Re-innovating the CO_2 transcritical efficiency for small and medium formats

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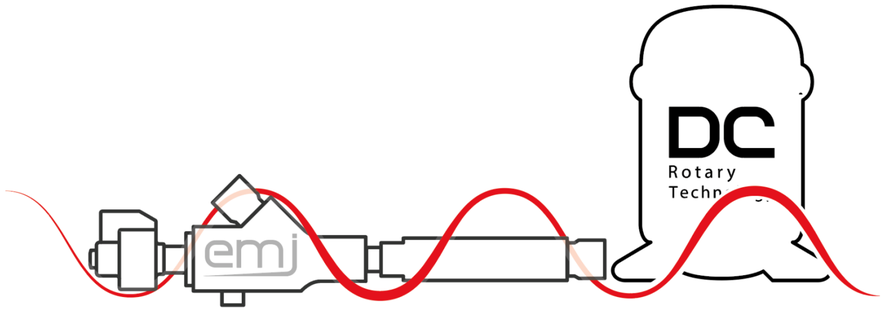
Continuous modulation for CO_2 systems

Latest innovation to further spread CO_2 technologies



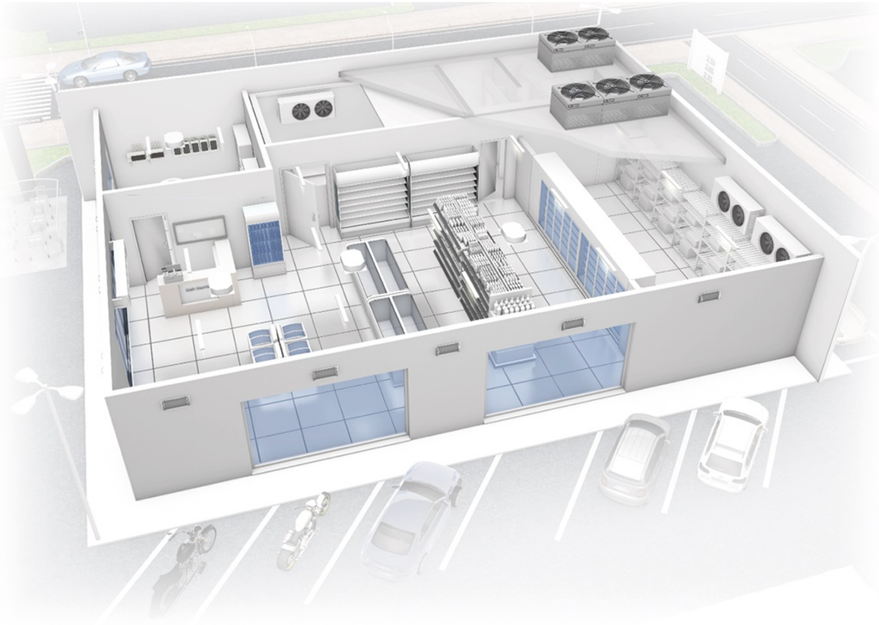
Background

- Energy efficiency always main target
- CO_2 as preferred natural refrigerant for remote system
- DC compressors technology as new option
- Modulating ejectors consolidated technology for warm climates

New target:

Small-medium formats

Next step of natural efficiency deployment

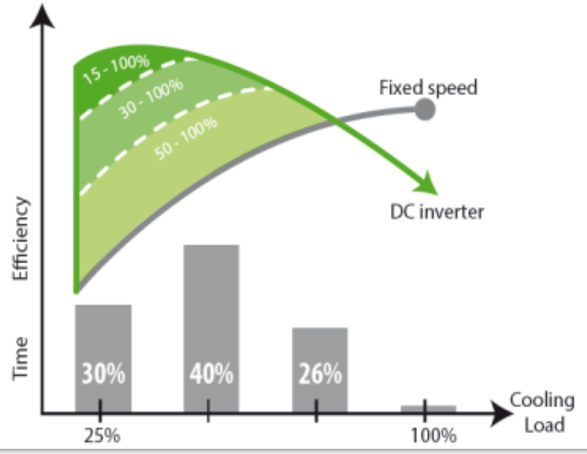


State-of-the-art technology

Efficiency in **ALL** conditions

DC technology

- Inverter driven DC compressor
- Very **wide modulation range** to always fit the cooling capacity
- **Maximum energy efficiency** at part load
- Minimum on/off cycles

