

RESEARCH REPORT



**HEALTH SECTOR JOINS GREEN RATINGS ERA**

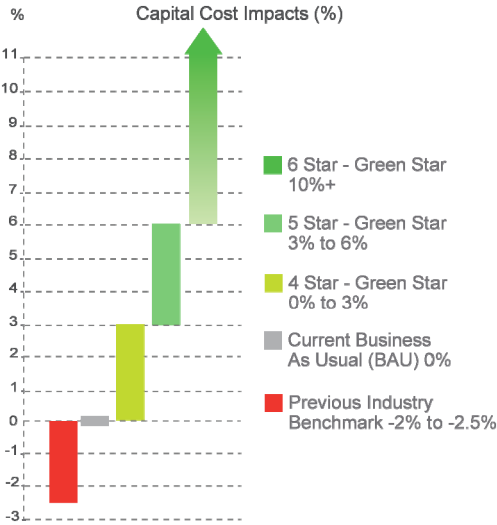
A study of the costs and benefits of sustainable healthcare facilities

**Overview**

Healthcare facilities present an enormous sustainability challenge. Hospitals are among Australia’s most complex and most energy-intensive facilities – using at least twice as much energy, per square metre, as commercial office buildings and around six times as much water. Addressing these challenges has previously posed a significant hurdle for the sector, and the traditional business case for green construction has rested firmly on the financial savings delivered through energy and water efficiencies as well as productivity benefits.

However, the rationale for green healthcare facilities encompasses not just economic advantage, but also improved patient outcomes, reduced medication costs, reductions in cross-infection rates, better staff health and reduced staff turnover, and community benefit through decreased environmental impacts. In response to this, expenditure on sustainability has grown by 2-2.5 per cent of total construction costs on most major hospital projects over the last five years. This is likely to increase as health departments continue their push towards more sustainable buildings.

While Green Star healthcare facilities do come at a cost (in the order of 0% to 3% for a 4 Star rating, 3% to 6% for a 5 Star rating and 10%+ for a 6 Star rating) energy and water initiatives alone have the potential to provide reasonable pay back periods that are typically in the order of 8+ years. On top of this, savings from reduced medication, faster patient recovery and reduced staff turnover are expected to significantly outweigh the savings in energy and water. Long-term operational, financial and health benefits, of which it is anticipated there are many, will only be tested as the boundaries of sustainability in buildings continue to be expanded, and invested in.



**About Green Star Healthcare**

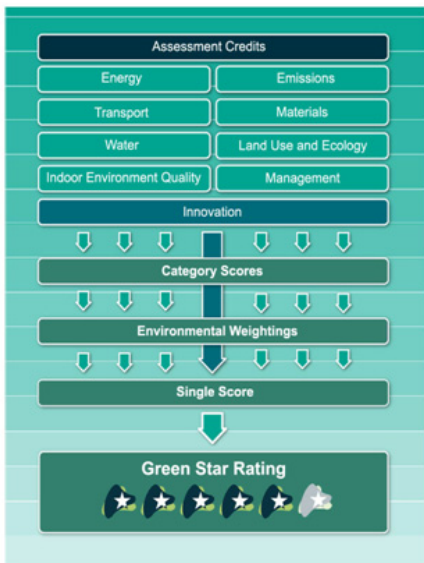
The Green Building Council of Australia recently released the Technical Manual – Green Star Healthcare. There is much interest in this new rating tool, which had been released in pilot form for some time.

The aims of the Green Star - Healthcare (v1) tool are to help owners and operators of healthcare facilities around Australia to:

- Minimise the environmental impact of their buildings
- Improve patient health outcomes and staff productivity
- Receive recognition for green leadership
- Achieve real cost savings

The Green Star rating system process can be best illustrated using the adjacent diagram produced by the Green Building Council of Australia (GBCA).

There are nine environmental impact categories within the tool, which are consistent across all of the GBCA’s assessment tools for various building types. The credits achievable within each category share some commonality, but do vary according to their appropriateness to their building type.



