1200 Buildings

CASE STUDIES

490
Spencer Street

490 Spencer Street is an excellent example of the efficiency gains made by reducing the heat load in an older small office building before embarking on upgrading of the mechanical systems.

Built
Late 1980s
NLA
300 m²
Tenancy
Offices
Building owner
Dave and Chris Collins of Green Spaces
Property manager
Green Spaces
Refurbishment project timelines
2008 - 2011
Project team
The Green Spaces Synergetics Environmental Engineering Joe Arcaro and Associates
NABERS Energy
Before: 3.5 (without energy offset) Target: 5.0
NABERS Water
Before: 2.5 Target: 5.0
Key refurbishment features
• "Virtual double glazing" • PV solar supplying 20% to 100% of building power depending on amount of sunlight and energy use • Energy efficient lighting • 100% Green energy • Water efficient appliances • Reuse and recycling of building materials • Web-enabled Building Management System (BMS)
Energy saving
Not yet determined
Water saving
Not yet determined
Greenhouse saving
Not yet determined
Project costs
Not available
Annual saving
Not yet determined

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Background

Green Spaces, as it is known, is a basic two storey office block situated at the north end of Spencer Street. It was built in the 1980s, as an original tilt-slab construction with no insulation, dominated by large west facing glass windows and a plain grey rendered concrete façade.

The Heating Ventilation and Cooling (HVAC) system was a typical reverse cycle centralised package, with two units cooling and heating the two floors separately.

Tenant comfort was only achieved by pouring large amounts of energy into the building - primarily though the HVAC.

Dr Dave and Chris Collins of Synergetics took over the southern side of the building in 2003.

Synergetics is an engineering company that investigates and models energy, heat and air flows, primarily for the mining and manufacturing industries. It was natural therefore that their inefficient building would become a focus for their expertise.

Objectives

According to Dr Collins, energy efficiency objectives are often compromised by other concerns such as building architecture and occupant behaviour. In this building refurbishment project, they wanted to avoid these compromises, and make energy efficiency the primary focus.

The question was: how to achieve energy efficiency within the constraints and limitations of existing buildings?

They set out their overall objective, which was to create a zero greenhouse gas emission building.

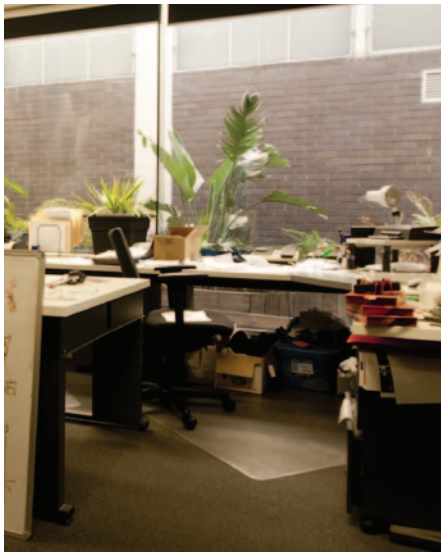
Planning

The planning, which started in mid-2008 and continued into 2009, outlined three stages.

Stage 1 - which has been accomplished, was to improve the working environment at a minimum cost. This effectively meant reducing the energy load of the building and utilising the workspace more efficiently.

Synergetics started out by undertaking a comprehensive and wholistic investigation of the building, to understand its performance problems. The basic premise is that each building has to be considered as unique, therefore not all solutions can be applied effectively to all buildings, but the processes and thinking about the solutions can be reproduced.

Firstly, Synergetics looked at the unique attributes of their building - what was good about it - and found the back and bottom of the building was surrounded by concrete which effectively produced a cave. This, they realised, had real possibilities. Conversely, the building limitations included many ventilation leaks and no insulation.



The investigation also included developing an understanding the materials that were used in the building, and thinking about how these could be reused in another context. In other words, how best to get value out of the building's embodied energy.

To help prepare and implement a detailed plan that was attractive as well as functional, Synergetics brought in an architect and employed experienced tradespeople.

Stage 2 - The second stage was termed 'energy scavenging.' The key objective was to determine how much energy could be retrieved from zero cost sources within and near the building?

The modelling indicated that they should be able to obtain 50 per cent of their energy needs from other sources: using outside air as an air conditioning economiser and air trapped in the ceiling cavity for heating in winter.

Continuing to lower energy consumption will also be continued throughout this stage – by doing things such as introducing low energy computers and reducing the number that are on at any one time, more efficient switching, providing an individual workstation power-board so all power is connected and one switch turns it off.

The aim is to make 'no regrets' changes that are justified on economic grounds alone.

