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Solutions.

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Sustainability of CO_2 technology and the role of control systems

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18th June 2013

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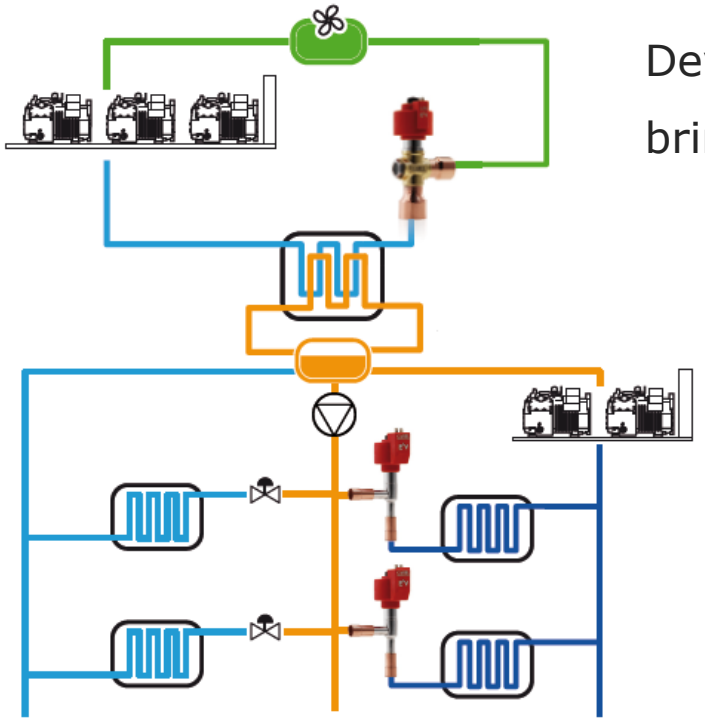
Agenda

1. Background
2. Technology evolution
3. Upcoming trends & performance analysis

Background



Late 90s

Developments in Secondary Systems use of brines for LT & MT

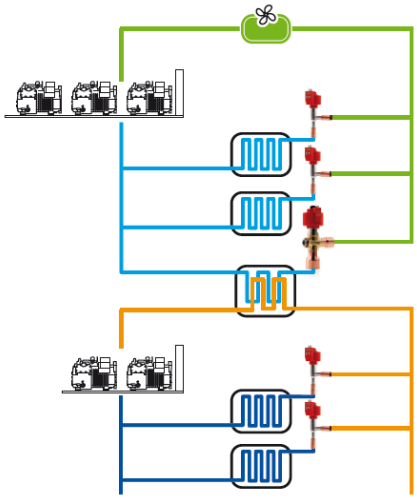
Advantages

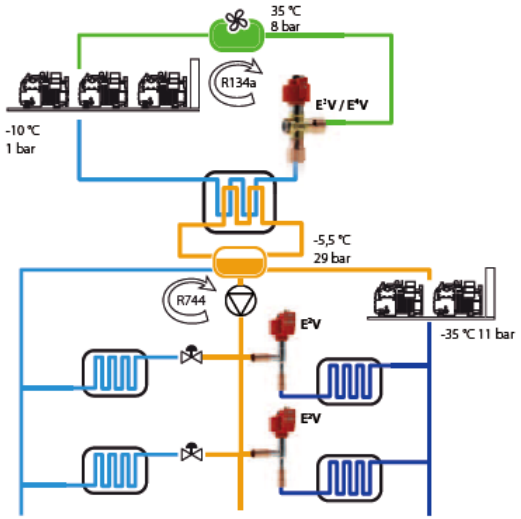
- Reduced refrigerant charge
- Any type of refrigerant on high stage
- Any type of Brine on Brine
- Widely accepted by retail

