BUILDING GREENHOUSE RATING

Ten Parramatta buildings put to the Australian Building Greenhouse Rating test with surprising results

What are the opportunities to improve energy performance in existing buildings? If the results of the 'Parramatta CBD Greenhouse Leaders' project are any indication, there are significant gains to be made through improving controls on building heating, ventilation and air-conditioning systems.

The Parramatta CBD Greenhouse Leaders project is a joint undertaking between ten leading building owners with commercial premises in Parramatta, the Parramatta City Council and the NSW Government's Sustainable Energy Development Authority (SEDA).

Participants in the project include eight of the largest property owners in Australia, and four of the largest buildings in the Parramatta CBD.

According to the energy efficiency consultant involved in this project, Dr Paul Bannister, Managing Director, Exergy Australia, improving the greenhouse performance of ten buildings in the Parramatta CBD focused on "relatively simple and inexpensive changes" to the control system of each building. And the results speak for themselves – a massive energy savings potential of $450,000 per year across the ten buildings.

"It's about filling the gap between what a building can do and what it is actually doing. In most cases, it's a question of maintenance and accessibility of the equipment that's in place," said Bannister.

Participants in the project include Parramatta City Council, AMP Henderson, Colonial First State Property, Investa Property Group, Deutsche Asset Management, Industry Superannuation Property Trust, Stockland Property Trust, Mirvac, ANZ Property and Henderson and Horning for Yalanga. All have agreed to an initial Australian Building Greenhouse Rating (ABGR) with a follow-up rating in one year's time to assess the greenhouse reductions achieved by fine tuning the controls.

The ABGR results ranged from one star to four stars, but the problem areas were surprisingly similar in all the buildings and included condenser water temperature, domestic hot water calorifiers, boilers and reheats, fan speed control, control instability and supply temperature and economiser controls.

What were the major problems?

Condenser Water Temperature

Across the board, condenser water temperature was an issue.

"It's standard practice to set building temperatures anywhere between 26 and 29 degrees Celsius. However, chiller performance improves by around 2 per cent for every degree Celsius decrease. There was a misconception that screw chillers needed to 'run hot', whereas you can take most screw chillers down to nearly 20 degrees Celsius. Some centrifugal chillers can go as low as 15 degrees Celsius," said Bannister.

Many of the systems were unstable with oscillating condenser water and cooling fans coming on and off. This was caused by the use of single speed cooling tower fans on several sites. However, at two sites where variable speed cooling tower fans were in use, the control programming was faulty and the fans were cycling between 100 per cent and off on a three minute basis. One site even had all the switchgear and controls to connect two speed fan control, but the final pieces of wiring had never been completed, leaving the site with single speed fans.

"The Parramatta CBD Greenhouse Leaders Project, an initiative of SEDA, Parramatta City Council and ten building owners, clearly demonstrates that you can take buildings of varying sizes and ages and find significant and simple savings that can be made in controls operation on the Building Management System."

Dr Paul Bannister
Managing Director
Exergy Australia

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Domestic Hot Water Calorifiers

The control of Domestic Hot Water was a big issue at one site, with the calorifier forcing boilers on all year round resulting in increased energy usage.

Control Stability

Control stability was a problem at most sites to some extent, with most PID controls showing some instability ranging from minor to fairly severe. More seriously the fundamental control logic used at two sites incorporated a switch between "cooling" "neutral" and "heating" modes which caused severe instability.

"The switch was causing the space temperature to oscillate through more than 1.5°C in some cases. The switch from neutral to cooling was causing the air supply temperature to change by 10° C or more. This can result in draughts from the air supply," Bannister said. " This sort of instability impacts on comfort and energy usage but will also wear out your valves and actuators, increasing maintenance costs and failures".

Pressure Control

Pressure control problems within fan speeds were common, due to poor commissioning or incorrect placement of the duct sensor, with fan speed turndown often poor.

Bannister says most VAV systems are capable of turning down to 50 to 60 per cent of peak flow in theory, but in practice, most rarely turn down below 90 per cent.

Accessing Equipment

Access to hot water reheat systems was often overlooked. Two of the buildings with difficult access scored one-star ratings.

"The lesson here is that if your current system is difficult to maintain, and, if you can't easily replace broken hot water valves now, then further down the track it's unlikely anyone will make the effort to check unless there is a catastrophic failure," says Bannister.

In one of the buildings Bannister looked at, the hot water valve couldn't be located and the maintenance contractor didn't know where it was. In another, access was restricted to crawling through the ceiling space in the plant room to get to the chilled water valve.

Bannister says the most common failure is for a valve to no longer close properly allowing hot or cold water through, which affects the control.

"Very few buildings have any form of automatic diagnostic for detecting faults, and many systems actually find ways of compensating. Thus a heating valve may leak causing terminal increases to the airflow to compensate or the primary unit pumps in cooler air to compensate," Bannister said.

Supply Temperature

Common problems with the supply temperature revolved around the use of the economy cycle, uncontrolled duct temperatures and excessive reheat use.

"Generally speaking, economy cycles are a marginal exercise in Sydney. They are often poorly implemented and operated and so the downside is significant if you get it wrong," said Bannister.

Overall, ABGR was an effective tool to identify poor performing buildings thus prompting further attention.

"Basically, most of the problems were simple reprogramming of control systems. Two of the sites needed a more major reprogram and one site needed a limited hardware upgrade," said Bannister.

Lessons learned

Bannister says it's important to understand that "yesterday's buildings aren't necessarily that much worse than today's buildings. New technology in buildings isn't enough to deliver good performance. It's about good maintenance and monitoring of that technology."

"It's also not enough to rely on control specification and commissioning to deliver efficiency. For example, a VAV system can deliver comfort to tenants but it may not be delivering efficiency," said Bannister.

Variability in contractor advice was also a difficulty. Often there was no documentation and sometimes it was a question of the wrong advice being offered.

Any surprises?

There was no conclusive evidence that any of the four air-conditioning systems in use – modern VAV, older VAV, VAV/induction and DX/condenser – was delivering better energy and greenhouse performance. Most would believe that a modern VAV system should be able to deliver excellent performance.

Similarly, it's generally assumed that gas is a lower greenhouse fuel. The results say otherwise. The 4-star rated building happens to be electric.

"Gas may be a lower greenhouse fuel, but it also introduces problems such as combustion efficiencies, boiler operation at low load, heat loss from pipe work and leaking hot water valves. In a cold climate it may well be worth overcoming the problems," Bannister said. "But in Sydney, where the seasonal heating load for buildings is very nearly nil, it probably isn't worth putting in the expensive infrastructure with the accompanying problems to heat a building on a few dozen mornings of the year."

Bannister adds it's interesting to note that most Sydney buildings that have their gas use under control actually turn the boiler off for upwards of nine months of the year.

"What it shows us is that simple buildings can generate better than average performance and that complex technology can deliver better performance through commissioning and good maintenance," said Bannister.

Where to next?

The ten buildings are currently implementing the control recommendations made by Bannister and will be re-rated in a year's time using the ABGR scheme.

"The typical Australian commercial building offers a range of opportunities for efficiencies and savvy building owners are likely to recognise an opportunity to reduce building outgoings through HVAC control strategies, thereby increasing the asset value," concluded Bannister.

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