Source: GBCA

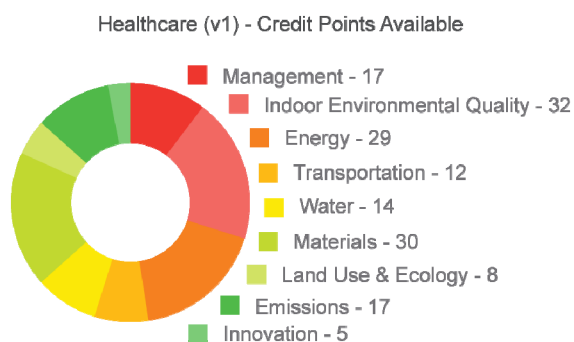
## About Green Star Healthcare (cont)

Credit point scores within each category are awarded to projects where they have met the overall objectives of Green Star and the specific aims of the Tool Credits.

All Category scores (with the exception of Innovation), are then weighted to ensure the categories are reflected appropriately. These weightings differ between States and Territories to reflect local sensitivities. The weighted scores generate an overall score which provides a Green Star Rating.

The Green Star points credit system contains numerous points available for each of the environmental categories (refer to graph).

The Green Star rating system ranges from One Star through to Six Stars. Only projects that achieve a rating of Four Stars or above are eligible for certification. The Green Star Healthcare – (v1) scoring requirements, after Environmental Weighting, are summarised in the following table:



Overall Weighted Score	Rating	Classification
45-59 Points	Four Star	Best Practice
60-74 Points	Five Star	Australian Excellence
75+ Points	Six Star	World Leadership

## Public and Private Hospitals

Health Departments in the various states are still determining their position on the Green Star tool, although some states have already committed to achieving Green Star ratings on specific projects, while other states are considering whether to seek formal ratings or to establish their own priorities. This paper is essentially about the cost impacts on public hospitals.

The situation is somewhat different for Private Hospitals where:

- There may be a marketing advantage associated with a Green Star certified rating.
- The cost of achieving a Green Star rating may be higher than is the case for public hospitals where higher Business As Usual standards have generally already been adopted.

## Take Up of Green Star

Green Star ratings have become a standard consideration in the commercial office market since the initial release of Office Design v1. The achievement of a high Green Star rating in the new office market has been perceived by the office developers as an essential part of marketing to attract long term tenants, preserve the value of the office building and provide healthier environments for the building occupants.