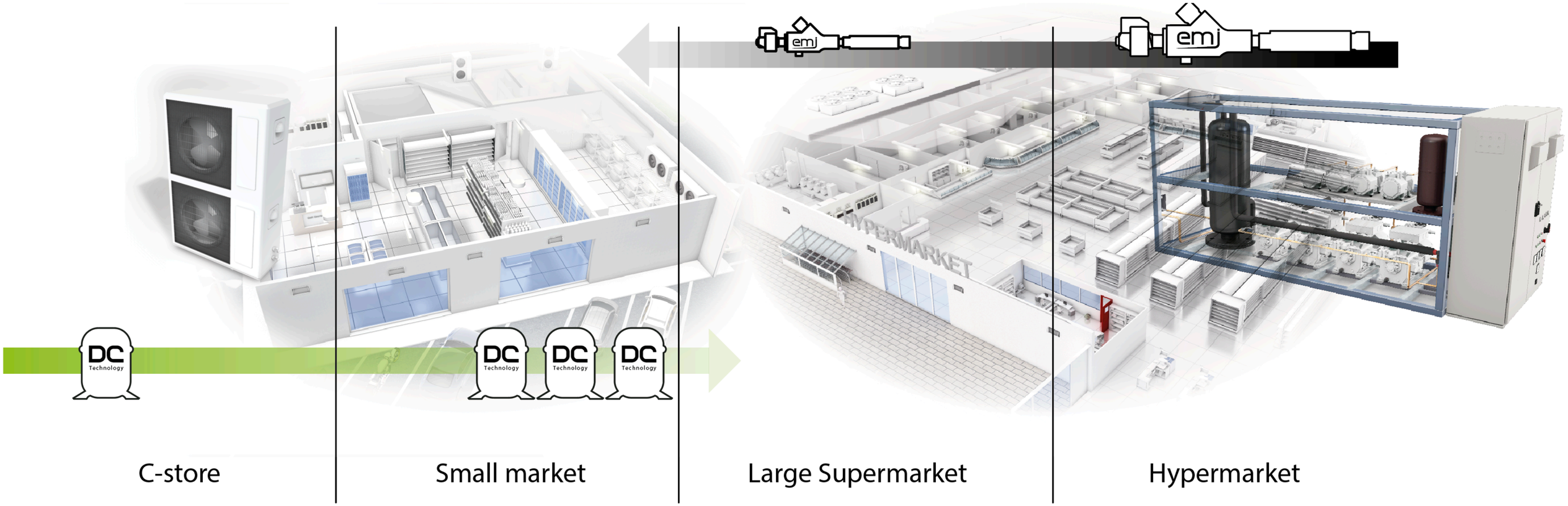


EmJ technology

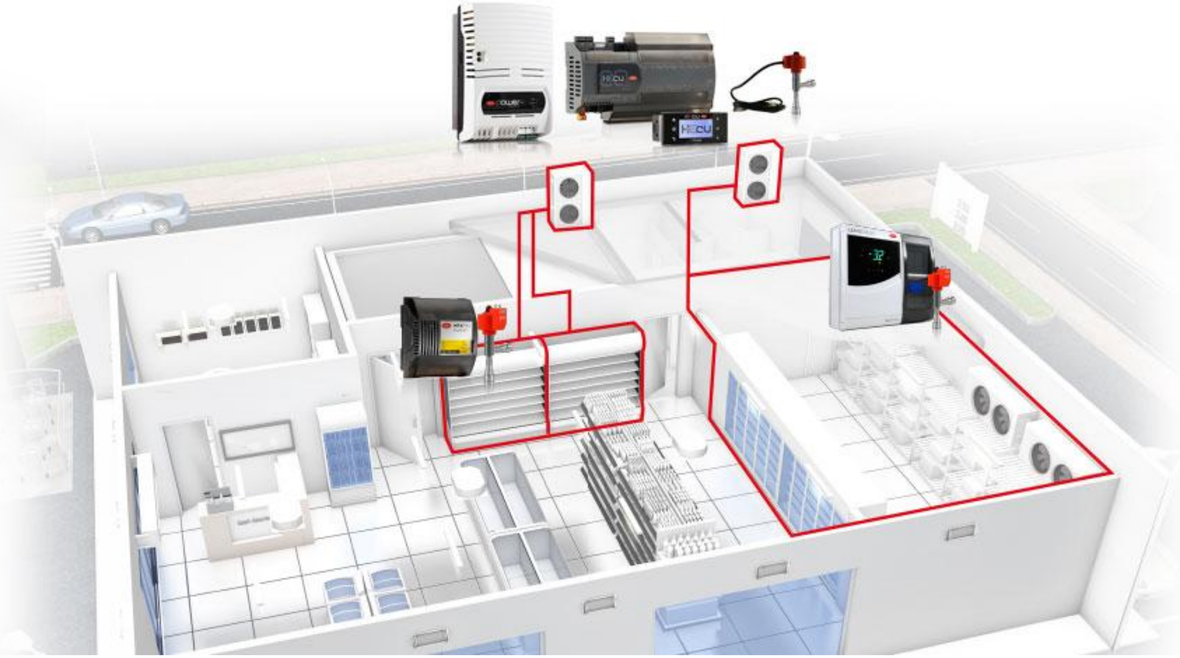
- **Continuous modulation** to match the different rack requirements
- **Fully optimized** control of the high pressure refrigerant flow
- **Flexibility** = scalability from **big** to **small supermarket**

