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The tech trap

Are smart
devices
making us
stupid?

Skills

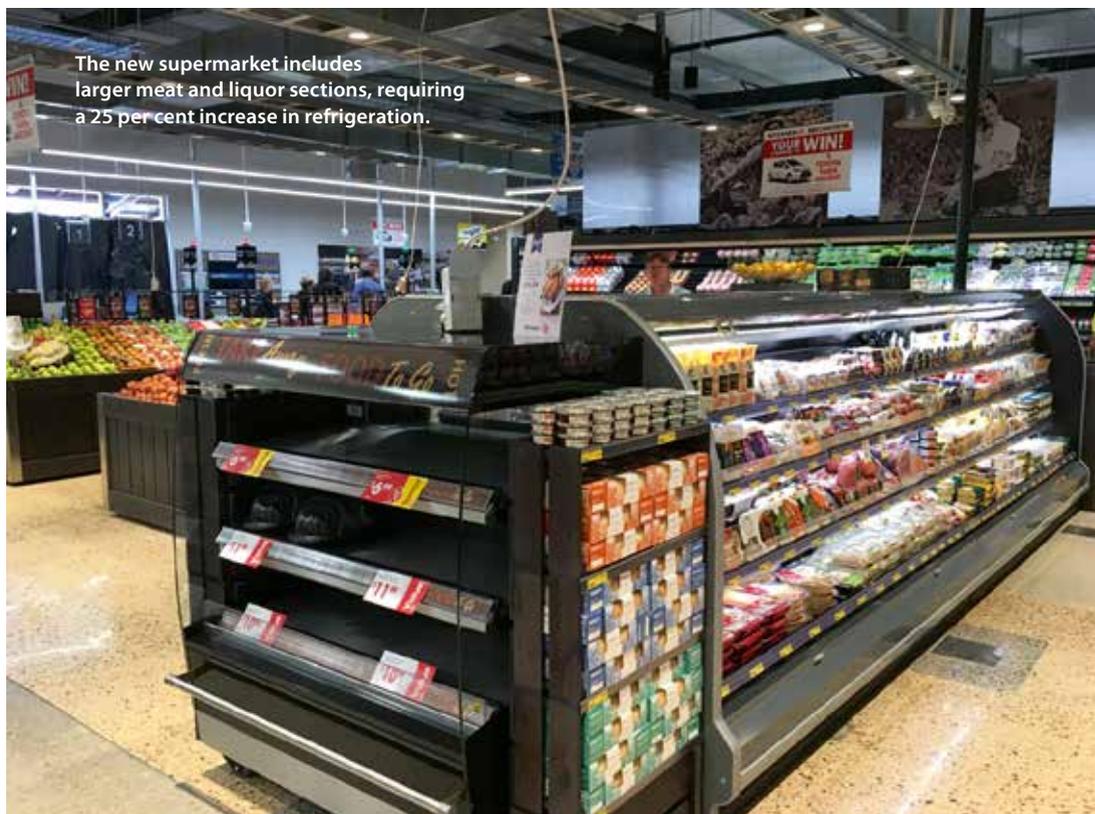
WORKSHOP

Calibration
and use of
instruments

Cooling Kelly Country

An Australia-first supermarket
solution in Beechworth

COOLING KELLY COUNTRY



The new supermarket includes larger meat and liquor sections, requiring a 25 per cent increase in refrigeration.

“ One summer evening in January 2016 . . . Beechworth’s only supermarket was razed to the ground in an arson attack

Such was the ferocity of the fire that firefighters had been unable to subdue it. The building’s entire structure had to be demolished.

The local community immediately rallied around the supermarket’s operators and staff, and before long a temporary pop-up supermarket was established in a former plumbing supplies store. This saved residents the 30-minute drive to surrounding towns – Wangaratta, Myrtleford or Wodonga.

The local council also made the former library building available to temporarily accommodate the Ritchies IGA liquor outlet that had been destroyed by the blaze as well.

COMMITTED TO THE REBUILD

Naturally, the property’s owners and Ritchies IGA were committed to rebuilding the supermarket as quickly as possible, and set about working with the local Indigo Shire council on plans.

But as is typical in such events, 12 months passed before insurance claims could be settled and construction of a new supermarket could begin.

The new building was designed to sit on exactly the same footprint as its predecessor in Loch Street.