Barriers

- High Energy - Pumps
- Maintenance costs
- PHE Efficiency Losses

Background





Late 90s | Early 2000s

Introductions of Sub critical Cascade Systems

R xxx /LT CO_2

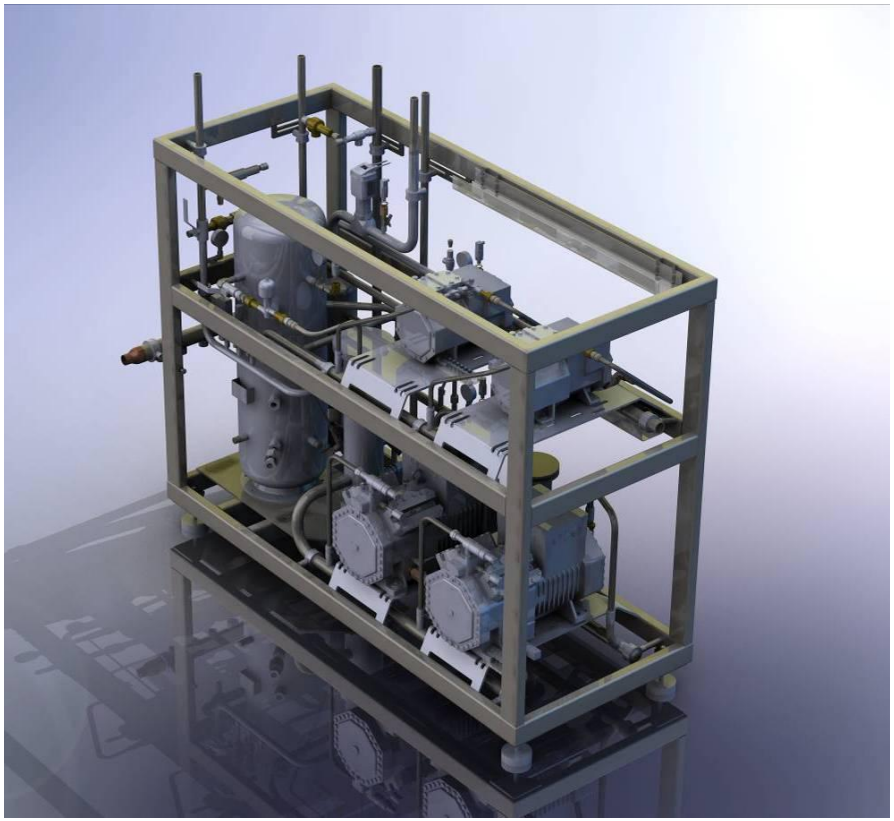
Advantages

- Reduced refrigerant charge – Rxxx
- Advancement in PHE control
- MT Evaporator efficiency
- Advancement in Evaporator control
- + LT Comps COP's

Barriers

- Cabinet Evaporator development
- Pump Flow
- Capital cost
- Training

Background



Late 90s | Early 2000s | Today

Favourable System Transcritical Booster DX

Advantages

- One Refrigerant – Simple System
- Evaporator Optimisation
- MT & LT COP's
- Heat Recovery
- Hot Gas Defrost

Barriers

- Warmer Climates
- Capital cost
- Resilience
- Training

Main Barriers – Training & Education

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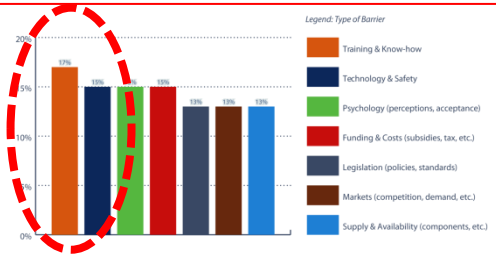
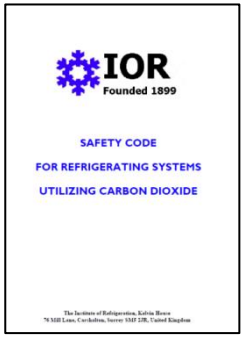
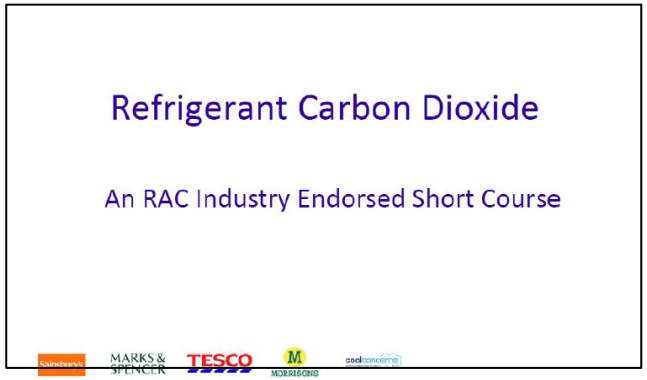
Central Point of Reference – R744.COM



