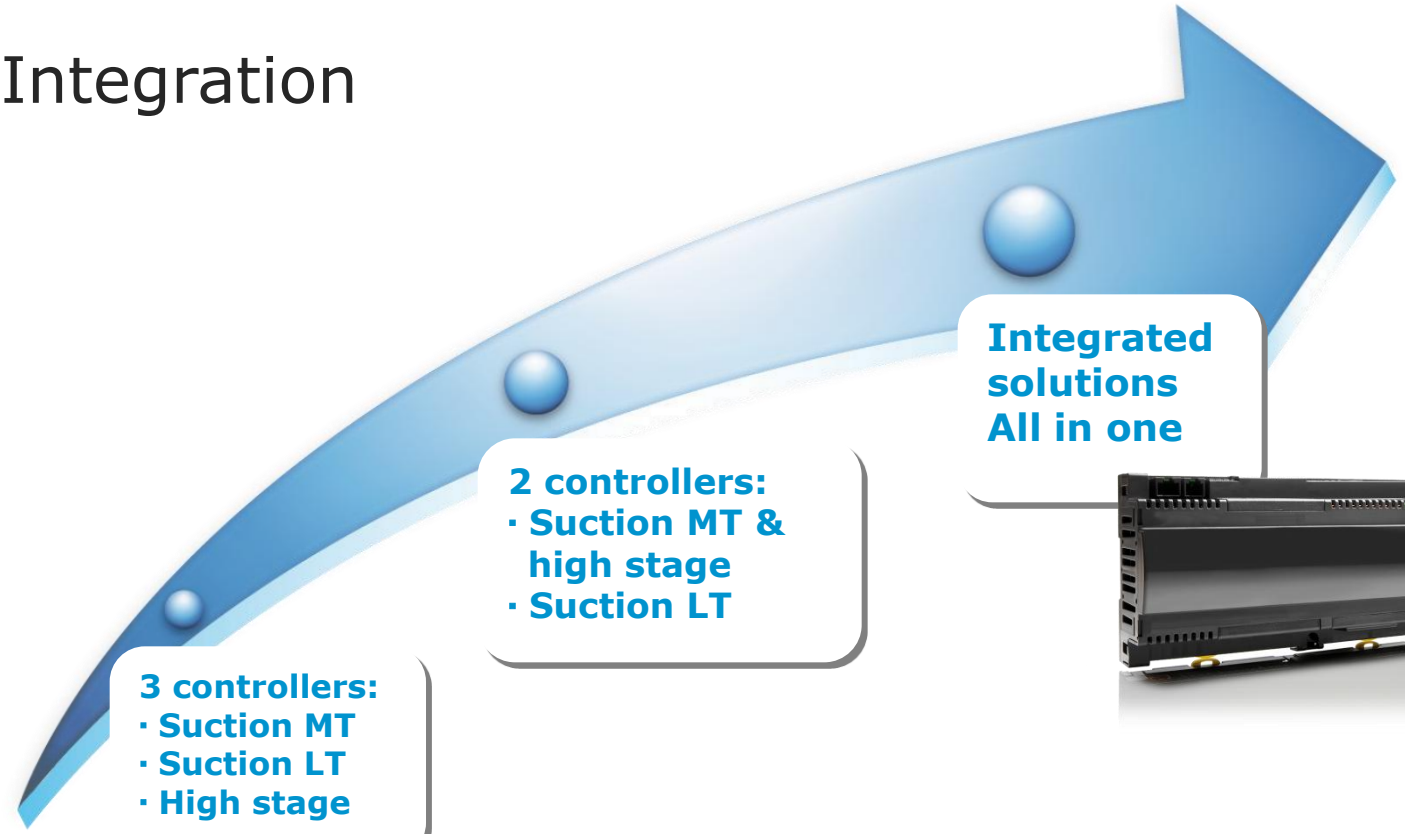
HVAC/R industries need to ride this trend

- General overview, detailed zooms
- Added value informations, user profiles differentiation
- Improve service levels through faster remote troubleshooting
- No hardware cost increase



# Integration




- Capital costs reduction
- Installation costs and complexity reduction
- Faster commissioning/maintenance
- Improved interaction and synchronization between components
- Increased safeties and backup procedures
- Easier understanding of working conditions

# Know how diffusion

Good basic knowledge is needed: dedicated training is required

European know how and expertise need to be exported to help $CO_2$ deployment in foreign countries.

