

SUPERMARKET OF THE FUTURE, NOW



The Coles Hallam store condenser deck.

Consolidating Coles' work on several pilot projects around Australia over the past decade, a new supermarket in Melbourne's south-east has achieved a 20 per cent reduction in energy consumption. As Sean McGowan reports, a combined cooling plant is at the heart of the energy savings for this ARBS Award winner.

Recognising the impact refrigeration and air conditioning has on its carbon footprint, Coles has been actively pursuing the sustainable design of its stores for more than a decade.

Coles has pioneered the development and trial of CO₂ cascade refrigeration systems since it opened its first environmental concept store at Gisborne in 2005.

More recently, it created a custom Green Star tool for supermarkets in conjunction with the Green Building Council of Australia (GBCA).

And while it isn't mandatory, the deliberate choice to rate its stores is a further step in the retailer's pursuit for a more sustainable future.

Now, through the development of its new Hallam store in Melbourne's south-eastern suburbs, Coles has shown that a 20 per cent reduction in energy consumption is possible. The reduction came predominantly through improved engineering design of refrigeration and air conditioning plants.

Combined with initiatives in lighting, mechanical services and water and waste management, the Hallam store proves that these energy reductions are achievable without substantially higher capital expenditure.

It means Hallam has become the retailer's base model, with an aim to achieve a minimum 4 star Green Star rating for future Coles stores.

"The major challenge to achieve a Green Star rating was to reduce energy consumption by 20 per cent, for a supermarket where 60 per cent of energy consumption is from commercial refrigeration," says Coles' engineering design manager, Rahil Gandhi.



The shopfront of the Coles store that set the bar for all future stores at a minimum 4 star Green Star rating.

“As the majority of the store’s energy reduction had to be achieved by reducing the energy consumption of the commercial refrigeration component, Coles has developed a strategy and innovative plant design to achieve these considerable energy savings.”

Other Coles engineering personnel to have played a decisive role in the implementation of the Coles Hallam project include the late Paul Sheahan, who was Coles national engineering refrigeration manager at the time; Coles building engineer Reg Binding and Coles refrigeration engineer CSP Sarathy.

COMBINED COOLING

At the heart of the energy savings realised within the new Hallam store is a 500kW combined cooling plant (CCP), which replaces the traditional use of separate refrigeration and air conditioning plants.

According to Gandhi, along with meeting an energy reduction target of 20 per cent, the primary focus of the Hallam trial has been to reduce refrigerant gas consumption and the associated global warming potential (GWP) of HFC refrigerants.

Reductions in refrigerant usage and carbon emissions led the company to pursue development of a CO₂ cascade refrigeration system, which reduces its overall carbon emissions footprint.

“Coles has pioneered the use of CO₂ cascade systems, having installed them at five stores before Hallam, including Gisborne in Victoria, and Westmead,

Katoomba, Greenacres and Rouse Hill in New South Wales,” Gandhi says.

Gandhi says the capital cost of installing CO₂ cascade systems was once very high, and a general lack of expertise in design, installation and commissioning held the technology back. These issues, he says, have now been overcome.

“ Hallam has become our base model for new stores. Many of the initiatives that were developed for this project are now business as usual. ”

“The commissioning of a cascade CO₂ system is more complex than standard systems, and there is a higher risk associated with the storage and use of large quantities of CO₂ in a supermarket compared to standard plant design,” Gandhi says.

The Coles Hallam installation incorporates the lessons learned from almost a decade of trialling these systems.

It features low and medium-temperature refrigeration compressor racks using CO₂ as the primary refrigerant,

with R134a used as the cascade refrigerant, to provide refrigerated cooling to the store’s refrigeration cases and cool rooms.

Waste not

In addition to a focus on energy efficiency through its refrigeration plant, Hallam Coles also features organic recycling of waste from its fresh food departments, which is turned into compost.

Customers can use a soft plastics recycling program that diverts four tonnes of waste from landfill every week.

Made up of lunch wrap, plastic bags and packaging, this material is collected and recycled to make garden seats, for community organisations around the country.

The cumulative effect of these programs is that about 65 per cent of the store’s waste is recycled.

Air conditioning for the store is supplied through the production of 6°C chilled water, via heat transfer from the R134a refrigerant to water using heat exchangers. This chilled water is then circulated to multiple fan coil units (FCUs) and air-handling units (AHUs) located throughout the retail area, as well as back of house and offices.

Heat rejection is achieved through the use of adiabatic condensers that utilise recycled rainwater.

“By working together as a CCP, we have eliminated duplication of assets resulting in a reduction in maintenance costs too,” says Gandhi.

“Furthermore, as the refrigeration and mechanical systems are CCP, the adiabatic condensers reduce the energy consumption of the compressors by more than 20 per cent by reducing the supply air temperature onto the condenser coils.”

“ Although the cost of installing CO₂ cascade systems was once very high, and a lack design and installation expertise held the technology back, these issues have been overcome. ”

Gandhi says that through this design, the quantity of synthetic refrigerants in use has been reduced by approximately 60 per cent, leading to a substantial overall reduction in GWP.

Interestingly, the system has been designed to allow for the replacement of R134a with R1234ZE – a new hydrofluoroolefin refrigerant with a very low GWP that offers comparable efficiency to R134a.

“R1234ze has a GWP rating of six, in comparison to R134a’s GWP rating of 1430,” says Gandhi.

