

GBCA Life Cycle Assessment in Green Star Discussion Paper Feedback

Forest & Wood Products Australia provides the following responses (in blue) to the questions posed (in grey) in the GBCA discussion paper “Life Cycle Assessment in Green Star”.

1. Summary of Questions

Is it appropriate for the GBCA to undertake this project or would any other organisation be better placed to do it. If yes, which organisation?

The forest and wood products sector welcomes the investigation of the GBCA in the introduction of a life cycle assessment (LCA) approach in the materials category of the Green Star tools. The success of the Green Building Council of Australia is acknowledged in transforming the Australian commercial building market in regards to environmentally focussed and green design and the broader understanding and education of all stakeholders involved. The GBCA is well placed to undertake this project as its Green Star tools are widely used in the commercial property sector.

The integration of an LCA approach into the Green Star tools will without doubt enhance the credibility of the Green Star tools and will create a strong incentive for the Australian property sector to make real and tangible reductions in environmental impact.

The forest and wood products sector expects however that the GBCA will in this endeavour also:

- engage positively and actively with all the individual building product sectors and their constituents; and
- seek practical advice from professional life cycle organisations such as the Australian Life Cycle Assessment Organisation (ALCAS).

Is the Australian market ready for LCA as a tool for assessing the environmental impact of materials? If no, in how many years time do you think the market would be ready?

Yes the market is ready.

The Australian building and construction sector has made significant progress in introducing environmentally based initiatives (both regulatory and voluntary).

The forest and wood products sector strongly supports the use of LCA in environmental assessment of materials and comparisons in buildings. LCA can provide a detailed structured process of quantifying all the potential environmental impacts of a product, element or building throughout its entire life (cradle to grave). LCA, when done in accordance with appropriately developed standards and

protocols, provides the only true scientifically based, level playing field approach to assessment.

The forest and wood products sector has been a supporter of an LCA approach for over a decade and was the first major Australian building products sector to undertake a detailed 'cradle to gate' LCI data collection R&D program. In 2009 the sector engaged the CSIRO to develop and publish LCI data for:

- forest processes, and the manufacturing of the following timber and wood products:
 - ✚ sawn timber
 - ✚ veneered product
 - ✚ panel products
 - ✚ engineered beams

For a summary of the forest and wood product LCI modules and boundaries see Fig 1 below.