## Turkey

**2009**: first subcritical cascade r134a/$CO_2$ system

**2012**: first transcritical booster $CO_2$ system

**Up to now**: 3 subcritical / 1 transcritical $CO_2$ plants

# Know how diffusion

## Brazil

**2009**: first subcritical cascade r134a/$CO_2$ system

**2012**: first transcritical booster $CO_2$ system

**Up to now**: 9 subcritical/ 1 transcritical $CO_2$ plants

## South Korea

**2008**: first subcritical cascade r134a/$CO_2$ system

**2011**: first subcritical pumped r134a/$CO_2$ system

**Up to now**: 5 subcritical/pumped r134a/$CO_2$ plants

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# Upcoming innovations & trends

# Condensing units

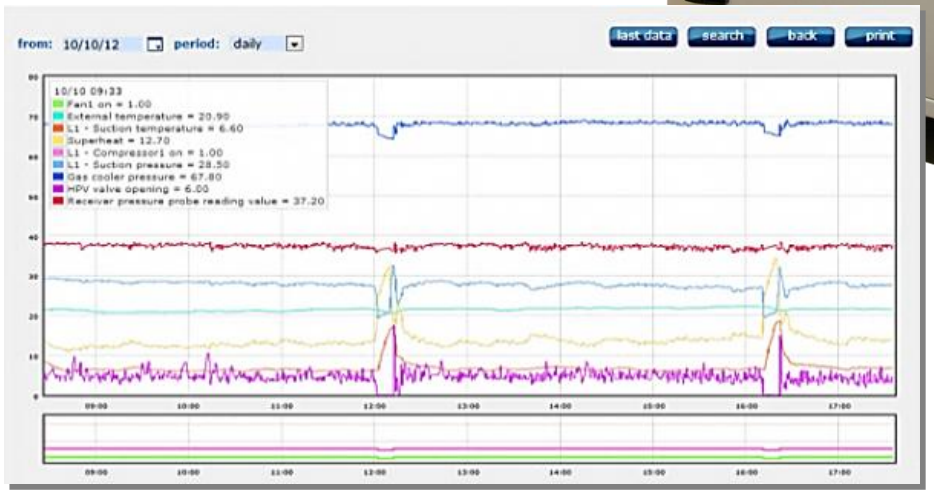
Good scale production of medium/large stores

- Continuous improvements
- Component availability
- Cost reductions
- Growing portfolio
- Introduction of small and cost effective solutions

Market is ready to move the focus to a new niche for $CO_2$

**Condensing units**

- Huge numbers
- Energy efficiency
- ROI
- Safeties

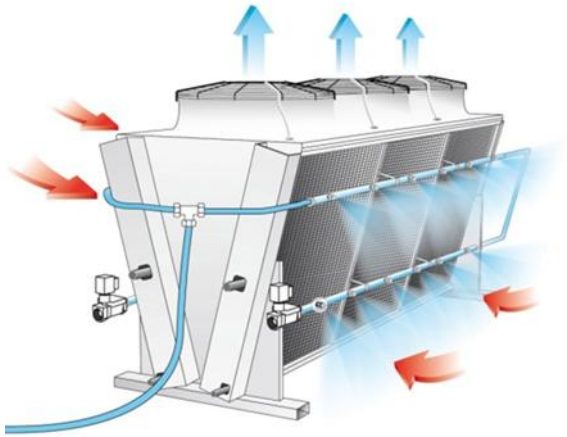



# Warmer climates

- Consolidate technology in northern European countries
- Attention is shifting to southern European countries
- Target: further decrease the acceptable lattitude

