



ATMO
sphere





TRANSCRITICAL CO₂ IN AUSTRALIAN SUPERMARKETS – CONTINUED SUCCESS

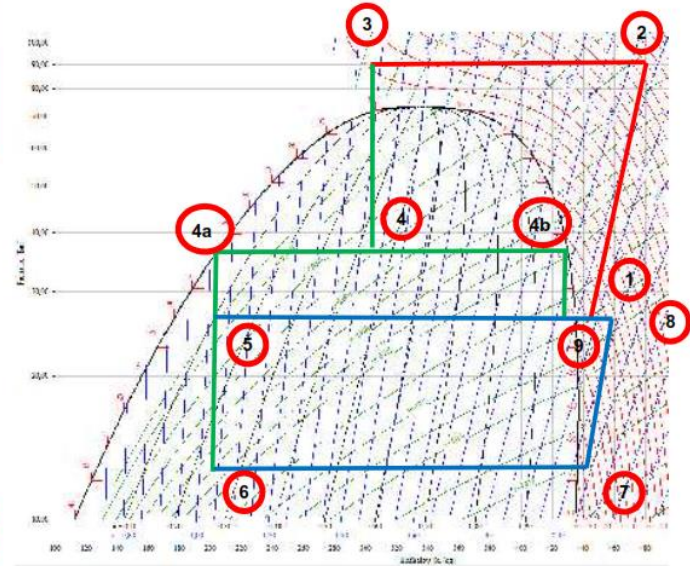
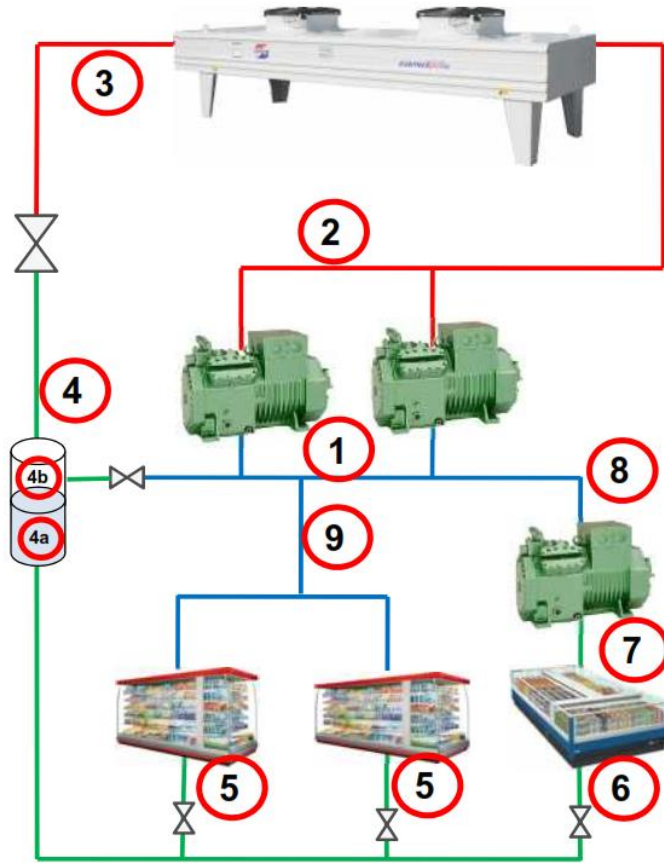
Mike Baker

Baker Refrigeration

M. IE Aust, C P Eng, M. AIRAH



Transcritical is here!



Transcritical is here!

- 14 x AJ Baker installs across Australia
- 4 more in design
- CO₂ Waterloop system on trial



Transcritical is here!

Ref	LT / MT loads & # Comps	Loc'n	GCOT Control Method	Other Features
1	26kW (3) / 111kW (3)	WA	R134A DX PHE desuperheater	
2	4kW (1) / 67kW (3)	VIC	R290/Chilled water PHE & adiabatic spray	
3	19kW (2) / 77kW (3)	WA	R134A DX PHE & adiabatic spray	
4	29kW (3) / 118kW (4)	WA	R513A (XP10) DX PHE & adiabatic spray	
5	29kW (3) / 121kW (4)	WA	R513A (XP10) DX PHE & adiabatic spray	FTE
6	4kW (1) / 67kW (3)	NSW	R290/Chilled water PHE & adiabatic spray	
7	4kW (1) / 67kW (3)	WA	Evaporative pre-cooling on gas cooler	
8	4kW (1) / 76kW (3)	QLD	R134A DX PHE & adiabatic spray	
9	20kW (3) / 148kW (5)	WA	R513A (XP10) DX PHE & adiabatic spray	FTE
10	4kW (1) / 76kW (3)	VIC	Evaporative cooling on gas cooler intake	Parallel comp & 60bar liquid
11	26kW (1) / 170kW (4)	NSW	Evaporative cooling on gas cooler intake	Parallel comp & FTE
12	8kW (1) / 90kW (3)	WA	R513A (XP10) DX PHE & adiabatic spray	
13	45kW (3) / 220kW (5)	SA	R513A (XP10) DX PHE & adiabatic spray	FTE
14	35kW (3) / 175kW (5)	SA	R513A (XP10) DX PHE & adiabatic spray	FTE

