Case study: Transcritical CO2 retail technologies taking Southern Tracks

Advansor
2015
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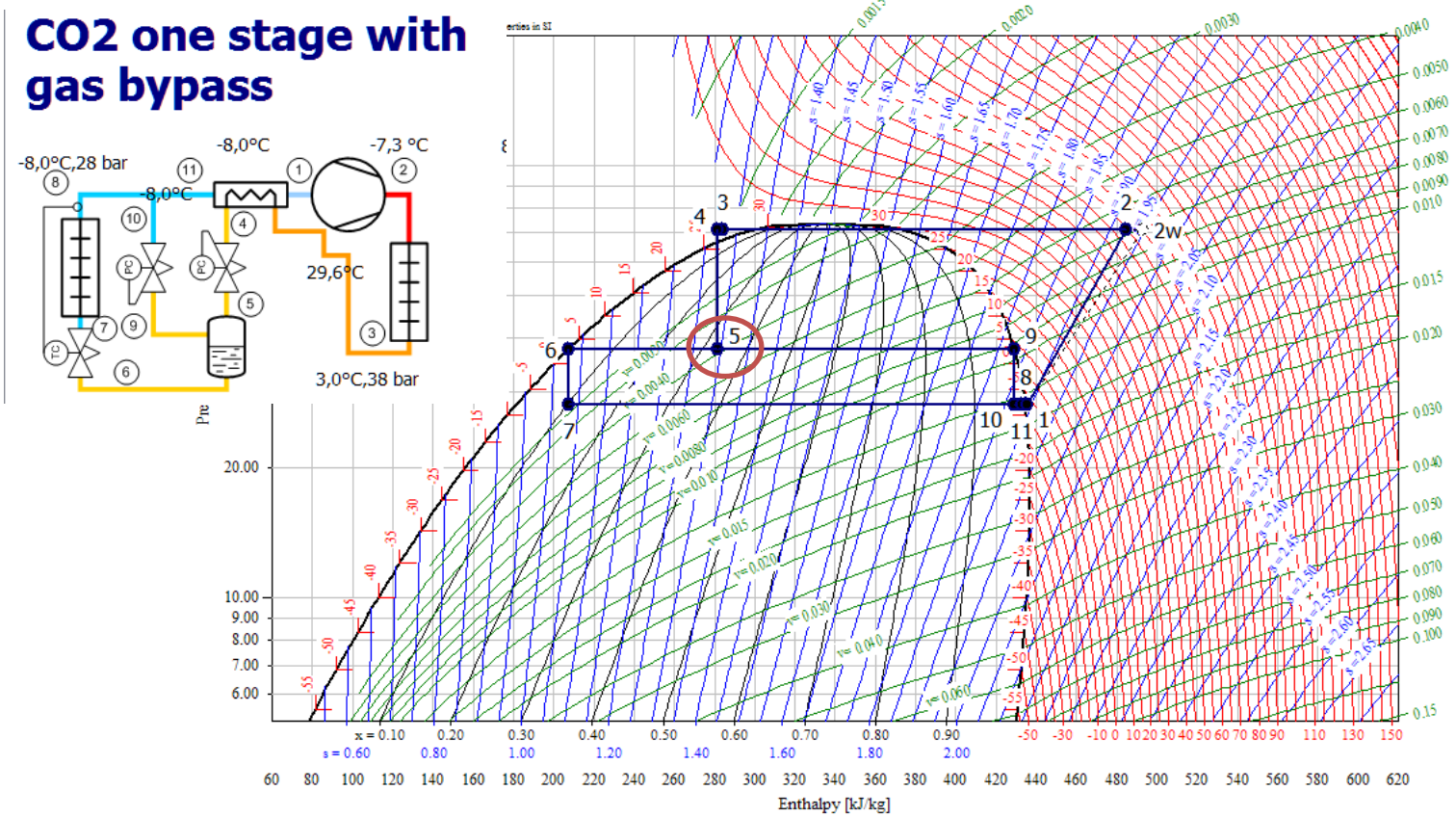
by Hillphoenix