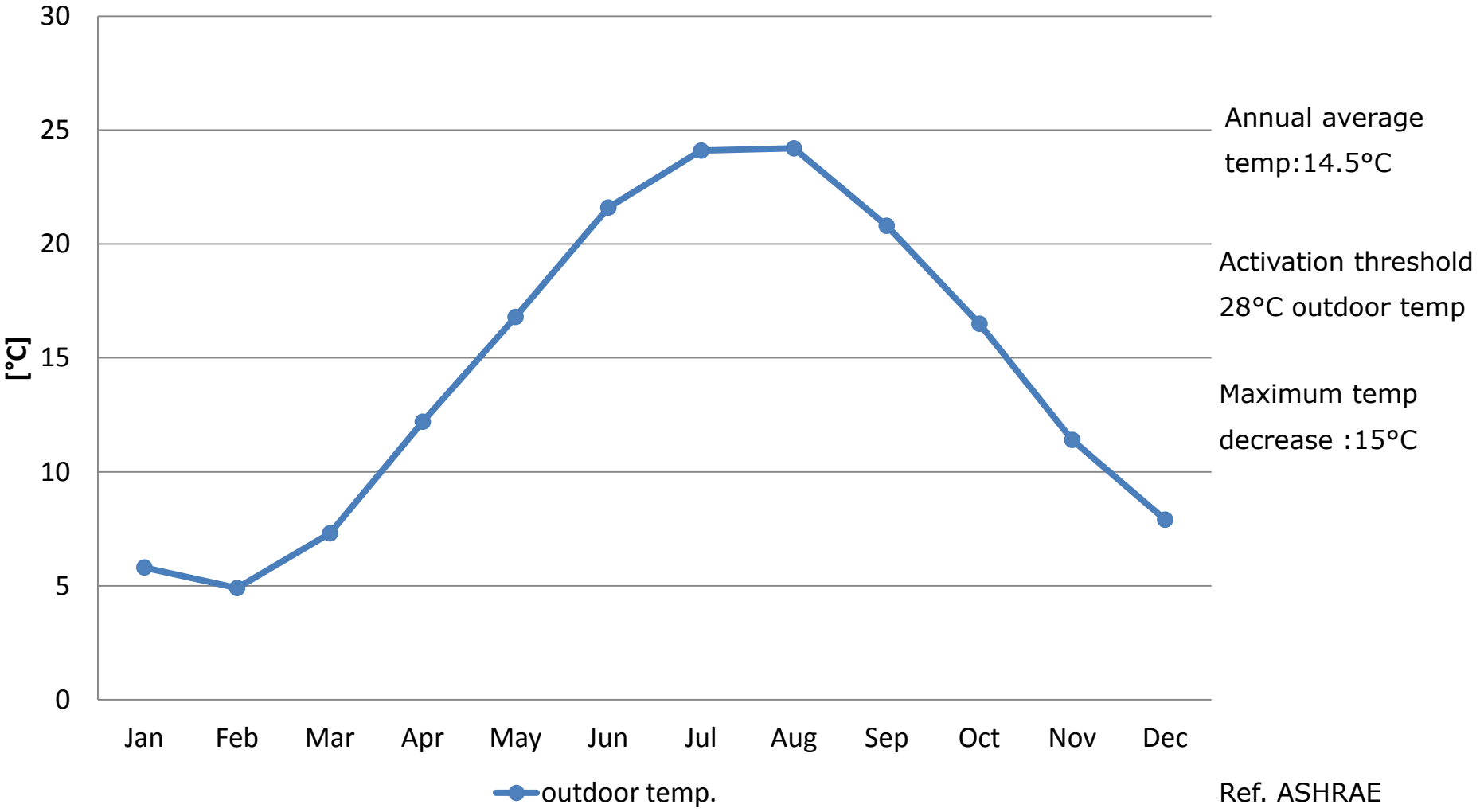
Tests are continuing in warmer climates countries,
assessing and comparing different solutions

One potential solution:
**Evaporative cooling system**



- Simple
- No invading
- Cost effective
- Integration with system controller
  (energy saving or safety activation)