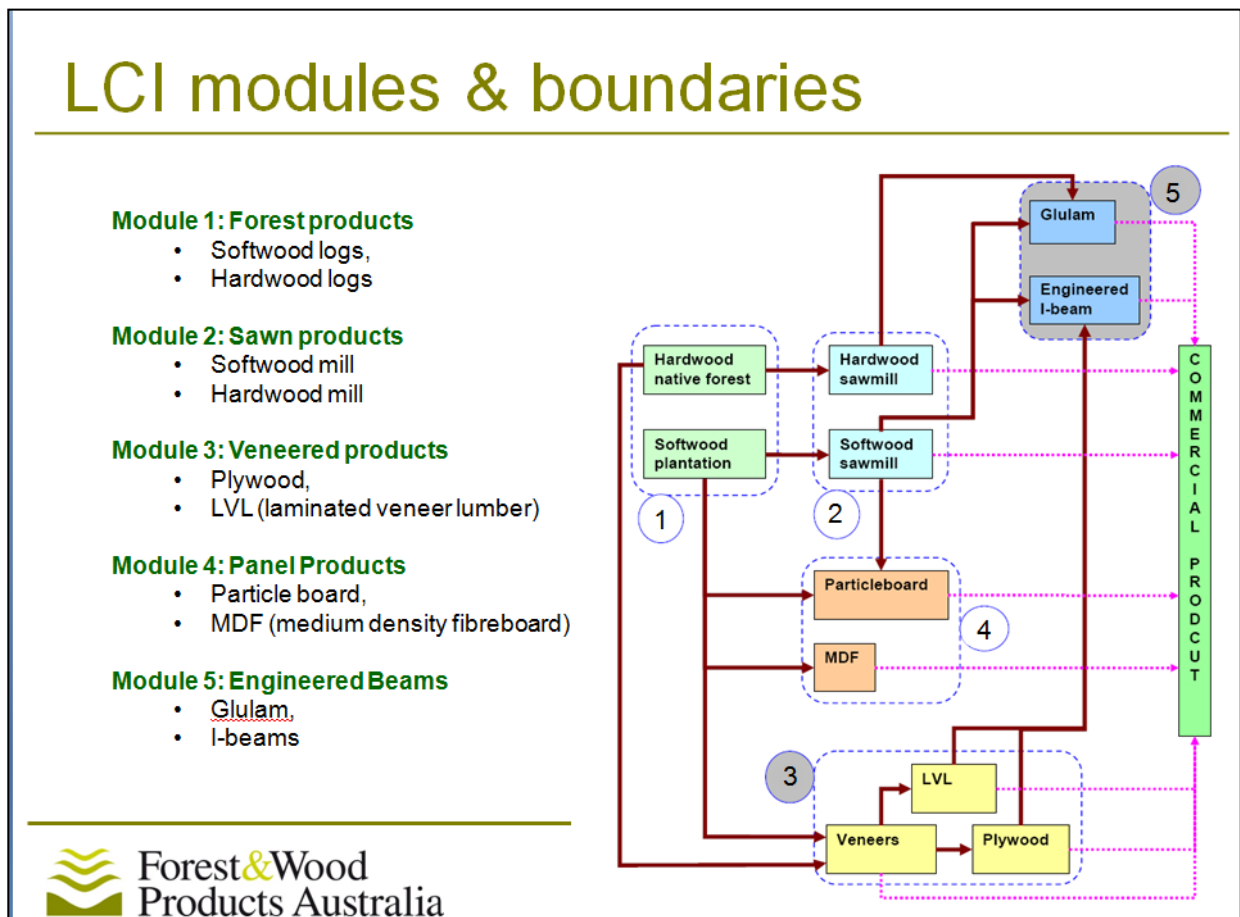


Fig 1: Wood and wood product LCI Project modules and boundaries (2009)

The forest and wood products sector was also a participant in the Building Products Innovation Council's (BPIC) Building Product Life Cycle Inventory Data project, funded through a grant from the Australian Government's Department of Innovation with matching dollars from industry. A selection of the forest and wood products LCI data is available within the BPIC database. Full access to the Australian forest and wood products LCI data can be made by application to Forest and Wood

Products Australia. This LCI data has been used by our industry to understand and improve their environmental performance of their processes, by property consulting companies in whole of building life cycle comparisons, as well as numerous research organisations in projects they have undertaken.

What do you see as the main barriers to implementing LCA as an assessment methodology for materials in Green Star?

We do not consider there to be barriers significant enough to stop implementing LCA with Green Star. In fact we think there are some excellent opportunities for the GBCA. However there are some elements that need to be addressed. These include the following.

- GBCA resolving an appropriate and fair approach to addressing life cycle assessment of buildings and ultimately the availability and appropriateness of LCA design tools for building professionals.
- Education of the benefits of LCA - many in the construction and property sector do not clearly understand what LCA is, nor do they comprehend the benefits that LCA can provide in terms of coming up with the best environmental solution and in providing environmental improvements in products and services. More extensive education and training is certainly needed and GBCA is well placed to be a vehicle for that training.
- Data availability, quality and consistency. The BPIC project was excellent in that it allowed all Australian building products manufactures to collect and supply data to a common accessible platform. However it is recognised that not all the data developed on the platform is at an equivalent level of accuracy and consistency (e.g. some data is cradle-to-gate while other data is only gate-to-gate).
- The current lack of incentives for Australian building materials industry to maintain industry average data or supply individual product LCI data (through commissioning product Environmental Product Declarations or the like). GBCA commitment to LCA would provide that incentive

If the GBCA decided to introduce the methodology described in this paper, how much notice would you recommend the GBCA give to the market?