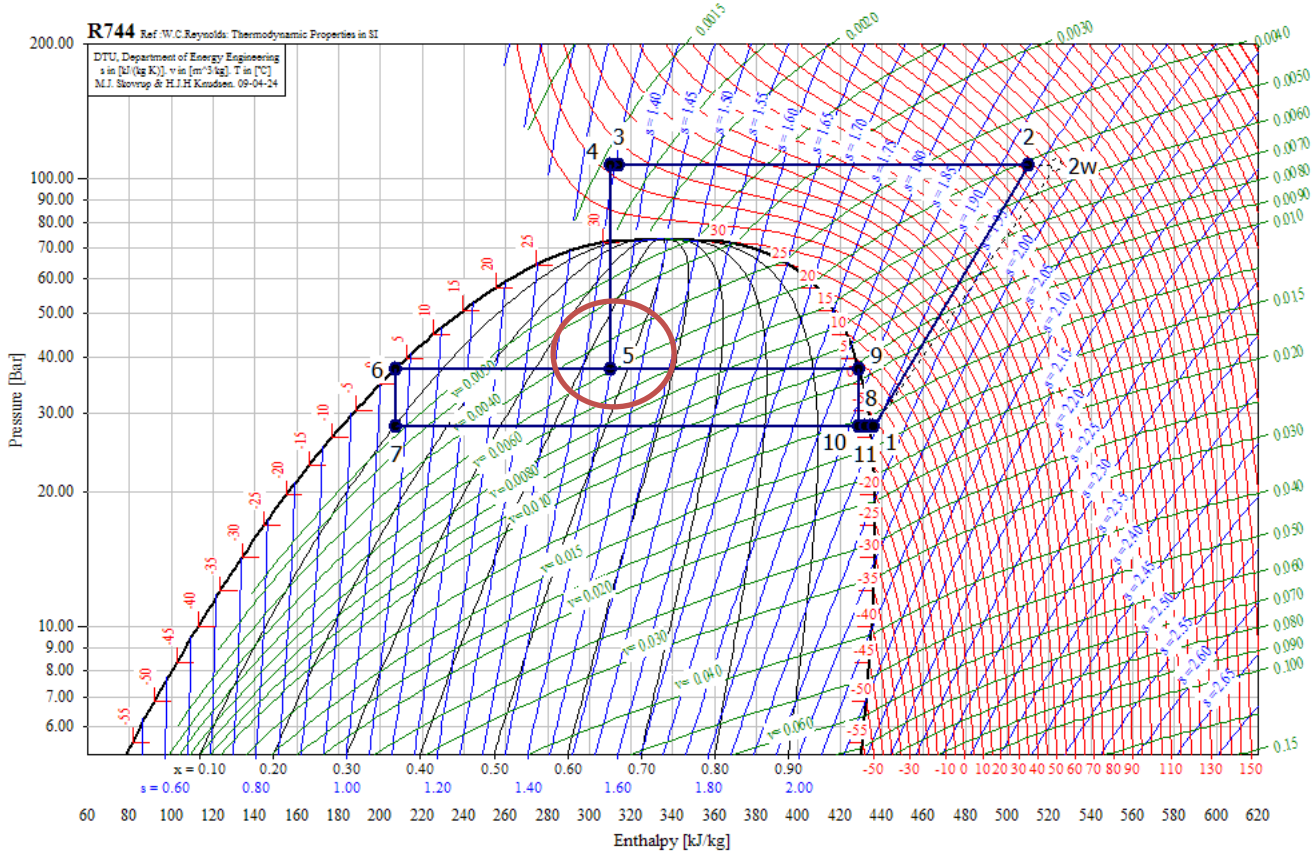
Definition of the hot climate challenge:



28°C ambient: approx 30% flash gas release at intermediate pressure

COP of TC CO2 @ SST-8 -> 2,4

Definition of the hot climate challenge:

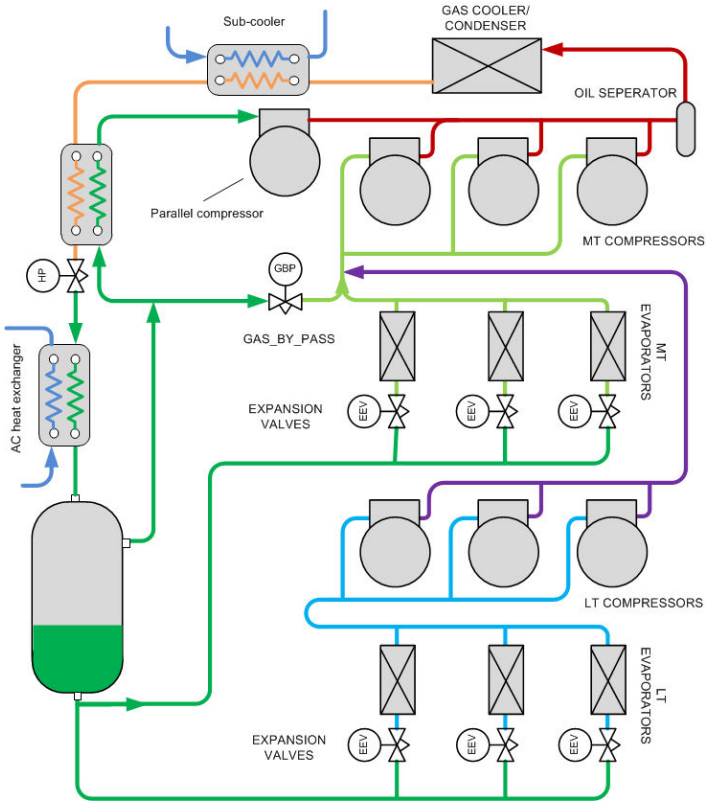


40°C ambient: approx 48% flash gas release at intermediate pressure

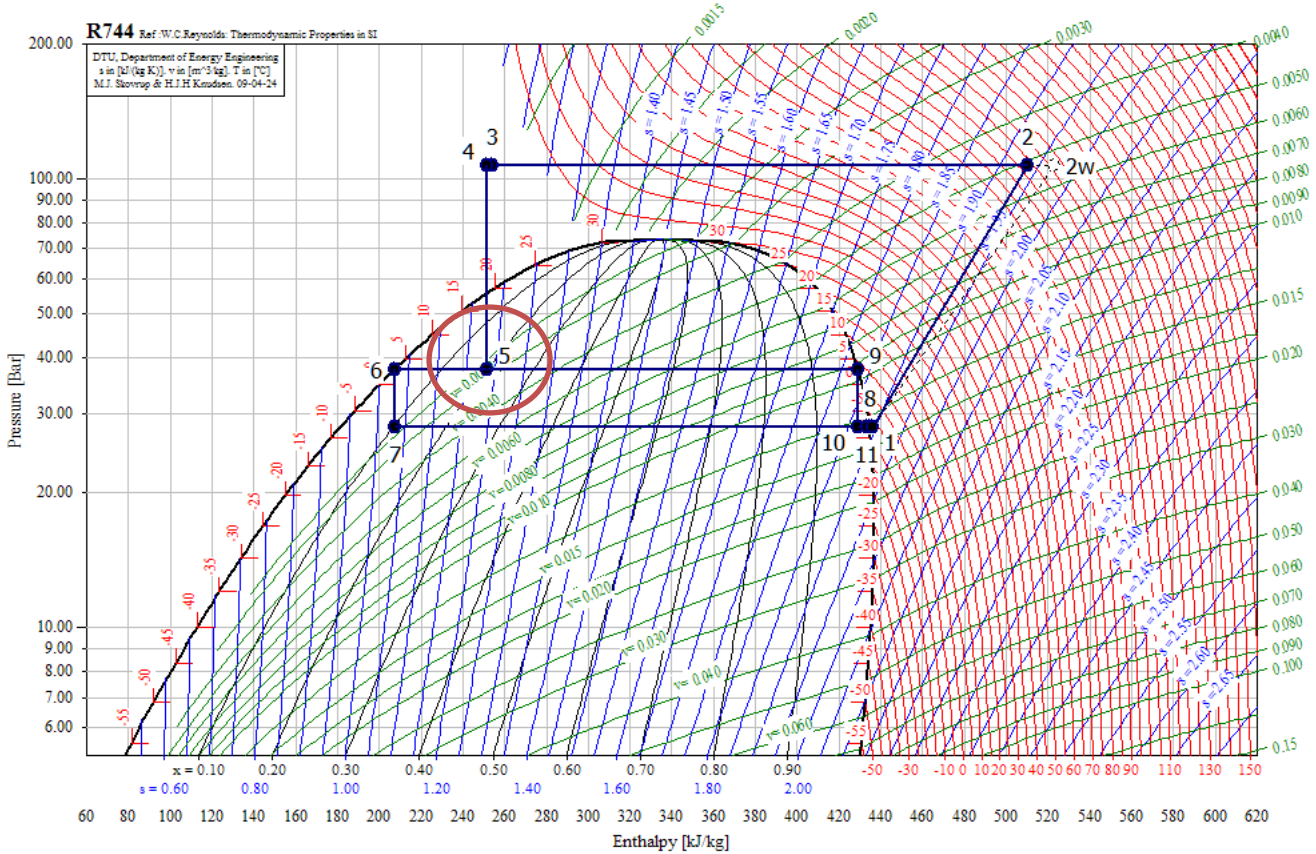
COP of TC CO2 @ SST-8 -> 1,4

Solutions to remove flash gas in hot climate and improve performance

1. High pressure sub coolers
2. Water spray systems
3. Adiabatic air cooling curtains
   - Peak savings 20%, Annual savings 10%
4. Parallel Compression systems
   - Peak savings 15-20%, Annual savings 6-10%
   - Already introduced to the market
5. Gas Ejectors
   - Peak savings approx. 25% expected
   - Annual savings approx 10-15%
   - Under development expected



Solution no.1 :Hi pressure sub coolers



40°C ambient and subcooling to 25°C: approx 20% flash gas release at intermediate pressure