# Warmer climates – Istanbul case study




Annual average temp:14.5°C

Activation threshold 28°C outdoor temp

Maximum temp decrease :15°C

Ref. ASHRAE

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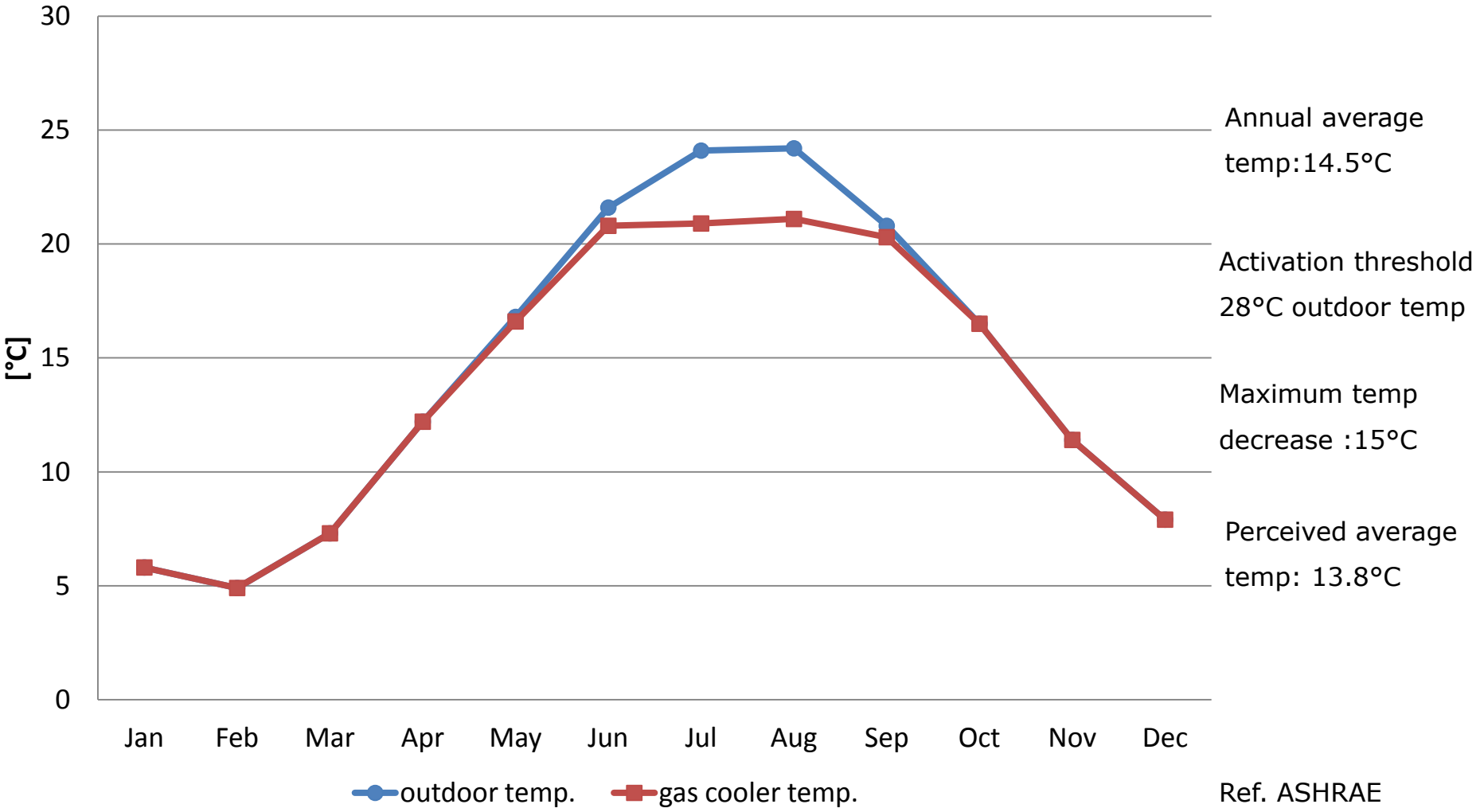