Technologies for all formats

Market size versus Application



CO_2 DC Condensing Units



Application background

- High volumes
- Cost driven
- No directly affected by F-Gas
- Influenced by refrigerant costs

New generation CO_2 CDU added values

- Natural
- High efficiency
- Wide cooling capacity modulation

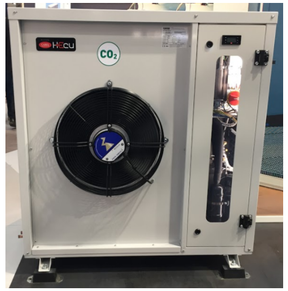
Control system main features

- Real-time communication with indoor units
- Optimum compressor envelope control
- Advanced remote monitoring (IOT)
- Ease of use: from installation to service

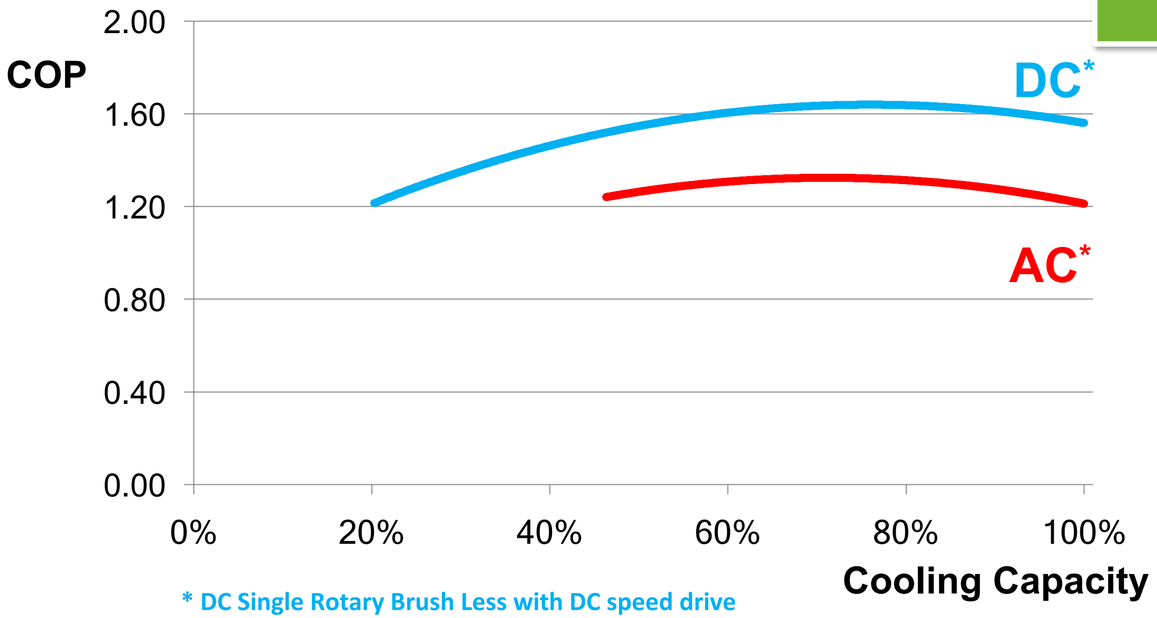
CO_2 DC Condensing Units

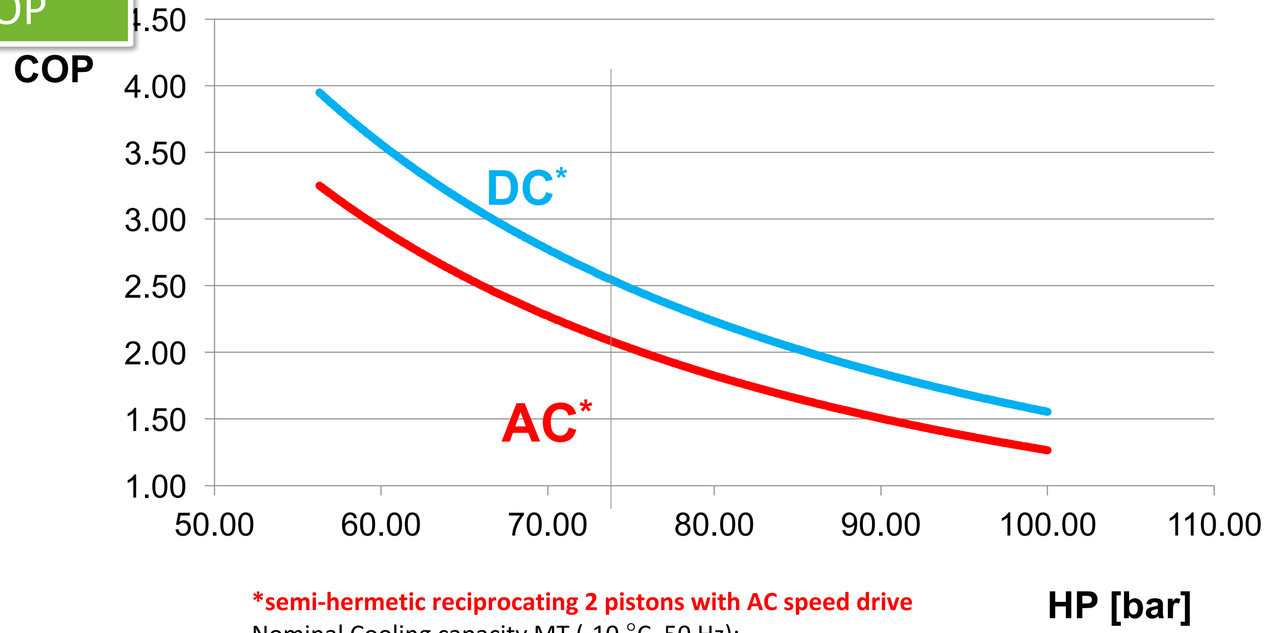
DC Vs AC Inverter driven compressors

- Higher efficiency in every load condition
- Wider modulation range
- Higher maximum speed (100rps)



Average 16% Higher COP





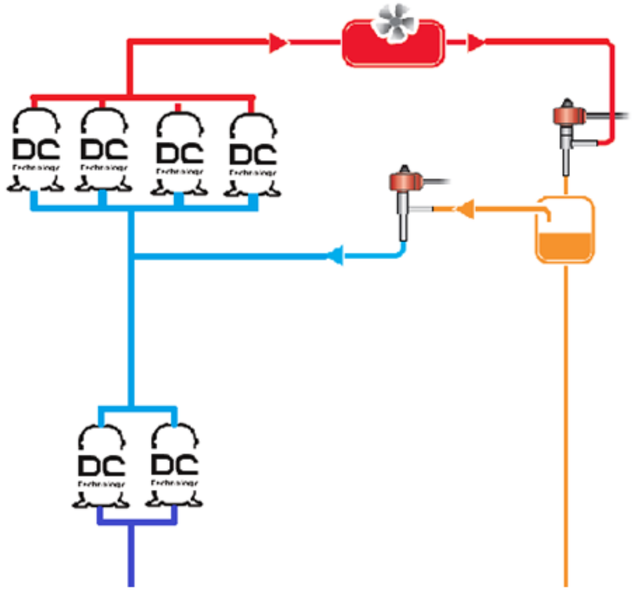
*** DC Single Rotary Brush Less with DC speed drive**
Nominal Cooling capacity MT (-10 °C, 60 rps):
- 2,1 kW (100 bar)

