

Your ref
Our ref
File ref

ARUP

Green Building Council of Australia
Level 15, 179 Elizabeth St
Sydney NSW 2000

Level 10 201 Kent Street
PO Box 76 Millers Point
Sydney 2000
Australia

t +61 2 9320 9320

d +61 2 9320 9420

f +61 2 9320 9321

haico.schepers@arup.com
www.arup.com

15 August 2012

Dear Sir/Madam

Arup Submission: LCA Assessment in Green Star Discussion Paper

1 Introduction

1.1 About Arup

Arup is a leader in green building design across Australia and the world. In Australia we have a number of Green Star Accredited Professionals and regularly undertake Green Star assessments on behalf of our clients. Accordingly, we have an understanding of the likely market response to the introduction of new Green Star credits based on our international experience of similar schemes and knowledge of the local market. We are also lifecycle practitioners and have contributed to the development of lifecycle assessment (LCA) methodologies for the built environment over the last decade.

We strongly endorse the development of a materials credit based on lifecycle assessment principles. We offer this submission to assist GBCA in balancing the practical and cost implications of introducing such a criteria with the need for robust transparent and fair methodologies in its application. We look forward to assisting the market with its implementation.

1.2 Overview of submission

The environmental performance of buildings can be strongly influenced by materials selection. However the selection of materials on environmental grounds is complicated by trade-offs between environmental outcomes across impact categories and also between lifecycle stages. LCA is a robust and proven methodology able to fully assess and compare different options for building design. A well designed LCA credit has the potential to overcome some of the shortcomings of the existing materials category of credits. Arup endorses the Green Building Council of Australia's proposal to include a lifecycle assessment credit within the Green Star materials category.

Across the world and within Australia environmental rating systems are endorsing LCA as the most robust and transparent methodology to rigorously assess the green credentials of materials. Many of these rating systems recognise that complete and consistent lifecycle inventories for the building and construction products are still in development. Accordingly many rating systems provide credits for simply carrying out an LCA rather than, or addition to, demonstrating an environmental improvement from material selection. Arup endorses this as a minimum short term approach to promote proficiency of LCA as a tool that delivers greater understanding and confidence in environmental outcomes

2 Response to specific questions and issues

2.1 Market readiness

Page 3 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?*
- *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?*
- *What do you see as the main barriers to implementing LCA as an assessment methodology for materials in Green Star?*
- *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 our view that the Australian green building market is ready for LCA in Green Star if it is transitioned in over a few years (i.e. generations of projects). A learning-by-doing approach would be of value.

The main barriers to the implementation of the credit include complexity, data availability, and an industry wide agreement on methodology. Another potential barrier is that LCA is currently a specialist subject with industry expertise tending to exist with only a relatively small number of organisations/individuals.

The supply chain may also be unwilling to participate in establishing Life Cycle Inventory (LCI) information and/or may undertake negative lobbying on the issue.

From a practical perspective, it is likely to take at least a year for the GBCA to draft, get feedback on, and finalise a new credit. Probably longer given the number of methodological decisions that need to be made. A phase-in approach might speed deliver and increase learning by doing; for example, initially rewarding projects for just doing an LCA.

If the credit is too complex to start with, it may result in few projects using it, which would defeat the purpose of having it in the first place. There needs to be a period of simply incentivizing uptake and familiarization with LCA. An alternative may be using default lifecycle impact factors for materials. This approach has been adopted by the Australian Green Infrastructure Council in their recently released Material Calculator.

More credit could be given for conducting more complete and robust LCAs. A narrative should be required, supported by evidence that explains how results were taken into account when making design decisions and materials specification.

2.2 Methodology

2.2.1 Scope of assessment

Page 10 Questions

The Green Building Council of Australia seeks your feedback on the following questions:

- *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?*
- *Please provide feedback on the list of inclusions and exclusions.*
- *Are there additional materials should be addressed by the inclusions and exclusions?*

The list of inclusions proposed seems logical. However, floor finishes, ceiling systems and internal partitions are obvious items to also include as product suppliers in these areas have been some of the biggest supports of LCA in Europe. These materials are often significant because of high churn rates and material replacement. Insulation should also be included as it affects operational energy and is relevant in terms of life-cycle trade-offs.

Gypsum, carpet, hardwood flooring, wall veneer, access floors, suspended ceiling, waterproofing and vapour barriers should be included to reward their omission where an exposed structure is chosen.

Clarity is needed between services conduits and ducting and exclusion of HVAC ducting for example.