It is believed that the market would need at least 18-24 months for needed activities such as: process and data preparation, education and implementation.

The list of inclusions may be expanded in the future, is it appropriate to start with a limited scope of assessment in order to simplify the LCA?

Yes, it is believed appropriate to start with a limited list of inclusions.

Please provide feedback on the list of inclusions and exclusions.

The inclusions appear adequate, other items suggested for inclusion are:

- reinforcing steel in reinforced and precast concrete
- permanent formwork (ie Bondek or similar)
- internal partitions and wall and ceiling finishes (where provided on commissioning)
- flooring / floor coverings (were provided on commissioning)
- mortar in brickwork
- stairs, handrails & balustrades
- shading structures on the exterior skin of the building

Are there additional materials that should be addressed by the inclusions and exclusions?

Ultimately, as the LCA process is implemented and accepted and better tools for design and assessment become available, all major building elements, fittings and furnishings should be included.

Is the use of a 'cradle to constructed, sealed and serviced' building approach appropriate?

Yes, as an introductory staged approach this is reasonable

Ultimately all life cycle stages of a building should be included: cradle to gate, operational and end-of-life. Recognising that other tools exist to assess operational energy impacts and the Green Star tools already include end-of-life (through the waste management category), the key first step should be the assessment and inclusion of the embodied impact of building materials (generally cradle to gate). Use of a 'cradle to constructed' approach will require an assessment of specific construction activities; GBCA may need to commission some work in this area if information is not found to be available.

Some commentators often assert that environmental impacts embodied in building materials (embodied impacts) are low compared to operational impacts and should therefore not be a priority for assessment. We consider this to be incorrect in the Australian property industry.

A number of recent studies specifically focussed on Australian buildings, both commercial and residential, have illustrated the importance of the embodied impacts of building materials.

The first, undertaken by Think Brick (2010) reported that the embodied impacts over the lifetime of a house (50 years) can be around half (45% - 59%) of the total greenhouse gas emissions when compared to energy consumption for heating, ventilation and cooling¹. For the homes modelled they reported that the breakeven point between embodied and operational impacts is 43 years, when HVAC operational emissions only are considered.

¹ Think Brick, 2010, "LCA of brick products, life cycle assessment report, final report after critical review", report by Energetics for Think Brick Australia, February 2020, p49.

A second, an LCA study undertaken by RMIT (2010)² investigating the HIA’s single storey standard house design with four different construction types (see opposite), reported the embodied impact of construction/materials ranging from 17% (Melb, type e) to as high as 51% (Sydney, type c) – see graphs below.

Table 1 Construction types to be compared.

Construction type	Cladding	Frame	Roof	Floor	Performance
a	Brick	Timber	House - concrete tile Garage - steeldeck	Elevated	5-star
b	Brick	Timber	House - concrete tile Garage - steeldeck	Slab	5-star
c	Brick	Steel	House - concrete tile Garage - steeldeck	Elevated	5-star
d	Brick	Steel	House - concrete tile Garage - steeldeck	Slab	5-star
e	Timber weatherboard	Timber	House - concrete tile Garage - steeldeck	Elevated	5-star