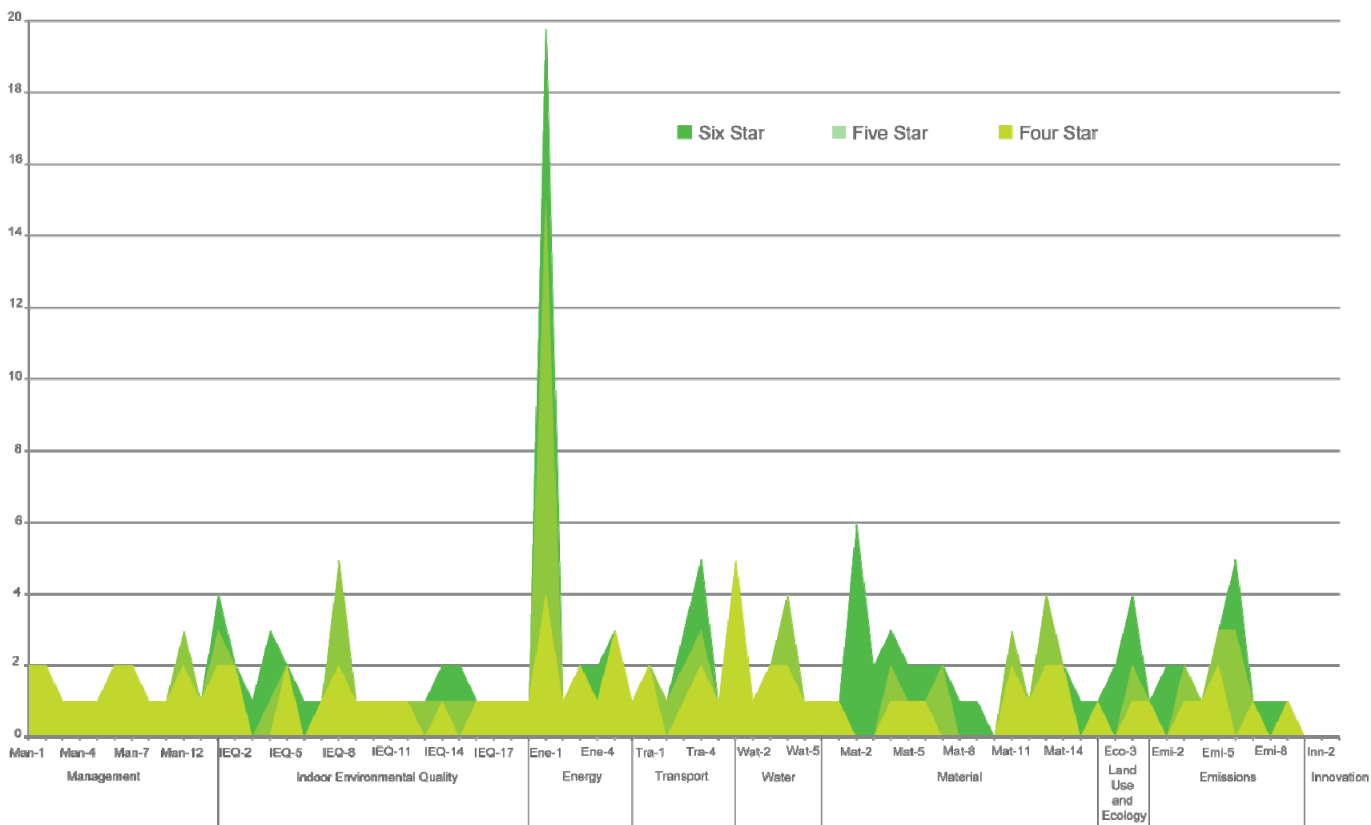
Since the release of the original Office Design tool, other tools have followed for different industry sectors, including Mixed Use Residential, Retail Centres, Education, Industrial, Mixed Use, Office As-built and Interiors, as well as the Healthcare tool.

Apart from the very high rate of take-up of Green Star for new major offices it is too early to determine the take up rate of the other tools.

The design approach for a four star Green Star solution can be considered fairly simply by adopting readily available credits within the tool framework. The key to a five star solution will be the approach taken with energy and the greenhouse gas emission reduction options employed, as well as the water recycling / reuse strategies implemented, and the opportunities to utilise the material re-use credits, etc.

## Take Up of Green Star (cont)

The graph below illustrates the dominant importance of energy/emission reductions in the Healthcare (v1) tool.



## Primary Drivers

Within the Healthcare system assets are not generally subject to industry driven market factors such as tenant attraction and retention, and building resale value. The majority of providers in the Healthcare sector fall into the public state run systems, and as such some of the drivers within the Commercial Office sector, do not apply.

There are many and varied benefits to developing a “green” healthcare facility both Quantifiable and Qualitative. A number of these benefits are outlined below:

Quantifiable Benefits	Qualitative Benefits
Improved energy efficiency	Improved Environmental Quality with potential for: <ul style="list-style-type: none"> <li>- Increased staff productivity</li> <li>- Greater staff attraction, recruitment and retention</li> <li>- Improved patient wellbeing and shorter recovery times</li> <li>- Improved experience/satisfaction for patients</li> </ul>
Reduced emissions	Improved patient wellbeing via increased Vitamin D from sunlight
Improved water efficiency	Risk mitigation from reduced infection control issues, etc.
Reduced operating and recurrent costs	Meeting Government expectations
Contribution to emission reduction obligations	Meeting Community expectations

Rather than providing substantial economic saving benefits in the short term, the key benefits within healthcare projects are likely to be more subjective, related to patient and staff well being, improved recovery times, increased productivity and reduced staff turnover, as well as the embedded environmental impact reductions.