Synergetics was keen not to make it a high tech building because they believe it removes the opportunity for occupants to interface with it, and they tend to lose ownership over their energy saving efforts. Occupant engagement is critical in achieving the educational benefits of green buildings.

Stage 3 – To continue to reduce energy demand and install a suitably sized HVAV system to replace the current one.

The aim is to have all these stages completed by the end of July 2011.

Implementation

The refurbishment of the building started in mid-2009. The building officially opened a year later in September 2010 with Stage 1 completed.

An architect with very practical skills was engaged, who focused both on the engineering and the aesthetics of the building. This dual focus was valuable in achieving effective design solutions.

The tenants remained in the building while it was being retrofitted which encouraged an evolutionary process that included their involvement in the design solutions.

The experience of highly qualified tradespeople was also vital when considering, selecting and implementing solutions.

Even though members of the project team were all from different disciplines, they were able to build bridges; to talk the same language and share the same objectives.

A firm that specialised in leak identification was engaged to pump air into and out of the building using a smoke generator to reveal leaks. Computer modelling had verified the leakage issue as a major source of energy loss. Tradespeople then came in to seal the leaks.

The second major problem was the insulation. The whole building was not insulated, including the metal roof above the second floor.

As it was prohibitively expensive to remove the roof with the air conditioning sitting on it, the team decided to put R3 insulation on top of a suspended ceiling. The space between the insulation and the metal roof was ventilated so that it reduced the heat load.

The architect also contributed other practical ideas regarding the creation of different zones inside the building to improve space utilisation and energy saving opportunities.

Features

Building

A significant feature of the building is what has been termed 'virtual double glazing'.

The building faces west, with large unprotected non-insulated glass. The radiant heat poured into the building, which was then being (wastefully) conditioned.

Instead of double-glazing the windows, a space was created between the west windows and the internal work zone using an internal glass partition. This space is not conditioned, but uses a side door into an adjoining laneway to naturally ventilate it. The same virtual glazing space was replicated on the first floor. The space is used for short meetings and a small foyer on the ground floor. The internal glass partition allows natural light to flow into the office area.

This zone effectively protects the air-conditioned working space from the effects of the western sun in the afternoons.

The internal glass partition was constructed using materials from another space.

It was a very low cost solution effectively building on the 'no regrets' model.

External blinds will also be fitted on the west side windows to reduce direct sunlight.

A false ceiling was made in the second floor to place the insulation between the office space and the metal roof, and the space is naturally ventilated.

Another feature is the perforated ceiling. The designers saw the value of the stored energy in the concrete floor. If carpets had been put in to reduce the noise levels, this would have effectively insulated the space. The concrete floor effectively provides air conditioning by stabilising zone temperatures, so the noise reduction was achieved by a perforated ceiled instead.

The other design focus was the efficient use of space.

If air conditioning is being used in work areas, it's important that these areas are efficiently utilised. Synergetics is keen to measure energy usage on an individual basis. Having more people working in the same conditioned area uses energy more efficiently and any energy savings made by the building also lowers the energy use per person. Consequently they set about re-organising work spaces. The virtual double glazed area became a breakout space and foyer.

The three-space car park at the rear of the building was renovated for office use with tenants encouraged to use the bike racks and public transport rather than driving their car to work.

The internal space is used cleverly. For example, the space beneath the staircase to the second floor was originally used for storage, but now has a toilet. An unused veranda was integrated into the building, pushing out the building envelope slightly. A water meter 'garden' was also transformed.

A key feature in the refurbishment was increasing the net tenantable area. In other words, making better use of the working space is part of the energy efficiency equation.

HVAC

A decision regarding the HVAC system has not been made at this stage.

The current system has reached the end of its life cycle, so it will need to be replaced. But, first the building owners want to see how far the energy loads can be reduced and to what actual performance levels, before defining the energy load and embarking on changing the air conditioning system.

For Synergetics, this is all about correct sizing. They anticipate that because the energy load has been reduced, the building will not need a system the size it previously used. Thus, this will be a major saving of energy and cost.

The HVAC will be investigated further in the third stage of the refurbishment project.

Energy load

The refurbishment project has concentrated so far on reducing energy loads. This includes:

- energy efficient lighting and appliances
- PV cells on the roof - a 10kW PV array, which provides 20 per cent of the original building power needs and up to 100 per cent of the modified building power needs
- energy efficient desktop computers with low energy hard drives and using laptops, that consume a quarter of the power, in preference to PCs
- remanufactured, low power Fuji Xerox printers, second-hand fridges and high efficiency dishwashers
- lights out stickers
- lighting timers
- zoned lighting in the open plan office
- presence sensors
- T5 fluorescent lights in office spaces, LED in foyer and conference rooms
- large windows to maximise natural light
- new windows - where installed - are double glazed
- a skylight was added to upstairs office to allow natural light
- 100 per cent Green Energy purchased from Simply Energy.

