For every high-performing sustainable office tower in Australia, there are hundreds of low-rise, energy-hungry suburban commercial buildings. As a project in Brisbane's inner north has demonstrated, large reductions in energy consumption can be achieved through modest investment.

AN ENERGY-NEUTRAL LOW-RISE

The building occupying 23 Edgar Street, Bowen Hills is typical of the thousands of low-rise commercial buildings found in the suburbs of Australian cities.

Built over 30 years ago, this two-level clay-brick and concrete block building with steel decking roof features 528 sq m of net lettable area (NLA). On the first level is 245 sq m of office space. At ground level 283 sq m includes office space, undercover car parking and a patio.

Before the building's refurbishment in 2010, the office space was served by inefficient twin T8 light fittings and an aging ducted air conditioning system. Annually, these consumed 12,500kWh and 37,500kWh, respectively – contributing to total base-building annual electricity usage of 62,500kWh.

Not only were these systems high energy users, but they lacked any user control. This meant the building remained fully lit and air conditioned even when many staff members spent large parts of their working day away from the office.

In response to increasing electricity tariffs and the emergence of mandatory energy disclosure, the building's owner sought a refurbishment that would both better serve the tenants' continuing needs and help to future-proof the property against rising energy costs.

As it happened, in 2008 a consulting engineering firm occupied the tenancy, and was considered well placed to investigate the opportunities for refurbishment.

It found that a 50 per cent reduction in air conditioning-related electricity usage could be achieved through the installation of an energy-efficient replacement that provided zonal control. A similar reduction could be achieved in lighting energy by installing new fittings and occupancy sensors.

It was calculated that these actions alone would equate to an annual saving of about 25,000kWh, with further savings achieved through the replacement of the building's hot water service, and installation of solar shading.

ENERGY-NEUTRAL

By dramatically reducing the building's base electricity consumption, the opportunity to off-set the remaining demand with onsite power generation was identified.

At a cost similar to that of the HVAC and lighting retrofit, solar photovoltaic (PV) generation proved the most viable solution. Although this meant the project cost would double, it was considered that an appropriately sized system installed on the building's roof could deliver an energy-neutral outcome.

With a total investment of $215,440, the retrofit and solar PV project was forecast to provide electricity savings of $14,000 per year based on 2008 tariffs.

"It would make us immune to future increases to electricity prices, and would provide a more attractive letting option in a period of oversupply and significant increase in demand," says Ken Saunders, director of building owner, Power Fifteen Pty Ltd.

In late 2009, the project was submitted to AusIndustry's Green Building Fund. This program was established by the Australian Government to provide financial grants of up to 50 per cent of the cost of retrofitting and retro-commissioning projects. The program is aimed at projects that cut greenhouse gas emissions through a reduction in base-building energy consumption.

Following a comprehensive documentation process, including NABERS energy auditing, the application was successful, and a grant of $107,720 was awarded. With the owner's capital expenditure now halved, the payback period was dramatically reduced.

"The Green Building Fund provided the extra financial incentive for us to explore the opportunity of solar power in order to make the building energy-neutral," says Saunders.

Work commenced on the retrofit of the building's HVAC system in February 2010. This comprised of the installation of two reverse-cycle air conditioning units, together with new air-handling units (AHUs), ducts and electronic controls.

During the installation of the roof-mounted air conditioning units, some structural reinforcing of the roof was required. Aluminium louvres, planned to be

New ducts, air handling units and electronic conrols were installed during the upgrade.

fitted as part of the solar PV installation, were added to provide shading to a number of windows.

At the same time the building's inefficient twin T8 light fittings were also replaced with efficient, single T5 fittings, presence (sensor) detector units and high-efficiency exit lights. Optimal placement of sensors was ascertained through careful examination of the office spaces' lighting intensity, and through behavioural studies of occupants.

To correctly size the solar PV system to at least meet the base building's new energy demands, energy monitoring was originally planned to occur at the completion of the services retrofit; however, this was not possible due to the building becoming vacant.

Rather, measurement of peak currents on air conditioning, lighting and general power circuits was taken over the second quarter of the 2010 calendar year. This revealed that pro-rata energy consumption for the building at full occupancy was approximately 33,000kWh – a demand reduction of approximately 47 per cent.

"Intricate energy balancing was undertaken to ascertain the energy use and enable the accurate sizing of the PV system," explains Saunders. "In our location, the whole of the roof was used to achieve the energy required."

23 Edgar St is a typical low-rise suburban commercial building.

> "The Green Building Fund provided the extra financial incentive for us to explore the opportunity of solar power in order to make the building energy-neutral"

Due to the requirement for safety anchor points associated with ongoing inspection and maintenance of rooftop equipment, a review of the roof area was implemented. The available space for the solar array was subsequently reduced.

This resulted in the size of the solar PV system being reduced from 20kW to a nominal 17kW system. Based on measured peak DC currents of 5.56A per phase, VDM Consulting determined the installation would provide theoretical pro rata annual energy generation of at least 32,000kWh.

As part of the retrofit, aluminium louvres were added to a number of windows to provide shading.

In September 2010, 88 x 190W monocrystaline panels and four associated inverters were installed.

Subsequent readings taken from the solar PV system's export meter for the period from May 23 to August 22, 2011 calculated a theoretical pro-rata annual energy generation of the installed system of 21,500kWh – a figure significantly lower than forecast.

Although less than expected, this generation capacity was consistent with the reduction in peak sun hours experienced in Brisbane (from 5.4 to 3.6 hours) due to inclement weather conditions at the time.

It is expected that an energy-neutral outcome will be achieved once peak sun hours return to average in Brisbane, and as tenants become familiar with the correct operation of the building's air conditioning zoning and set-point controls.

Australia's commercial building stock is a substantial contributor to the nation's greenhouse gas emissions; this much has been clearly established. And with commercial building disclosure requirements having kicked in, and utility prices on the rise, the benefits of bringing existing building up to speed are obvious.

Yet until now, most of the attention around optimising existing commercial office buildings has centred on those in the inner-city.

Of course, energy-efficiency retrofit opportunities are also available to owners of suburban low-rise commercial buildings. This is something amply demonstrated by the vastly improved performance of 23 Edgar St, Bowen Hills.

"There are many buildings of similar size all over Australia that could become energy-neutral with a similar outlay," says Saunders. "And this would seem to be a good investment for both building owner, the Government and for the environment." ▲

PROJECT AT A GLANCE

The professionals

Owner: Power Fifteen Pty Ltd

Engineering consultant: VDM Consulting

Equipment at a glance

Controls: Electronic Zoning

Lighting sensors: Presence detectors

Metering: Ecovation Eco.IQ

Reverse-cycle packaged AC units: Mitsubishi FDC450HKXE6 and FDC28HKXE6 reverse-cycle

Solar PV system:
16.72kW grid connected solar photovoltaic system
1 x CMS10000 Inverter – 3 x 18 module strings
3 x CMS2000 Inverter – 1 x 11 module string per inverter
88 x 190W Monocrystaline panels

T5 lighting:
T-Bar 36W High-efficiency exit lights