## Business As Usual (BAU)

Minimum environmental standards in public hospitals have improved significantly in recent years. The following is a summary of significant items that have become BAU over the past few years:

Energy Reduction Measures	Other Measures
Building management system with energy conservation features	Increased natural daylight provision
External Shading	Rainwater harvesting and reuse
Efficient facades (glazing)	Efficient water fixtures and fittings
High efficiency lighting	Waste management reduction
Variable speed drives (VSD's)	Reduced VOC's (material choices)
Higher efficiency plant and equipment	Minimisation of PVC material usage
Increased insulation	Improved air quality

Davis Langdon estimate that the adoption of greener BAU outcomes over the last five years, have resulted in cost increases of around 2% of total construction costs.

Other drivers which have impacted on cost include the current trend towards single in-patient rooms with individual room controls. This increases overall floor areas and costs (including operating costs) but has other perceived benefits such as reduced infection rates and increased flexibility in design.

The criticality of infection control, etc in acute hospital departments also poses challenges to sustainable design, restricting the extent to which some sustainability initiatives can be considered, e.g. temperature and lighting control in theatres, etc.

Travel and engineering (plant) area requirements are also on the increase with major Hospitals incorporating travel and engineering area provisions equating to approximately 40% of the hospital's functional areas. This is due to a number of factors including larger plant rooms due mainly to OH&S requirements, provision for future proofing and the incorporation of sustainable design attributes.. This increase in areas makes the natural lighting issue even harder to achieve due to larger floor plates.

An increasing need for future proofing in hospital designs due to rapidly changing technology is also a consideration, where future flexibility needs to be considered to be a true "sustainable" facility, and avoid obsolescence.

The importance of security, including secure parking and direct access to the hospital for staff as well as visitors can in many cases contradict an environmental desire to reduce car-parking provisions, but for a hospital this is a critical issue, as nurses, for example, should not be reliant on public transport when doing shift work. Also, many large hospitals are now located out of city centres, often with barely adequate public transportation available.

Recent hospital surveys found that creating a healing environment is one of the biggest priorities for facility users. Factors such as air quality, comfortable indoor spaces, natural lighting, access to outdoor areas, visibility, and reduced staff travel time (i.e. avoiding very long corridors) are key issues for staff, with some being considered more important than energy conservation. This is worth noting given the high importance put on the Energy Category within the Healthcare (v1) tool.

## Achieving a High Energy Score

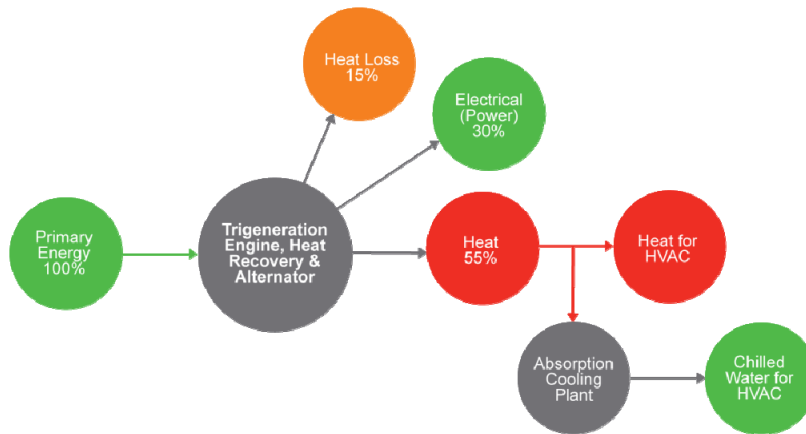
Given the high number of points available within the Energy Category particularly the Greenhouse Gas Emissions credit of the Healthcare tool (20 available points); great emphasis will be put on the energy systems employed within facilities. Trigeration systems are emerging as the most important system being proposed by designers for assisting with the upgrading of major hospitals from 4 Star designs to 5 Star designs.