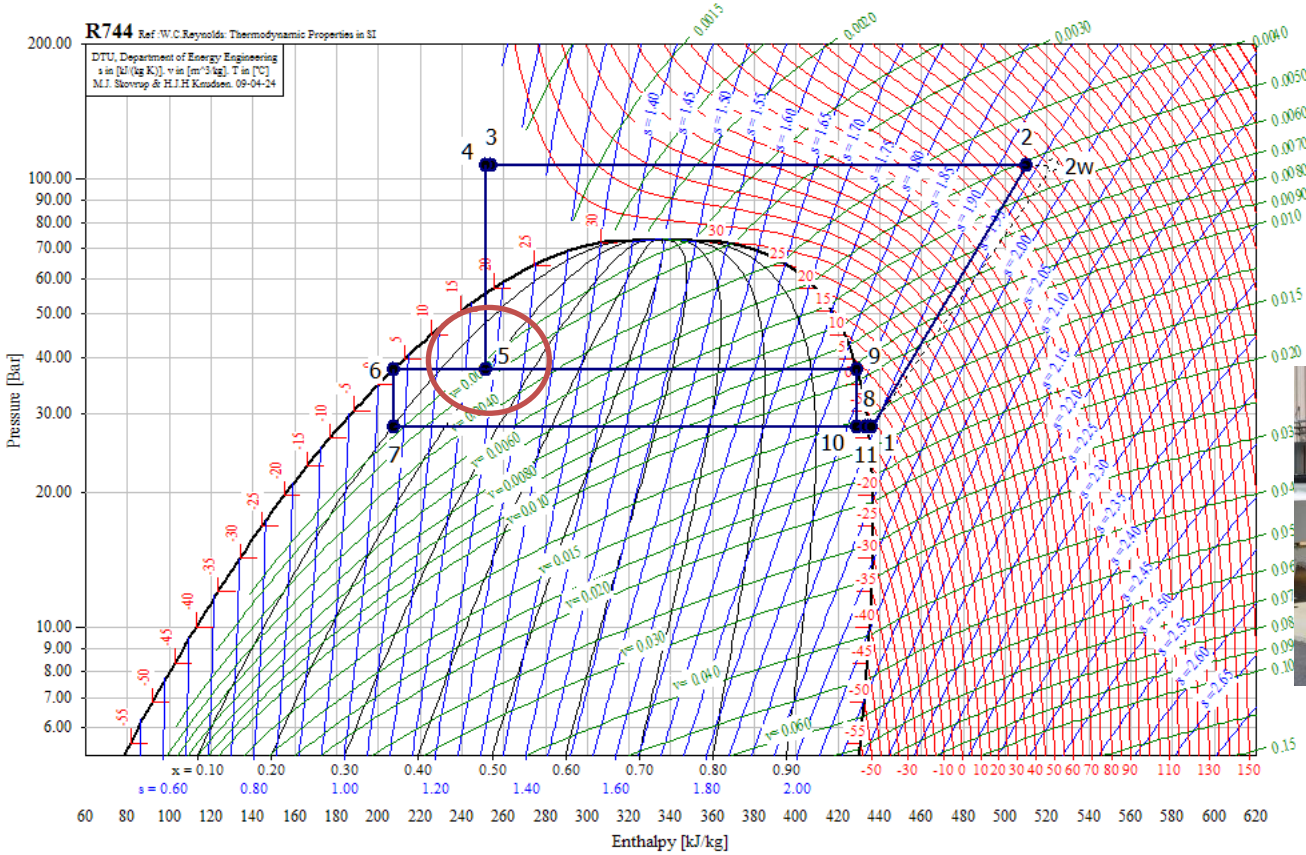
COP of TC CO2 @ SST-8 -> 2,1

However, energy for the chilled water production to be included

COP total with chilled water production included @SST-8 -> 1,8

Approved and tested solution, applied in Romania, Italy and Spain

Solution no.2 and 3:
Utilising wet bulb air temperatur approach



Peak savings 20%

Annual savings : 6-10%

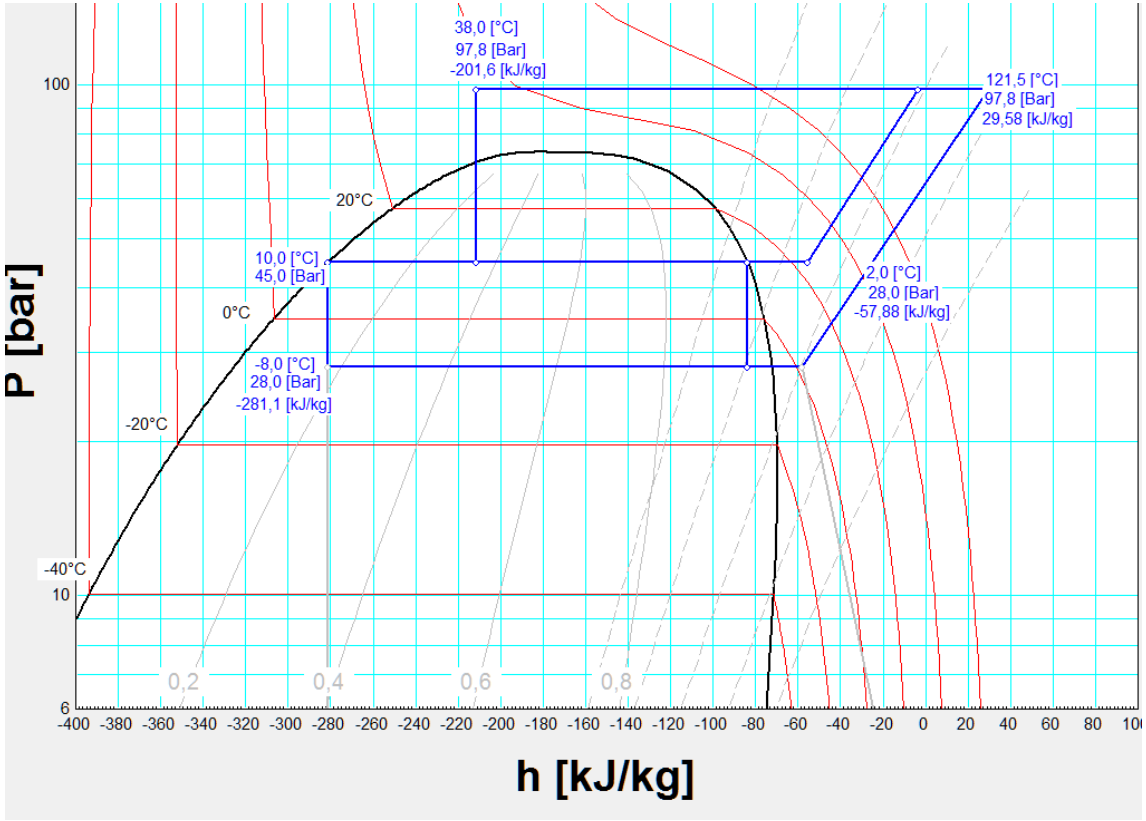
40°C dry ambient / 27Wet Bulb : approx 28% flash gas release at intermediate pressure

COP of TC CO2 @ SST-8 -> 1,9

based on ”evaporative free cooling” no energy for chilled water.

