



High-efficient integrated CO₂-
based solutions around the world

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CONTENTS

/Motivation

/Integrated CO₂ booster systems

/Conclusions

BITZER DRIVES THE INDUSTRY: COMPRESSOR TECHNOLOGY & SUSTAINABILITY

- / BITZER has a long history of providing solutions with natural refrigerants: NH₃, HC and CO₂
- / 1995-1998: First prototype compressors for sub-critical CO₂ applications
- / 2000: Commissioning of the first R404A/R744 cascade system in a supermarket in Bettembourg / LU by Linde
- / 2002: Commissioning of the first HFC free McDonald's restaurant in Vejle / DK by the DTI (R290/R744 cascade)
- / 2004: Commissioning of the first all CO₂ system for transcritical application in Wettingen / CH by Linde
- / 2016: More than 60.000 sold CO₂ compressors, mainly in commercial applications
- / > 1.600 supermarkets with integrated system solutions in operation with BITZER compressors
- / Flag ship stores all over the world, e. g. in Australia, Brazil, Germany, ...

WHY CO₂?

- / Safe refrigerant, category A1
- / Sustainable and naturally occurring, $GWP_{100} = 1$ kg CO₂ eq. / kg emission
- / Not covered by F-gas regulation, no taxation, easy disposal
- / Naturally superior annual energy efficiencies in moderate climates
- / Ideal for heat reclaim, specially for tap water > 60 °C
- / Preferred for integrated solutions MT + LT + HRC + AC
- / Low TEWI values, savings in energy cost
- / Potential for the application of innovative technologies e. g. ejectors, etc.

WHY INTEGRATED?

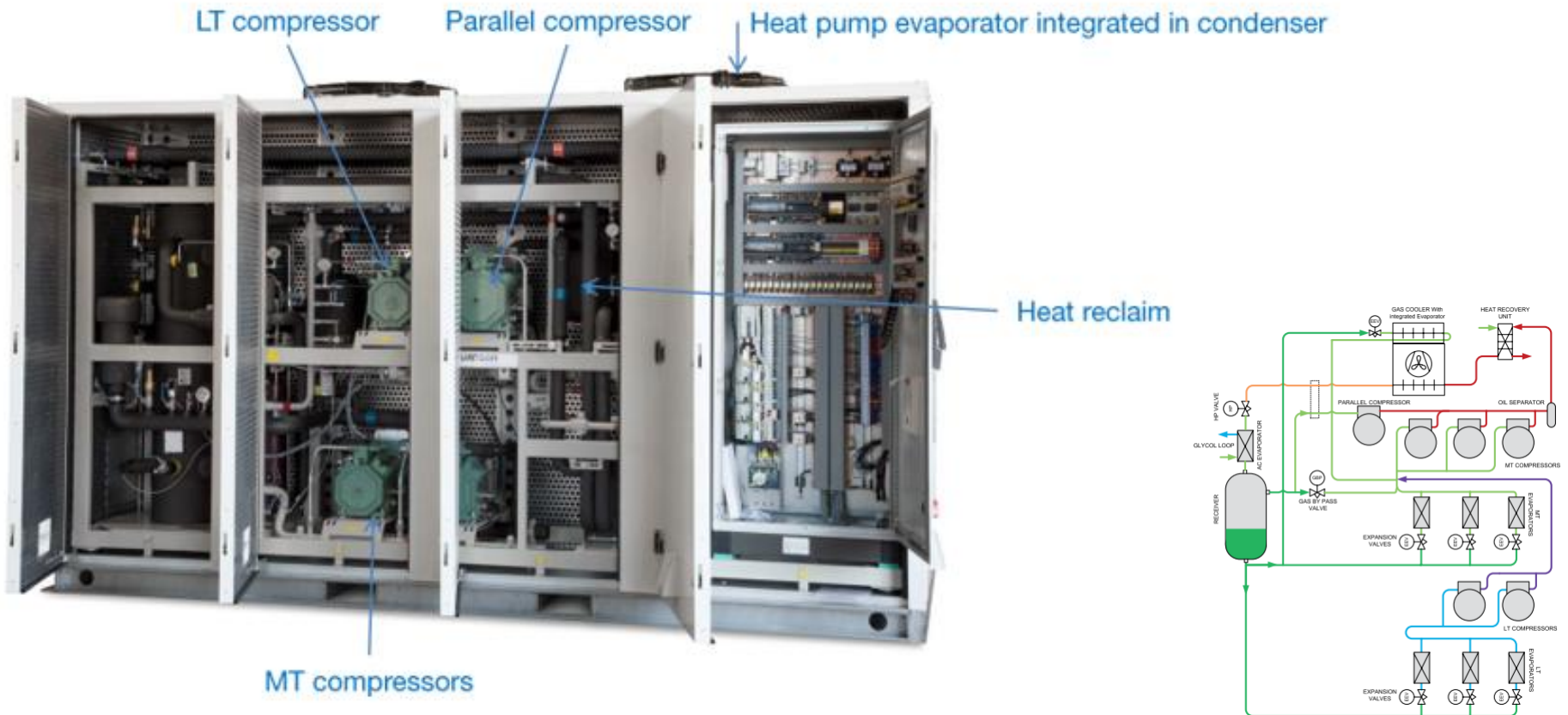
- / High seasonal energy efficiency
- / Avoiding combustion of fossil energy



