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Ecolibrium

Phased

The HFC phase-down
definitively explained.





The refrigeration system was built offsite and lifted into place. Images: Courtesy Refrigeration Innovations.

A story of fire and cold

When fire destroyed the only supermarket in a small Victorian country town in 2016, all that was left – ironically – was a children’s firetruck amusement ride. Two years on, the Beechworth supermarket has now been rebuilt with an Australian-first refrigeration design, as **Sean McGowan** discovered.

As far as country towns go, Beechworth – at the edge of Victoria’s high country – is one of the special ones.

Located 280km north-east of Melbourne and about 40km south of the Murray, Beechworth was largely born out of the Gold Rush of the mid-1850s.

In its heyday, the town drew men and women from across the country, as well as from the US, the UK, parts of Europe, and China in search of gold. Mining camps in the surrounding areas sprang up in their thousands as prospectors and miners took to working the local creeks and quartz reefs. Gold fever was rife.

More than 160 years on, the town retains much of its Gold Rush heritage. It is now

home to almost 4,000 residents, with that population swelling during holiday periods as tourists and holiday-makers visit.

Many local businesses rely on the tourism trade, while others exist to serve the local community.

One of those businesses is the Ritchies IGA supermarket in Loch St.

THE TOWN’S ONLY SUPERMARKET

The sole occupant of the building for more than 15 years, the town’s only supermarket was an important part of the community before it was destroyed in an arson attack in January 2016.

Building the refrigeration plant offsite had numerous benefits

The fire left almost nothing of the supermarket behind. What remained of the damaged building had to be demolished.

The local community immediately rallied around the supermarket’s operators and staff. Before long a temporary supermarket was operating in a former plumbing supplies store – saving townfolk the 30-minute drive to the towns of Wangaratta, Myrtleford or Wodonga, as well as preserving many local jobs.

The local council also made the former library building available to temporarily accommodate the Ritchies IGA liquor outlet.

Beechworth's architecture reflects its Gold Rush origins.



FEATURE

The refrigeration system serving the rebuilt supermarket is a transcritical CO₂ system. It serves all aspects of the store's refrigeration and provides store cooling and heating (via waste heat).

Redden worked closely with the project's builder, Premier Building and Construction, and architect The Retail Group, to ensure the refrigeration system was considered part of the store environment and not just a stand-alone entity.

"The Retail Group were extremely influential in helping to convince the store developer and mechanical services teams of the outcomes we were trying to achieve," Redden says.

Committed to redeveloping the site for a new supermarket as quickly as possible, the property's owners worked with Ritchies IGA and the local Indigo Shire Council on a blueprint for the future. After settling insurance claims, construction commenced the following February.

STATE-OF-THE-ART REFRIGERATION

The new Ritchies IGA Beechworth opened in April this year.

Although the building sits on exactly the same footprint as its predecessor, 25 per cent more refrigeration was required to cater for a larger product range, particularly across the meat and liquor departments.

Appointed to the project as refrigeration consultant, Refrigeration Innovations has been involved in many Ritchies IGA projects around the state.

"I have been discussing the transition to natural refrigerants with them for some time," says Refrigeration Innovations' Dave Redden, F.AIRAH. "And it was felt by Ritchies that the time was right for all new greenfield sites and re-builds to adopt natural refrigerants.

"The brief at Beechworth was to design a system that used natural refrigerants, and ensured there was sufficient confidence in the installers and the equipment to make it happen."

"There tends to be a demarcation in buildings where there is refrigeration on one side and mechanical services on the other. But in this case both disciplines needed to come together to achieve the outcomes we were seeking."

Specialising in supermarket refrigeration installation and service, contractor MB Refrigeration was soon on board. MB set about installing the refrigeration plant while working alongside local mechanical services contractor Hydro-Spec.

The selected refrigeration plant was a pre-built, single-package unit contained on a common platform.