Global Warming 6 Star Lifecycle

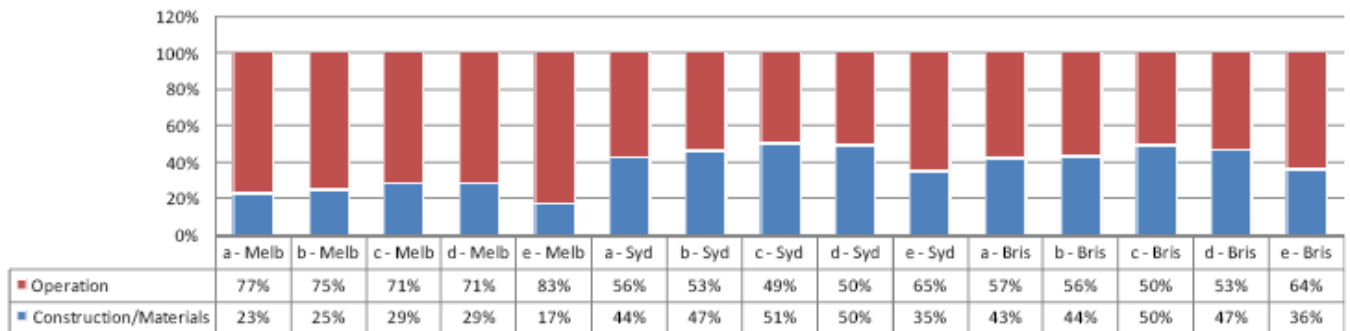


Figure 28 Construction and materials versus operation and maintenance in a 6 star construction types at various locations.

The research is showing that, in the Australian context the embodied impacts, particularly the greenhouse gas emissions, of building materials are very significant and, in some cases, can be greater than operational impacts. In the case of greenhouse emissions this will only become more significant as buildings continue to improve their energy efficiency and thermal performance.

The potential for improvements therefore (ie reduction in environmental impact) are just as great as improvements in energy efficiency. The Green Star tools need to be at the forefront of the property sector to drive the industry in making these improvements.

Is it practical to make qualified assumptions about the origin and the distances that material must be transported in a Green Star design submission, i.e. at a tender stage when some the specific materials are unknown?

Yes, this would appear appropriate at a ‘tender stage’.

The majority of structural timber products used in Australia are made in Australia. Current building industry LCI data includes the average environmental impacts for

² RMIT, 2010, “Comparative Life Cycle Assessment of Alternative Constructions of a Typical Australian House Design” study undertaken for the Forest and Wood Products Australia, (PNA147-0809), (Pre-public release draft April 2010)

transport of raw materials. There is no reason that a similar exercise could not be undertaken to provide impacts for average transport distances to key markets.

It is believed that impacts from imported timber products are also available as suppliers from America and Europe have investigated these for their export markets.

Care, however, needs to be taken that project designers use the industry averages rather than specify local product use at the tender stage only to then substitute for overseas products in the final design phase. This can create a point of difference for suppliers of local product in a tender.

Is 1m² of GFA an appropriate unit?

Yes, per m² of gross floor area (GFA) as the “functional unit” seems appropriate for this first stage introduction.

Further functional units might be identified for different elements of a building at a later stage.

Are there constraints to using this unit?

We are not aware of any constraints on using this unit however it is unlikely that this one approach will fit all potential use applications and as such should be assessed as the program evolves.

Is it appropriate to limit the number of environmental impact categories to six?

Yes, it is appropriate to commence with a limited number of categories. However, we disagree with some of the categories included in this paper. We consider the following categories listed by GBCA appropriate

- Climate change
- Mineral and fossil fuel depletion (Abiotic Depletion)
- Eco-toxicity (to land and water)
- Human toxicity

We do not consider the following categories appropriate at the initial stage:

- Land transformation and use.
- Water depletion.

If more categories are to be included, which categories do you recommend be included? What method should be applied to determining the impact categories the LCA will take into account?

The following LCA impact assessment categories are commonly reported and feature in many standards and initiatives and as such could quite easily be included:

- **Ozone layer depletion** – *a commonly reported impact category. Ozone-depleting gases cause damage to the stratospheric ozone (the Ozone Layer).*

Common sources of these gasses in the construction industry are in refrigerants and blowing agents (ie blown insulating foam).

- **Eutrophication** - *a commonly reported impact category. Eutrophication is an over enrichment of nitrates and phosphates in watercourses. In the construction industry this can result from uncontrolled runoff from construction sites or lack of maintenance of drainage or sewage systems.*
- **Acidification** – *one of the most widely used indicators. Acidic gasses such as sulphur dioxide react with atmospheric water to form ‘acid rain’. Acidic gasses are commonly emitted as a result of combustion of fossil fuels which has direct relevance to the construction industry and the products used.*

If fewer categories are to be included which categories do you recommend be removed?