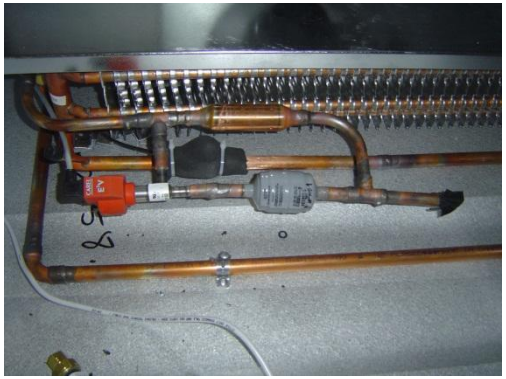
R744.com

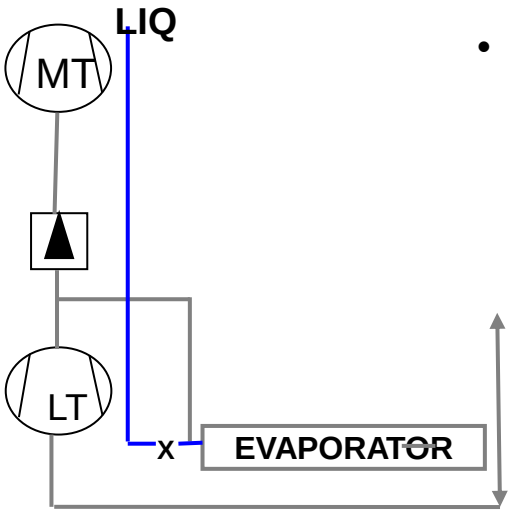
- Main criteria for emerging countries, centralise training
- Industry support is a MUST
- Electronic E learning platforms
- Hands on Training





Today – CO_2 Hot Gas Defrost

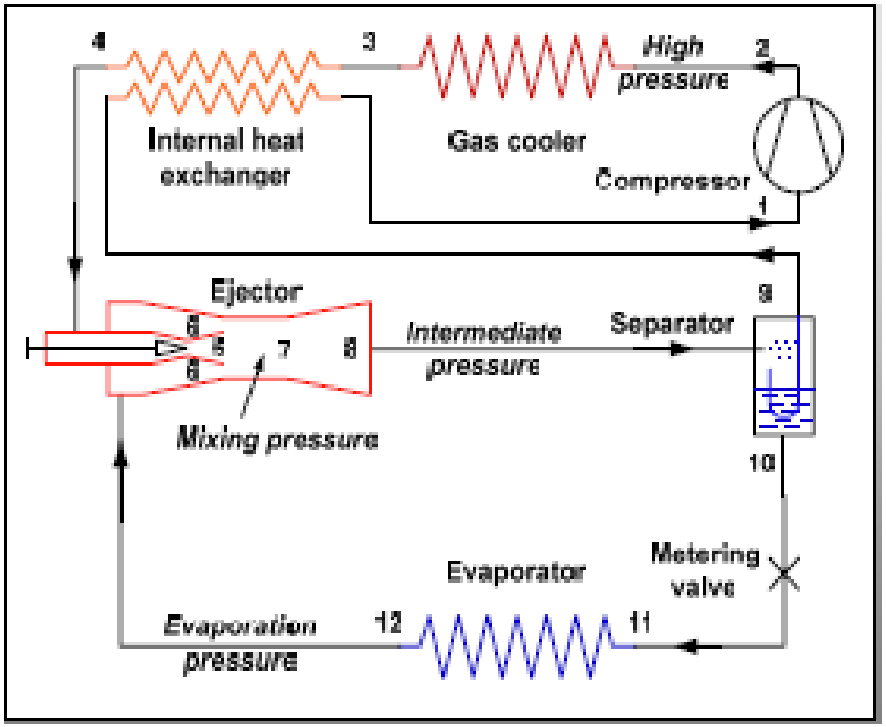




- Additional benefits which CO_2 systems deliver is utilisation of useful heat.
- Integrated management of HP valve during the defrost requirements.
- Swift short defrost duration
- Longer stock life & case performance