***semi-hermetic reciprocating 2 pistons with AC speed drive**
Nominal Cooling capacity MT (-10 °C, 50 Hz):
- 2,4 kW (100 bar)

*Lab test data

CO_2 Multi DC Racks

Multiple parallel DC compressors



Background

- Small formats
- Intensive roll outs
- High attention on costs

New systems added values

- Natural
- High efficiency
- Wide modulation range, perfect capacity control, food quality
- Compact and light solution

Control system main features

- All in one solution: direct drive of all system components
- DC inverter compressors synchronization
- Optimum compressors envelope control
- 10y+ DC compressors experience

CO_2 Multi DC Racks

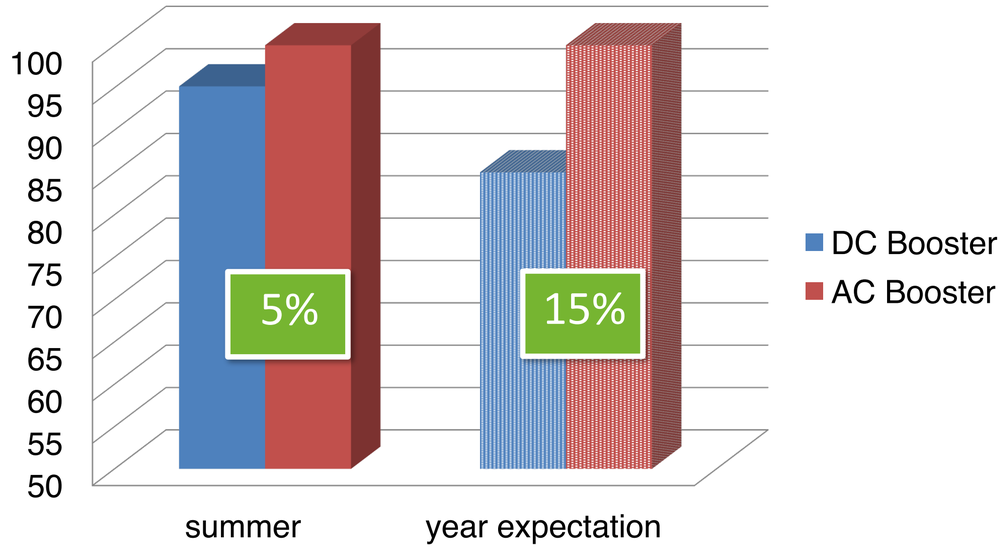
DC Vs AC field data comparison: Advansor experience

Compressor rack: 33kW MT, 3kW LT

Energy consumption observed during summer 2017

Main issue: ✓ **solved**
oil return and balance in hermetic compressors

Results:
Very stable evaporation temperature
Minimum on/off cyclings
5% energy saving in **summer period**
Up to **15% yearly saving** expected (under monitoring)



