

Old star, green star

The greenest buildings are actually well-managed existing buildings, argues *Craig Roussac*.

OFFICE BUILDINGS CONSTRUCTED during the past five years are, in general, more energy efficient than older buildings.¹ This is to be expected. Prior to the advent of the National Australian Built Environment Rating Scheme, NABERS², and the Green Building Council of Australia's Green Star³ rating scheme, it was difficult for developers to define an eco-efficiency objective for a new office development. Now architects and engineers have 'star' ratings to target, and the buildings they design often display attributes and operational performances that exceed those targets.

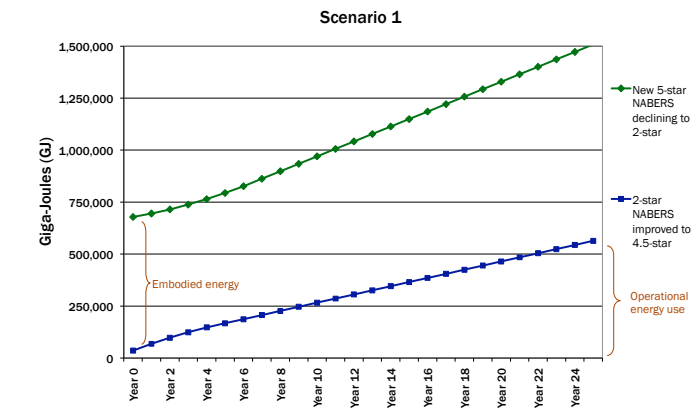
This is a positive development, of course, however, it will take considerable time before today's new buildings transform the sector's emissions profile. Statistics from the Property Council of Australia indicate that over the past five years the Australian office market has grown by at least 2.5 million square metres in net terms. If we gross that number up by 50 per cent (to allow for the replacement of demolished stock), it is likely that in the order of 3.6 million square metres of new office accommodation was constructed during the period 2003–2008.⁴ This implies that of the estimated 22 million square-metre Australian commercial office market⁵, 83 per cent is at least five years behind the times.

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The bright side to this apparently sluggish rate of churn through the existing stock is that while 'operational' energy use is one part of the story, 'embodied' energy (the energy consumed by all of the processes associated with the production of a building, from the mining and processing of natural resources to manufacturing, transport and product delivery⁶) is the other.

A building's annual operating energy use is typically only a fraction of the energy required to build and outfit it in the first place: the Investa Sustainability Institute estimates this ratio as 1:24.⁷ In other words, it takes a typical medium-sized Australian CBD office building 24 years to use more energy through operating than it has embodied in its materials. As with any design question, 'rules of thumb' should be applied with extreme caution. Change the numerator or denominator only slightly and the 24-year 'payback' becomes meaningless. High-rise office towers, for example, have been found to embody up to 60 per cent more energy than mid-sized CBD buildings.⁸

The concept of a new building paying back its embodied energy over its lifetime is itself, in fact, highly suspect. This is especially true where the construction of a new building requires the demolition of existing premises. Consider the following two scenarios modelled on 25,000 square metres (NLA – net leasable area) ~ 35,700 square metres (GFA – gross floor area) office buildings in Sydney's CBD.



Scenario 1: Well-managed existing building compared to a new building allowed to decline.

This scenario compares an existing 2-star NABERS Office Energy-rated building to a new building designed and constructed to achieve an 'exceptional' 5-star NABERS rating. The existing building improves to 4.5 stars after five full years of excellent monitoring and maintenance as well as modest improvements to its technology. The new green building starts out operating at 5 stars, but its performance declines to slightly below average (2 stars) due to relatively poor maintenance over the first six years of operation.⁹

As can be seen, the energy embodied in the new building at construction (19 giga-joules/square metre GFA¹⁰) is never repaid. (Note: the energy embodied in the existing building has been ignored because it is a sunk cost, it cannot be reversed.) After 25 years, the new building will have been responsible for 2.7 times more greenhouse emissions than the well-maintained older building.