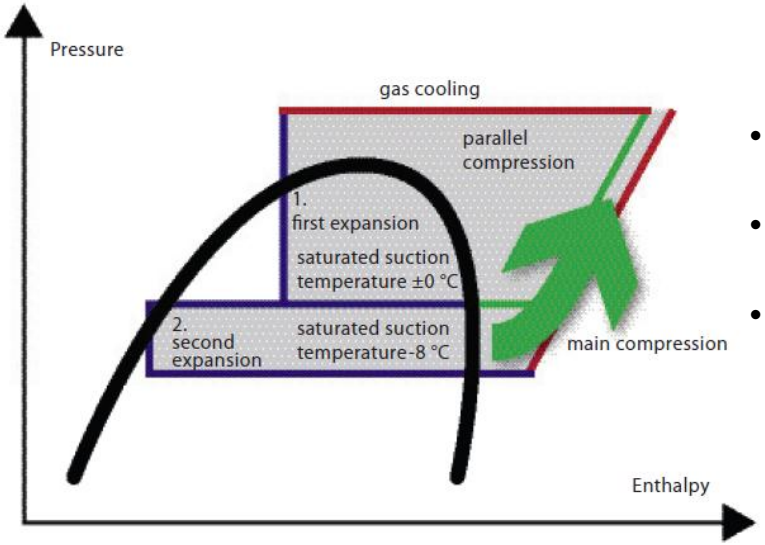
Today – CO_2 Ejector Technology

Research results today demonstrate that applying CO_2 Transcritical ejector in the system is one of the promising methods to increase the system efficiency. In addition, ejector simplicity (no moving parts) construction comparing to expanders, low cost and reasonable efficiency make it closer to practice.



- Invented by Gay in 1931
- Early stages in implementation
- COP Improvements + 18%
- Increased cooling Capacity +5%

Today - Parrellel Compression in CO_2



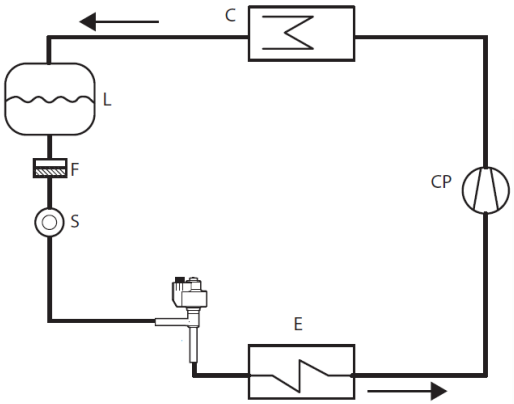
Advantages

- Thermodynamic losses can be compensated at High ambient
- The additional compressor operates @ higher temperature
- With this configuration , significant energy can be realised

Barriers

- Additional capital costs
- Training

Evolution in CO_2 Technology



In the Past:

Standard HFC Systems

- Consolidated knowledge
- Simple and well known technology
- Simple Tools and maintenance procedures
- Electro-mechanical backup
- Manual management in case of problems

Main Priority:
Food Safety, No Focus on System Efficiency

Evolution in CO_2 Technology

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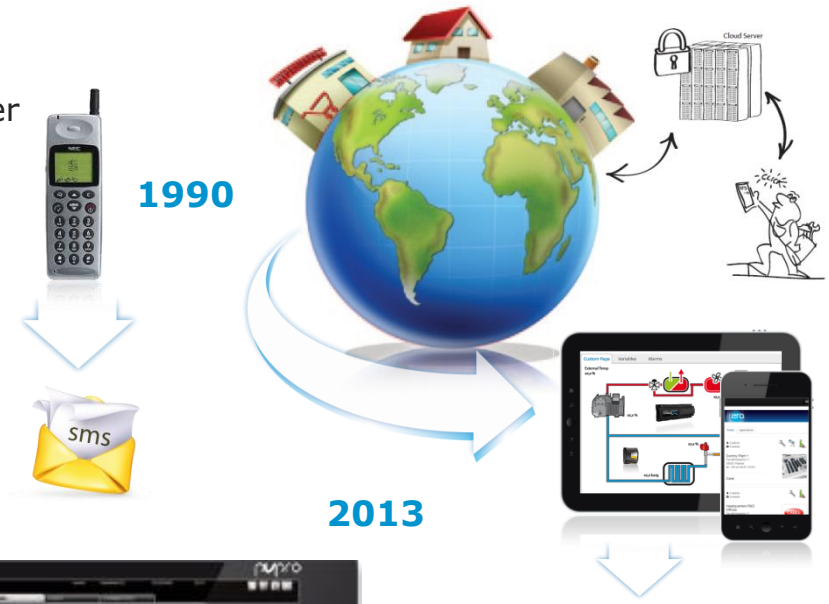
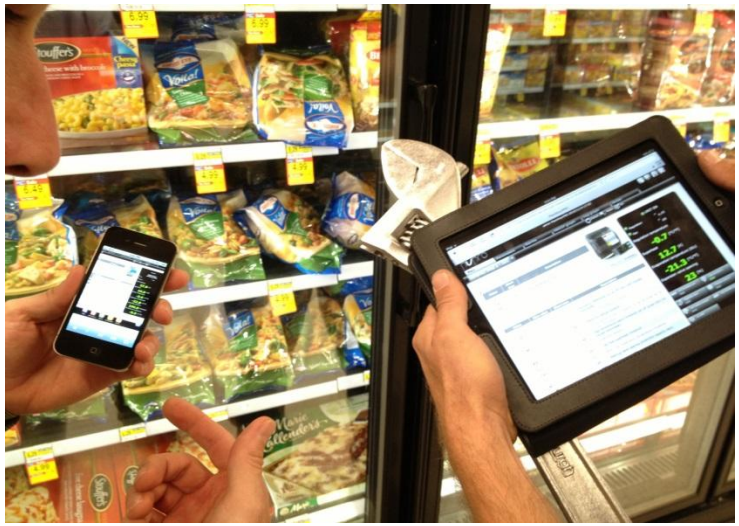
Fast growing and technological improvements in consumer applications