We recommend that the following categories be removed in the initial introduction:

- Land Transformation & Use and
- Water Depletion.

The ALCAS *Best Practice Guide to Life Cycle Impact in Australia*³ notes that **Land Transformation and Water Use** are *‘provisional methods that need development’*; both use a simple summation approach (total volume of water, total area of land). This simple summation approach gives distorted results for broad scale agricultural products including forests.

As many commentators point out, the impacts of water use have very different implications depending on where and how it is used, an aggregated measure of total water used (e.g. as embodied water quantified in m³) does not provide a truly meaningful indicator for environmental assessments and profiles of products such as those for construction, which are sourced from many different geographical regions and in the case of timber, consume water over long time periods⁴. The vast proportion of the water attributed to forest consumption, approx 95% , is due to ‘evapo-transpiration’ as part of the natural hydrological cycle, falling later as rain; only approx 5% is actually used in the physical growth of the tree. A current Agricultural LCI project is investigating water use for broad scale agricultural products in Australia funded through the Rural Industries R&D Corporation (RIRDC). **It is suggested that the Water Depletion impact category not be used until a more detailed and useful approach is agreed in Australia. Note: If this impact category is retained and weighting is used then a minimal weighting value should be applied.**

Land Use and Land Transformation is another ‘provisional’ indicator of current questionable value. On one hand ‘land transformation’ could be seen as highly relevant to the construction industry as most construction projects will result in direct and dramatic land use change to the site on which they are built. In addition construction products/projects consume significant quantities of products from mining and quarrying, which represent some of the most dramatic examples of land

³ Currently undergoing a revision and updating

⁴ 2012, “A Guide to Understanding the Embodied Impacts of Construction Products”, Construction Products Association – *and excellent overview of EPD systems in a European context – available at <http://www.constructionproducts.org.uk/sustainability/products/sustainability-of-products/>*

use change. It should be noted though that globally LCA land use indicators are still in their infancy and no single established standard has emerged. While the effects of many indicators are acknowledged to be regional, the effect of land use change can change over very small distances complicating the quantification of land use. Land Use is often taken as a proxy for, biodiversity impact, an important measure of the effect of land use change which is hard to quantify effectively and far more complex than just a straight 'total area' metric. **Again, it is suggested that this impact category not be used until a more detailed and useful approach is agreed.**

If six impact categories are appropriate, are the six categories above the most appropriate?

No. If six impact categories are included they should be:

1. Climate change,
2. Mineral and Fossil Fuel depletion.
3. Toxicity – Human and Eco-toxicity (air, water and soil pollution),
4. Ozone layer depletion
5. Eutrophication,
6. Acidification,

Is it appropriate to refer to the AusLCI impact categories? Is there an alternative which should be used? Why?

Yes, it would be appropriate to refer to the AusLCI impact categories.

Is it appropriate to reference the BPIC LCI weightings? If not, what should be used instead?

The question of weightings is particularly contentious. By its nature LCA provides detailed feedback on a range of environmental impacts, when these can be seen assessed and compared then a rich understanding is available of action & effect. It is also acknowledged however that less technical users of LCA tools may not want to know (or may not understand) the detail and rather are looking for a simple single score approach to appreciate action & effect, if this is the case then weightings are required.

There are concerns with the BPIC LCI weightings that they are not statistically representative and also that they might be biased towards a range of issues and attitudes at the time of the exercise. Some results reported seem quite strange, for instance: the Australian average value for *Land Transformation and Use* at 20% is higher even than the *Global Warming* value at 19%⁵; particularly concerning in light of the feedback on the previous page that Land Transformation and Use is a provisional method in need of development.

⁵ 2010 Bengtsson. J, et al, "Weightings of Environmental Impacts in Australia, November 2010", Building Products Innovation Council

It is strongly suggested that if the GBCA really feel weightings are necessary then the GBCA undertake a specific Buildings Related Weighting Exercise with their own broad membership group building on the previous BP LCI work.