Trigeration plants are now preferred to the earlier Cogeneration plants that simultaneously produced electricity and heat. These plants are also known as Combined Heat and Power (CHP) plants.

## Achieving a High Energy Score (cont)

Trigeneration is the modern name for a plant that simultaneously produces:

- Electricity,
- Heat, and
- Converts heat energy to chilled water for cooling.



The primary energy source in Australia is normally natural gas; however other forms of cheap energy such as waste heat from industrial processes may be used as a primary energy source.

Conventional thermal (e.g. coal fired) power stations only convert around 30% of the fuel energy into electricity for consumers after process and transmission losses. The remainder of this heat is rejected to a body of water, or the atmosphere depending on particular site economics and location. This type of conventional thermal plant therefore has three major down sides:

- Primary fuel emissions are higher because of the fuel used (normally coal in Australia),
- There are significant transmission losses between power plants and end users, and
- Only some 30% of the primary energy is converted into a usable form (electricity) for users.

The above is in sharp contrast to the outputs from well designed and operated Trigeneration plants that:

- Normally use a clean fuel (natural gas),
- Convert up to 80% of available primary energy into usable form (around 30% electricity and 50% heat for heating or generation of chilled water), and
- Eliminate transmission losses

As a result of the above Trigeneration plants offer substantial reductions in Greenhouse Gas Emissions and contribute to a significant point score in the Energy Category of the Green Star tool.

Trigeneration systems also provide additional energy independence and redundancy for hospitals.

Detailed feasibility studies are required for each Trigeneration proposal as:

- There are many Trigeneration configurations available
- Primary energy costs for Trigeneration vary by site
- Water costs vary by site
- There is a need to fully test sensitivities to assumptions made in each feasibility study (e.g.; energy escalation rates)
- There are significant costs for associated works including plant space/building costs, land cost, supply authority costs, heat rejecting plant costs, etc

It is important that these feasibility studies proceed early in the project design phases so that the overall design can proceed without potential for major changes in the latter part of the design process.

As a guide typical Trigeneration plants are costing in the order of \$3.5m to \$4.5m per Megawatt including all associated plant, heat exchangers, chillers, building costs, project costs, etc. This represents an extra cost of around \$1.5m to \$2.5m per Megawatt above the use of conventional plant. The associated green house gas reductions are likely to be in the order of 7000 to 8000 tonnes per Megawatt per annum.

Life cycle costs vary widely by site, load profile and primary energy cost. Pay back periods of 8+ years plus are being demonstrated on some projects.

## Capital Cost for Increased Green Star

One of the challenges of incorporating sustainability within health projects is that few facilities are standalone new build. The majority of Hospital works incorporate amendment to, or refurbishment of existing facilities and have the added complexity of tying into existing central plant systems and linkages. This can lead to limitations on expansion opportunities and flexibility in enabling future proofing provisions.

Constraints associated with availability of land, building orientation and the ability to avoid large floor plates may also be encountered on existing sites, leading to less than optimal designs. This may add to the cost of projects as alternative solutions in achieving category requirements are investigated, i.e. numerous internal atria, light shafts and extensive glazed facades, etc in the pursuit of natural light, and the like.

## Costs of 4 and 5 Star

Davis Langdon's research show that the cost of achieving 4 Star Green Star in Healthcare (v1), is in the range of 0% to 3% above baseline costs.

5 Star Green Star is in the order of 3% to 6% above baseline costs.

The primary cost differentiator relates to the energy / emission reduction approach, and the incorporation of a Trigeneration plant.

The adjacent graph represents the approximate cost differentials based upon a cost per square metre of weighted category point for a five star target project.

It should be noted that due to the integrated nature of the design some categories costs are interlinked, and the systems assisting Indoor Environment Quality (IEQ) are heavily related to the Energy category, which is why the IEQ "cost" appears extremely low. The management category ranking is due in part to the low weighting it receives as well as the interpretation of the cost of commissioning.