Methods of Gas Cooler Outlet Temperature Control

- Adiabatic Sprays
- Evaporative Pre-cooling
- Mechanical Sub-cooling
- Parallel Compression

Adiabatic Sprays

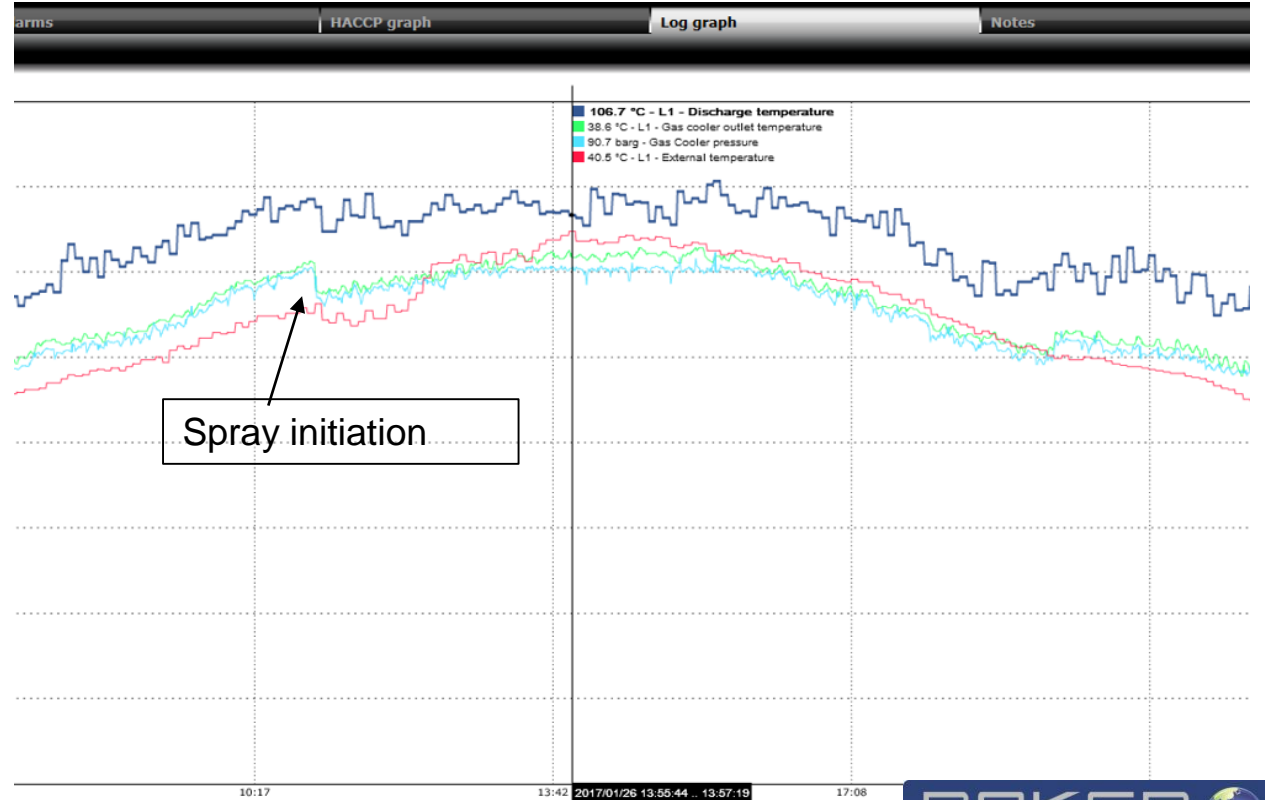
- Alters the inlet air conditions to the gas cooler, hence reducing GCOT & flash gas
- Simple control method
- Ideal for low humidity climates
- Caution with hard water locations & spray pattern/design