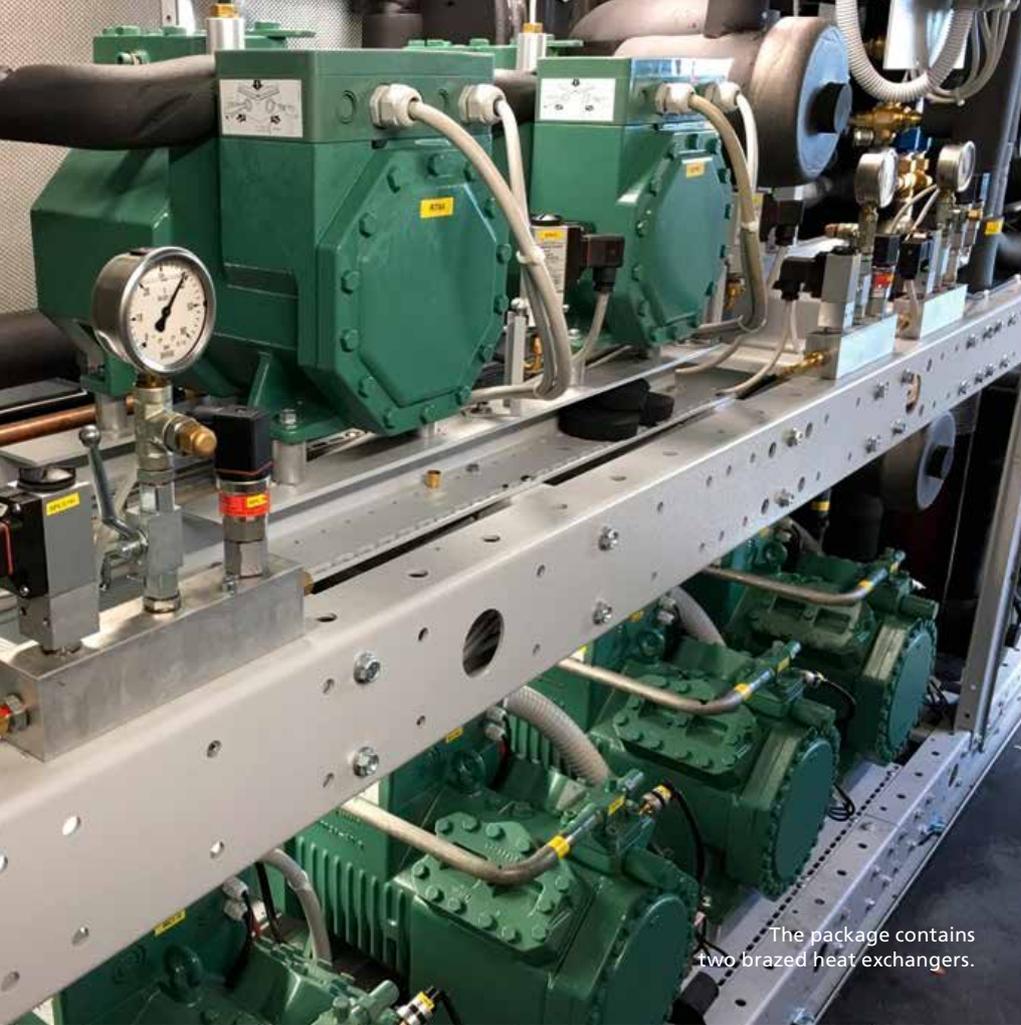
It incorporates low-temperature sub-critical compressors, medium-temperature transcritical compressors, air conditioning and parallel compressor.

Lead compressors are all inverter driven to match the load required, and save further energy by reducing compressor cycling, therefore reducing peak power load.

Built off-site, the refrigeration system was transported via road to Beechworth, and lifted into the new building's rooftop.

The plantroom has been carefully soundproofed to reduce the noise impact on local residents, and meets the noise levels requested of local authorities.

Redden says that on a project like this, building the refrigeration plant offsite had numerous benefits.



The package contains two brazed heat exchangers.

Gas ejector technology is most efficient in warmer climates such as those in Australia

“It reduced time on site and allowed the rest of the building works to take place while the plant was being built and shipped,” he says. “We were also able to coordinate crane lifts with other trades, thereby freeing up areas of works.”

The package unit also contains two brazed-plate heat exchangers – one for cooling and another for heating. These are connected to the store’s mechanical coils via pumps, and utilise water/glycol as heat transfer to the cooling and heating coils.

Overall, the refrigeration plant provides 21kW of low-temperature refrigeration cooling, 98kW of medium-temperature refrigeration, 105kW of cooling comfort load, and 110kW of comfort heating load by utilising waste heat.

AN AUSTRALIAN FIRST

Gas ejector technology – commonly used overseas in transcritical CO₂ installations operating in hot climates – has also been used at Ritchies IGA Beechworth in what is thought to be an Australian first.