“By using R1234ze, there is a significant reduction in GWP, which in turn reduces the adverse impact on climate change. Using R1234ze has also demonstrated moderate energy savings in the refrigeration plant.”

ADDITIONAL ENERGY SAVINGS

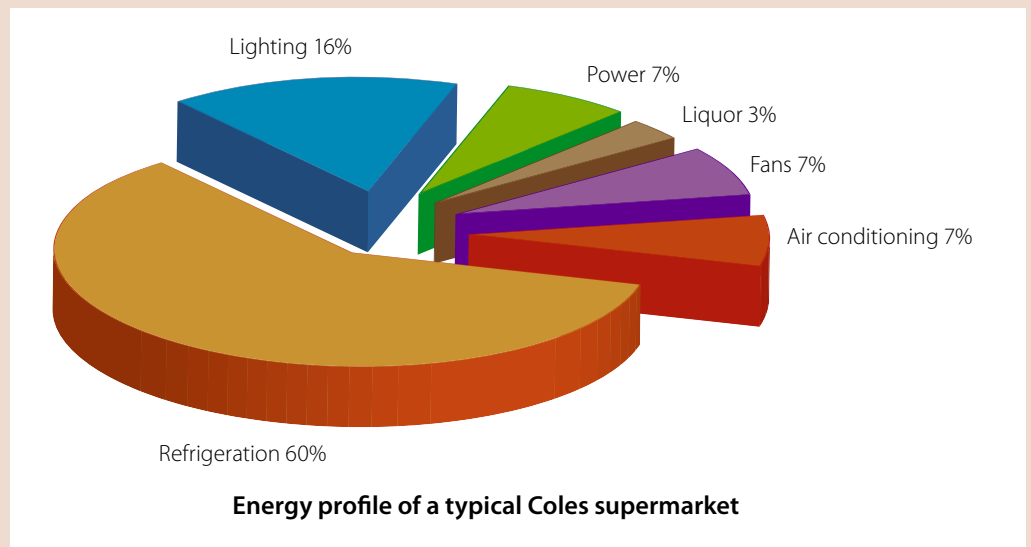
The Hallam store’s overall refrigeration system is complemented by the use of refrigeration cases that incorporate dual air screens that reduce warm air infiltration. This reduces the energy consumption of the cases while efficiently maintaining product temperatures.

To reduce the energy consumption of the store’s air conditioning further, an outside air management system has also been incorporated.

“We control the quantity of outside air coming into the store relative to the occupancy levels throughout the day,” says Gandhi.

He says this system is much more efficient than a conventional mechanical system because it only treats the outside air required for use.

Coles energy profile



A typical Coles supermarket consumes a substantial amount of energy.

Refrigeration is the largest consumer, operating 24 hours a day and responsible for about 60 per cent of the total store’s energy consumption. Lighting and general power consumption make up an aggregate 23 per cent of consumption.

The spill over from the refrigeration cases also serves to remove humidity from the air, complementing the air conditioning system and driving further energy consumption reductions.

The combined refrigeration and air conditioning initiatives have delivered a 40 per cent energy reduction alone. The Hallam store’s refrigeration and air conditioning systems consume approximately 1800kWh per day, compared to an average 3000kWh per day in a typical store.

BRIGHT IDEAS

Through collaboration with its lighting suppliers, the Coles engineering team has developed customised LED light fittings that deliver reduced energy and maintenance costs, while providing up to three times the lifespan of fluorescent fittings.

“These lights maintain a good standard of colour rendition and a more consistent lux output over the life of the fitting,” says Gandhi. “The consumption of energy for lighting at Hallam is 50 per cent less than a typical Coles store.”

The design of Coles Hallam also incorporates rainwater storage tanks, allowing for the harvesting of rainwater from its extensive roof. Along with being used by the refrigeration system’s adiabatic condensers, this water is also used to flush the store’s toilets.

“About 500,000 litres of water is required to run the adiabatic cooling system annually,” says Gandhi.

“Our water tanks harvest 1.4 million litres, so the system is entirely self-sufficient. This means that at times of water restriction and drought, we can still operate our store without impact on local water storage supplies.”

Adding to the store’s reduced potable water use, the landscaping has been designed such that vegetation has been planted within drainage swales.

TARGETING 4 STARS

In 2009, Coles embarked on a project to develop a “supermarket of the future” that would be more energy efficient and could be delivered at a lower cost. The retailer evaluated all available building energy rating tools that could be used to measure the proposed supermarket, as well as all existing 750 stores nationwide.

This included consideration of the GBCA Green Star and NABERS tools, neither of which offered a rating tool for supermarkets.

This led to the GBCA offering Coles in 2010 the opportunity to develop a custom pilot tool for Coles’ supermarkets. This necessitated participating parties to disclose intellectual property that might be commercially sensitive in nature.

Coles embraced this opportunity, and in the following 10 months developed the Coles Custom Pilot Tool, which was GBCA-approved in August 2011.

Coles Hallam is now the first supermarket to undergo the rating process, with Coles seeking a 4 star Green Star rating.

“Hallam has become our base model for new stores,” says Gandhi. “Many of the initiatives that were developed for this project are now business as usual.”

Gandhi says Coles is still exploring further improvements, and experimenting with different refrigerants, as well more efficient refrigeration case models.

“Coles engineering is proud of the benefits achieved at Coles Hallam,” Gandhi says, “and is proactively striving to build on this with more sustainable innovations in our new store brief.”

Coles Hallam won the Refrigeration Project Excellence Award at the 2014 ARBS Awards. ▲