The above is based on a large scale new build hospital development. Costs will vary for smaller facilities, where some aspects of sustainable design will be easier to accommodate. Conversely, facilities with larger, deep floor plates will encounter difficulty in achieving some points economically. The costs associated with refurbishment of existing facilities will also vary widely dependent upon the existing conditions and site constraints.

The above cost increases relate to capital cost only, and do not factor in any cost benefits that may be derived from the intangible economic benefits a sustainable healthcare facility may generate over its lifetime.

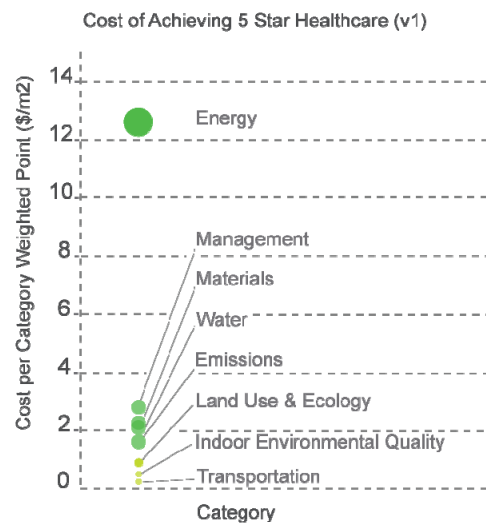
## Costs of 6 Star

Davis Langdon is of the opinion that achieving 6 Star ratings on large acute hospitals is yet to be demonstrated to be viable and a 6 Star Green Star target would require substantial additional funding above Business As Usual.

The situation however may be different on smaller facilities where a range of additional ESD features can be more economically incorporated into designs. For example:

- Natural ventilation
- Improved access to places of respite
- Increased natural light penetration
- Increased opportunities to improve line of sight to views for a higher percentage of floor areas
- Higher percentage of roof area to accommodate ESD features
- More potential for use of green roofs

It is estimated that the additional cost of achieving a 6 star rating on a smaller Healthcare facility may be in the order of 10%+ above BAU.



## Recurrent Costs Savings

The quantifiable economic benefits of improved energy efficiency, reduced emission charges and improved water efficiency have the potential to reduce healthcare operational costs. Total energy and water costs for a major hospital are typically around 1% of total annual operating costs, so it follows that annual operating costs can be reduced, for example, by some 0.2% if energy and water costs are reduced by say 20%. Such Energy and Water initiatives have the potential to provide reasonable pay back periods that are typically in the order of 8+ years.

One of the economic challenges associated with justifying the business case for many attributes within high energy usage facilities is the long term establishment of discounted energy tariffs, which many facilities have in place. This impacts on the economic justification of new plant in terms of payback periods.

More research is needed to quantify the qualitative benefits listed earlier in the Primary Drivers section. However, it needs to be noted that any established improvement in staff productivity, staff retention and patient wellbeing has very significant potential to reduce healthcare operational costs. For example, staff costs in an acute hospital may be in the order of 70% of all operational costs. So it follows if savings can be made in this cost centre then significant overall cost savings are possible.

## Summary

Dedicated funding, or the introduction of incentives and grants to facilities incorporating sustainable attributes could be one way of separating funding streams and stimulating investment into greener design solutions.

Any such investment will lead to the need for much greater emphasis on life cycle costs and payback period assessments during the evaluation of sustainability options to justify the incorporation of additional capital cost items.

The challenge for health providers will be to not only weigh up the viability of sustainable options but to prioritise these against the competing needs for new facilities and equipment. This is not going to be an easy task in an industry where funding availability and facility requirements are often at odds.

If you would like to discuss the details of this report further, please contact Lee Williams, Director and Davis Langdon's Sustainability Leader, by email: [lwilliams@davislangdon.com.au](mailto:lwilliams@davislangdon.com.au) or by phone: 03 9933 8800