Is it appropriate to have separate credits for each of the environmental categories or should the total score be weighed together and assessed in one credit?

Yes it is appropriate to have separate credits for each of the environmental categories. If the score is assessed as one credit then the 'richness' of information is lost and there is no indication as to what environmental categories have improved or by how much.

Is it practical to establish a standard practice reference case for low-rise, mid-rise and high-rise buildings of different classes? If not, what other methods could be used to establish a reference case?

Yes it is practical to establish a standard practice reference case for the first introduction of an LCA 'Base Building' assessment in Green Star. It should be noted though that the expectation would be that as soon as appropriate LCA tools for building designers, architects and engineers are available that GBCA would evolve its approach replacing the simple reference case method with a more comprehensive full life cycle assessment of the actual building including all phases: embodied, operational and end-of-life.

Should the reference case distinguish between new building on a green field site, refurbishment of existing buildings and fit-outs? How can an equitable system be developed which acknowledges the advantages of the options from an environmental impact perspective?

Yes the reference case should distinguish between new building on a green field site, refurbishment of existing buildings and fit-outs. In refurbishments and fit-outs, reuse of existing structure and materials should be strongly encouraged.

If the reference case is constructed in a similar manner to that described above, would you be able to provide your interpretation of how this may operate in practice?

The reference case approach seems relatively straightforward, however it is unclear from the discussion paper whether the GBCA is planning to do one single standard benchmark case for each of the low/medium/high-rise categories which all future 'improved' projects are compared against; or whether a reference case, using the standard practices, would be required to be developed for each individual project for comparison with the 'improved' building. GBCA needs to be clearer on the approach it is proposing.

Can LCA methodology in the Green Star Materials category operate without a reference case? If so, how do you see this working?

Yes an LCA methodology in the Green Star Materials category could operate without a reference case. It is envisaged that in the very near future LCA design

tools will be available that allows designers to quite easily and rapidly undertake life cycle assessments of the buildings they are designing. In this instance the designer could undertake a sensitivity analysis with a range of different design options to determine the most effective approach that could then be optimised along with other design considerations.

Is it practical to conduct two iterations of the LCA with different inputs for the project?

Conducting two iterations of the LCA with different inputs for the project is the necessary minimum iterative design process. One needs to do this to make the assessment of the interactive and interdependent impact of alternatives designs and materials.

How much additional time would it take to do the second iteration of the LCA having completed the first one? Is it 25% more, 50% more, 100% more etc?

Accurate advice should be obtained from professional life cycle consultants experienced in assessing building structures. In the future with commercial design tools it is anticipated that additional iteration times would be dramatically reduced and would simply be a normal part of the design process.

Does the intended content of Table 1 include enough data to determine the input parameters for the standard practice case LCA? If not, what is missing?

It is suggested that a group of experienced building industry professionals from a range of different areas of expertise (Expert Reference Panel) be used to review the assumptions in table 1 and provide advice back on additional items.

What would be the best way to determine the rules for the input parameters in Table 1?

Through the use of a representative Expert Review Panel.

Is it appropriate to nominate ISO 14025 as the reporting mechanism?

In the absence of an accredited and approved Australian Standard then the use of an ISO standard is appropriate.

Is percentage reduction in impact an appropriate way to award points for improvement?

Yes percentage 'reduction in impact' is an appropriate way to award points for improvement but the GBCA needs to look at each impact case and set appropriate levels/targets. It will also be important to include a point scheme that recognises percentage 'increase in impact' and allocates an appropriate 'negative' point if an action simply burden shifts from one impact category to another. For instance an action that reduces climate change impact (global warming) may in fact cause an increase in 'eco-toxicity'.

Is it appropriate to have separate credits for each of the environmental categories or should the total score be weighed together and assessed in one credit?