Large scale availablity of:

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





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connect • collect • process
tService

Smartphone Applications

Evolution in CO_2 Technology

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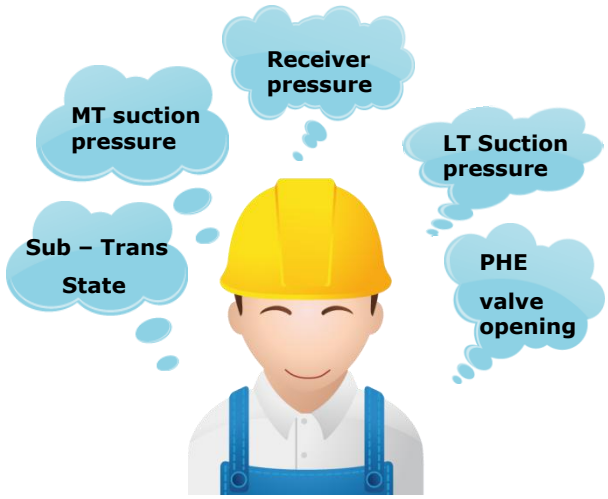
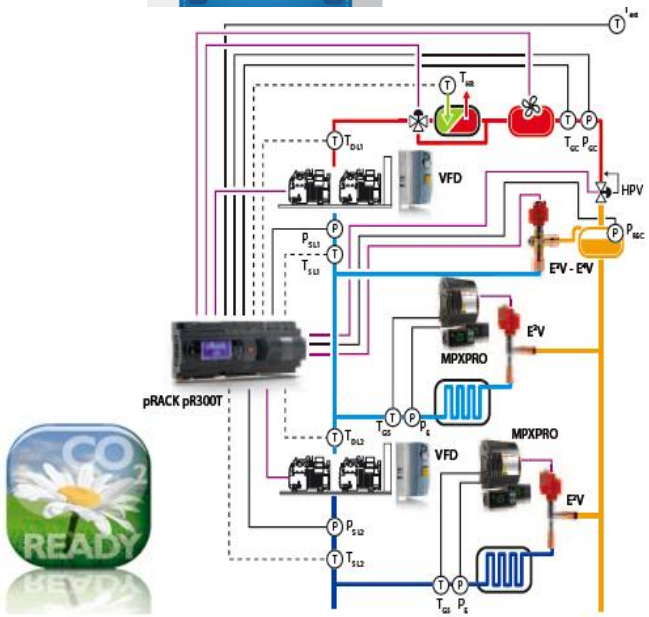
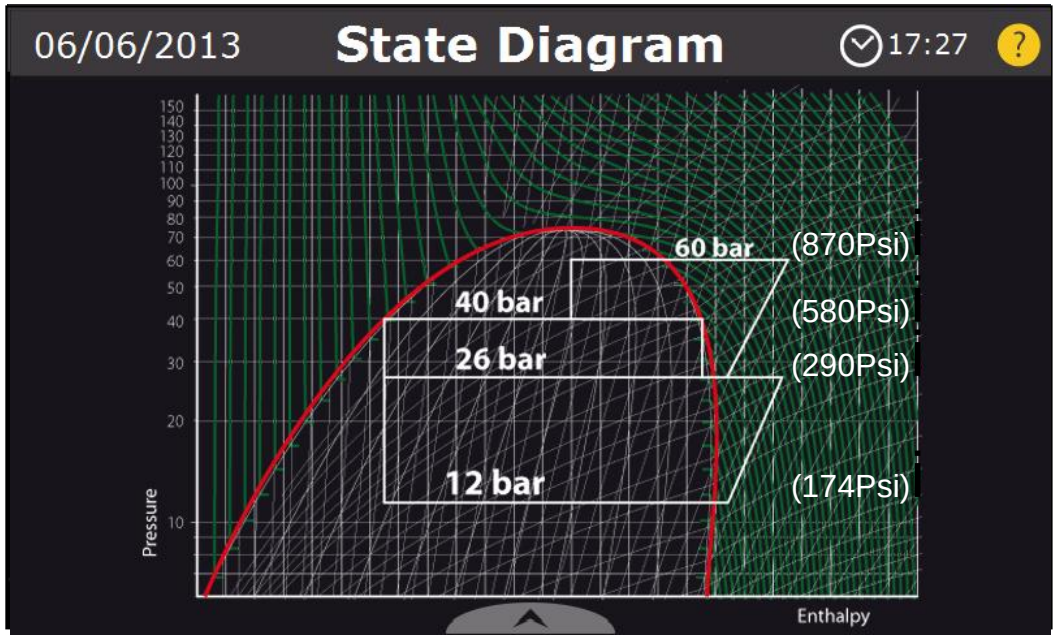