CO_2 Modulating Ejector Racks

Background

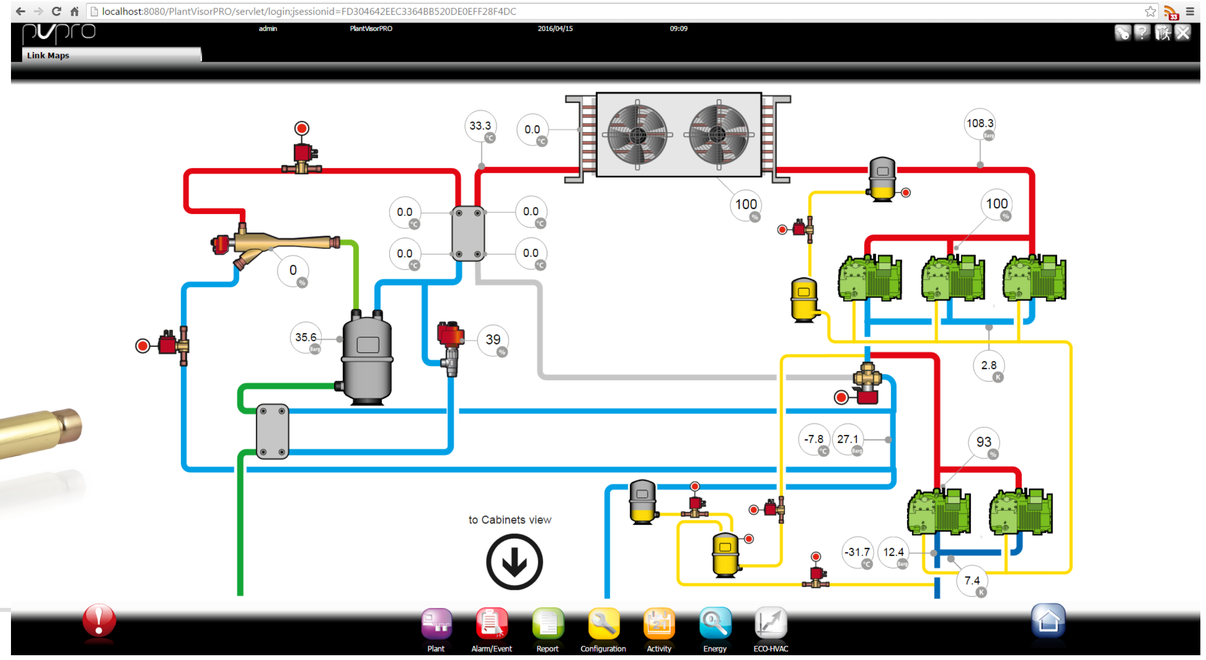
- Technologies available for large formats
- Sustainability in small formats: complexity and cost reduction

System added values

- High efficiency in all climates
- Efficient adaptation to different working conditions
- Reduced system complexity, no extra devices required

Control system main features

- All in one solution: direct drive of all modulating devices
- Real-time connection to cabinets
- MT and Parallel compressors exchange
- Ease of use: from installation to service