Applied in combination with a parallel compressor in the transcritical CO₂ system, this technology can reduce energy consumption by between 10 and 20 per cent compared to a conventional booster transcritical system – depending on the ambient temperature the ejector is working at.

The multi-ejector used at Beechworth contains six ejectors of varying sizes,



The technology can reduce energy consumption by between 10 and 20 per cent.

allowing the system to modulate to different ejectors depending on load demands.

Redden says this gas ejector technology is most efficient in warmer climates such as those in Australia where systems are operating in a supercritical mode.

“When receiving CO₂ from the gas cooler, an ejector acts as an expansion valve in

lower-temperature subcritical operation. The CO₂ is two-phase at that stage, as there’s liquid and gas coming off the gas cooler. From there gas is entered from the medium-temperature suction line and diverts the gas to a receiver where it is combined with the flash gas. As this flash gas is at a much higher pressure, less energy is used to compress it.”



The new supermarket requires 25 per cent more refrigeration than the old, but uses less energy.

regulates all functions such as temperature and defrosts. These are linked by a communications “highway” back to the central graphing and logging centre, which records all events and generates fault alarms as they occur.

The system also allows for the “floating” of temperatures and control set-points within pre-determined limits. This contributes to the energy savings, particularly during store closing at night.

“Especially interesting is the machine-learning software in the gas ejector control unit,” says Redden. “Over a period of commissioning time, it learns the best strategies for controlling its capacity.

“This type of software will become more commonplace as it develops over time, but it is an exciting process to witness.”

A FEW MONTHS ON

Since reaching practical completion and opening in April, the new, energy-efficient supermarket has been embraced by the local Beechworth community.

Even though it has only operated for a few months to date, the refrigeration plant has already contributed to a significant reduction in the supermarket’s carbon footprint compared to the old store. Energy data has shown a month-by-month reduction in kilowatt hours compared to the old store of between 14 per cent and 35 per cent – despite the 25 per cent increase in refrigeration.

Further energy savings are also made because the size of the parallel compressor is reduced, requiring less energy from it when the gas is received.

Redden says the gas cooler is also fitted with an adiabatic cooling system for use during warmer months to reduce the air temperature onto the gas cooler coil.

CLOSE CONTROL

The supermarket’s refrigeration and HVAC systems are controlled on several fronts.

The main refrigeration controller is able to load and unload compressor capacity as required. This achieves optimum temperature control and energy efficiency by maintaining a steady suction pressure.

All cases and coolrooms are fitted with electronic valves, and a controller



Low-noise fans were fitted to the gas cooler to satisfy local noise restrictions.



“Ritchies Beechworth is another example where Refrigeration Innovations and The Retail Group could show that the return on investment is a financial and social one,” says Ian Williamson, director of The Retail Group.

“The level of investment is project-specific, but the more you put in the greater the return. Ultimately, the solutions adopted by Ritchies can create a more sustainable, energy-efficient business that delivers a better balanced response and improved space.”

Fine-tuning at Ritchies IGA Beechworth remains ongoing.

“One of the things we have learned is that keeping the heating running overnight in the cold winter period has resulted in a warm store at opening that doesn’t require a warm-up period,” says Redden.

“We monitored the energy use before and after we implemented this, with no discernible change in energy recorded.”

The fact that the gas cooler fans don’t run overnight because waste heat is diverted through the store has also delivered an energy reduction. Further energy efficiencies are also expected

to be achieved as the performance of the supermarket’s refrigeration cases is evaluated. “CO₂ is such an efficient refrigerant,” says Redden, “that standard settings can always be improved on.” ■

PROJECT AT A GLANCE

The personnel

- **Builder:** Premier Building and Construction
- **Client:** Ritchies IGA Beechworth
- **Fitout:** The Retail Group
- **Electrical contractor (light and power):** Watters Electrical
- **Electrical contractor (refrigeration):** Ace Electrics
- **Mechanical services contractor:** Hydro-Spec
- **Refrigeration contractor:** MB Refrigeration

- **Refrigeration services engineer:** Refrigeration Innovations

The equipment

- **Compressors:** Bitzer
- **Controls:** Danfoss
- **Gas cooler:** Luvata
- **Mechanical controls:** Innotech
- **Refrigeration cases:** Hussman, Bonnet, Arneg
- **Refrigeration plant:** SCM Beijer

(Source: Refrigeration Innovations)