With the HFC phase-down under way, refrigeration systems incorporating natural refrigerants such as CO₂ are gaining popularity. **Sean McGowan** reports on the rebuilding of a supermarket in country Victoria using an Australian-first refrigeration and HVAC design.

Beechworth is a picturesque heritage town in Victoria’s high country. Its historic courthouse, prison and the Ned Kelly Vault all mark this as one of the stomping grounds of the bushrangers in the mid-1800s – Kelly country.

Located almost 300km north-east of Melbourne and about 40km south of Albury-Wodonga, the town is now home to almost 4,000 residents. And that population swells during holiday periods as visitors flock to the locale to enjoy the ski fields, wineries and region’s natural beauty.

Many local businesses in Beechworth rely on this tourist trade, but just as many exist to provide vital services and steady employment to locals. One such business is the Ritchies IGA supermarket in Loch Street.

ARSON ATTACK

One summer evening in January 2016, while hundreds of locals and visitors enjoyed the Opera in the Alps event at the local golf course, Beechworth’s only supermarket was razed to the ground in an arson attack.

The town woke the next morning to the devastating news that the fire had left almost nothing behind – except, ironically, the scorched remains of a children’s firetruck amusement ride.



Dropping in the prefabricated plant.



The pump station for the heating and cooling loops before pipe insulation was fitted.

INTERNATIONAL EXPERTISE

Detailed discussions with the refrigeration plant manufacturers both in Australia and in Italy were crucial to the project's success.

"We had the opportunity to meet and speak with the refrigeration plant manufacturer's technical engineer while he was here in Australia, to ensure he was on board with what we were trying to deliver," says Dave Redden, F.AIRAH, from Refrigeration Innovations

"As this was going to be a first in Australia, you don't get a trial run!"

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

He says The Retail Group were extremely influential in convincing the store developer and mechanical services teams to share this approach.

"There tends to be a demarcation in buildings where there is refrigeration on one side and mechanical services on the other," he says. "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 worked alongside local mechanical services contractor Hydro-Spec to successfully install the refrigeration plant. This was a pre-built, single package unit contained on a common platform.

However, an expanded product range – particularly across the meat and liquor departments – demanded a 25 per cent increase in refrigeration on the site.

This resulted in a natural refrigerant solution being designed by the project's refrigeration consultant, Refrigeration Innovations.

Company principal Dave Redden, F.AIRAH, had already been involved in many Ritchies IGA projects around Victoria. He had also held discussions with the group about transitioning to natural refrigerant solutions before the rebuilding of the Beechworth supermarket.

"It was felt by Ritchies that the time was right for all new greenfield sites and rebuilds to adopt natural refrigerants," says Redden.

"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."

The refrigeration system in the rebuilt supermarket is a transcritical CO₂ system. It serves all aspects of the store's refrigeration requirements, as well as providing store cooling and heating via an innovative waste heat reclaim system.

POWER OUT

During a recent planned power outage that affected the town, Redden says there was no loss of CO₂ and the plant re-started on power up, with performance as expected.

"Detractors of CO₂ say this is a problem," says Redden. "But this experience only provides more confidence in the resilience of CO₂ systems."

The transcritical CO₂ system 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. Further energy savings are achieved by reducing compressor cycling and therefore reducing peak power demand.

The transcritical CO₂ system adopted at Beechworth also features two brazed-plate heat exchangers – one for cooling and another for heating. These are connected to the supermarket's mechanical coils via pumps, and use a water/glycol mix as a heat-transfer agent to the cooling and heating coils.

Such is the efficiency of the system that it provides 21kW of low-temperature refrigeration cooling, 98kW of medium-temperature refrigeration cooling, 105kW of comfort cooling and 110kW of comfort heating through the utilisation of waste heat.

Redden says there are many benefits of using a pre-fabricated system.

"Having the plant prefabricated into a demountable plant room was a huge advantage, as it saved many hours of onsite assembly work," he says. "The interconnect to the store was made so much smoother as we were on a finish deadline and had to have the store open for the client (on time)."



A view of some the CO₂ compressors.

LESSONS FROM THE DESIGNER

Dave Redden of Refrigeration Innovations offers a few tips on how to best approach a CO₂ refrigeration project.