Reference: http://www.creapolis.de/kunden/Carrier/X113/2014-11-11/PraesentationCarrierWeb_140820.html

INTEGRATED SYSTEMS. IS THIS TECHNOLOGY COMPLEX?

- / It's no rocket science, it's just refrigeration!
- / Smart controls
- / Compact designs



Reference: Advansor

HOW EFFICIENT ARE INTEGRATED SYSTEM SOLUTIONS?

- / Supermarket with 1.600 m² heated area
- / Capacities LT / MT / Heating = 15 kW / 60 kW / 50 kW
- / Annual kilowatt-hours electricity / heat = 200.000 kWh/a / 100.000 kWh/a

Savings: 10.600 €/a = 1.350.000 Yen/a

Fossil: 0,12 € / kWh
Electricity: 0,10 € / kWh

Savings: 3.800 €/a = 484.000 Yen/a

Fossil: 0,06 € / kWh
Electricity: 0,15 € / kWh

Savings: 400 €/a = 51.000 Yen/a

Fossil: 0,04 € / kWh
Electricity: 0,25 € / kWh

Reference: http://www.creapolis.de/kunden/Carrier/X113/2014-11-11/PraesentationCarrierWeb_140820.html

HOW EFFICIENT ARE INTEGRATED SYSTEM SOLUTIONS?

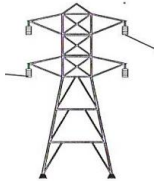
/ Case Study: Booster system with parallel compression in a Tokyo climate

/ Annual Energy Efficiency $\frac{176.247 \text{ kWh/a} + 58.161 \text{ kWh/a}}{74.442 \text{ kWh/a}} = 3,15$



$Q_o = 176.247 \text{ kWh/a}^*$

* Full load

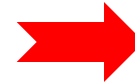


$P_{el} = 74.442 \text{ kWh/a}$

$P_{el\ c} = 61.682 \text{ kWh/a}$

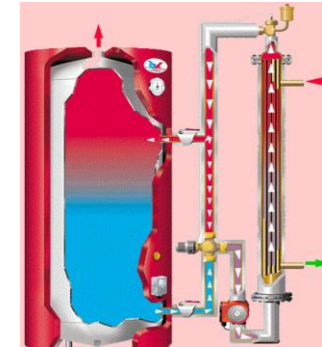
$P_{el\ h} = 12.760 \text{ kWh/a}$

$Q_c = 250.689 \text{ kWh/a}$



$Q_h = 58.161 \text{ kWh/a}^*$

* water 25 °C => 55 °C



Reference: Kaelte Fischer

Savings Heat Reclaim:

$14,5 \text{ t CO}_2 \text{ eq / a}^*$

*Therm. 0.25 kg/KWh



Reference BITZER, Simulated data, Capacities
LT / MT / Heating = 2 kW / 18 kW / 5..20 kW

Reference: www.ahrinet.org

HOW ABOUT INTEGRATED SYSTEM SOLUTIONS IN XXL?

- / Distribution centre with 3.800 + 6.100 m² LT & MT stacking ground
- / Capacities LT / MT / Heating = 410 kW / 770 kW / 400 kW