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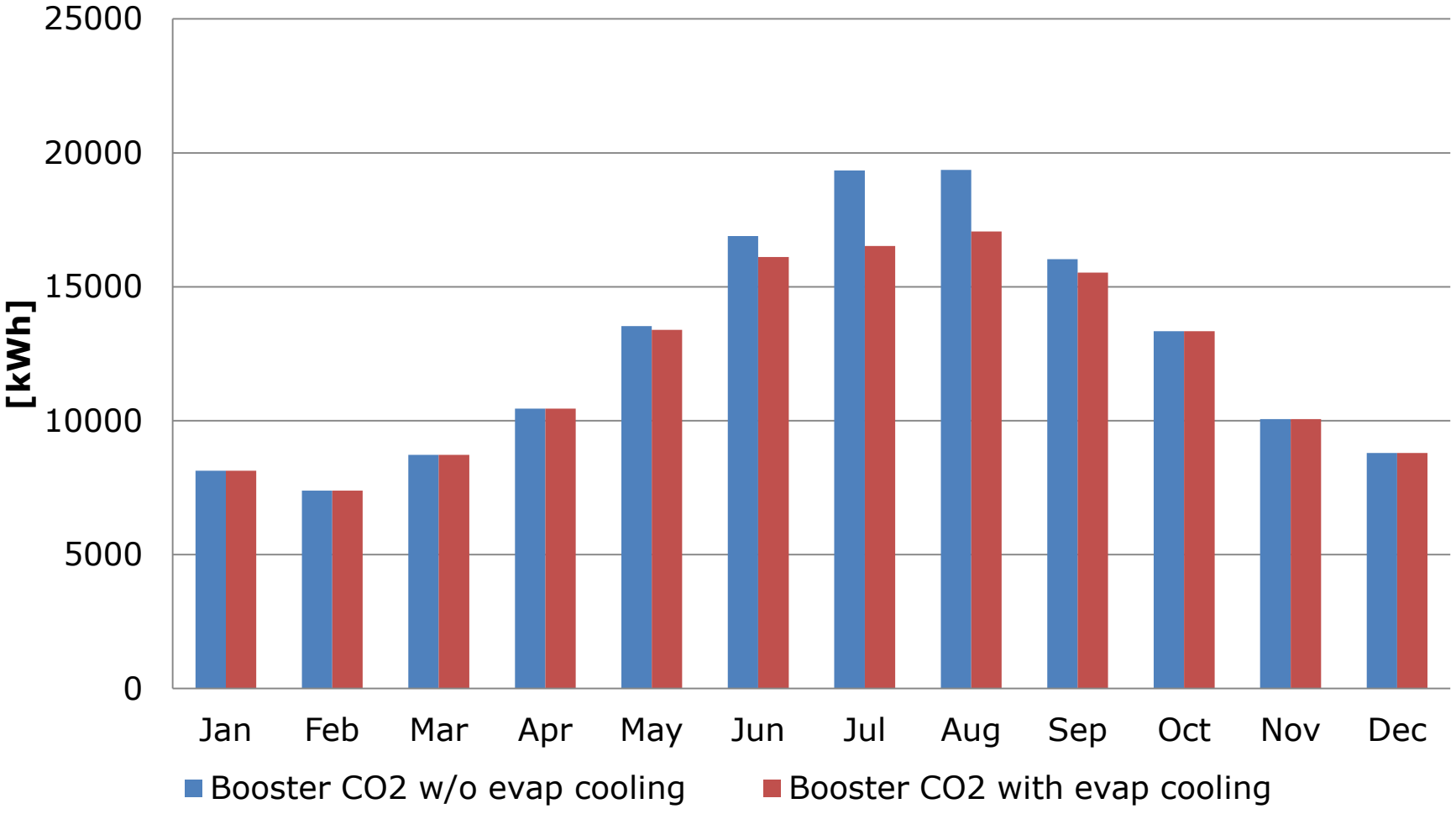