High Ambient Considerations

Adiabatic Sprays

- 9% drop in GCOT.
- 35°C initiation
- Would not rely on this method alone for max efficiency



Evaporative Pre-Cooling

- Alters the inlet air conditions to the gas cooler, hence reducing GCOT & flash gas production
- Pre-cooler pad design
- Ideal for low humidity climates
- Good for hard water locations
- Maintenance is necessary, & more costly than adiabatics

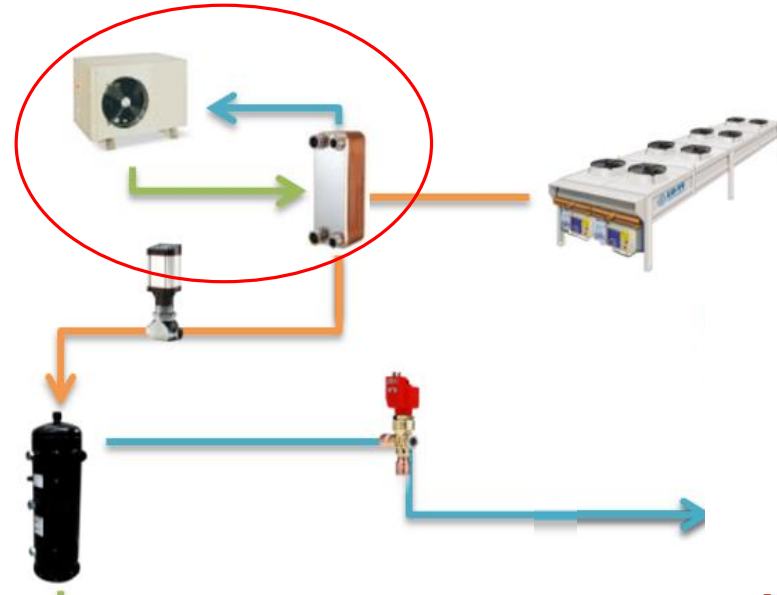
Evaporative Pre-Cooling

- 8% drop in GCOT.
- 26°C GCOT initiation
- Installations done both in vertical & horizontal air flow



Mechanical Sub-Cooling

- Refrigerated system on gas cooler outlet (+10°C SST)
- Trials done with R290 / Water system to the main PHE, as well as a direct R513A (XP10) unit.
- Reduces GCOT to reduce the quantity of flash gas



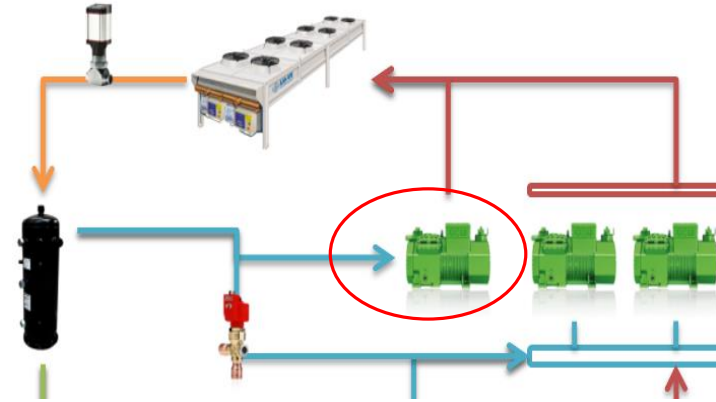
Mechanical Sub-Cooling

- Initiation temp 25°C
- This option does not introduce additional energy usage, and gives excellent GCOT control.
- Goal is to make this option 100% HFC free – system currently under testing.