In addition a simple cut off rule should be applied at say 95% of material content/fabric of the inclusions must be included in the LCA.

2.2.2 Boundary definition

Page 11 Questions

The Green Building Council of Australia invites feedback from industry stakeholders on the proposed system boundary:

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

Cradle to 'construction completion' is a well recognised system boundary in LCA circles. However, ignoring in use and end of life goes against the principle of LCA and understanding impacts in the widest sense. Material selection on an environmental basis should be made when the full picture including operational and end of life impacts are taken into account. This is a stance the GBCA should take.

It is environmentally desirable to include some aspect of in-use and end-of-life within the assessment. This allows maintenance and materials replacement to be taken into account and therefore favour more durable materials. A whole of life approach allows the important question of design for end of life, reuse and recycling to be addressed.

Further, for timber and other organics, it may be the only rational way to account for net sequestration of carbon, which may also become important as multi-storey timber construction is growing in UK, Europe, Canada, NZ, and Australia may follow¹. The credit could required consideration of the application of a discount factor for wood and other organic material developed to take into account sequestration and end-of-life benefits.

¹ See for example Lend Lease's Docklands project Forté set to be the world's tallest timber residential building.

Extending to whole of life equals more effort, but this can be offset by more simplifications to still yield a more robust result. For example, Green Star forces design teams to use conservative assumptions about hours of operation, occupancy levels etc. The GBCA's rationale is that this enables fair benchmarking across all projects. A similar approach might be possible for LCA, where conservative assumptions about in-use and end-of-life impacts or benefits are factored in.

Arup also recognises that Green Star seeks to rate operational and end of life impacts within other credits but that these do not necessarily input into decisions regarding material selection.

2.2.3 Inclusion of transport

Page 11 Questions

The Green Building Council of Australia invites feedback from industry stakeholders on the proposed system boundary:

- *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*

It is practical to include transport if you set out a default distance for specific materials for assessors to apply in the absence of specific data. This will encourage the materials industry to set out their own data for use in studies.

You could set default distances for each material, which would enable comparisons to be made between materials (e.g. concrete vs steel vs timber). However it wouldn't address differences within materials (e.g. steel from Australia vs steel from China). A similar issue occurs with scope 2 carbon emissions, with materials from Tasmania likely to have far lower emissions related to electricity than materials from Victoria.

An alternative recommendation is set out default origins rather than distances and apply general rules on mode of transport one should assume, which could be overridden if products are procured from different origin and/or transported by different mode.

2.2.4 Functional unit

Page 12 Questions

The Green Building Council of Australia invites feedback from industry stakeholders on the functional unit:

- *Is 1m² of GFA an appropriate unit?*
- *Are there constraints to using this unit?*
- *If there are constraints or reservations about the proposed functional unit, what are the alternatives?*

The functional unit of impacts per m² is a good basis for a FU. Particularly because it means LCA findings can be taken back to architectural decisions at a most basic level.

However, if the credit uses the reference case approach then it is unnecessary because points will be awarded on a percentage reduction. A per m² unit is only useful if you want to compare between projects.

The use of the functional unit could potentially result in a loss of detail, particularly when addressing specific aspects such as envelop, or internal fitout strategy. We would therefore advise that results should be reported also at this level to allow drilling down to each component category, defined by strategy.

There is also the potential to use a per occupant basis, as building smaller is the first step to reducing embodied impacts, which would be lost if normalized to per m². However, this would only become relevant if comparing to an industry benchmark rather than a Standard reference case which presumably would have the same occupant density. As per current operational energy credits the occupant density could be taken into account in the credit interpretation.

2.2.5 Environmental impact categories

Page 13 Questions

The Green Building Council of Australia invites stakeholders to provide feedback:

- *Is it appropriate to limit the number of environmental impact categories to six?*
- *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?*
- *If fewer categories are to be included which categories do you recommend be removed?*
- *If six impact categories are appropriate, are the six categories above the most appropriate?*
- *Is it appropriate to refer to the AusLCI impact categories? Is there an alternative which should be used? Why?*

A range of categories is important to ensure that tradeoffs are acknowledged.

Arup agrees with the proposal to include climate change, resource depletion (but split between fossil and mineral), land transformation and water as impact categories.

Removal of the toxicity categories is recommended as models and methods in this area, are contentious, and can prove misleading in interpretation. Ozone depletion potential and photo-chemical smog should also be considered for inclusion as they are relevant to Australia.