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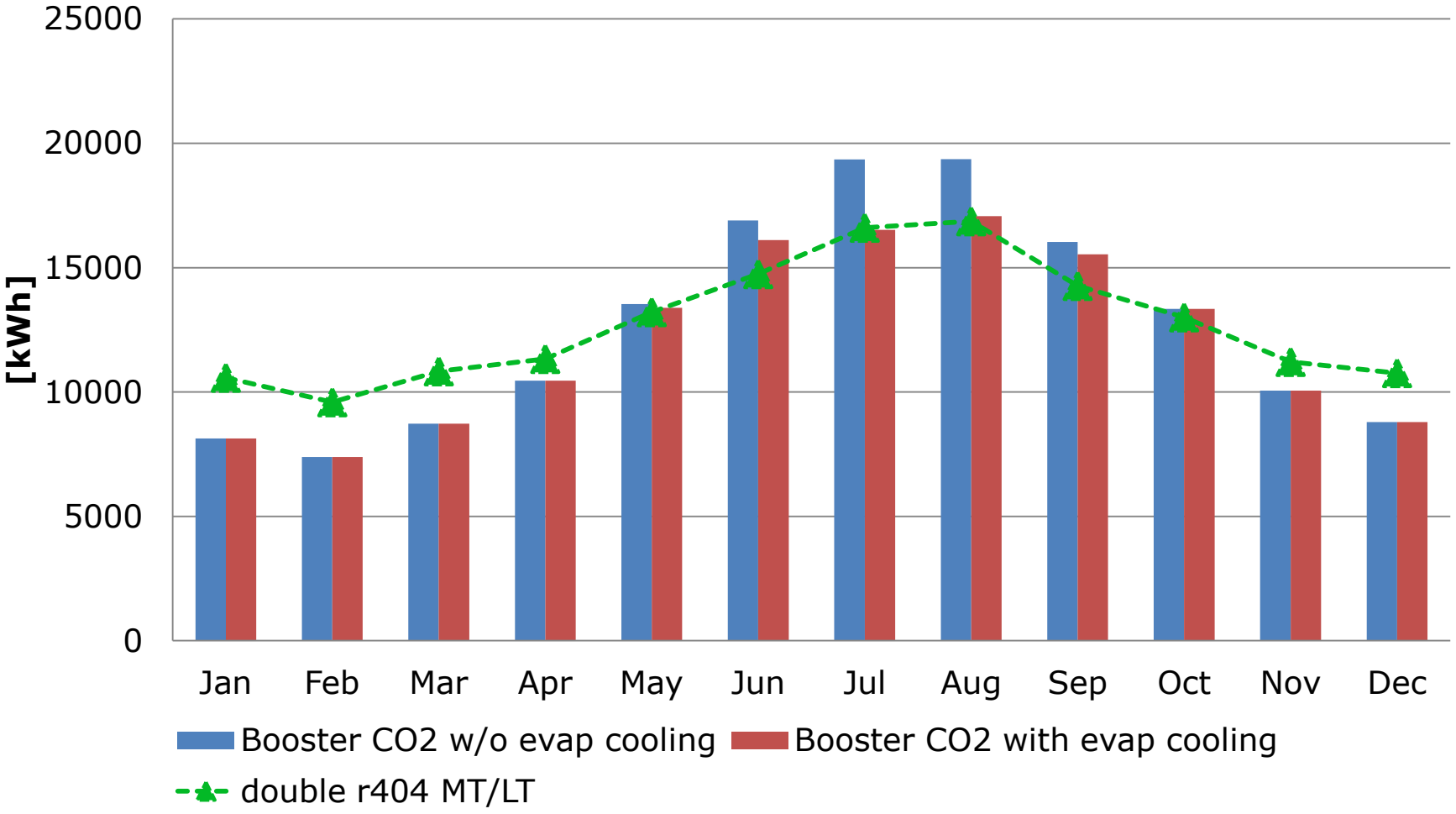