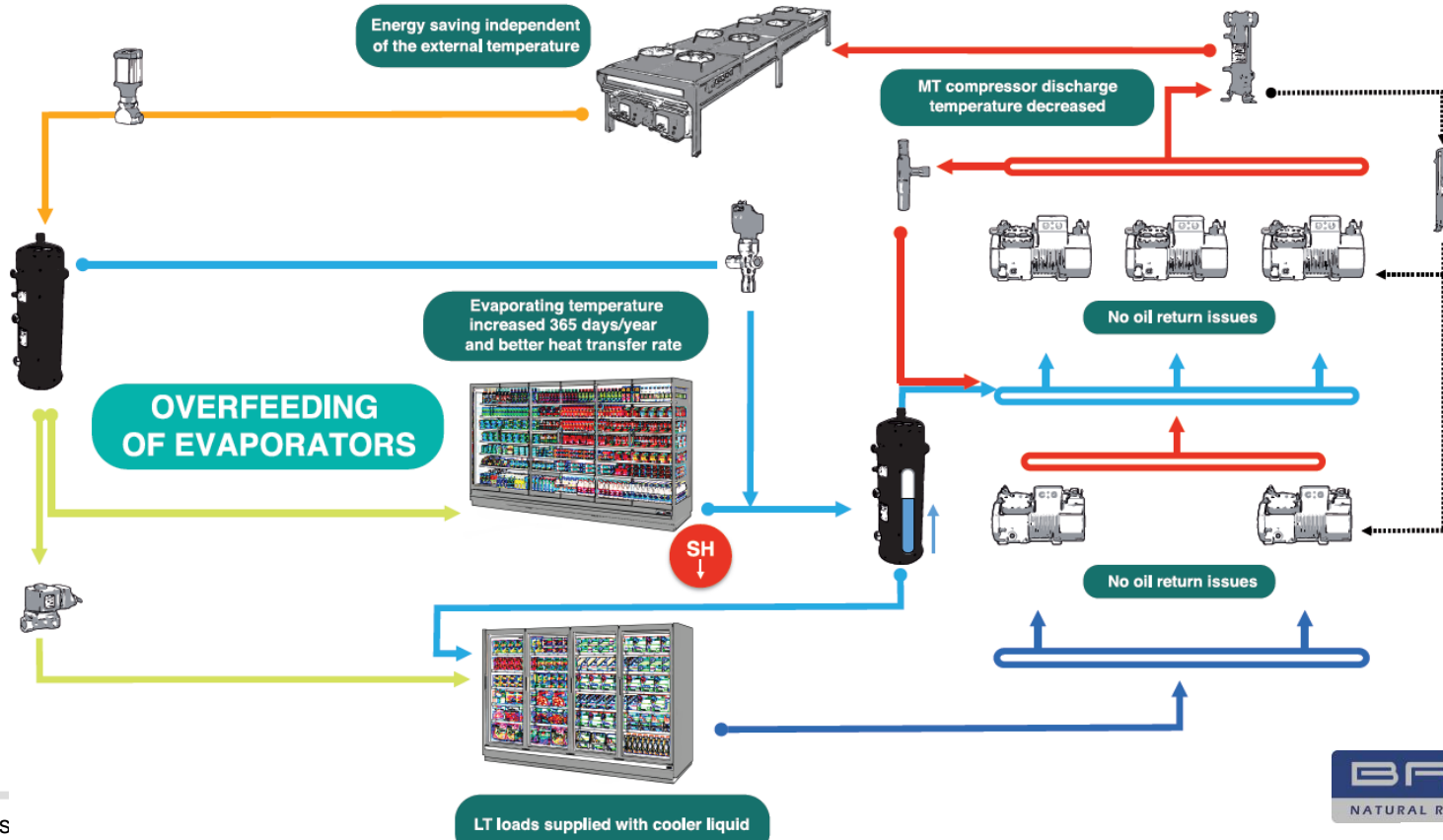


Parallel Compression

- Additional MT compressor connected to liquid receiver
- Allows a more efficient recycling of flash gas – no need for pressure reduction to MT suction P. FG v/v still in use.
- Comp. COP increase of 16% to 30%, depending on GCOT.
- Correct settings needed to get optimal utilisation.