Conceal complexity behind

HVAC/R industries need to adapt this trend

- General overview, detailed information
- Added value , Kpi system performance, COP
- Improve service levels through faster remote troubleshooting
- Reduced operational costs, limit false diagnostics
- Benchmarking data





Evolution in CO_2 Technology

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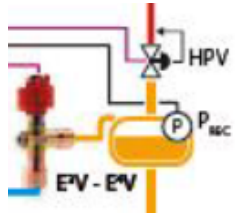
Integrated Hardware

Integrated solutions All in one

2 controllers:
- **Suction MT & high stage**
- **Suction LT**

3 controllers:
- **Suction MT**
- **Suction LT**
- **High stage**

Dual Suction Group

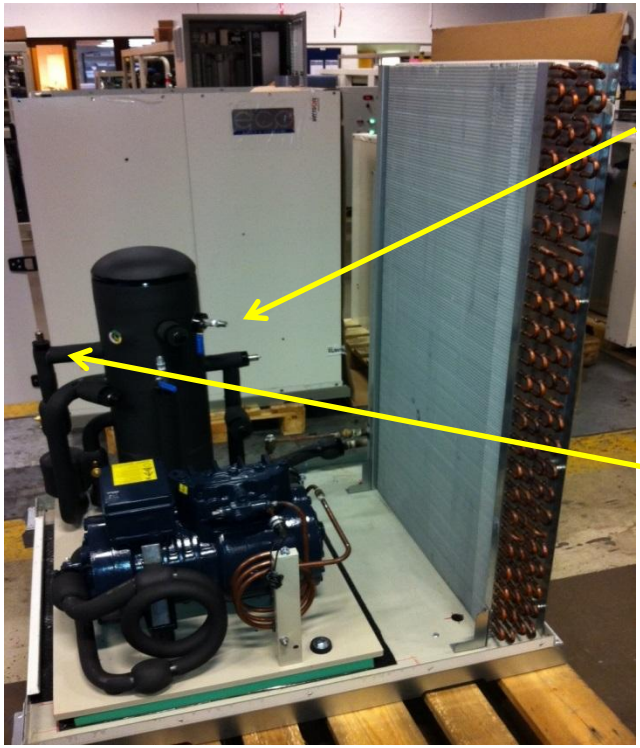