The impact categories should also aim to expose trade-offs and not be limited to situations where all impacts would rise and fall together (e.g., if only limited to categories which primarily result from burning of fossil fuels: GWP, smog, ADP-fossil, acidification and eutrophication).

2.2.6 Weighting of environmental impacts

Page 14 Questions

The Green Building Council of Australia seeks stakeholder feedback on the proposed Weightings and points:

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

While weightings are not essential for LCA results to be calculated, they are somewhat inevitable in Green Star. If LCA is wrapped up in one credit each impact category will be required to be weighted. If the six LCA categories are written up as separate credits, then weightings will become implicit in the number of points available for each credit.

Notwithstanding, Arup recommends the impacts are reported separately rather than within a single score. In this way you can get architects, designers and clients to interact with the separate impact categories and build up an understanding of each. It is not a black box.

Nominating each impact as a separate category would also enable a phase-in over time of different impact categories and allow the industry to build capacity.

Awards in each category should also reflect the maturity/confidence of the impact assessment method. This would allow only the few that have the greatest consensus to earn

credit for improved performance with an additional point available for reporting on all and associated confidence levels.

2.2.7 The Standard Practice Reference Case

Page 17 Questions

The Green Building Council of Australia invites feedback from stakeholders:

- *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?*
- *Should the reference case distinguish between new building on a green field site, refurbishment of existing buildings and fitouts? How can an equitable system be developed which acknowledges the advantages of the options from an environmental impact perspective?*
- *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?*
- *Can LCA methodology in the Green Star Materials category operate without a reference case? If so, how do you see this working?*
- *Is it practical to conduct two iterations of the LCA with different inputs for the project?*
- *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?*
- *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?*
- *What would be the best way to determine the rules for the input parameters in Table 1?*

It is practical, and consistent with energy performance modelling done for the Building Code of Australia and some of the Green Star tools. The challenge will be defining the reference case in such a way that it is representative.

The proposed method requires two models be created which has the potential to increase cost and complexity. An alternative approach could be that in the first instance a point is awarded for creating one model and submitting to GBCA. In two years time (say) GBCA is sitting on a batch of case study LCAs. This database could then be applied to create benchmark levels for future LCA to be measured against in Green Star. Additional levels of reward (points) should be given for showing how the model was used in design to facilitate change and reduce environmental impact of the project.

The approach of initially awarding points for simply doing an LCA is a good way to build capacity. This could be made even simpler with the use of default factors, the approach currently adopted by the Australian Green Infrastructure Council.

LCA application should be considered in terms of new build, existing buildings and fit out.

There is not a need to distinguish between greenfield and non-greenfield sites as land use aspects are addressed elsewhere in Green Star.

There should be some recognition of the embodied energy benefits of refurbishment. If a reference case or absolute benchmarks are set based on new-build, then the refurbishment will use less material, therefore immediately has benefit.

A reference case is the ideal goal in the long-run, but perhaps not practical to implement immediately. Once ready to incorporate, there should be many more options to better represent the variety of buildings, and not just limited to three. There should at least be the same options as defined for the baseline energy model building. (This is steel-framed in the US/LEED/ASHRAE reference, which is different from the low-rise building system proposed in Table 1.)

The Standard Practice Reference Case could also be developed over time by awarding more points for the preparation of a reference case LCA along with the design case. These reference cases could then be compiled allowing future applicants to “look up” their

reference case if it is cost-prohibitive to create their own. Alternatively, GBCA could commission a batch of reference cases.

2.3 Reporting mechanism

Page 17 Questions

The Green Building Council of Australia invites feedback from industry stakeholders on the use of ISO 14025 EPDs:

- *Is it appropriate to nominate ISO 14025 as the reporting mechanism?*
- *Is there an alternative that is preferred or should be considered?*

The European standards:

- EN 15804:2012 Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products
- EN 15978:2011 Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method

Should be considered in place of the more general ISO 14025:2006. These European standards are emerging as a common platform accepted all over Europe as the way of communicating environmental performance of products and buildings, and it is therefore appropriate if also building certification schemes makes use of its provisions with respect to data handling and data format. The Germany based DGNB scheme already adopts the provisions of this standard. The French HQE scheme is aligning its data requirements with EN 15804.