FTE – Full Transcritical Efficiency



• SST Δ
-5°C to
-2.8°C

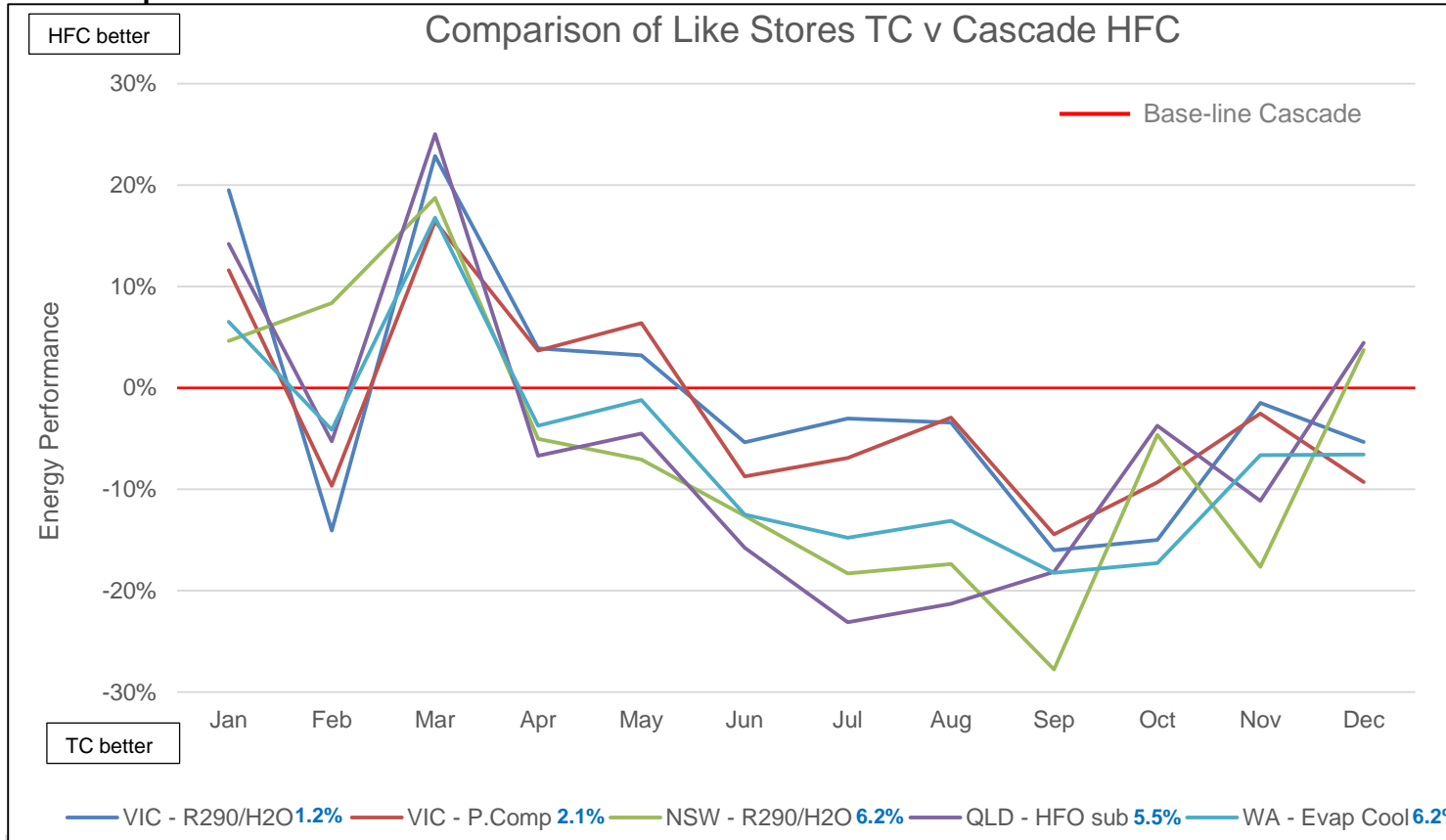
5.5% ↓
in REC.
Full yr
saving

FTE – Full Transcritical Efficiency

- Uses liquid overfeed on MT cases to then feed LT cases
- Raises the MT system evaporating temperature
- LT cases receive cooler liquid
- Oil return is uninterrupted in entire circuit
- Works both subcritical & transcritical
- 80 systems worldwide, 5 in Australia
- Approved by Bitzer International



Energy Savings



- Comparison stores within 20-30km radius
- Configuration is 1xLT CO₂ & 3xMT R134A
- Annual savings range from 1.2% to 6.2%
- Optimisation is ongoing to see further savings

Conclusions

- Energy savings are being realised in Australia with TC CO₂ when compared to Cascade CO₂/HFC.
- GCOT control / flash gas control is an imperative for energy efficient operation in Australia.
- From our site trials, ambient conditions can dictate the methods utilised.
- Each method of GCOT control has a place.



Conclusions

- Adiabatic or evaporative air pre-conditioning are simple yet effective method, when used in conjunction with additional methods.
- Secondary methods such as mechanical sub-cooling is simple, with savings dependent on climatic conditions and are comparable with parallel compression gains.
- Subcooling gives added benefits throughout the system, with further trials being undertaken.

Conclusions

- Parallel Compression, with some form of gas cooler air intake conditioning, gives a stable, cost effective and energy efficient solution.
- Additional savings with FTE, or MT liquid over-feeding, are being experienced also.



The Road Ahead



- Continued roll-out of TC CO₂ across the country
- Further stores being planned for Qld & SA, very challenging environments (4 under construction)
- CO₂ water loop system currently under trial, with a full installation complete by June – THE FIRST ONE.....
- Enhancements to high ambient operation under trial in WA (a game changer...)

BAKER

NATURAL REFRIGERANT SYSTEM



Thank you very much!