Yes it is appropriate, and important, to have separate credits for each of the environmental impact categories rather than a total score weighed together and assessed in one credit. The separate category approach ensures that users are quite clear of the impact of their actions, and can make decisions accordingly. Should the Aus LCI Building Product inventory dataset be used in a LCA methodology within Green Star rating tools?

Yes the ALCAS AusLCI datasets should be used. It is noted that the AusLCI database is currently rather light on data, but it is understood that it will be populated with average industry building product data over the next twelve months..

Should a European LCI be used?

No, European LCI data should not be used unless it is specific to a European product. Where possible, Australian data should always be used.

Are penalties needed?

No, penalties should not be needed.

What data sources would be acceptable for a credible LCA to be conducted?

Those described by the BPIC LCA Protocol hierarchy of data sources, but with AusLCI at the top of the hierarchy.

- 1. From the ALCAS AusLCI national database*
- 2. From the BPIC/LCI database*
- 3. From other acknowledged Australian data sources (documented for source, age, representativeness and data quality assessment).*
- 4. From other authoritative sources (e.g. Ecoinvent, USNLCI) adapted for relevance to Australian conditions (energy sources, transport distances and modes and so on, and documented to show how the data is adapted for relevance in Australia).*
- 5. From other sources with sensitivity analysis reported to show the significance of this data for the results and conclusions drawn.*

Is it appropriate to exclude fit-outs based on the lack of an agreed functional unit for fit-out items?

It is suggested (as per p4) that a range of major fit-out items should be included – in particular internal partitions, wall & ceiling finishes and flooring / floor coverings. The functional unit could still remain m² of gross floor area (GFA).

Will the proposed LCA methodology accommodate existing LCA systems and tools?

There appears no major reason why the proposed LCA methodology would not accommodate existing LCA systems and tools. As long as the GBCA approach, aligns with any accepted Australian approaches developed by Australian tool developers and ALCAS.

What constitutes an LCA practitioner, what qualifications should be required, and should the system ALCAS are developing be referenced?

It is believed that ALCAS is currently developing a certification approach for Australian LCA practitioners. This system should be referenced. It should be noted however that once appropriate LCA based building design tools have been developed and accredited that there may be no need for a certified LCA practitioner in general building assessment. What will be critical though is appropriate training for building designers using these tools so that they clearly understand the principles of life cycle assessment and the environmental impact of their decisions.

How much would you estimate it would cost to complete the assessment outlined in this paper? And how does that cost compare to the cost of demonstrating compliance with the current Materials Category in Green Star?

Accurate advice should be obtained from professional life cycle consultants experienced in assessing building structures.

Is the requirement to adhere to international standards necessary?

Yes, in the absence of alternative accredited Australian Standards.

Which are the relevant standards that Green Star related LCAs should adhere to?

In the absence of relevant accredited Australian standards appropriate ISO standards should be used. These would include a number of standards in the ISO 14040 and ISO 14020 series. It is also noted that in Europe countries are attempting to harmonise their approach through the European Committee for Standardisation (CEN) process – GBCA should monitor how this harmonisation progresses.

Is the requirement to use recognised software necessary?

Use of appropriate and benchmarked computer based design tools and software will no doubt speed up any LCA assessment process and reduce the reliance on more expensive LCA consultants during the design process. GBCA should, in conjunction with ALCAS, assess the suitability and appropriateness of software and tools and provide advice on this to designers.

Should the GBCA recognise particular softwares?

Yes, it is suggested that building LCA design software needs to be accredited, just as LCA practitioners need to be. However a fair and equitable basis needs to be applied and this should be undertaken in conjunction with the assistance and imprimatur of an independent source such as ALCAS.

Which software should be recognised, and why?

Not for us to comment on. This assessment needs to be undertaken by an appropriately skilled and qualified body.

Does equivalent software exist for LCA?

We do not believe we are qualified enough to provide pertinent comment on these three questions.

Is the requirement for peer review necessary?

Yes – if comparative assertions are to be made then a peer review is requirement of that process.