Dual High Pressure Valve Management

Heat Reclaim

- 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

Upcoming Trends – CO_2 Condensing Units



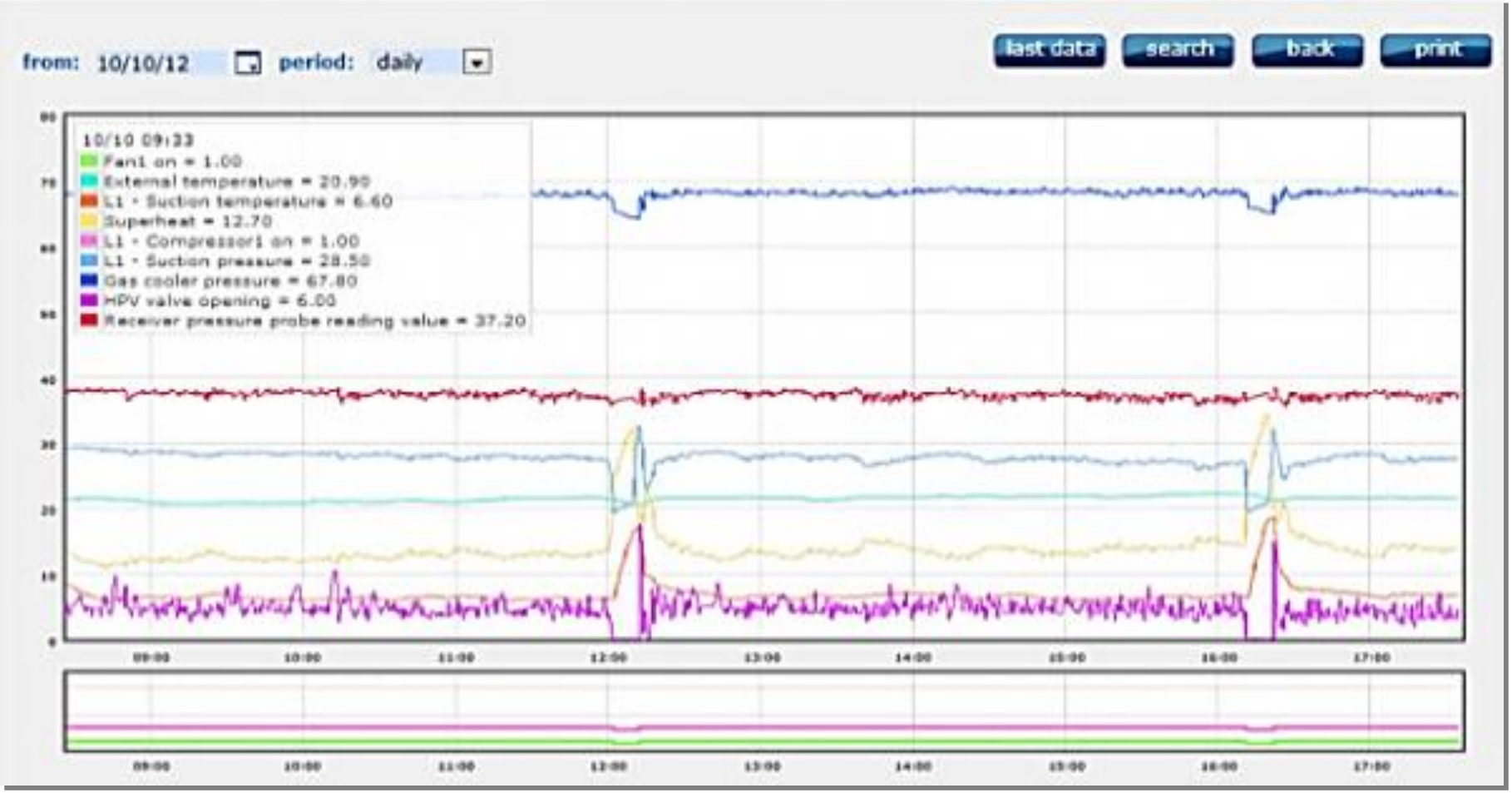
Transcritical
High Pressure Valve

Transcritical
Gas Bypass Valve

Integrated compact controls

Upcoming Trends – CO_2 Condensing Units

Operational Data



Conclusions

- Conceal Complexity behind
  - HMI
  - Integrated solutions
  - Exporting knowledge so we are not reinventing the wheel.

- New Opportunities
  - Transcritical CO_2 coondensing units

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thank you for your attention, any questions?