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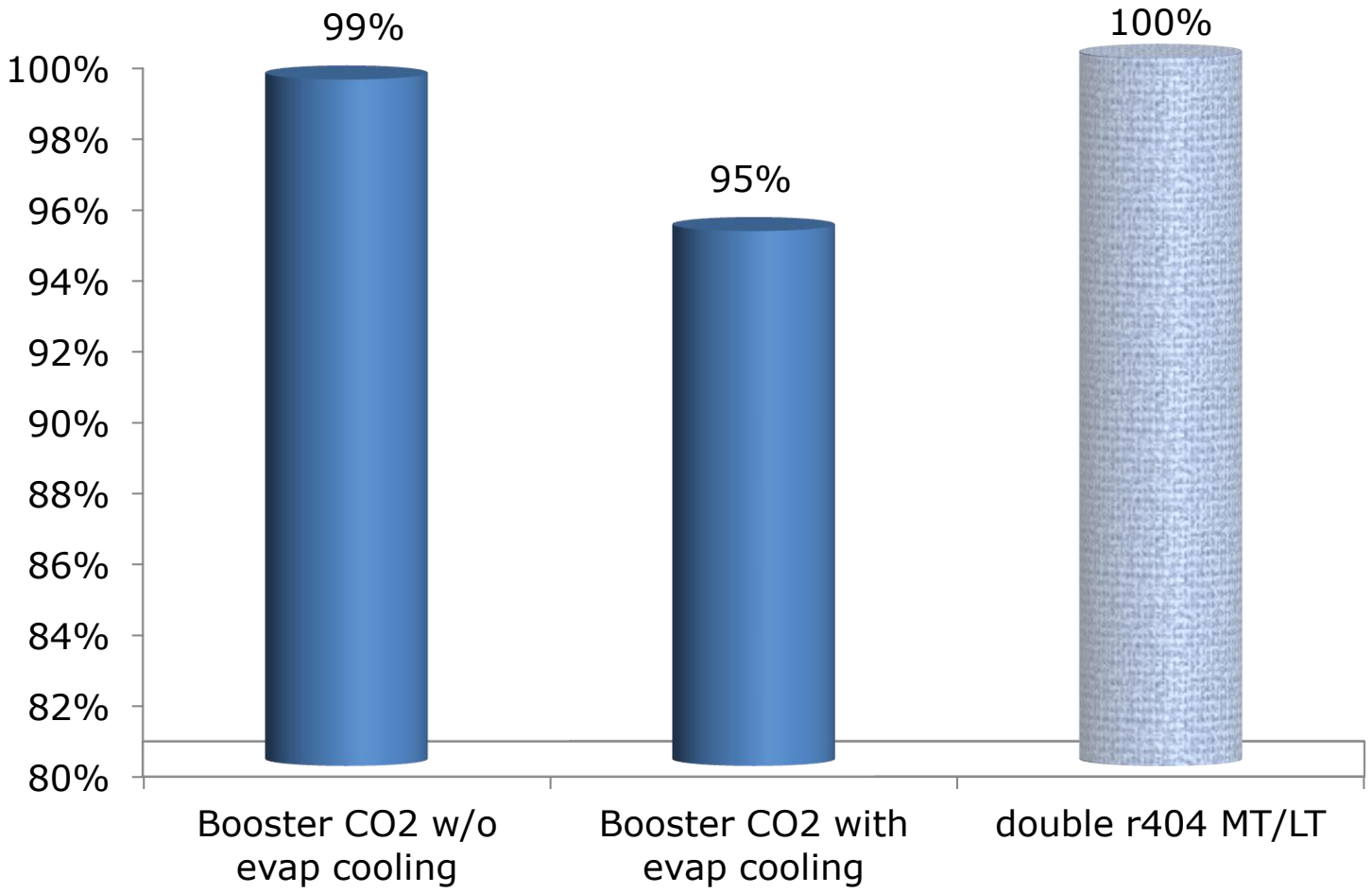

# Conclusions

- Conceal complexity behind
  - HMI
  - Integrated solutions
  - Exporting knowledge
- New opportunities
  - Condensing unit
  - Warmer climates

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