Trials in Atlanta and other US sites

Solution no. 4: Parallel compression



Peak savings 15-20%,
Annual savings 6-10%

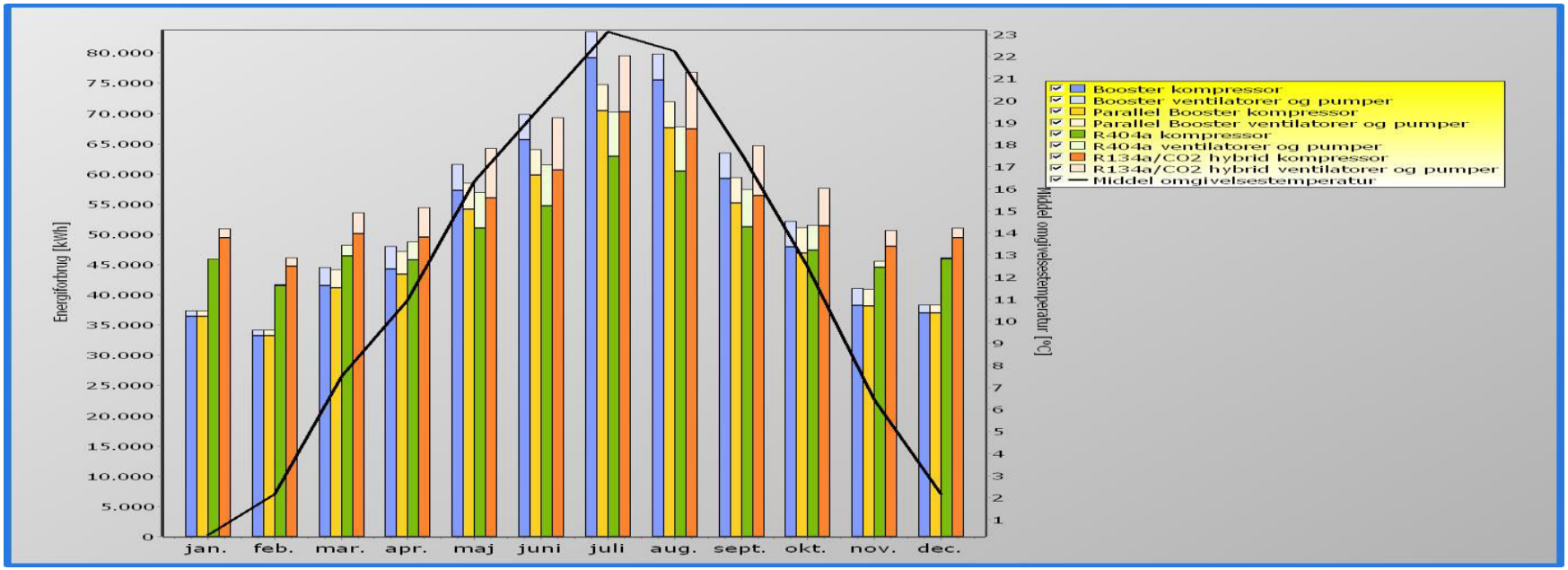
36 dry ambient : approx 38% flash gas removed at intermediate pressure

COP of TC CO2 @ SST-8 -> 1,9

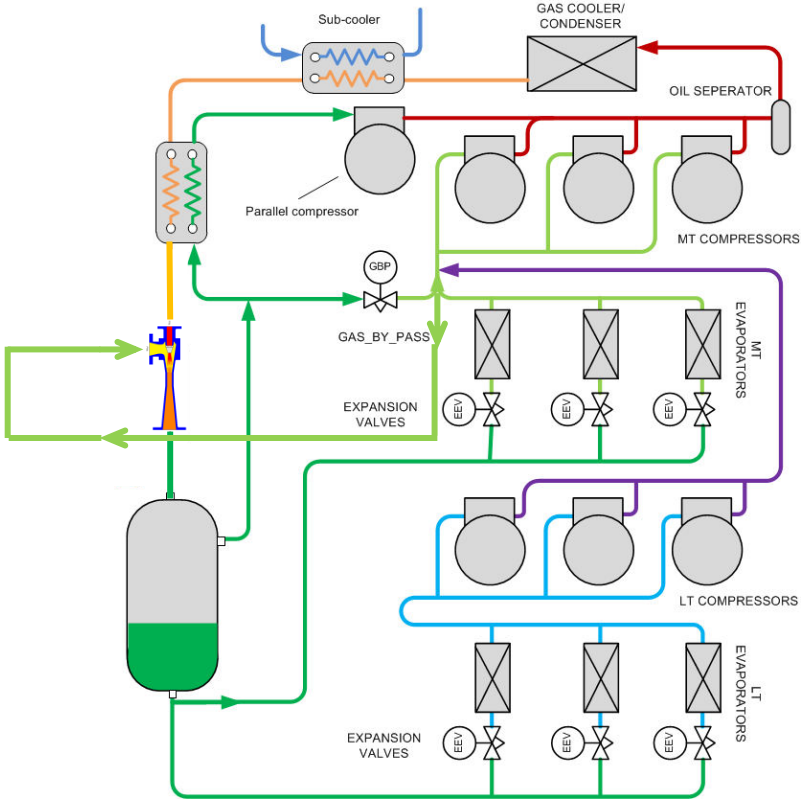
Approved and tested solution, applied: in Sweden, Denmark, Germany, Poland, Romania, Schweiz, France, Italy, Spain and US