Water

The building now uses 5-star rated water saving toilets saving 6 litres per flush.

The cisterns are filled from the hand washbasins.

Importantly only cold water connections are installed in the kitchen and bathroom sinks to avoid energy wastage by heating of hand water.

Waste

Great care was taken throughout the building retrofit to reuse and recycle materials where possible to minimise embodied energy and emissions. This included using:

- suitable second-hand furniture, workstations and carpet where possible
- building materials such as glass, frames and doors from pre-existing offices
- modified desks and partitions – fabricated from pre-existing components
- paper used in the office is from Australia and contains 80 per cent recycled content

The ceiling tiles and other materials that could not be used were recycled. Any new equipment was Australian made where possible to minimise embodied energy due to transport. This often meant leaving redundant materials them in the lane outside the building with a sign saying “free to take”. Dave was very surprised that most material left out was taken – the ceiling tiles were used to modify a recording studio. He proposes that while it would need to be carefully managed, maybe this policy could be adopted city-wide?

Environment

Green Spaces has sought to extend the boundary their energy saving efforts from the building itself to beyond. This means:

- behaviour modification to reduce personal energy consumption.
- installing bicycle racks in the street outside the building, and in the virtual glazed space to encourage bicycle parking.
- encouraging occupants to travel to and from work using bikes or public transport.
- installing showers, again available for cyclists
- indoor plants to refresh air and serve as natural sound and visual barriers.
- foliage planted in laneway
- a 3-phase outlet is provided in the laneway for charging electric cars (Green Spaces is yet to purchase an electric car for company use).

Building management and controls

The building has an efficient and robust custom-built Building Management System (BMS). Installation entailed rewiring the building with off-the-shelf components and hardware. Each power circuit is separately metered, and the web-enabled BMS records the power consumption or generation in real time. It can track seasonal changes in building performance, as well as the PV solar system's contribution to electricity generation.

The BMS will help provide data on the building's average energy performance and calculate the NABERS rating, which will be done in September, 2011.

Challenges

The main challenge is dealing with a low efficiency existing building, but Synergetics believes this can be overcome with tenacity.

In an old building, one problem can lead to another and structures and components are never quite square, or not the right size. For example, there was a bow in the floor that needed levelling. It would be much easier to throw everything out into a skip and start again with new materials, than it is to reuse them. However, Dr Dave believes the benefits are enormous, and the commitment to doing it right is worthwhile.

The other challenge was the cost of installing PV solar. This was far more expensive than first estimated, and Synergetics suggests that there is opportunity to reduce the costs as the economies of scale increase, which will make it far more attractive to adopt this technology in the future.

Outcomes

Energy

Zero carbon on a sunny day – energy generated by the solar panels offsets all consumption based on BMS data.

Water

Water consumption will be tracked and compared with other similar buildings.

Social

While formal surveys have not been conducted with tenants regarding how they feel about the building, regular weekly meetings of The Green Spaces Committee are held to keep in touch with issues and opportunities.

Maintenance

Financial savings from better managed maintenance are considerable.

Commercial

The initial rental income was about $40,000 per year. Because of the energy efficiency and space utilisation strategies, this rental income has increased dramatically.

Overall

Synergetics concedes that this type of refurbishment is not for the faint hearted, but the result is immensely satisfying and profitable.

Lessons

The building owners are not confident that for a small existing building, cost effectiveness can be measured in terms of energy savings alone.

Green Spaces works on the principle that the returns come from better quality, longer term tenants.

By Green Spaces calculations, they will spend approximately $250,000 for building improvements but, this cost will be offset by increased rental income.

From the owner's experience, tenants are interested in moving into a space that is responsibly managed and are prepared to pay higher costs and will stay for longer.

When energy consumption is measured on a per person basis, it raises the issue of efficient space utilisation. This, is the key to investing in energy efficient practices. Better space utilisation of air conditioned space means lower energy consumption per person, and provides owners with the opportunity to earn more money from rent. This goes hand in hand with providing a lower energy building for environmental and social reasons.

The future

Achieving high levels of energy and water efficiency is an ongoing objective.

The next stage will involve scavenging existing energy sources, continuing to reduce the energy load and to correctly size a replacement HVAC system.

The long term objective is to manage the performance of the building to make sure it always has a zero carbon footprint.