- **Do your homework before presenting your ideas.** "It takes two to tango," says Redden. "And the customer holds all the money."
- **Be honest.** "In your presentations of energy and cost savings, it is better to err under than over."
- **Get the contractor on board.** "Ensure the installing contractor is fully conversant with the installation and what you are trying to achieve, as he can be your best or worst asset. I have had to expend considerable effort to overcome

the negative arguments put forward by contractors who have not been exposed to the new and emerging technologies.

"Similarly, other contractors have embraced the technology and progressed – they will be the future of contracting.

"I think it was Charles Darwin who said it would not be the fittest or strongest who survive, but those who can adapt to change."

■ **Before and after.** "Show the hard data to the client upon completion of the project and do a 'before and after' on energy bills. It is amazing to see the difference."

■ **Be confident (and natural).** "CO₂ and other natural refrigerants are the way of the now and the future. There's no going back."

The project adopted a walk-in plant room, which was craned onto the rooftop of the new building.

The plant room has been carefully sound-proofed to reduce the noise impact on residents and meets the noise levels required by local authorities.

"Beechworth is a very quiet country town at night," says Redden, "so reducing neighbour disturbance was high on our list of priorities."

The plant room also provides a safe, weatherproof environment in which service personnel can carry out their work without being exposed to the elements. This is particularly useful given the cold winters and hot summers experienced in the region.

BREAKING NEW GROUND

In what is considered to be an Australian first, gas ejector technology has been used at Ritchies IGA Beechworth.

Commonly used overseas in transcritical CO₂ installations in hot climates, gas ejector technology (used in conjunction with a parallel compressor within the transcritical CO₂ system) 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 ejector block at Beechworth consists of six individual ejectors of varying sizes, allowing the system to modulate to different ejectors depending on load demands.

According to Redden, gas ejector technology is most efficient in warmer climates. This includes those across most of Australia, where systems operate in supercritical mode.

"When receiving CO₂ from the gas cooler, an ejector acts as an expansion valve in lower-temperature subcritical operation," explains Redden.

"The CO₂ is two-phase at that stage, as there is 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 required to compress it."

Further energy savings can also be realised because the size of the parallel compressor is reduced. It therefore requires less energy when the gas is received.

To reduce the air temperature onto the gas cooler coil during warmer months, the gas cooler installed at Beechworth has also been fitted with an adiabatic cooling system.

IN-STORE CONTROLS

The new refrigeration systems are controlled by a main refrigeration controller that can load and unload compressor capacity as required. Redden says that by maintaining a steady suction pressure, optimal temperature control and energy efficiency is achieved.

All refrigerator and freezer cases and coolrooms within the supermarket are fitted with electronic valves. A controller regulates all functions, including the temperature and defrosts. These are linked by a communications "highway" back to the central graphing and logging centre, where all events are recorded and fault alarms generated.

The control system also allows for "floating" temperatures and control set-points within pre-determined limits. This contributes to the store's total energy savings, particularly when it is closed overnight.

Also, machine-learning software has been used to control the gas ejector system.

"Over a period of commissioning time, the system learns the best strategies for controlling its capacity," says Redden.

"This type of software will become more commonplace as it develops over time. It is an exciting process to witness."

COMMUNITY BENEFITS

A little over two years after the original supermarket was destroyed, the new Ritchies IGA Beechworth opened in April 2018.

The opening was welcomed by the local Beechworth community. Those behind the supermarket's design have reason to be happy with the refrigeration system too.

According to The Retail Group's director Ian Williamson, the Ritchies IGA Beechworth project has demonstrated the value of innovative refrigeration solutions.

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

In the rebuilding of the Beechworth supermarket, he says the return on investment is two-fold.

"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."

Fine-tuning of the transcritical CO₂ refrigeration system remains ongoing, with the project team already taking some valuable lessons. This includes the benefits of keeping the heating operating overnight during the winter period.

"Having a warm store at opening (that doesn't require a warm-up period) is good for not only staff efficiency but welcoming to customers," says Redden. "We monitored the energy use before and after we implemented this, and there was no discernible change in energy recorded."

Though it remains too early to paint a full picture of the supermarket's energy performance since opening in April, savings of between 4.5 and 14 per cent have been recorded.

"CO₂ is such an efficient refrigerant that standard settings can always be improved on," says Redden. "We are looking forward to measuring this during the upcoming summer." ■

PROJECT AT A GLANCE

THE EQUIPMENT

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

THE PERSONNEL

- ▲ **Architect:** The Retail Group
- ▲ **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

(Source: Refrigeration Innovations)