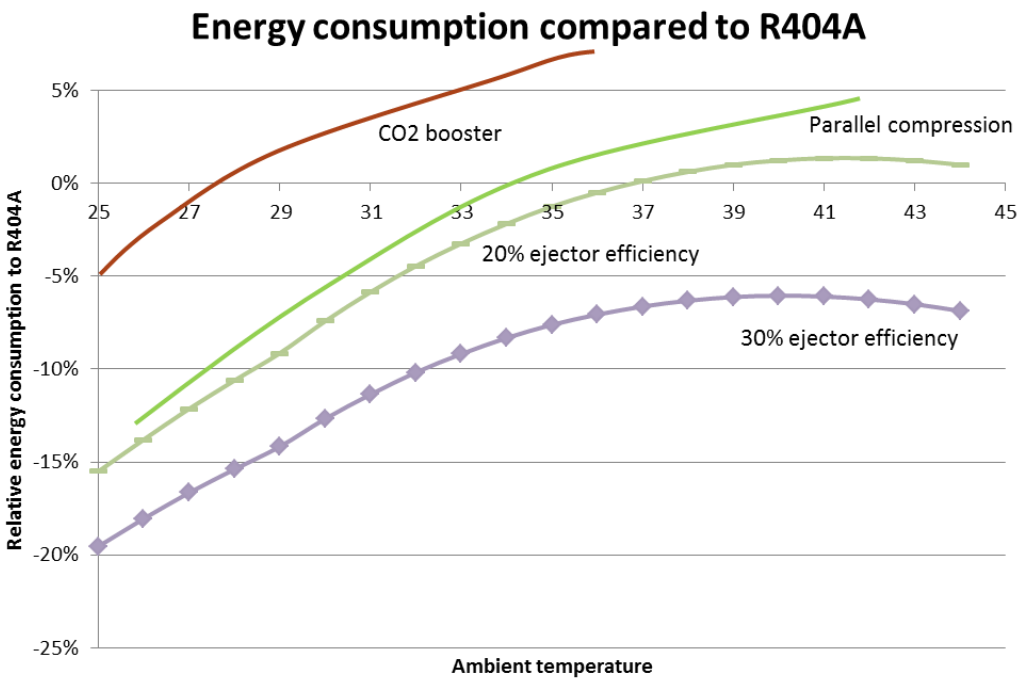
Annual simulations

Cooling capacity = 255 kW @-10°C		REF	Better	Good	Worse
Freezing capacity = 40 kW @-30°C					
		CO2 Booster	CO2 Booster+IT	R404A	R134a/CO2 hybrid
Italy, Milano	Power consumption [kWh/year]	653.845	621.901	641.870	718.931
	Savings, relative to CO2 Booster [%]	ref	-4,9	-1,8	10,0
Spain, Madrid	Power consumption [kWh/year]	699.985	660.185	662.435	743.058
	Savings, relative to CO2 Booster [%]	ref	-5,7	-5,4	6,2
Rumania, Bucharest	Power consumption [kWh/year]	649.586	616.091	642.791	718.583
	Savings, relative to CO2 Booster [%]	ref	-5,2	-1,0	10,6



Gas Ejector – improvement in hot climate





Peak savings 22-27% expected
Annual savings 12-16% expected

Conclusion – there is a brigth future outlook for enhanced CO2 solutions in commercial applications

	COP design point	Energy savings to standard R744	System simplicity	Maintenace cost	Total system cost	State of technology
Hi pressure sub coolers	1,8	6-10%	***	***	****	Proven
Wet bulb approach[1)]	1,7-1,9	6-10%	****	**	**	Proven
Parallel	1,8	6-10%	*****	*****	****	Proven
Parallel + gas ejector	2,2[2)]	12-16%[2)]	*****	*****	****	In test

[1)] Depending high on the wet bulb design temperature – best in dry climate

[2)] Expected data – to be validated during in 2015