2.4 Data inventories

Page 19 Questions

The Green Building Council of Australia seeks stakeholder feedback on the proposed Data inventory:

- *Should the Aus LCI Building Product inventory dataset be used in a LCA methodology within Green Star rating tools?*
- *Should a European LCI be used?*
- *Are penalties needed?*
- *What data sources would be acceptable for a credible LCA to be conducted?*

The Aus LCI Building Product inventory dataset is the most relevant LCI to Australian specific products. However, to date the LCI is incomplete and inconsistent and further development is required before this can be relied upon as the sole source of LCI data. Arup would encourage the consideration of international LCI data including those which are more advanced in their development. Industry bodies within Australia have also developed robust product specific LCA data which should also be considered especially where there has been independent peer review. The use of non-Australian LCI data and industry data introduces additional uncertainty. This should not preclude their use, but rather require reporting of uncertainty and confidence levels with LCA.

Reporting on data quality should be required. GBCA should set out the data quality scale. Penalties should be levied where poor quality, AND unrepresentative data is used.

2.5 Applicable Green Star Tools

Page 20 Questions

The Green Building Council of Australia invites feedback from industry stakeholders:

- *Is it appropriate to exclude fitouts based on the lack of an agreed functional unit for fitout items?*

Arup agrees that it is too soon to require equipment, furniture and fixings of fit out, but of finishes, at least gypsum walls, carpet and flooring and floor finishes should be included. It is not the functional unit that is the barrier, but rather the reference case. If the reference case is eliminated for near-term award, then it buys more time to better develop how benchmark these components.

2.6 Other matters for discussion

Page 21 Questions

The Green Building Council of Australia invites feedback from stakeholders on the issues listed in section, as well as any other matter you believe should be addressed:

- *Will the proposed LCA methodology accommodate existing LCA systems and tools?*
- *What constitutes an LCA practitioner, what qualifications should be required, and should the system ALCAS are developing be referenced?*
- *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? the requirement to adhere to international standards necessary?*
- *Which are the relevant standards that Green Star related LCAs should adhere to?*
- *Is the requirement to use recognised software necessary?*
- *Should the GBCA recognise particular softwares?*
- *Which software should be recognised, and why?*
- *The requirements of the Energy category within Green Star rating tools, stipulate that any energy simulation software used are BESTEST compliant. Does equivalent software exist for LCA?*
- *Is the requirement for peer review necessary?*

2.6.1 Cost

Arup estimates that an initial detailed LCA including comparison against a standard reference case would be in the order of \$30,000 to \$40,000. However, this may reduce over time as the work becomes more commoditised. Current compliance costs are estimated at no more than \$20,000.

2.6.2 Accreditation

The use of accredited LCA practitioners is encouraged although not yet in existence. GBCA should look to ALCAS in the development of an accreditation process.

2.6.3 Peer review

Peer review is an important component of comparative LCA and should be adopted where comparison to reference case is awarded points. A credit which rewards only the development on an LCA (but no comparison or reward for improved performance) may not require such rigour. However peer review pay add a cost burden to the credit.

Therefore providing that the Green Star review is be rigorous enough a separate peer review need not be required. GBCA may need to contract with LCA practitioners to conduct review of the LCA portion.

The mechanism of denial-appeals, and the additional fees to appeal, will incentivise adequately robust LCA modelling.

2.6.4 Software

There are a number of existing LCA software products available to assist with the preparation of LCA. GaBi and Simapro are used extensively by practitioners in Australia and overseas and are useful for complex cradle to gate analyses with multiple scenario comparisons and sensitivity testing. However, so long as robust LCI data is adopted the use of such software should not be mandated and an LCA could be completed using spreadsheets.

2.6.5 Industry bodies

Arup acknowledges ALCAS as the recognised industry body for LCA. Arup also acknowledges the significant work undertaken by BPIC in developing a construction industry specific LCI data. The ongoing involvement of these bodies in the development of the credit is essential to the credibility of the credit.

3 Recommendations for draft credit

Arup recommends that the LCA credit takes a tiered approach in awarding credits as follows:

- A point is awarded for the preparation of an LCA using GBCA published default factors for materials (e.g. kg CO₂e per kg of each material type). This would then simplify the credit and result in good uptake.
- An additional point is awarded where it can be shown that the LCA results are used in material selection and to inform design decisions with evidence to demonstrate changes made.
- Bonus points are awarded for the preparation of a detailed LCA using project specific inputs. Further points are also awarded for:
 - reporting of all impact categories
 - reporting across whole of life
 - reporting against a Standard Reference Design, and
 - where improved performance is demonstrated across a range of impact categories compared to the Standard Reference Design.

Should you wish to further discuss the above, please do not hesitate to contact me. We look forward to working with GBCA and the industry in the implementation of the credit.

Yours faithfully



Haico Schepers