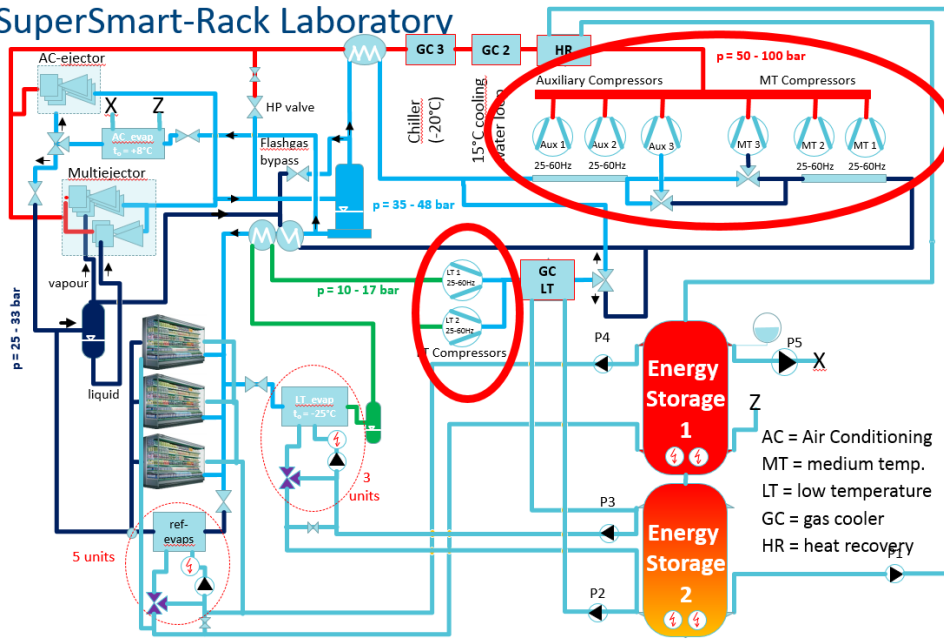


Reference: Carrier

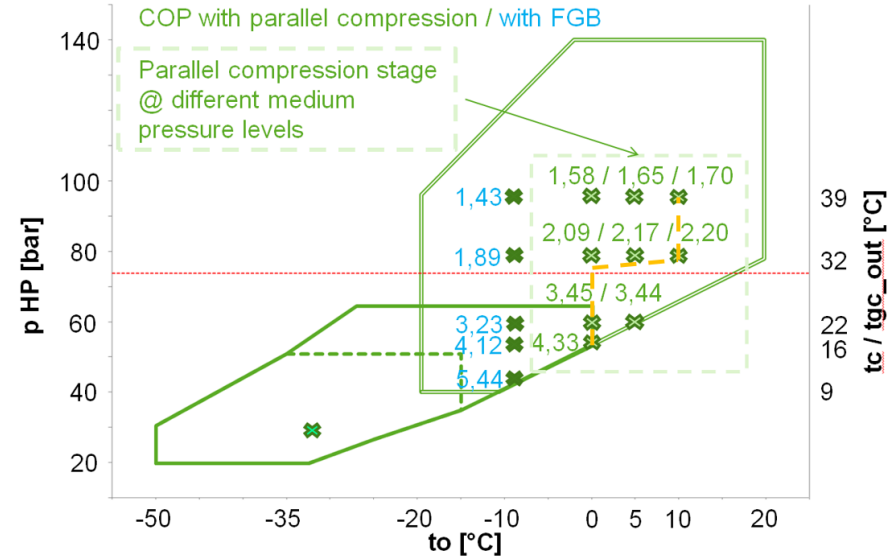
CAN WE EXPECT FURTHER IMPROVEMENTS OF THE ENERGY EFFICIENCY?

Yes, by applying ejectors, smart controls and other innovative technologies!

SuperSmart-Rack Laboratory



Sintef: SuperSMART project



SCHAUFLENER Academy: Parallel compression with optimized medium pressure levels

HOW ABOUT BITZER?

BITZER provides the most beneficial CO₂ compressor offering:

- / Three product families for a wide field of application in all kind of systems for sub- and transcritical CO₂ applications
- / Technical documentation and software
- / Technical training, individual support and special services

BITZER CO₂ compressors set new standards and show the benchmark

- / Trendsetting technology
- / Highest efficiency and reliability
- / Smooth operating behaviour, low sound & vibration levels
- / Proven long term reliability
- / ASERCOM certified products



CONCLUSIONS

- / CO₂ is the ideal refrigerant for integrated solutions
- / Integrated systems are just refrigeration and have a compact design
- / Integrated system solutions offer high annual energy efficiencies and reduce or even avoid the combustion of fossil energy for heating
- / Integrated system solutions offer significant cost savings
- / The limits of efficiency can be further pushed!
- / BITZER: Optimized, energy efficient, reliable and certified CO₂ compressors
- / > 1.600 supermarkets with integrated system solutions in operation with BITZER compressors



solutions for asia

natural refrigerants

9 & 10 February, 2016 – Tokyo

Thank you very much!