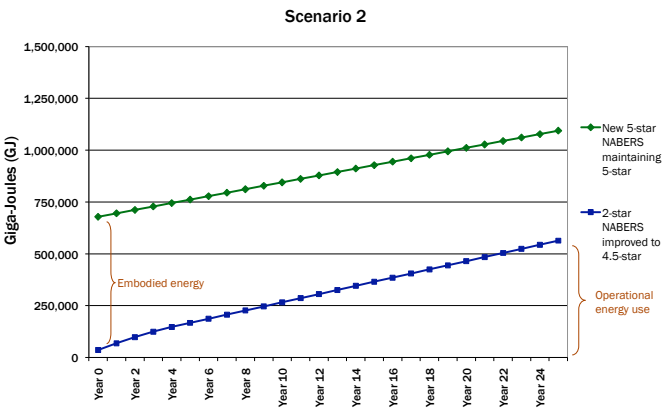
Scenario 2: Well-managed existing building compared to a well-managed new building.

Let's now assume the operating performance of the new green building is maintained at the 5-star NABERS Energy level due to excellent monitoring and maintenance plus ongoing investment in technology. The good news is that the embodied energy in the new green building will eventually be repaid thanks to its superior operating performance. The bad news is that it will be responsible for almost two times more greenhouse emissions for the first 25 years of life and it will take 190 years to pay back its embodied energy debt.

In practice, embodied energy is never paid back. There are many reasons for developing new green buildings, just as there are often many reasons for replacing old, underutilised and dilapidated stock. For new green buildings to be justified they must be needed, stand a reasonable likelihood of performing as expected and deliver a 'net' benefit to society. In environmental terms, this means they should cause less environmental harm than the alternatives.

Given the urgency of the climate crisis, now is the time to consider how we can extend the life of buildings by taking a rigorous and long-term approach to their design, maintenance and ongoing management.

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FOOTNOTES

- ¹ Administrators from both the National Australian Built Environment Rating Scheme (NABERS) and the Green Building Council of Australia's 'Green Star' rating scheme report market-leading performance is being achieved by newly constructed buildings seeking accreditation.
- ² See <http://www.nabers.com.au>
- ³ See <http://www.gbca.org.au>
- ⁴ Net increase in stock from January 2004 – January 2009 in markets monitored by the Property Council of Australia was 2.4 million square metres (NLA). This figure excluded growth in North Ryde, East Melbourne, Wollongong and Sunshine Coast during the period.
- ⁵ The Property Council of Australia, January 2009 and Jones Lang Lasalle, June 2009.
- ⁶ Milne, G., C. Reardon, 2008, *Embodied Energy in Your Home Technical Manual*, Reardon et al. Prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, p136. Available from: <http://www.yourhome.gov.au/technical/embodied>.
- ⁷ Calculated by taking the median 'whole building' energy consumption for the Investa Property Group portfolio in 2003/04 (1,147 MJ/m² NLA converted to GLA using an estimated 70 per cent area efficiency) divided by the embodied energy for a 'medium-height office building' (15-storey, with 3 basements, granite facade, aluminium-framed windows, reinforced concrete frame and total 50,000m² GFA) of 18.98GJ/m² GFA presented as a case study on *Greening the Building Life Cycle: Life cycle assessment tools in building and construction*, 2001, RMIT Centre for Design. Available from <http://buildlca.rmit.edu.au/>.
- ⁸ Treloar, G.J., R. Fay, B. Ilozor, P.E.D. Love, 2001, *An analysis of the embodied energy of office buildings by height, Facilities*, 19[5/6]. 204-214.
- ⁹ For a discussion of the existing Australian commercial office stock's upgrade potential, refer to Roussac, C. and Kuiper, G. 2009, *How low can we go? What is the scope for reducing emissions from commercial real estate?*, Working Paper 1, Investa Sustainability Institute. Available from <http://www.isi.org.au/>
- ¹⁰ 18.98GJ/m² (GFA) statistic derived from Treloar, G.J., 1996, *The Environmental Impact of Construction – A Case Study*, Australia and New Zealand Architectural Science Association Monographs, No. 001, Australia and New Zealand Architectural Science Association, Sydney, November, 89. Referenced in *Greening the Building Life Cycle: Life cycle assessment tools in building and construction*, 2001, RMIT Centre for Design. Available from <http://buildlca.rmit.edu.au/>.