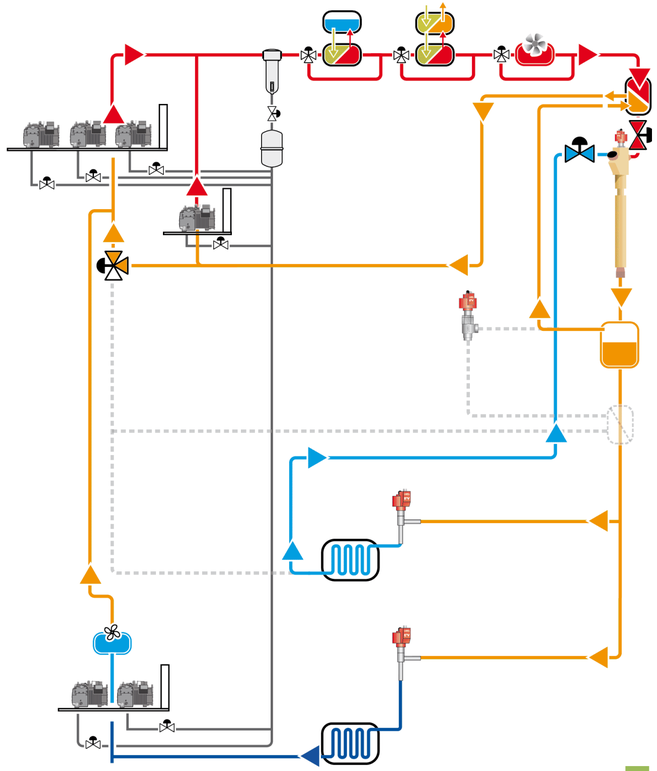


CO_2 Modulating Ejector Racks

Update of existing compressor rack: Crea lab

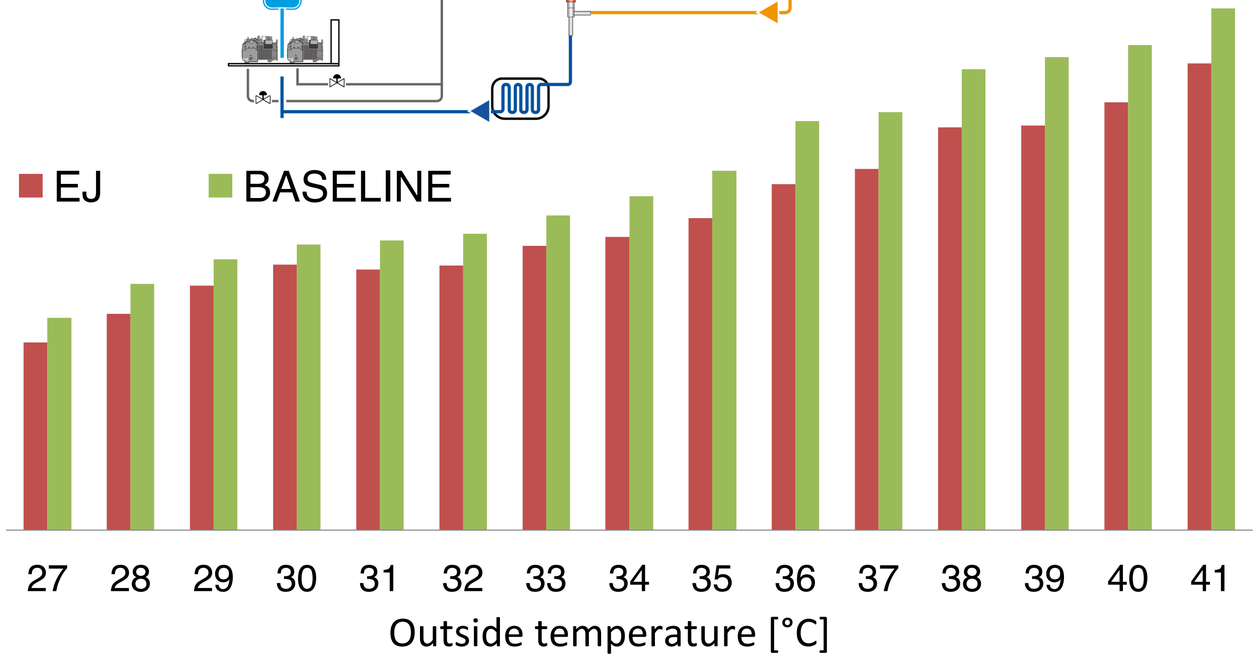
Standard CO2 transcritical compressor rack not designed for emj

Emj installation (instead of HPV) and minimum system changes
Only ejector and baseline mode
Summer 2017 – North Italy – Ext temp up to 41°C



Up to
18%
Energy saving
@36°C

Results
Energy saving from 8 to 18% in all working conditions
Up to 18% saving @36°C outside temperature
Up to 6-10% yearly saving expected

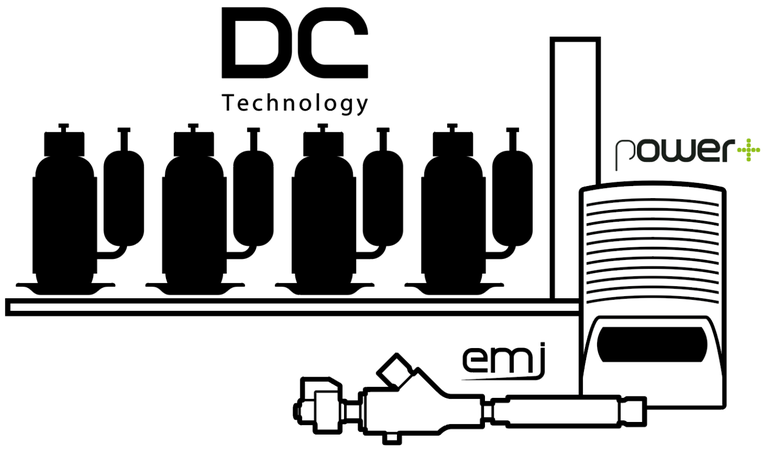


[***Laboratory test** data]

Conclusions

Continuous modulation
great opportunity for further spread CO_2 deployment

- **Perfomance**: to enhance system efficiency, stability and food quality
- **Cost effectiveness**: to reduce system and components complexity to decrease return of investments
- **Ease of use**: to improve the users confidence
- Sustainable in **small formats**



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CAREL

Thank you very much!